Aus dem Institut für Medizinische Soziologie
Direktor: Univ.-Prof. Dr. phil. Nico Dragano

Arbeitsbedingungen im Lebenslauf und Gesundheit im Alter

Schriftliche Habilitationsleistung zur Erlangung der Venia Legendi
für das Fach Medizinische Soziologie an der Hohen Medizinischen Fakultät
der Heinrich-Heine-Universität Düsseldorf

Vorgelegt von
Dr. phil. Sten Morten Wahrendorf
Düsseldorf, 2019

Eidesstattliche Erklärung

Hiermit versichere ich an Eides statt, dass ich die vorliegende schriftliche Habilitationsleistung ohne unerlaubte Hilfe angefertigt und das benutzte Schrifttum vollständig erwähnt habe. Zudem versichere ich, dass die Habilitationsschrift noch von keiner anderen Fakultät abgelehnt worden ist.

Bei den wissenschaftlichen Untersuchungen, die Gegenstand dieser schriftlichen Habilitationsleistung sind, wurden ethische Grundsätze und die jeweils gültigen Empfehlungen zur Sicherung guter wissenschaftlicher Praxis beachtet.

Düsseldorf, den 15. Januar 2019

Dr. phil. Sten Morten Wahrendorf

Zusammenfassung

Die vorliegende Schrift versammelt acht Originalarbeiten, deren übergeordnete Fragestellung der Einfluss von Erwerbs- und Arbeitsbedingungen im Lebenslauf auf die Gesundheit im Alter ist. Die Arbeiten untersuchen sowohl die Auswirkungen von Arbeitsbedingungen auf mentale Gesundheit und gesundheitliche Einschränkungen, wie auch die Auswirkungen auf allgemeine Lebensqualität und Arbeitsfähigkeit. Konzeptioneller Rahmen der Arbeiten sind stresstheoretische Grundlagen der Arbeitsepidemiologie zur Untersuchung psychosozialer Belastungen und deren Ausweitung entlang der Lebenslaufperspektive. Als empirische Grundlagen dienen Daten aus insgesamt fünf internationalen Studien, inklusive retrospektiver Lebenslaufdaten zur Untersuchung zurückliegender beruflicher Karrieren. Zur statistischen Analyse verwenden die Arbeiten unter anderem neuere Verfahren der Sequenzanalyse, da diese eine verfeinerte Untersuchung von Lebenslaufdaten erlauben.

Insgesamt stützen die Ergebnisse der Arbeiten die Annahme, dass ungünstige Arbeitsbedingungen im Lebenslauf die Gesundheit im höheren Lebensalter negativ beeinflussen. Dies gilt für psychosoziale Belastungen am Arbeitsplatz, aber auch für zurückliegende berufliche Karrieren in Form prekärer und diskontinuierlicher Karrieren sowie kumulierter Benachteiligung im Erwerbsleben. Zudem zeigen die Ergebnisse, dass Belastungen im Erwerbsleben ihren Ursprung bereits im Kindesalter haben können.

Die Arbeiten tragen zu einem erweiterten Verständnis sozialer Determinanten der Gesundheit im höheren Lebensalter bei, das gegenwärtige und frühere Lebensphasen berücksichtigt. Zudem ergänzen die Arbeiten die Arbeitsstressforschung, indem, zusätzlich zu einzelnen Arbeitsbelastungen, auch Belastungen durch Merkmale gesamter Erwerbskarrieren betrachtet werden. Schließlich tragen die Arbeiten zu einer methodischen Weiterentwicklung bei, da sie die Qualität und Möglichkeiten einer Analyse von Lebenslaufdaten für lebenslaufepidemiologische Fragestellungen aufzeigen.

Liste der zugrundeliegenden Originalarbeiten

1. **Wahrendorf M.**, Hoven H., Goldberg M., Zins M., & Siegrist J. (2018). "Adverse employment histories and health functioning: the CONSTANCES study." *International Journal of Epidemiology*: online first.

2. **Wahrendorf M.**, Marr A., Antoni M., Pesch B., Jöckel K.-H., Lunau T., Moebus S., Arendt M., Brüning T., Behrens T., & Dragano N. (2018). "Agreement of self-reported and administrative data on employment histories in a German cohort Study: a sequence analysis." *European Journal of Population*: online first.

3. Götz S., Hoven H., Müller A., Dragano N., & **Wahrendorf M.** (2018). "Age differences in the association between stressful work and sickness absence among full-time employed workers: evidence from the German socio-economic panel." *International Archives of Occupational and Environmental Health* 91:479-496.

4. **Wahrendorf M.** (2015). "Previous employment histories and quality of life in older ages: sequence analyses using SHARELIFE." *Ageing & Society* 35:1928-1959.

5. **Wahrendorf M.**, & Blane D. (2015). "Does labour market disadvantage help to explain why childhood circumstances are related to quality of life at older ages? Results from SHARE." *Aging & Mental Health* 19:584-594.

6. **Wahrendorf M.**, & Siegrist J. (2014). "Proximal and distal determinants of stressful work: framework and analysis of retrospective European data." *BMC Public Health* 14:849-861.

7. **Wahrendorf M.**, Blane D., Bartley M., Dragano N., & Siegrist J. (2013). "Working conditions in mid-life and mental health in older ages." *Advances in Life Course Research* 18:16-25.

8. **Wahrendorf M.**, Sembajwe G., Zins M., Berkman L., Goldberg M., & Siegrist J. (2012). "Long-term effects of psychosocial work stress in midlife on health functioning after labor market exit—results from the GAZEL study." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 67:471-480.

Inhaltsverzeichnis

1 Einleitung

Gesundheit und Krankheit im höheren Lebensalter haben häufig eine lange Entstehungsgeschichte. Das gilt für zahlreiche multifaktorielle Erkrankungen, die in der älteren Bevölkerung das Morbiditäts- und Mortalitätsgeschehen prägen, inklusive chronischer Erkrankungen, wie Herz-Kreislauf- und Atemwegserkrankungen, muskuloskeletale Beschwerden und zunehmend auch psychische Erkrankungen (Roth et al. 2018). Die epidemiologische Forschung unterstreicht daher die Bedeutung einer Lebenslaufperspektive, die auch Expositionen und Merkmale früherer Lebensphasen integriert und im zurückliegenden Lebenslauf den Schlüssel zu einem vertieften Verständnis späterer Gesundheit sieht (Kuh et al. 2014; Richter, Günther & Herke 2016).

Für viele der oben genannten Krankheitsbilder liegen aus arbeitsepidemiologischen Kohortenstudien bereits wichtige Hinweise dafür vor, dass psychosoziale Arbeitsbelastungen einen Anteil an ihrer Entstehung haben (Rugulies, Aust & Madsen 2017; Kivimäki & Steptoe 2018). Jedoch bleibt bei der Untersuchung der Einflüsse auf die Gesundheit unklar, wie groß der Anteil der Arbeitsbedingungen daran genau ist, da von einem komplexen Wechselspiel mit anderen Risikofaktoren im Lebenslauf auszugehen ist. Dies schließt weitere Belastungen im Erwerbsleben und mögliche Ursachen, die bis ins Kindesalter reichen können, ein. Zudem liegen bislang nur wenige Studien dazu vor, die prüfen, inwiefern Belastungen auch über das Erwerbsleben hinaus bis ins höheren Lebensalter fortwirken. Eine weitere Kritik an bisherigen Studien besteht darin, dass die Messung psychosozialer Belastungen sich meist auf einen einzigen Zeitpunkt im Erwerbsleben beschränkt (z.B. Kivimäki et al. 2012; Reinhardt, Wahrendorf & Siegrist 2013) und damit nur einen begrenzten Zeitraum abdeckt (Benach et al. 2014; Wahrendorf & Chandola 2016). Es fehlt damit die Information, wie stabil die Belastungen sind und ob Belastungen im Erwerbsverlauf wiederholt auftreten bzw. chronisch sind. Gerade vor dem Hintergrund sich verändernder Arbeitsmärkte mit flexiblen, unsicheren und prekären Beschäftigungsverhältnissen erscheint dies problematisch (Kalleberg 2009; Brückner & Mayer 2005; Benach & Muntaner 2007). Eine verfeinerte Betrachtung von Arbeitsbelastungen über einen längeren Zeitraum unter Berücksichtigung der komplexen Wechselwirkungen mit weiteren Faktoren scheint daher für verlässliche Aussagen sinnvoll.

Aus methodischer Sicht erfordert eine solche Untersuchung umfangreiche Daten zu Arbeitsbedingungen und weiteren Faktoren über den Lebenslauf. Die meisten arbeitsepidemiologischen Kohorten umfassen aber eher homogene Berufsgruppen und sind per Definition auf Personen beschränkt, die zu Beginn der Studie gerade arbeiten. Dadurch ist

zum einen das Spektrum unterschiedlicher Berufe oft eingeschränkt und die Wechselwirkungen mit weiteren Faktoren, inklusive Merkmalen aus der Kindheit, sind nicht abschließend geklärt. Zum anderen bleiben weite Teile der Bevölkerung (z.B. erwerbslose Frauen) unberücksichtigt. Geburtskohortenstudien, die im letzten Jahrhundert starteten und bis heute im Feld sind, stellen ein mögliche Lösung dar. Doch sind in diesem Fall Informationen zu Erwerbs- und Arbeitsbedingungen noch häufig auf das frühe Erwachsenalter begrenzt und Daten zur Gesundheit im Alter sind noch nicht verfügbar. Eine zunehmend häufiger angewandte Methode ist daher die, in laufenden Studien durch retrospektive Interviews auch Lebenslaufdaten zu erheben (Börsch-Supan et al. 2013; Blane 1996). Dabei handelt es sich um detaillierte retrospektive Angaben zum früheren Lebenslauf der Studienteilnehmer, die mit den übrigen Daten der Studie verbunden werden können, beispielsweise zurückliegende Erwerbsverläufe mit der Gesundheit im Alter. Allerdings stellt sich aus methodischer Sicht die Frage nach der Qualität solcher Lebenslaufdaten und existierende Ansätze zur statistischen Auswertung der gesammelten Berufsbiographien (bzw. "Berufssequenzen") stoßen schnell an ihre Grenzen.

Zusammengefasst stellt die Ausweitung des Forschungsstands zum Zusammenhang zwischen Arbeitsbelastungen und Gesundheit im Alter die Forschung vor konzeptionelle und methodische Herausforderungen. Konzeptionell geht es vor allem um die Frage, wie Arbeitsbelastungen im Lebenslauf mit weiteren Faktoren im Lebenslauf verbunden sind und darum, dass die Messung von Belastungen verfeinert und auf gesamte Erwerbsbiographien ausgeweitet werden sollte. Dies stellt aus methodischer Sicht aber Anforderung an Daten und Methoden. Dazu sollten Lebenslaufdaten verlässlich erhoben und anhand neuerer Verfahren ganzheitlich analysiert und nutzbar gemacht werden. Die hier zusammengefassten Arbeiten liefern neue Antworten und Perspektiven zu diesen Punkten.

Der nächste Abschnitt fasst den Hintergrund der Originalarbeiten zusammen, inklusive theoretischer Grundlagen und Konzepte der Arbeitsstressforschung, Stand der Forschung und methodischer Grundlagen, gefolgt von den zentralen Forschungsfragen. Daran schließt die Vorstellung der eigenen Arbeiten und schließlich eine Gesamtdiskussion der Ergebnisse entlang der Forschungsfragen samt Fazit an.

2 Hintergrund und Forschungsstand

2.1 Psychosoziale Belastungen und Gesundheit [1]

Wer im Erwerbsleben dauerhaft psychosozialen Arbeitsbelastungen ausgesetzt ist, hat ein erhöhtes Risiko, körperlich oder mental zu erkranken. Um dies in dieser Deutlichkeit sagen zu können, hat es jahrzehntelange Forschung gebraucht. Die Forschung konnte in den letzten Jahrzehnten vor allem die Frage nach gefährdenden Belastungen spezifizieren und eine kausale Beziehung zwischen Belastungen und Erkrankungen auf Basis epidemiologischer Kohortenstudien nachweisen. Damit sind psychische Arbeitsbelastungen für die heutige Medizin von besonderer Bedeutung, vor allem wenn es um die Prävention, Behandlung und Rehabilitation berufsbedingter Erkrankungen inklusive chronischer Erkrankungen geht.

Was sind psychosoziale *Belastungen?*
Als psychische Arbeitsbelastungen gelten in der Stressforschung vor allem Belastungen (oder „Stressoren"), die als Bedrohung oder Herausforderung empfunden werden (Epel et al. 2018; Fink 2016). Solche Stressoren können innerhalb des Erwerbslebens in vielfältiger Gestalt auftreten und reichen weit über die einfache Frage hinaus, wie viel eine Person arbeitet (also wie hoch die Anforderungen im Beruf sind). Sie können auch durch Arbeitsinhalte (z.B. monotone Tätigkeit), einzelne Merkmale der Beschäftigungsverhältnisse (z.B. befristeter Vertrag, prekäre Arbeit), soziale Beziehungen am Arbeitsplatz, oder durch Arbeitsplatzsicherheit oder der Belohnung am Arbeitsplatz geprägt sein.

Um aus der Vielzahl dieser potenziellen Einzelbelastungen solche herauszufiltern, die in ihrer Kombination besonders belastend für die Gesundheit sind, hat die Arbeitsstressforschung spezifische Modelle entwickelt. Bis heute dominieren zwei Arbeitsstressmodelle die Forschung, das Anforderungs-Kontroll-Modell (Karasek & Theorell 1990) und das Modell beruflicher Gratifikationskrisen (englisch: „Effort-Reward Imbalance (ERI) model") (Siegrist 1996; Siegrist & Wahrendorf 2016). Beide Modelle betrachtet jeweils die Kombination zweier Dimensionen. Die Kernannahme des Anforderungs-Kontroll-Modell (englisch: „Demand-Control (DC) model") lautet, dass Stressreaktionen insbesondere dann entstehen, wenn Beschäftigte hohe Anforderungen aber zugleich keine Kontrolle über die eigene Arbeit haben (sog. „job strain"). Kontrolle bedeutet, ob der Erwerbstätige Entscheidungsspielraum bei der Tätigkeit hat (z.B. Mitwirkung bei der Arbeitsgestaltung) und ob die Tätigkeit das Einbringen

[1] Teile dieses Abschnitts sind auch in erweiterter Form erschienen, siehe: (Wahrendorf & Chandola 2016; Wahrendorf 2018)

fachlicher Fertigkeiten und Kompetenzen zulässt bzw. Möglichkeiten der fachlichen Weiterbildung bietet. Damit folgt das Model einem vorherrschenden Paradigma der Stressforschung, bei dem fehlende oder eingeschränkte Kontrolle entscheidend für die Intensität von Stressoren ist (Lazarus 1966). Das Modell beruflicher Gratifikationskrisen betrachtet hingegen, ob eine hohe Verausgabung am Arbeitsplatz auch mit entsprechender Belohnung einhergeht. Im Fokus steht somit die Tauschgerechtigkeit bzw. das Verhältnis zwischen erbrachter Leistungen und erhaltener Belohnungen (Gratifikationen). Die Kernannahme des Modells lautet, dass beide Komponenten im Gleichgewicht stehen müssen, also reziprok sind (Siegrist 2005). Stressreaktionen entstehen nach diesem Modell vor allem dann, wenn Erwerbstätige sich stark verausgaben, aber keine angemessene Belohnung erfahren (sog. „Gratifikationskrise“ oder kurz „ERI“). Belohnung schließt finanzielle Entlohnung, Belohnung durch Wertschätzung und Anerkennung, langfristige Aufstiegschancen und Schutz vor dem Verlust des Berufes in Form von Arbeitsplatzsicherheit ein.

Mit Hilfe dieser Modelle sind Arbeitsbelastungen klarer spezifiziert, wobei aus konzeptioneller Sicht - zusätzlich zu existierenden Anforderungen und Verausgabungen im Beruf - entweder das Bedürfnis nach Kontrolle oder nach Belohnungen im Vordergrund der Modelle steht. Ein wichtiger Vorteil theoretischer Modelle ist, dass sie aus der Komplexität und Vielzahl von Berufen bestimmte Belastungskonstellationen identifizieren, die berufsübergreifend angewandt werden können. Das heißt, Belastungen können entlang der beiden Modelle für eine Reihe verschiedener Berufe bestimmt werden. Dabei stehen die beiden Modelle keinesfalls in Konkurrenz zueinander, sondern setzten einander ergänzende Schwerpunkte. Zu beiden Modellen hat die Forschung im Verlauf der Zeit standardisierte Fragebögen (Lang- und Kurzversionen) entwickelt, die in zahlreichen Studien bereits eingesetzt wurden. Im Gegensatz dazu, ist die Forschung zu Belastungen aufgrund von einzelnen arbeitsbezogenen Aspekten weniger ausgeprägt, dies mit Ausnahme von überlangen Arbeitszeiten, Schichtarbeit oder empfundener Arbeitsplatzunsicherheit, die auch gut erforscht sind.

Forschungsevidenz

Zahlreiche Studien, systematische Reviews sowie zunehmend auch Metaanalysen berichten einen Zusammenhang zwischen den oben genannten psychosozialen Arbeitsbelastungen und Gesundheit. Dies liegt zum einen an der steigenden Anzahl an Studien, zum anderen aber auch daran, dass Studien vergleichbare Daten zu Arbeitsbelastungen für Metaanalysen zur Verfügung stellen (vor allem durch den Einsatz standardisierter Fragebögen zu den oben genannten Arbeitsstressmodellen). Bedeutsam ist vor allem das sogenannte IPD-Work Konsortium (englisch: „individual-participant data meta-analysis in working populations“) – ein Zusammenschluss von über 60 Wissenschaftlern mit dem Ziel Berufskohorten zu bündeln

(für eine Übersicht siehe Dragano 2018). Metaanalysen integrieren in diesem Zusammenhang publizierte und auch nicht publizierte Studien, um einem möglichen Publikationsbias vorzugreifen (da eher positive Befunde publiziert werden). Auf Basis der IPD-Work Metaanalysen konnten vor allem erhöhte Risiken für kardiovaskuläre Erkrankungen (spezifisch: Herzinfarkt einschließlich Myokardinfarkt, Schlaganfall oder weitere koronare Herzerkrankungen) nachgewiesen werden (Dragano et al. 2017; Kivimäki et al. 2012; Kivimäki et al. 2014; Dragano 2018). Eine der umfangreichsten Metaanalysen geht beispielsweise von einer Risikoerhöhung um 1.23 (1.10 – 1.37) für Belastete im Vergleich zu Nichtbelasteten aus (gemessen durch „job strain"). Gesicherte Evidenz liegt - erneut auf Basis von Studien, Reviews oder Metaanalysen - ebenso für psychische Erkrankungen vor, gemessen in Form selbstberichteter depressiver Symptomatik, klinisch diagnostizierter Depressionen und psychotropischer Medikation (Rugulies, Aust & Madsen 2017; Harvey et al. 2017; Madsen et al. 2017; Theorell et al. 2015; Bonde 2008). Eine umfangreiche Metaanalyse geht etwa von eine mittleren Risikoerhöhung für Depressionen von 1.59 (1.43 – 1.78) für Belastete im Vergleich zu Nicht-belasteten aus (gemessen durch „ERI"). Allerdings dürfen aufgrund der komplexen Messung von psychosozialen Belastungen, die klare Einteilungen in belastet vs. nicht-belastet erschwert, die Werte der genannten Risikoschätzer für kardiovaskuläre Erkrankungen und Depressionen nicht als endgültig interpretiert werden. Sie weisen aber eindeutig auf eine Risikoerhöhung hin. Dazu kommen vermehrt Befunde zu Diabetes (Ferrie et al. 2016; Kivimäki et al. 2015), aber auch zu krankheitsbedingter Frühberentung (Juvani et al. 2014; Elovainio et al. 2005; Hintsa et al. 2015) oder Arbeitsunfähigkeitstagen (AU-Tage) (Head et al. 2007; Mortensen et al. 2017; Ndjaboué et al. 2014).

Erklärungen / Ätiologisches Modell

Zur Beantwortung der Frage, warum psychische Arbeitsbelastungen einen negativen Einfluss auf die Gesundheit haben können, liegen in der Literatur verschiedene Annahmen vor (Epel et al. 2018; Kivimäki & Steptoe 2018; Havranek et al. 2015; Chandola et al. 2008; Sapolsky 2004; Kuntz-Hehner & Angerer 2018). Eine Möglichkeit sind indirekte Auswirkungen der Belastungen über Verhaltensweisen, die ihrerseits das Risiko einer Erkrankung erhöhen. Das kann etwa eine unausgewogene Ernährung oder mangelnde Bewegung aufgrund überlanger Arbeitszeiten sein, wie auch erhöhter Alkohol- und Tabakkonsum. Ein Zusammenhang zwischen Arbeitsbelastungen und diesen Verhaltensweisen gilt erneut auf Basis von Metaanalysen als gesichert, vor allem für Alkoholkonsum (Virtanen et al. 2015; Kouvonen et al. 2005a) und Rauchen (Kouvonen et al. 2005b).

Eine andere Möglichkeit, warum psychische Belastungen mit Gesundheit zusammenhängen, ergibt sich aus der physiologischen Stressreaktion des Körpers. Die Annahme ist, dass

wiederholte oder chronische Belastungen den Körper überfordern und zu einem Zustand der „allostatischen Last“ führen können (englisch „allostatic load“) (McEwen 2012; Shonkoff, Boyce & McEwen 2009). Dieser Zustand geht weit über eine einmalige Stressreaktion zur kurzfristigen Mobilisierung von Energie hinaus und kann bleibende Schäden verursachen. Das umfasst vor allem die übermäßige Ausschüttung von Stresshormonen (Adrenalin, Noradrenalin und Cortisol) und eine dauerhafte Aktivierung des Herz-Kreislauf Systems. Auswirkungen auf das kardiovaskuläre System sind zum Beispiel Bluthochdruck und eine reduzierte Herzfrequenzvariabilität (Kivimäki & Steptoe 2018), aber auch eine Erhöhung des Ruhepuls, gekoppelt mit Unruhe und Schlaflosigkeit. Ein dauerhaft erhöhter Cortisol-Spiegel schwächt zudem das Immunsystem und steht damit in Verbindung mit einer Reihe von Entzündungs- und Immunmarkern (z.B. Produktion von Zytokinen) oder bedeutet einen Überschuss an Energie ohne verbraucht zu werden (Blutfette, Blutzucker). Folgen können Koronararterienstenosen bzw. Arteriosklerose oder eine Glukoseintoleranz sein.

Für diese genannten biologischen Erklärungen existiert gesicherte Evidenz auf Basis experimenteller Untersuchungen und zunehmend auch aus epidemiologischen Beobachtungsstudien (Bellingrath & Kudielka 2016). Beispielsweise liegen Befunde für Zusammenhänge zwischen Arbeitsstress und Cortisolspiegel (Eddy et al. 2018), zu Markern des kardiovaskulären Systems (Schnall et al. 1998; Gilbert-Ouimet et al. 2014; Chandola, Heraclides & Kumari 2010) und zu Immunparametern vor (Eddy et al. 2016; Hansen et al. 2009). Die Studien bestätigen, dass Beschäftigte mit Arbeitsbelastungen (vor allem gemessen anhand beider Arbeitsstressmodelle) erhöhte biologische Stressreaktionen aufweisen.

Forschungsbedarf

Die arbeitsepidemiologische Forschung hat entscheidende Fortschritte gemacht und breite Evidenz für den Einfluss von psychosozialen Belastungen auf die Gesundheit geschaffen. Wichtig waren vor allem die Entwicklung von Arbeitsstressmodellen und deren Untersuchung im Rahmen von Kohortenstudien sowie darauf aufbauenden Metaanalysen. Trotz Fortschritts beschränken sich aber bisherigen Studien meist auf das mittlere Erwerbsalter (ca. 30 bis 55 Jahre) und homogene Berufskohorten. Sie folgen einem klassischen Kohortendesign und untersuchen das Risiko einer Neuerkrankung in Abhängigkeit einer Arbeitsbelastung zu Beginn der Studie. Zwei Forschungslücken bleiben hierdurch bestehen:

Zum einen ist durch die Untersuchung von Berufskohorten, die das höhere Lebensalter noch erreichen müssen, noch nicht abschließend geklärt, ob Arbeitsbelastungen über das Erwerbsleben hinaus einen Einfluss auf die Gesundheit haben können. Unklar bleibt auch, ob die Stärke der Zusammenhänge für verschiedene Altersphasen gleich oder unterschiedlich

sind. Zudem bedeutet die Fokussierung auf bestimmte Berufsgruppen, dass das Spektrum der Berufe eingeschränkt ist und komplexe Wechselwirkungen mit weiteren Faktoren unklar bleiben. Das umfasst auch mögliche Ursachen einer erhöhten Belastung im Kindesalter oder die Kumulation von Arbeitsbelastungen mit anderen Belastungen.

Eine zweite Kritik an bisherigen Studien lautet, dass die Messung psychosozialer Belastungen zu statisch ist (Benach et al. 2014; Wahrendorf & Chandola 2016), da sie sich meist auf die einmalige Messung von Arbeitsstress beschränkt. Dadurch könnte die Komplexität heutiger Arbeitsmärkte mit flexiblen, unsicheren und prekären Beschäftigungsverhältnissen (Kalleberg 2009; Brückner & Mayer 2005) nur unzureichend abgedeckt sein. Eine Einmalmessung könnte die Messung von Arbeitsbelastungen zudem verzerren, da es immer auch zufällige Verzerrungen nach oben oder unten bei der Datensammlung geben kann. Zudem fehlt die wichtige Information, ob Belastungen im Erwerbsverlauf wiederholt auftreten bzw. chronisch sind. Wiederholte Messungen von Arbeitsbelastungen oder die Betrachtung der Expositionsdauer über einen längeren Verlauf könnten also Fehlklassifikationen vermeiden und die Reliabilität bei der Messung chronischer Exposition gegenüber Arbeitsbelastungen erhöhen. Gerade wiederholte oder chronische Belastungen sind es aber laut Literatur, die den Zustand der allostatischen Last bestimmen, vor allem in Situationen in denen eine „wiederholte Aktivierung“ oder „fehlende Anpassung“ vorliegt (McEwen 2012). Hier scheint es nötig, dass Information zur wiederholten Belastung oder zur Intensität integriert wird und auch Merkmale gesamter Erwerbsverläufe betrachtet werden, etwa zur Bestimmung unsicherer Erwerbskarrieren (z.B. Anzahl an Phasen der Arbeitslosigkeit oder unfreiwilliger Arbeitsplatzverlust).

Die Ausweitung der Forschung zur Erklärung der Gesundheit im Alter entlang dieser Punkte entspricht zentralen Ideen der Lebenslaufperspektive. Das betrifft nicht nur die Idee, dass frühere Lebensphasen zur Erklärung späterer Gesundheit integriert werden (Kuh et al. 2014), sondern auch die Betonung, dass komplexe Wechselwirkungen im Lebenslauf zur Entstehung von Krankheiten beitragen, inklusive der Kumulation von Risiken im Lebenslauf. Der nächste Abschnitt fasst daher Kernideen der Lebenslaufperspektive zusammen.

2.2 Die Lebenslaufperspektive in der Epidemiologie

Die Lebenslaufperspektive ist in den Sozial- und Verhaltenswissenschaften bereits länger verankert (Elder, Johnson & Crosnoe 2003) und sie hat sich in den letzten Jahrzehnten auch in der Epidemiologie etabliert (Kuh & Ben-Shlomo 1997; Bartley 2016). Sie stellt ein wichtiges

analytisches Konzept - oder „Lebenslaufmodelle“ - mit Annahmen darüber, auf welche Weise Expositionen im Lebenslauf auftreten und einen Einfluss auf die Entstehung von Erkrankungen haben können (Kuh et al. 2003). Eine zentrale Unterscheidung ist die Frage, ob Belastungen unabhängig auftreten und einen eigenständigen Einfluss auf Erkrankungen im Alter haben (unabhängig von späteren Umständen im Lebenslauf), oder mit anderen Belastungen im Lebenslauf zusammenhängen bzw. kumulieren. Entsprechend unterscheidet die Lebenslaufperspektive ursprünglich zwei Modelle (Kuh & Ben-Shlomo 2004): (1) das Modell der kritischen Perioden („critical period model“), und (2) das Modell der Risikoakkumulation („risk accumulation model“).

Das Modell der kritischen Perioden

Durch das Modell der kritischen Perioden wird die Bedeutung des Zeitpunkts (oder „timing“) von Belastungen im Lebenslauf betont. Das Modell nimmt an, dass Expositionen dann Auswirkungen auf die Gesundheit haben können, wenn sie zu einem bestimmten Zeitpunkt im Lebenslauf, also in einer „kritischen Periode“, auftreten. Diese Auswirkungen können in der Regel nicht rückgängig gemacht werden. Das bekannteste Beispiel ist die sogenannte „Barker-Hypothese“ laut der die Lebenserwartung und das Erkrankungsrisiko einer Person bereits im Mutterleib entscheidend verankert bzw. „biologisch programmiert“ werden (Barker 1990). Die Annahme ist in diesem Fall, dass durch ein problematisches Gesundheitsverhalten der Mutter während der Schwangerschaft die Ausbildung wichtiger Organe und Körperfunktionen beeinflusst wird. Studien, die einen Zusammenhang zwischen niedrigem Geburtsgewicht (≤ 2500 Gramm) und Herz-Kreislauferkrankungen im Erwachsenenalter aufzeigen, unterstützen diese Annahme (Havranek et al. 2015). Auswirkungen zeigen dabei unabhängig von Faktoren im Erwachsenenalter (z.B. sozioökonomische Position) und treten oft verzögert im Laufe des Lebens auf. Die Forschung spricht hier auch von einem „Latenzmodell“. Eine weniger deterministische Variante des Modells der kritischen Perioden stellt das Modell der sensitiven Perioden („sensitive period model“). In diesem Fall würde eine Exposition zwar während der sensitiven Periode ihren stärksten aber nicht einzigen Effekt auf die Gesundheit haben und nicht irreversibel sein - eine Idee, die im Falle von Arbeitsstress und Gesundheit realistischer erscheint.

Übertragen auf den Zusammenhang zwischen Arbeitsbelastungen im Lebenslauf und Gesundheit ließe sich entlang dieses Modells fragen, ob es bestimmte Lebensphasen gibt, in denen Arbeitsbelastungen einen stärkeren oder schwächeren Einfluss auf die Gesundheit haben. Da die Forschungsevidenz für einen Zusammenhang bislang auf das mittlere Erwerbsalter beschränkt ist (etwa zwischen 30 und 55), könnte angenommen werden, dass diese Altersphase selbst eine Art kritische Periode ist. Die Teilhabe am Arbeitsmarkt könnte

in dieser Phase besonders wichtig sein, da die Erwerbsrolle aufgrund hoher Verantwortungen und wichtigen materiellen Folgen für das höhere Lebensalter einen vergleichbar hohen Stellenwert einnimmt (Willis & Martin 2005; Willis, Martin & Rocke 2010). Denkbar ist dadurch einerseits, dass Arbeitsplatzunsicherheit oder fehlende Aufstiegschancen eine stärkere Belastung für das mittlere Erwerbsalter darstellen (Chandola et al. 2008). Andererseits könnten Beschäftigte über 55 aber auch vulnerabler gegenüber Stressoren sein, da Alternsprozesse häufig auch mit einem Wandel der Copingfähigkeiten und physiologischen Veränderungen einhergehen (Hobfoll 1989; Lazarus & DeLongis 1983). Dadurch wären die Zusammenhänge im Falle von Belastungen gerade für ältere Erwerbstätige ausgeprägter. Zu einer möglichen Moderation durch das Alter liegen allerdings bisher nur vereinzelte und heterogene Befunde vor (Shultz et al. 2010; Donders et al. 2012; Payne & Doyal 2010; Burr et al. 2017). Meist taucht das Alter nur am Rande der Analysen auf, und die wenigen existierenden Studien zu einer möglichen Moderation betrachten unterschiedliche Expositionen und unterschiedliche Gesundheitsmaße. Eine abschließende Beurteilung ist dadurch nicht möglich.

Das Modell der Risikoakkumulation

Das Modell der Risikoakkumulation oder Kumulationsmodell betont die Bedeutung der Intensität und Häufigkeit von Belastungen. Es geht also nicht um die Frage, in welchem Zeitfenster eine Belastung auftritt, sondern wie lange und wie häufig Belastungen im Lebenslauf vorkommen. Das Modell der Risikoakkumulation nimmt dabei vor allem an, dass Belastungen mit weiteren Belastungen zusammenhängen. Diese Kumulation von Risiken schließt nicht nur weitere Belastungen im Erwerbsalter ein (Turner, Wheaton & Lloyd 1995), sondern auch längere „Belastungskarrieren“, die bereits im Kindesalter beginnen können (Ferraro & Shippee 2009; Dannefer 2003).

Damit lenkt das Modell die Aufmerksamkeit auf gesamte Lebensläufe und betont den Wert einer holistischen Perspektive, die einzelne Aspekte nicht von größeren Biographien isoliert (Sackmann & Wingens 2003; Aisenbrey & Fasang 2010; George 2014). Nach diesem Modell könnten Benachteiligungen im Kindheitsalter beispielsweise mit geringeren Bildungschancen zusammenhängen, die wiederum die Chancen auf dem Arbeitsmarkt bestimmen und die Wahrscheinlichkeiten eines belastenden Berufs mit starken Belastungen vergrößern. Im schlimmsten Fall kann jede dieser Belastungen (inkl. früher Benachteiligung) einen eigenständigen Einfluss auf die Gesundheit haben, es also eine additive Kumulation von Belastungen samt Auswirkungen geben. Frühe soziale Benachteiligungen hätten damit nicht nur einen eigenständigen Effekt auf die Gesundheit, sondern erhöhen zugleich auch das Risiko weiterer Belastungen im Lebenslauf, die jeweils Folgen für die Gesundheit haben. Die

Soziologie beschreibt dies als „Matthäus Effekt“ (Merton 1968), bei dem Benachteiligungen (oder auch Erfolge) zu weiteren Benachteiligungen (oder Erfolgen) führen und somit wachsende Ungleichheiten produzieren (siehe auch: Siegrist 2015). Denkbar ist auch, dass eine frühe Benachteiligung nicht direkt mit Gesundheit verbunden ist, Personen aber auf einen Pfad setzt, der wiederum die Wahrscheinlichkeit von ätiologisch wichtigen Belastungen erhöht. Damit würde keine additive Kumulation von jeweils wichtigen Belastungen erfolgen, sondern frühe Benachteiligung indirekt über späterer Risikofaktoren auf die Gesundheit wirken. Diese Differenzierung des Kumulationsmodell wird auch als „Pfadmodell“ bzw. „Modell der Risikoketten“ bezeichnet und betont, dass sowohl additive Effekte wie auch indirekte Effekte von frühen Belastungen zu erwarten sind (Power & Hertzman 1997).

Mit Blick auf den Zusammenhang zwischen Arbeitsbelastungen im Lebenslauf und Gesundheit sprechen eine Reihe von Studien für das Kumulationsmodel. Dazu gehören zum Beispiel Studien, die von einer Dosis-Wirkung Beziehung zwischen Anzahl wiederholter Belastungen durch Arbeitsstress und dem Risiko schlechter Gesundheit berichten (Chandola, Brunner & Marmot 2006; Åhlin et al. 2018; Gilbert-Ouimet et al. 2012). Das gilt für Herz-Kreislauf-Erkrankungen und für psychische Erkrankungen[2]. Weitere Unterstützung findet das Modell durch zahlreiche Studien, die aufzeigen, dass Armut in der Kindheit und Bildungsherkunft die Wahrscheinlichkeit von Belastungen im Erwerbsleben erhöhen. Dies gilt für eine erhöhte Wahrscheinlichkeit von Jugendarbeitslosigkeit (Caspi et al. 1998), finanzielle Schwierigkeiten (Kuh et al. 1997; Kuh & Wadsworth 1991), unsichere Beschäftigung und Arbeitsplatzunsicherheit (Power & Matthews 1997), Arbeitsstress (Elovainio et al. 2007) und auch für kumulierte Benachteiligung im Berufsleben (Dragano & Wahrendorf 2014).

Zusammengefasst unterstreicht das Kumulationsmodell, dass der Fokus auf einzelne Belastungen nicht adäquat das ganze Spektrum an krankheitswertigen Belastungen im Lebenslauf abbildet und dass frühe Belastungen meist mit weiteren gesundheitlichen Belastungen verbunden sind. Das Modell der kritischen Periode unterstreicht hingegen, dass, wenn Belastungen in einem bestimmten Zeitfenster auftreten, schwerwiegende Auswirkungen möglich sind. Wichtig ist zu betonen, dass die Modelle keineswegs in Konkurrenz zueinander stehen, sondern durchaus parallel wirken können. Sie setzen aber wichtige, jeweils unterschiedliche Schwerpunkte für die Analyse und Interpretation der Zusammenhänge über den Lebenslauf. Für die nachfolgenden Arbeiten ist vor allem der Gedanke, dass die Fokussierung auf einzelne Expositionen nicht zielführend ist, sondern längere Zeiträume betrachtet und gesamte Berufsbiographien betrachtet werden sollten, wichtig.

[2] Eine detaillierte Übersicht existierender Studien mit Mehrfachmessungen und deren Zusammenhang mit Gesundheit findet sich unter (Wahrendorf & Chandola 2016)

2.3 Methodik [3]

Datenquellen

Aus methodischer Sicht erfordert die Analyse von Arbeitsbelastungen im Lebenslauf detaillierte Daten. Solche Daten waren in der Forschung lange selten. Sie sind in der Vergangenheit aber zunehmend verfügbar. Ein erster Grund ist die wachsende Zahl an prospektiven Bevölkerungsumfragen mit längeren Beobachtungszeiträumen. Diese Studien ermöglichen wiederholte Belastungen zu ermitteln, bzw. Belastungen können für unterschiedliche Lebensphasen bestimmt und untersucht werden. Ein weiterer wichtiger Grund ist, dass laufende Studien zunehmend anhand retrospektiver Interviews Lebenslaufdaten (englisch: „life history data“) erheben (Börsch-Supan et al. 2013; Blane 1996; Vanhoutte & Nazroo 2016). Dabei werden detaillierte Angaben zum früheren Lebenslauf der Studienteilnehmer (inkl. Berufsbiographie) erhoben, die mit den übrigen Daten der Studie verbunden werden können. Eine ähnliche Strategie verfolgt das sogenannte "Record-Linkage" bei dem administrative Daten mit den übrigen Daten der Studie verknüpft werden. Im besten Fall liegen hier auch für die Befragten Daten zu zurückliegenden Berufsbiographien vor.

Tabelle 1. Kurzübersicht der verwendeten Studien

Studie	**Länder**	**Stichprobe**	**Stichprobengröße (Baseline)**	**Verfügbare Daten**
SHARE	11 Länder in Europa	Bevölkerung mit 50 Jahren oder älter	N=30.434 (2004-2005) / plus 16 neuer Länder seit Baseline	Zweijährliche Wiederholungsbefragungen plus Lebenslaufdaten durch retrospektive Interviews in 2008-2009 (SHARELIFE)
SOEP	Deutschland	Bevölkerung mit 18 Jahren oder älter	N=12.245 (1984) / plus neue Bundes-länder seit Baseline	Jährliche Wiederholungsbefragungen
HNR - Studie	Deutschland	Bevölkerung zwischen 45 und 75 (aus Ruhrgebiet)	N=4818 (2002-2003)	Zweimalige Wiederholungsbefragungen plus Lebenslaufdaten durch retrospektive Interviews in 2011-2014 und Verknüpfung administrativer Daten
GAZEL	Frankreich	Gas und Elektro Arbeiter von Elétricité de France zwischen 35 und 50	N= 20.625 (1989)	Jährlicher Wiederholungsbefragungen
Constances	Frankreich	Bevölkerung zwischen 18 und 69 Jahren	N=200.000 (2012-2019)	Jährliche Wiederholungsbefragungen plus Lebenslaufdaten durch retrospektive Interviews zu Baseline

[3] Teile dieses Abschnitts sind in erweiterter Form auch erschienen unter: (Vanhoutte, Wahrendorf & Prattley 2018)

Einen Überblick der in den Originalarbeiten verwendeten Studien und verfügbarer Daten gibt Tabelle 1. Weitere Details zu den einzelnen Studien sind in den Originalarbeiten selbst beschrieben. Alle in den Originalarbeiten verwendeten Studien verfügen über Wiederholungsbefragungen. Neben regulären Befragungen, in denen Merkmale zum Zeitpunkt der Befragung erhoben werden (z.B. Gesundheit oder derzeitiges Einkommen), nutzen 6 der 8 Originalarbeiten auch retrospektive Interviews zur Ermittlung von Lebenslaufdaten. Dazu kommt im Falle der HNR-Studie Studie die Besonderheit, dass Berufssequenzen sowohl durch retrospektive Interviews als auch durch Record-Linkage vorliegen.

Berufssequenzen / Sequenzanalyse

Lebenslaufdaten auf Basis retrospektiver Interviews oder administrative Daten weisen eine Besonderheit auf: Im Gegensatz zu prospektiven Daten liegen sie in der Regel in einem „Spell-Format“ vor, bei dem für jede der zurückliegenden Erwerbsphasen Angaben zum Beginn und zum Ende samt Details zu den einzelnen Berufen vorliegen (z.B. Arbeitszeit oder Branche). Somit können für jeden Teilnehmer individuelle Berufssequenzen bestimmt werden, etwa für Befragte über 45 die Erwerbsituation für jedes Altersjahr zwischen 25 und 45 (21 Jahre). Herkömmliche Ansätze, beispielsweise Regressionsmodelle oder Überlebensmodelle, stoßen zur statistischen Auswertung und umfassenden Betrachtung dieser Sequenzen schnell an ihre Grenzen, da sie sich auf einzelne Ereignisse oder Outcomes und deren Prädiktion konzentrieren. Eine wichtige Entwicklung ist an dieser Stelle die wachsende Bedeutung der Sequenzanalyse (Studer & Ritschard 2016; Abbott 2001; Aisenbrey & Fasang 2010). Ihre Stärke ist der ganzheitliche Blick oder die „holistische Perspektive“ auf Sequenzen als Analyseeinheit. Im Gegensatz zu anderen statischen Verfahren ist das Ziel somit nicht, die Beziehung zwischen einzelnen Variablen zu betrachten, sondern durch Bestimmung von Summenmaßen oder Beschreibung von Sequenzmustern, Visualisierungen oder dem Vergleich von Sequenzen, ein Gesamtbild der Sequenzen zu geben.

Die nachfolgende Tabelle präsentiert vier Berufssequenzen als Beispiel. Die Sequenzen decken den Zeitraum zwischen 25 und 45 ab und sind als Buchstabenfolge dargestellt. Jeder Buchstabe steht in diesem Beispiel für eine von vier möglichen Erwerbsituationen („E“=Vollzeit erwerbstätig; „e“=Teilzeit erwerbstätig; „a“=arbeitslos; „h“=Hausarbeit). Die beiden ersten Sequenzen gehören zu Personen, die zu Beginn Vollzeit erwerbstätig waren, dann eine fünf-jährige Episode von Hausarbeit hatten (zu jeweils unterschiedlichen Zeitpunkten) und anschließend bis 45 Teilzeit arbeiteten. Die dritte und vierte Sequenz enthalten beide 17 Jahre Vollzeit Erwerbstätigkeit und vier Jahre Arbeitslosigkeit. Sie weisen allerdings unterschiedliche Muster auf.

Tabelle 2: Beispiele für Berufssequenzen zwischen 25 und 45 und Kurzbeschreibung

Berufssequenz	**Kurzbeschreibung**
EEEEEhhhhheeeeeeeeeee	5 Jahre Vollzeit erwerbstätig, gefolgt von einer Episode von Hausarbeit (5 Jahre) und anschließender Teilzeiterwerbstätigkeit
EEEhhhhheeeeeeeeeeeee	3 Jahre Vollzeit erwerbstätig, gefolgt von einer Episode von Hausarbeit und anschließender Teilzeiterwerbstätigkeit
EEaaaaEEEEEEEEEEEEEE	Vollzeiterwerbstätigkeit mit einer frühen vierjährigen Episode von Arbeitslosigkeit
EEaEEEEEEEaEEEaEEEaEE	Vollzeit erwerbstätig mit wiederholten Episoden von Arbeitslosigkeit

Legende. „E“=Vollzeit erwerbstätig; „e“=Teilzeit erwerbstätig; „a“=arbeitslos; „h“=Hausarbeit

Mit Hilfe solcher Sequenzen können verschiedene Summenmaße ermittelt werden. In den Beispielen der Tabelle können etwa die Anzahl an Episoden von Arbeitslosigkeit oder die Anzahl der Jahre, in denen der oder die in einer spezifischen Situation war, bestimmt werden. Weitere Beispiele für Summenmaße auf Basis differenzierterer Sequenzen sind die Anzahl an Berufswechseln oder Karriereunterbrechungen, oder die Betrachtung von Mobilitätsprozessen. Dazu kommt aber auch, dass durch den Vergleich von individuellen Sequenzen anhand von Distanzmaßen genau quantifiziert werden kann, wie unterschiedlich oder ähnlich einzelne Sequenzen sind (Studer & Ritschard 2016). Diese Information ist wertvoll, denn sie ermöglicht es letztlich Sequenzen mit ähnlichen Mustern (geringer Distanz zueinander) zu gruppieren und somit Typen von beobachteten Berufsbiographien zu bilden. Jeder Befragte kann dann einem dieser Typen zugeordnet werden. Summenmaße und Typenzugehörigkeit können wiederum als unabhängige (zur Prädikation von Gesundheit) Variable im Rahmen herkömmlicher Verfahren (z.B. Regressionsmodelle) verwendet werden.

Sozialepidemiologische Untersuchungen wenden verstärkt Verfahren der Sequenzanalyse zur Bildung von Typen an, die dann zur Prädiktion von Gesundheit genutzt werden. Zum Beispiel zeigen Studien, dass bestimmte Typen von Erwerbs- und Familienbiographien mit einem erhöhtem Mortalitätsrisiko für Frauen zusammenhängen (Sabbath et al. 2015a; McKetta et al. 2018; Sabbath et al. 2015b; Benson et al. 2017). Das sind vor allem diskontinuierliche Berufsbiographien alleinstehender Frauen. Darüber hinaus zeigen Studien unter Männern und Frauen, dass Biographien, die von einer frühen Elternschaft und geringer Erwerbsbeteiligung geprägt sind, mit erhöhten Stress- und Entzündungsmarker zusammenhängen, dies auch nach Kontrolle wichtiger Confounder (Lacey et al. 2015b). Gleiches gilt ebenso für Adipositas und weitere Marker eines metabolischen Syndroms (McMunn et al. 2016; Lacey et al. 2016; Lacey et al. 2017). Auch zu allgemeiner

Lebenszufriedenheit, selbst-berichteter Gesundheit und depressiven Symptomen liegen Studien für einen Zusammenhang von Berufsbiographien und Gesundheit vor (Lacey et al. 2015a; Ponomarenko 2016; Bennett & Waterhouse 2018; Stone et al. 2015). Eine Studie aus England berichtet zum Beispiel, dass Frauen über 65 vor allem dann eine gute Gesundheit berichten, wenn sie nach einer Phase der Kindeserziehung wieder erwerbstätig waren (Lacey et al. 2015a). Ein andere Studie aus Deutschland berichtet hingegen, dass es gerade diese Frauen sind (Rückkehr in den Arbeitsmarkt nach Erwerbspause), die im Alter eine erhöhte depressive Symptomatik bzw. eine vermehrte Einnahme von Antidepressiva aufweisen (Engels et al. 2019).

2.4 Forschungsfragen

Die in dieser Schrift versammelten Originalarbeiten tragen in ihrer Gesamtheit zur Erweiterung dreier miteinander verbundener übergeordneter Fragestellungen bei.

Als erstes geht es darum, wie mit Hilfe von Lebenslaufdaten die Messung von Arbeitsbelastungen über den Lebenslauf ausgeweitet werden kann und ob Arbeitsbelastungen mit weiteren Faktoren über den Lebenslauf zusammenhängen. Zweitens stellt sich die Frage, wie Arbeitsbelastungen im Lebenslauf mit späterer Gesundheit zusammenhängen, auch über die Erwerbsphase hinaus. Die dritte Frage richtet sich an die Qualität der verwendeten Lebenslaufdaten. Dabei geht es um die Machbarkeit und Praktikabilität bei der Durchführung retrospektiver Interviews, aber auch um die Qualität selbst-berichteter Angaben. Die hier zusammengefassten Arbeiten liefern neue und weitergehende Antworten auf diese bislang wenig untersuchten Fragen.

Nachfolgend werden die einzelnen Originalarbeiten und die Kernergebnisse nacheinander kurzgefasst vorgestellt. Die Vorstellung erfolgt in chronologischer Reihenfolge. Es folgt dann eine zusammenfassende Betrachtung der Ergebnisse entlang der oben genannten Forschungsfragen samt Diskussion und Fazit.

3 Eigene Originalarbeiten

Originalarbeit 1 (Titel: "Long-term effects of psychosocial work stress in midlife on health functioning after labor market exit—results from the GAZEL study.")

Die erste Arbeit untersuchte langfristige Auswirkungen psychosozialer Arbeitsbelastungen auf gesundheitliche Einschränkungen (englisch: „health functioning") im Rentenalter im Rahmen einer großen prospektiven Kohortenstudie, der französischen GAZEL Kohortenstudie. Die Messung von Arbeitsbelastungen erfolgte durch beide Langversionen der Fragebögen des Anforderungs-Kontroll-Modells (mittlere Belastung auf Basis von zwei Messzeitpunkten) und dem Modell beruflicher Gratifikationskrisen (Belastung zu einem Zeitpunkt). Gesundheit wurde mit Hilfe eines standardisierten Fragebogens zur Erfassung selbst-berichteter mentaler und körperlicher Einschränkungen gemessen. Die Arbeit analysierte Zusammenhänge für insgesamt 6053 Männer und Frauen, die zwischen der Messung von Arbeitsbelastungen und der Gesundheit (9 Jahre später) berentet wurden.

Die Ergebnisse zeigten, dass psychosoziale Arbeitsbelastungen mit verminderter mentaler und körperlicher Gesundheit nach dem Austritt aus dem Erwerbsleben zusammenhängen. Dies gilt für beide Arbeitsstressmodelle und für die jeweiligen Einzelskalen der Modelle (z.B. Kontrolle oder Belohnung). Zusammenhänge sind auch dann beobachtbar, wenn selbst-berichtete Gesundheit zum Zeitpunkt der Arbeitsbelastung berücksichtigt wurde, und wenn für weitere potentielle Confounder adjustiert wurde, inklusive Alter, Geschlecht und soziale Position. Zudem zeigte sich in kombinierten Regressionsmodellen, dass beide Arbeits-stressmodelle einen unabhängigen Einfluss auf die Gesundheit haben. Einschränkend muss allerdings berücksichtigt werden, dass es sich bei der GAZEL Kohorte um eine relativ homogene Berufsgruppe mit vergleichsweise guten Arbeitsbedingungen handelt (Gas- und Elektroarbeiter von Elétricité de France). Bestimmte Berufsgruppen und Frauen sind unterrepräsentiert. Auf geschlechtsspezifische Analysen wurde daher verzichtet. Zudem muss berücksichtigt werden, dass keine Belastung über einen längeren Zeitraum betrachtet wurde.

Zusammenfassend unterstreicht die erste Originalarbeit anhand prospektiver Daten die Bedeutung von psychosozialen Arbeitsbelastungen nicht nur für das mittlere Erwerbsalter, sondern auch für die Gesundheit über die Erwerbsphase hinaus. Die Arbeit ist eine der ersten wissenschaftlichen Arbeiten, die auf Basis einer Berufskohorte Auswirkungen psychosozialer Belastungen auf die Gesundheit auch über das Erwerbsleben hinaus untersucht.

Originalarbeit 2 (Titel: "Working conditions in mid-life and mental health in older ages.")

In der zweiten Arbeit ging es um Zusammenhänge zwischen Arbeitsbedingungen im mittleren Erwerbsalter (zwischen 40 und 55 Jahre) und mentaler Gesundheit (depressive Symptome) im Rentenalter. Die Arbeit untersuchte erstmals neben psychosozialer Arbeitsbelastungen auch einzelne Merkmale der beruflichen Karriere als mögliche Belastungen. Dazu nutzte die Arbeit erstmals die retrospektiven Lebenslaufdaten der SHARE Studie und ermittelte für jedes Altersjahr die Erwerbsituation. Die nachfolgende Abbildung fasst die hieraus resultierenden Sequenzdaten getrennt für Männer und Frauen zusammen und zeigt für die Lebensjahre zwischen 15 und 65 die Verteilung sieben möglicher Erwerbssituationen (ein sogenanntes „Chronogram"). Man sieht, dass sich Erwerbsbiographien zwischen Männern und Frauen deutlich unterscheiden. Zusammenhänge zwischen Arbeitsbelastungen und Gesundheit wurden in der Folge entsprechend getrennt für Männer und Frauen untersucht.

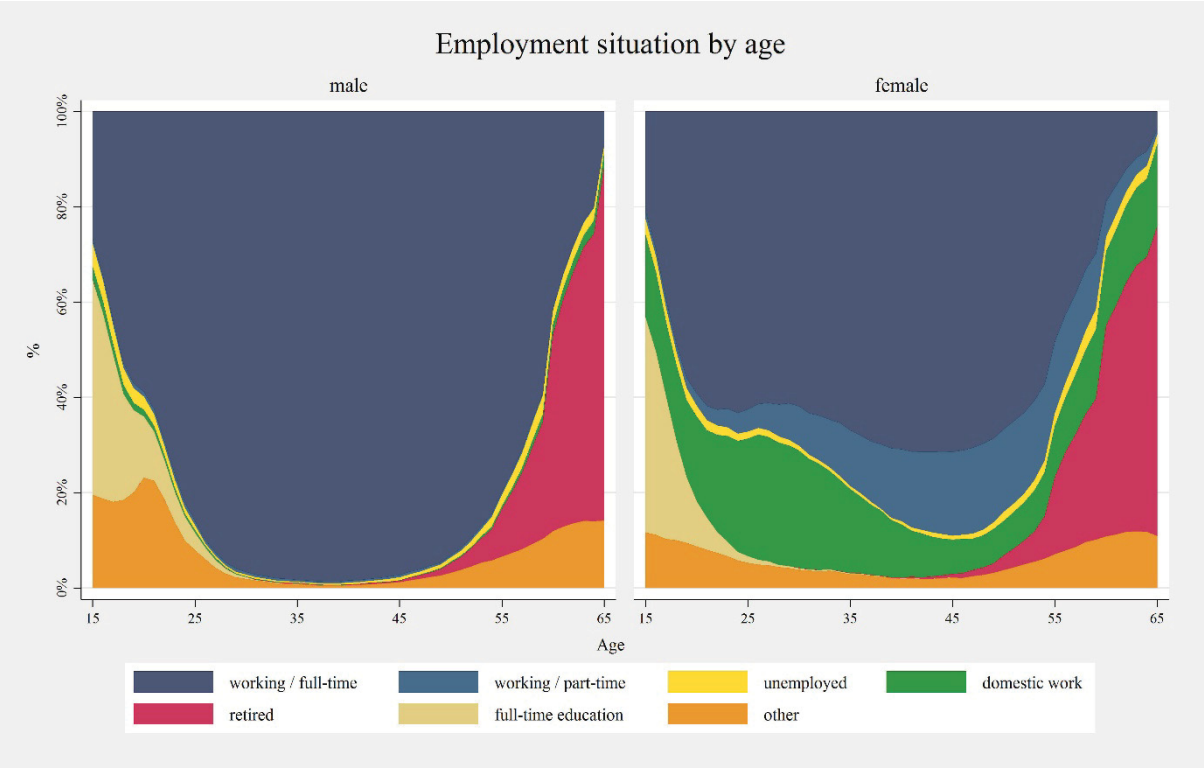


Abbildung 1. Erwerbssituation nach Alter für Männer und Frauen (N=8609);
entnommen aus (Wahrendorf et al. 2013), mit freundlicher Genehmigung des Verlags (Open Access).

Die Ergebnisse zum Zusammenhang zwischen Arbeitsbedingungen und Gesundheit zeigten, dass Arbeitsbelastungen mit erhöhter depressiver Symptomatik zusammenhängen, es aber auch Unterschiede nach Geschlecht gibt. Im Falle psychosozialer Arbeitsbelastungen

(gemessen anhand von Kurzversionen beider Arbeitsstressmodelle für den Hauptberuf) und mittleren beruflichen Position zeigten sich Zusammenhänge für beide Geschlechter. Phasen der Arbeitslosigkeit, unfreiwilliger Arbeitsplatzverlust (aufgrund von Entlassung) und unstabile Biographien (häufiger Arbeitsplatzwechsel oder insgesamt geringe Erwerbsbeteiligung) bedeuteten allerdings nur für Männer ein erhöhtes Risiko für depressive Symptome. Alle berichteten Zusammenhänge galten auch, wenn Teilnehmer mit einer längeren krankheitsbedingten Phase der Erwerbslosigkeit oder einer Berentung vor 60 von den Analysen ausgeschlossen wurden und ebenso in multivariaten Modellen in denen die sozioökonomische Position im Alter und Gesundheit vor dem mittleren Lebensalter berücksichtigt wurde. Einschränkend muss allerdings erwähnt werden, dass die retrospektive Messung der Arbeitsbedingungen aufgrund depressiver Verstimmungen getrübt sein kann. Vor allem im Hinblick auf den Zusammenhang zwischen psychosozialer Belastungen und mentaler Gesundheit kann dies kritisch sein, womöglich aber weniger kritisch im Falle der einzelnen Merkmale zurückliegender beruflicher Karrieren.

Zusammengefasst legen die Ergebnisse der zweiten Arbeit erneut die Bedeutung psychosozialer Belastungen für die mentale Gesundheit im Alter dar und erweitern die Messung von Arbeitsbedingungen um einzelne Merkmale beruflicher Karrieren. Im Falle von Männern zeigen sich dabei auch Zusammenhänge für diskontinuierliche Biographien. Zudem weist die Arbeit auf Unterschiede von Erwerbsbiographien zwischen Männern und Frauen hin.

Originalarbeit 3 (Titel: "Proximal and distal determinants of stressful work: framework and analysis of retrospective European data.")

Während die ersten beiden Arbeiten Zusammenhänge zwischen Arbeitsbedingungen und Gesundheit in der nachberuflichen Lebensphase untersuchten, betrachtete die dritte Arbeit mögliche Determinanten psychosozialer Arbeitsbelastungen im Erwerbsleben. Diese wurden wieder anhand der Lebenslaufdaten berenteter Männer und Frauen der SHARE Studie aus insgesamt 13 Ländern bestimmt. Es ging vor allem um die Wechselwirkungen psychosozialer Arbeitsbelastungen mit weiteren individuellen Merkmalen der beruflichen Karriere sowie sozioökonomischer Merkmale in der Kindheit. Dazu kam die Betrachtung von länderspezifischen Rahmenbedingungen, gemessen anhand spezifischer Makroindikatoren zur Beschreibung arbeits- und sozialpolitischer Programme, ermittelt aus amtlichen Statistiken. Kernergebnisse sind in der nachfolgenden Abbildung dargestellt, die jeweils den Anteil der Personen mit einem hohen kritischen Belastungswert zeigt.

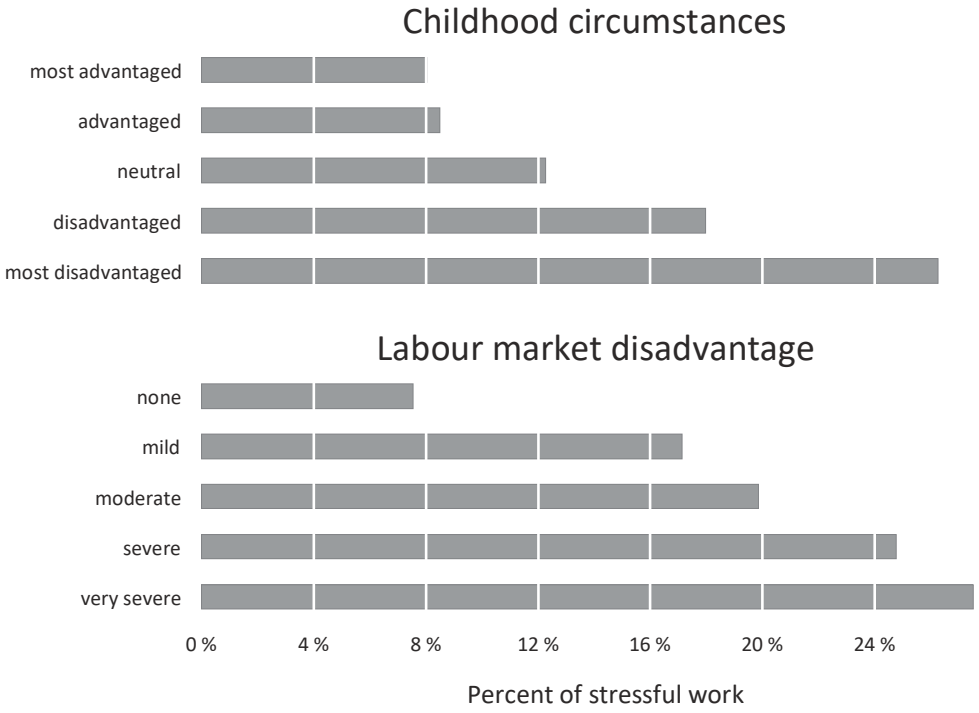


Abbildung 2. Anteil an psychosozialen Belastungen nach Bedingungen in der Kindheit und Benachteiligungen im Erwerbsleben; entnommen aus (Wahrendorf & Siegrist 2014), mit freundlicher Genehmigung des Verlags (Open Access).

Abbildung 2 weist auf einen klaren Zusammenhang zwischen sozioökonomischen Merkmalen in der Kindheit (Englisch: „childhood adversity“) und der Wahrscheinlichkeit hoher Belastungen im Erwerbsleben hin. Sozioökonomische Merkmale beruhen auf einem Summenscore, der den früheren Beruf des Vaters plus drei weitere Indikatoren einschließt (geringe Anzahl an Büchern, schlechte Wohnbedingungen und beengte Wohnsituation). Eine erhöhte Wahrscheinlichkeit für Belastungen findet sich auch für kumulierte Benachteiligungen im Erwerbsleben, bestimmt durch einzelne Merkmale der beruflichen Karriere (unfreiwilliger Arbeitsplatzverlust aufgrund von Entlassung oder Betriebsschließung, mittlere berufliche Position und Arbeitslosigkeitsepisoden). Dies verdeutlicht, dass einzelne Merkmale der beruflichen Karrieren mit psychosozialer Belastung zusammenhängen.

Ein weiteres Ergebnis betraf die Variation von Belastungen entlang länderspezifischer politischer Programme. Konkret zeigte sich, dass zwei Arten politischer Maßnahmen mit verminderter Belastung einhergingen. Dies waren zum einen ausgeprägte integrative Maßnahmen mit dem Ziel Personen am Arbeitsmarkt zu halten und vor einem drohenden Arbeitsplatzverlust zu bewahren (z.B. umfangreiche Weiterbildungsmaßnahmen und eine umfangreiche aktive Arbeitsmarktpolitik). Zum anderen war dies der Umfang an protektiven

oder kompensatorischen Maßnahmen, beispielsweise der Umfang an finanziellen Unterstützungsleistungen im Falle von Arbeitslosigkeit („Lohnersatzleistungen“) oder im Falle von krankheitsbedingter Frühberentung.

Insgesamt liefern die Ergebnisse der Arbeit wichtige Hinweise auf eine Kumulation von Arbeitsbelastungen über den Lebenslauf, bei dem frühe soziale Benachteiligung mit kumulierten Belastungen im Erwerbsleben zusammenhängen.

Originalarbeit 4: (Titel: “Does labour market disadvantage help to explain why childhood circumstances are related to quality of life at older ages? Results from SHARE.“)

Die vierte Arbeit verband in gewisser Weise die Arbeiten 2 und 3, indem sie sozioökonomische Bedingungen in der Kindheit, kumulierte Belastungen im Erwerbsleben und zusätzlich auch allgemeine Lebensqualität in der nachberuflichen Lebensphase untersuchte (getrennt für Männer und Frauen). Untersucht wurde, ob frühe Benachteiligung und Arbeitsbelastungen mit Lebensqualität im Alter zusammenhängen, und in welchem Ausmaß der Zusammenhang zwischen früher Benachteiligung und Lebensqualität durch Belastungen im Erwerbsleben erklärt werden kann.

Insgesamt zeigte sich, dass sowohl ungünstige Bedingungen in der Kindheit wie auch Belastungen im Erwerbsleben mit geringerer Lebensqualität zusammenhängen - auch dann, wenn in multivariaten Regressionen beide Faktoren jeweils füreinander adjustiert wurden. Zusätzlich zeigten die Ergebnisse (inkl. spezifischer Tests zur Prüfung möglicher Mediationen in Mehrebenenmodellen), dass der Zusammenhang zwischen früher Benachteiligung und Lebensqualität nur teilweise über Arbeitsbelastungen erklärt werden kann (siehe Abbildung 3). Die berichteten Ergebnisse galten für Männer und Frauen. Neben Alter und Bildung berücksichtigen die multivariaten Modelle auch die Partnerschaftsbiographie (auch durch die Lebenslaufdaten ermittelt) und funktionale Einschränkungen im Alter.

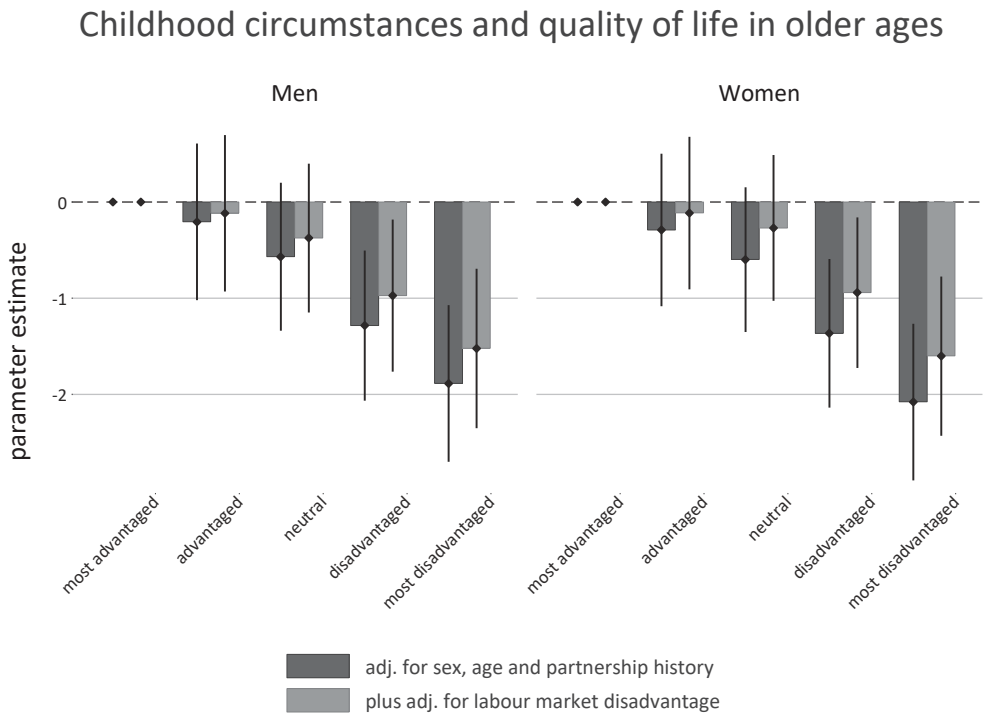


Abbildung 3. Bedingungen in der Kindheit und Lebensqualität im höheren Lebensalter: Mehrebeneschätzer und Konfidenzintervalle für Männer (N=4808) und Frauen (N=5463); entnommen aus (Wahrendorf & Blane 2015), mit freundlicher Genehmigung des Verlags (Open Access).

Die vierte Arbeit weist zusammengefasst erneut auf die Bedeutung von ungünstigen beruflichen Karrieren für die Gesundheit im Alter hin. Sie zeigt zudem, dass diese mit vorberuflichen Faktoren in Beziehung stehen und deutet auf eine Kumulation von Risiken im Lebenslauf, sowohl für Männer wie auch für Frauen.

Originalarbeit 5: (Titel: "Previous employment histories and quality of life in older ages: sequence analyses using SHARELIFE.")

Während die bisherigen Arbeiten zur Bestimmung von Arbeitsbedingungen im Erwerbsleben entweder psychosoziale Arbeitsbelastungen im Beruf oder Merkmale beruflicher Karrieren verwendeten, fasste die fünfte Arbeit gesamte Berufsbiographien zu einzelnen Typen zusammen und untersuchte deren Zusammenhang mit Lebensqualität im Alter. Wieder waren retrospektive Lebenslaufdaten der SHARE Studie die Grundlage und es erfolgten die Auswertungen getrennt für Männer und Frauen. Die Typenbildung beruhte auf sequenzanalytische Verfahren zum Vergleich von zurückliegender Berufsbiographien

(zwischen 30 und 65 Jahren) von insgesamt 4808 Sequenzen für Männer und 4907 Sequenzen für Frauen. In beiden Fällen wurden Biographien 10 unterschiedlichen Typen zugeordnet. Die Prototypen der einzelnen Typen und deren Verteilung sind in Abbildung 4 dargestellt.

Für nahezu alle Männer (94 % der Männer) waren Biographien von langen Perioden in Vollzeitarbeit geprägt, die früher oder später in Berentung endeten („reguläre Biographien“). Im Vergleich dazu waren Biographien der Frauen wesentlich heterogener. Neben regulärer Biographien waren Biographien auch durch lange Phasen von Hausarbeit geprägt, die entweder vor einer Erwerbsphase auftraten („gemischte Biographien“) oder gesamte Biographien prägten („Haushalts-Biographien“).

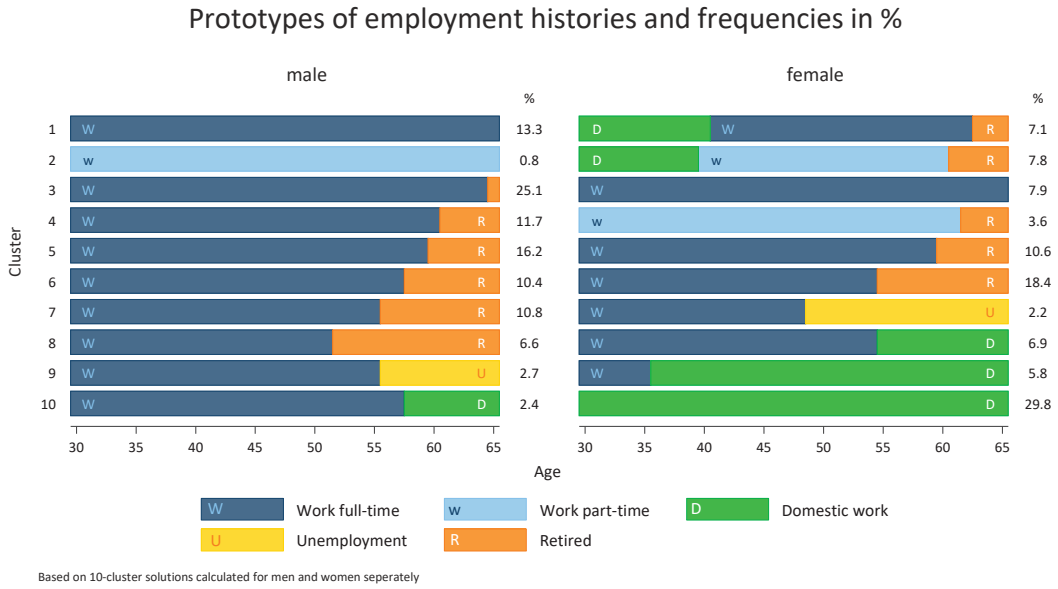


Abbildung 4. Prototypen von Berufsbiographien für Männer (N=4808) und Frauen (N=4907) und Häufigkeiten (%); entnommen aus (Wahrendorf 2015), mit freundlicher Genehmigung des Verlags.

Hinsichtlich des Zusammenhangs mit Lebensqualität wurde deutlich, dass Frauen mit gemischten Erwerbsbiographien und Männer mit regulären Biographien (und einer Berentung nach 60) die vergleichsweise höchste Lebensqualität im Alter hatten. Hingegen zeigten sich niedrigere Werte für Teilnehmer, die zwischen 55 und 60 bereits in Rente gingen (aber nicht davor). Schließlich hatten Frauen mit kontinuierlichen Erwerbs- oder Haushaltsbiographien vergleichsweise niedrigere Lebensqualität im Alter. Es ist wichtig zu betonen, dass gerade die letztere Gruppe (fast 30 % der Frauen) in herkömmlichen Studien auf Basis von Berufskohorten nicht berücksichtigt wurde. Die Zusammenhänge galten auch nach Ausschluss von Teilnehmern, die vor oder im Erwerbsleben eine schlechte Gesundheit

hatten. Sie blieben in multivariaten Analysen außerdem dann bestehen, wenn eine Reihe von Lebenslauffaktoren (inkl. soziale Herkunft, Partnerschaftsbiographie) und zusätzlich das derzeitige Einkommen kontrolliert wurden.

Die fünfte Arbeit ist eine der ersten wissenschaftlichen Arbeiten, die durch Verfahren der Sequenzanalyse Typen von beruflichen Karrieren für Männer und Frauen identifiziert und diese dann in Zusammenhang zur Lebensqualität im Alter setzt. Sie folgt damit konzeptionell der Idee der Lebenslaufperspektive einer ganzheitlichen Betrachtung von Erwerbskarrieren zur Erklärung von Gesundheit im höheren Alter.

Originalarbeit 6: (Titel: "Age differences in the association between stressful work and sickness absence among full-time employed workers: evidence from the German socio-economic panel.")

Während die Arbeiten 2 – 5 mit Hilfe der Lebenslaufdaten der SHARE Studie die Messung von Arbeitsbedingungen auf einen längeren Beobachtungszeitraum ausweiteten, stand in der sechsten Arbeit eine weitere Idee der Lebenslaufperspektive im Vordergrund, nämlich, ob die Folgen einer psychosozialen Belastung für die Gesundheit nach der Altersphase variieren. Die Arbeit betrachtete hierzu auf Basis des SOEPs (Sozioökonomisches Panel) die Folgen von Arbeitsstress für Arbeitsunfähigkeitstage (AU-Tage) im Folgejahr entlang von vier Altersgruppen.

Die Kernbefunde sind in der nachfolgenden Abbildung getrennt für Männer und Frauen zusammengetragen. Insgesamt berichteten ältere Beschäftigte im Durschnitt mehr AU-Tage als jüngere Beschäftigte. Zusätzlich zeigten sich für alle Altersgruppen konsistente positive Zusammenhänge zwischen einer Belastung und der Zahl an AU-Tagen im Folgejahr. Das galt auch nach Berücksichtigung der sozialen Position (Beruf, Bildung und Einkommen) und selbst-berichteter Gesundheit zu Baseline. Zwar waren die Zusammenhänge für die älteren Altersgruppen insgesamt etwas ausgeprägter, allerding zeigten sich keine bedeutsamen Unterschiede bei der Prüfung von Interkationen zwischen Altersgruppen und Arbeitsstress und somit auch keine eindeutigen Hinweise darauf, dass Auswirkungen der untersuchten Belastungen nach Alter variieren.

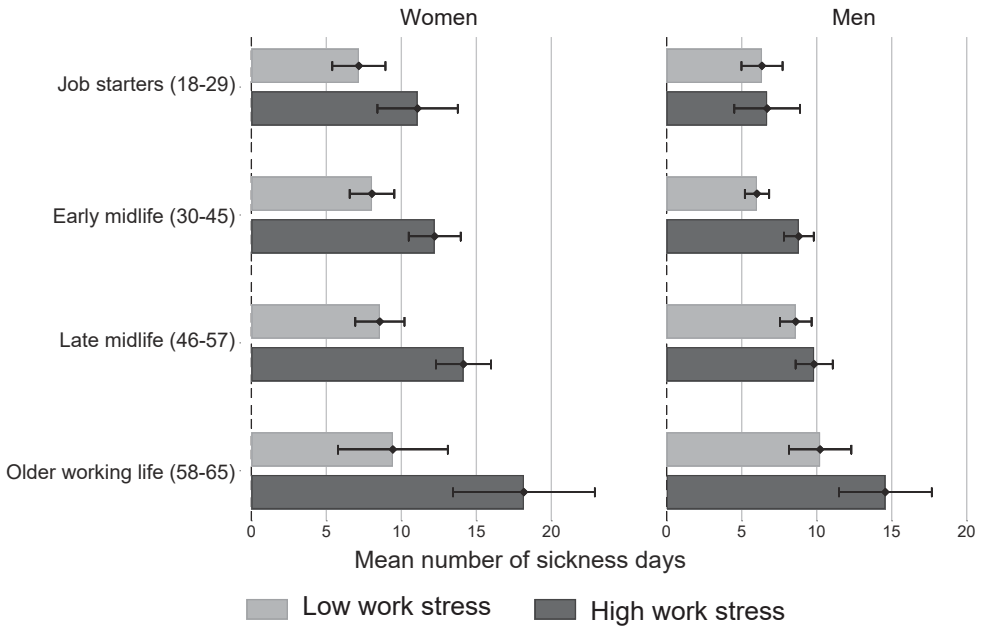


Abbildung 5. Vorhergesagte AU-Tage nach Arbeitsstress (für ERI-Ratio > 1) nach Altersgruppe für Frauen und Männer mit Konfidenzintervallen (95%). Werte sind adjustiert für Partnerschaft, Beschäftigungsjahre, Anzahl der im Haushalt lebenden Kinder, Beruf, Bildung und Einkommen; entnommen aus: (Götz et al. 2018), mit freundlicher Genehmigung des Verlags (Open Access).

Im Gegensatz bisheriger Studien zum Zusammenhang zwischen Arbeitsstress und AU-Tagen, die entweder auf Berufskohorten oder Querschnittsdaten beruhen, verwendete die Arbeit bevölkerungsbasierte Daten und untersuchte die Folgen psychosozialer Belastungen auf AU-Tage im Folgejahr.

Originalarbeit 7: (Titel: "Agreement of self-Reported and administrative data on employment histories in a German cohort study: a sequence analysis.")

Die siebte Arbeit unterscheidet sich grundlegend von den übrigen Arbeiten dieser Schrift. Sie leistet einen methodischen Beitrag indem sie die Verfügbarkeit und Qualität selbst-berichteter Lebenslaufdaten untersucht. Hierzu greift die Arbeit auf die angesprochene Besonderheit der HNR-Studie zurück, in der Berufsbiographien durch retrospektive Lebenslaufdaten und durch die Verknüpfung mit administrativen Daten (Sozialdaten des IAB) ermittelt wurden. Auf dieser Grundlage verglich die Arbeit zunächst Teilnehmer, die selbst-berichtete Biographien lieferten, mit der Teilgruppe zu der Verwaltungsdaten verfügbar waren. Anschließend verglich die Arbeit die Berufsbiographien aus beiden Quellen und untersuchte, ob das Ausmaß der Übereinstimmung nach soziodemographischen, gesundheits- und

erwerbsbezogenen Merkmalen variiert. Konkret quantifizierte die Arbeit anhand von Distanzmaßen der Sequenzanalyse für jede Person das Ausmaß der Übereinstimmung zwischen beiden Quellen (36 Berufsjahre). Damit erfolgte kein einfacher Vergleich bestimmter Merkmale der Biographie (z.B. Übereinstimmungen der Erwerbssituation für ein bestimmtes Jahr), sondern Berufsbiographien wurden als Ganzes miteinander verglichen und das Ausmaß ihrer Übereinstimmung quantifiziert.

Hinsichtlich der erzielten Stichproben zeigte sich, dass der Großteil der Studienteilnehmer (97%) selbst-berichtete Biographien lieferte. Im Gegensatz hierzu konnten für 63% der Studienteilnehmer administrative Daten ermittelt und verknüpft werden. Neben der Größe unterschieden sich die Stichproben auch in Bezug auf ihre Zusammensetzung. So waren selbstberichtete Biographien vergleichsweise häufiger für Frauen und für Personen mit höherer Bildung verfügbar sowie für Selbständige oder Berufe im öffentlichen Sektor.

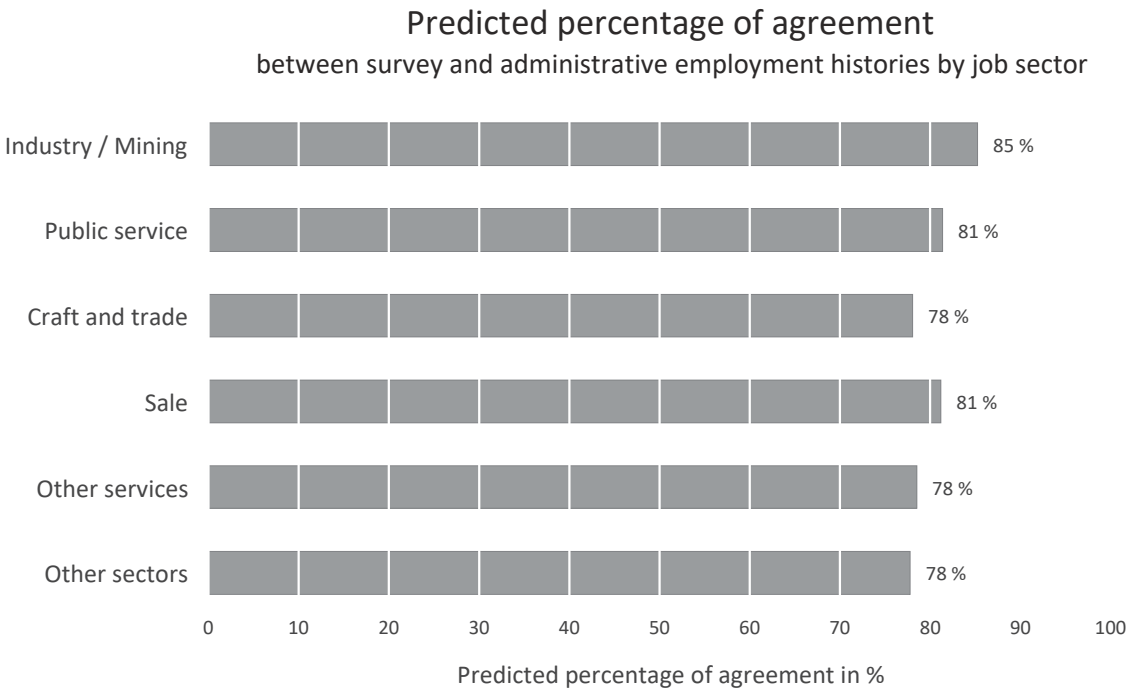


Abbildung 6. Vorhergesagter Anteil an Übereinstimmung zwischen selbst-berichteten und administrativen Berufsbiographien nach unterschiedlichen Berufszweigen. Werte sind adjustiert für Geschlecht, Alter, Bildung, Erwerbsstatus, körperliche Aktivität und depressive Symptome; entnommen aus: (Wahrendorf et al. 2018b), mit freundlicher Genehmigung des Verlags (Open Access).

Die Übereinstimmung der Biographien aus beiden Quellen war hoch. Bei mehr als der Hälfte der Befragten war die Übereinstimmung 89% oder höher (Median) mit einer mittleren Übereinstimmung von 80%. Das bedeutet, dass die Sequenzen im Durchschnitt für 29 der

verglichenen 36 Jahre übereinstimmten. Etwas niedrigere Werte fanden sich für Frauen sowie für bestimmte Berufszweige (siehe Abbildung 5). Es zeigten sich aber keine Unterschiede für Alter oder Gesundheit.

Zusammengefasst zeigt die Arbeit, dass beide Strategien zur Gewinnung von Berufsbiographien (über retrospektive Interviews oder über Record-Linkage) jeweils zu unterschiedlichen Stichproben führen, so vor allem zu größeren Stichproben im Falle von Interviews. Die hohe Übereinstimmung individueller Biographien deutet darauf, dass beide Strategien reliable Daten liefern. Die Arbeit ist eine der ersten wissenschaftlichen Studien zum Vergleich selbst-berichteter Lebenslaufdaten mit administrativen Daten. Innovativ ist dabei vor allem die Anwendung von Distanzmaßen zur Quantifizierung der Übereinstimmungen.

Originalarbeit 8: (Titel: "Adverse employment histories and health functioning: the CONSTANCES study.")

Die achte Originalarbeit dieser Schrift verknüpfte wieder retrospektive Lebenslaufdaten mit Gesundheit. Die Daten stammen aus der französischen CONSTANCES Studie. Insgesamt sechs Maße gesundheitlicher Einschränkungen wurden untersucht, einschließlich affektiver, physischer und kognitiver Einschränkungen. Mit Ausnahme affektiver Einschränkungen (gemessen auf Basis berichteter erhöhter depressiver Symptomatik) beruhten alle Maße auf medizinischen Untersuchungen bzw. standardisierten Tests. Ungünstige berufliche Karrieren wurden durch Merkmale zur Bestimmung prekärer und diskontinuierlicher Karrieren sowie kumulierter Benachteiligungen gemessen. Zusammenhangsanalysen erfolgten getrennt für Frauen und Männer.

Die Ergebnisse zeigten, dass ungünstige berufliche Karrieren mit einem erhöhten Risiko gesundheitlicher Einschränkungen zusammenhängen. Dies galt insbesondere für wiederholte Episoden der Arbeitslosigkeit, eine anhaltende niedrige berufliche Position sowie einer insgesamt geringen Erwerbsbeteiligung. Im Falle depressiver Symptome war dies auch für die kumulierte Zahl an Jobs mit befristeten Verträgen der Fall. Die Zusammenhänge waren auch dann konsistent, wenn Personen die eine krankheitsbedingte Phase der Erwerbslosigkeit hatten von den Analysen ausgeschlossen wurden, und unter Kontrolle von Alter, Partnerschaft und Bildung. Während im Falle depressiver Symptome und Lungenfunktion Hinweise für einen stärkeren Zusammenhang bei Männern vorlagen, waren für die übrigen Gesundheitsmaße die Zusammenhänge für Männer und Frauen ähnlich. Die untere Abbildung fasst die Ergebnisse für zwei der verwendeten Gesundheitsmaße zusammen.

Eine Stärke der Arbeit ist, dass sie auf Basis von Lebenslaufdaten erstmals Zusammenhänge zwischen ungünstigen beruflichen Karrieren und einem umfassenden Satz von Markern gesundheitlicher Einschränkungen untersucht, inklusive fünf objektiver Gesundheitsmaße.

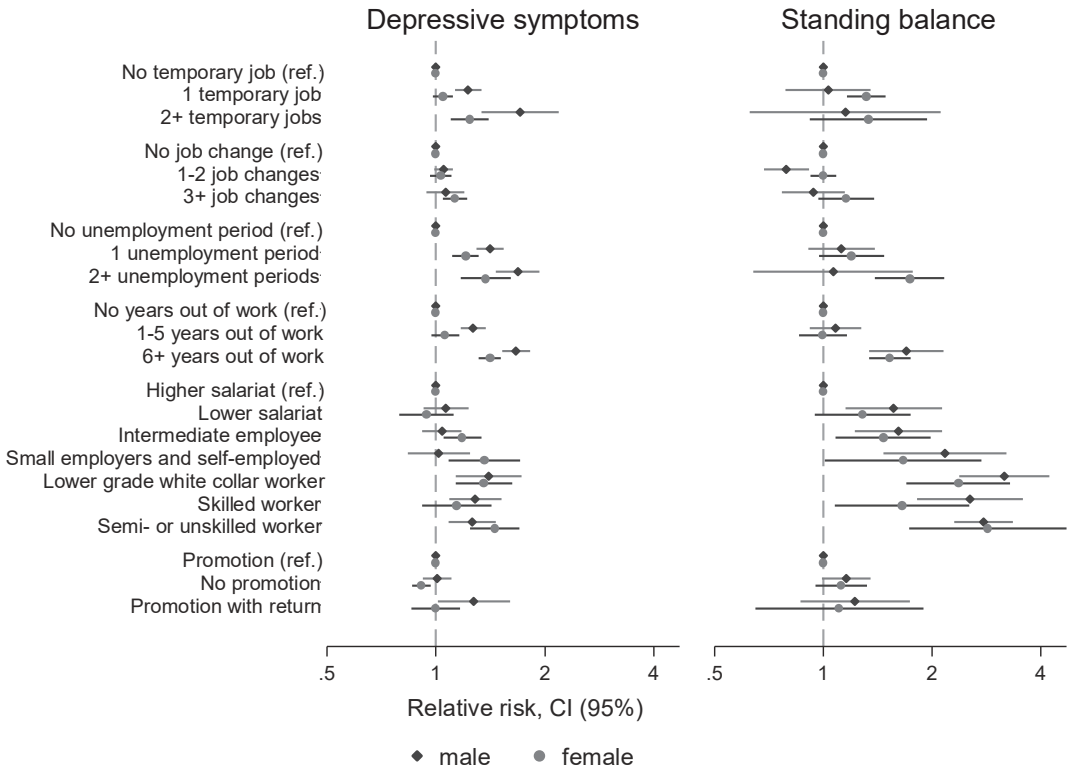


Abbildung 7. Zusammenhang zwischen Erwerbsmerkmalen und Gesundheit (depressive Symptome und Stehbalance): Relative Risiken und Konfidenzintervalle (95 %) adjustiert für Alter, Partnerschaft und Bildung. Personen die vor 45 berentet wurden oder eine krankheitsbedingte Erwerbsunterbrechung hatten sind von den Analysen ausgeschlossen; Werte entnommen aus: (Wahrendorf et al. 2018a), eigene Darstellung.

4 Gesamtdiskussion

Die acht Originalarbeiten dieser Schrift erweitern durch ihre Ergebnisse die Forschung zum Einfluss von Erwerbs- und Arbeitsbedingungen über den Lebenslauf auf die Gesundheit im Alter. Die erste Erweiterung betrifft dabei die umfassende Messung von Arbeitsbedingungen im Erwerbsleben und die Untersuchung von deren Wechselwirkungen mit weiteren Faktoren im Lebenslauf. Die zweite Erweiterung betrifft die beobachteten Zusammenhänge der untersuchten Arbeitsbedingungen mit unterschiedlichen Gesundheitsmaßen. Drittens illustrieren die Arbeiten die Qualität von retrospektiven Lebenslaufdaten und deren Potenzial für lebenslaufepidemiologische Fragestellungen.

4.1 Arbeitsbedingungen im Lebenslauf

Neben dem Einfluss von Arbeitsbedingungen auf die Gesundheit mittels Einfachmessung psychosozialer Arbeitsbelastung im Beruf (Wahrendorf et al. 2012), untersuchten die präsentierten Arbeiten auch Belastungen über einen verlängerten Zeitrahmen. Dabei wurden nicht nur Belastungen im Beruf selbst, sondern auch mögliche Belastungen aufgrund spezifischer Merkmalen beruflicher Karrieren (Wahrendorf et al. 2018a; Wahrendorf et al. 2013) und deren Kumulation analysiert (Wahrendorf & Blane 2015; Wahrendorf & Siegrist 2014). Dies unterscheidet sich von bisherigen Ansätze arbeitsepidemiologischer Forschung und folgt der Idee der Lebenslaufperspektive, dass erweiterte Zeiträume, und nicht nur Einfachmessungen, zur Expositionsmessung betrachtet werden sollten. Wichtig waren in diesem Zusammenhang die Analysen der Lebenslaufdaten aus SHARE und CONSTANCES, durch die detaillierte Erwerbskarrieren rekonstruiert und analysiert werden konnten. Auf dieser Basis konnten auch ganze Typen von Erwerbsbiographien identifiziert werden (Wahrendorf 2015). Dies ermöglichte auch, Personen, die lange nicht erwerbstätig waren, in die Analysen zu integrieren und dem Genderbias bisheriger Studien entgegen zu wirken (Worts et al. 2016; Messing et al. 2003). Vor allem die Typenbildung hat in der Epidemiologie zunehmende Nachahmung und Verbreitung gefunden. Eine mögliche Erweiterung besteht zudem darin, weitere Dimensionen bei der Typenbildung zu integrieren und auf dieser Basis zum Beispiel Typen von „work-family histories“ zu identifizieren (Sabbath et al. 2015b; Lacey et al. 2015b). Ein Beispiel hierzu ist eine weitere, hier nicht integrierte Arbeit, auf Basis der Lebenslaufdaten der HNR-Studie (Engels et al. 2019).

Ungünstige Arbeitsbedingungen im Erwerbsleben treten allerdings nicht unabhängig voneinander auf, sondern sind meist Teil ganzer Belastungskarrieren. Das zeigen die ausgewählten Arbeiten insbesondere für soziale Benachteiligung in der Kindheit (Wahrendorf & Blane 2015; Wahrendorf & Siegrist 2014). Konzeptionell entspricht dies der Idee einer Risikoakkumulation in der Lebenslaufforschung bei der Belastungskarrieren häufig ihren Ursprung bereits in der Kindheit haben (Dannefer 2003). So knüpfen die hier vorhergestellten Arbeiten an bisherige Studien an (Caspi et al. 1998; Kuh et al. 1997; Kuh & Wadsworth 1991; Elovainio et al. 2007), erweitern diese aber, indem Kindheit nicht nur mit einzelnen Aspekten im späteren Erwerbsleben assoziiert wird, sondern auch mit kumulierten Belastungen und ganzen beruflichen Karrieren. Ein ähnlicher Befund zeigte sich in hier nicht vorgestellten Arbeiten für den Zusammenhang zwischen Bildung und kumulierter Benachteiligungen im Erwerbsleben (Dragano & Wahrendorf 2014). Weitere Arbeiten zeigen einen Zusammenhang zwischen sozialer Benachteiligung zu Beginn der Erwerbskarrieren und diskontinuierlichen Typen von Biographien im späteren Erwerbsalter (erneut auf Basis von Lebenslaufdaten) samt einem vergleichsweise frühen Erwerbsaustritt im Alter (Wahrendorf et al. 2018c; Hoven et al. 2017).

Eine der vorliegenden Originalarbeiten lieferte zudem erste Hinweise darauf, dass Belastungen im Erwerbsleben mit länderspezifischen Rahmenbedingungen assoziiert sind (Wahrendorf & Siegrist 2014). Im Gegensatz zu bisherigen Studien auf Basis existierender Typologien von Wohlfahrtsstaaten, folgte die Arbeit aktuellen Empfehlungen, spezifische Makroindikatoren zu verwenden (Lundberg 2008; Bambra 2011). Vor allem ausgeprägte integrative und kompensatorischen Maßnahmen hingen mit einer verminderten Belastung zusammen. Eine Ausweitung dieser Befunde ist allerdings zur Klärung möglicher kausaler Zusammenhänge im Rahmen von Trendanalysen nötig, die die Verläufe von Arbeitsbedingungen (Anstieg oder Abnahme) in Abhängigkeit zu Verläufen länderspezifischer Programme betrachtet.

Insgesamt zeigen die zugrundeliegenden Originalarbeiten, wie mit Hilfe von Lebenslaufdaten eine Erweiterung der Expositionsmessung im Rahmen epidemiologischer Studien möglich ist. Das schließt eine intensive Aufbereitung gesammelter Lebenslauf und die Anwendung der Sequenzanalyse ein.[4] Hierdurch konnten sowohl Summenmaße als auch Typen von Biographien ermittelt und deren Zusammenhang zur Gesundheit analysiert werden.

[4] Dies bildet den Kern eines laufenden NIH-Projekt, das Lebenslaufdaten der SHARE und ELSA Studie vergleichend aufbereitet. Neben Erwerbsbiographien, bereitet das Projekt auch Partnerschaft-, Fertilitäts-, Gesundheits- und Wohnbiographien auf.

4.2 Arbeitsbedingungen im Lebenslauf und Gesundheit im Alter

Ein wichtiger Befund der vorgestellten Arbeit ist, dass krankheitswertige Arbeitsbelastungen nicht nur auf einzelne Stressoren innerhalb von Berufen begrenzt sind (Wahrendorf et al. 2012; Götz et al. 2018), sondern auch einzelne Merkmale oder Typen beruflicher Karrieren Auswirkungen auf die Gesundheit im Alter haben können (Wahrendorf et al. 2018a; Wahrendorf & Blane 2015; Wahrendorf 2015; Wahrendorf et al. 2013). Im Hinblick auf die Gesundheit, untersuchten die Arbeiten subjektive und objektive Maße, inklusive mentaler Gesundheit, gesundheitliche Einschränkungen, allgemeiner Lebensqualität und AU-Tage. Die Auswirkungen zeigten sich nicht nur für Gesundheit im Erwerbsleben selbst, sondern auch über das Erwerbsleben hinaus. Zusammenhänge ungünstiger Karrieren, insbesondere diskontinuierlicher Karrieren, waren im Falle mentaler Gesundheit konsistenter für Männer als für Frauen. Im Hinblick auf mögliche Variationen der Zusammenhänge nach Altersphasen konnten die Arbeiten letztlich keine Anzeichen für kritische Altersphasen ausmachen.

Die Arbeiten erweitern den bisherigen Forschungsstand zum Zusammenhang zwischen Arbeitsbelastungen und Gesundheit, indem zunächst Zusammenhänge für psychosoziale Belastungen über das Erwerbsleben hinaus nachgewiesen wurden. Zum anderen knüpfen die Ergebnisse an Studien an, die aufzeigen, dass vor allem wiederholte Belastungen durch Arbeitsstress oder Arbeitsplatzunsicherheit mit Gesundheit und Krankheit zusammenhängen, einschließlich mentaler Gesundheit, Markern des metabolischen Syndroms und kardiovaskulären Erkrankungen (Cuitún Coronado, Chandola & Steptoe 2018; Chandola, Brunner & Marmot 2006; Gilbert-Ouimet et al. 2012; Trudel et al. 2016; Bentley et al. 2015; Bartley 2005; Kim & von dem Knesebeck 2015; Åhlin et al. 2018; Ndjaboue et al. 2017). Ähnlich gilt dies für Studien zu geschlechtsspezifischen Auswirkungen auf mentale Gesundheit (Mc Munn 2017). Zusätzlich stimmen die Ergebnisse mit denen aus Studien überein, die eine sozioökonomische Benachteiligung über den Lebenslauf mit vermehrter Stressreaktion, KHK-Sterblichkeit und gesundheitlichen Funktionseinschränkungen im Alter verbinden (Castagné et al. 2018; Vineis et al. 2017; Kuh et al. 2014; Stringhini et al. 2017).

Die derartige Ausweitung der Forschung stimmt konzeptionell mit der Lebenslaufperspektive der Epidemiologie überein (Elder, Johnson & Crosnoe 2003; Kuh et al. 2003; George 2014). Das betrifft - neben dem Nachweise von Zusammenhänge über den Lebenslauf - vor allem die Idee des Modell der Risikoakkumulation einer erweiterten Perspektive bei der Betrachtung von Expositionen, ohne diese von größeren Kontexten und gesamten Lebensläufen zu isolieren (Sackmann & Wingens 2003; Aisenbrey & Fasang 2010; Dannefer 2003). Die zugrundeliegenden Arbeiten lieferten dabei wichtige Hinweise, dass vor allem drei Typen von

Erwerbskarrieren schädlich für die Gesundheit sein können (Wahrendorf et al. 2018a; Wahrendorf 2015; Wahrendorf et al. 2013; Wahrendorf & Blane 2015): prekäre Karrieren (z.B. befristete Verträge und häufiger Arbeitsplatzwechsel), diskontinuierliche Karrieren (z.B. Unterbrechungen durch Arbeitslosigkeit) und kumulierte Benachteiligung (z.B. dauerhafte niedrige berufliche Position oder intragenerative Abwärtsmobilität).

Ähnlich wie im Falle existierender Arbeitsstressmodelle kann davon ausgegangen werden, dass ungünstige Erwerbskarrieren entlang dieser drei Typen eine psychosoziale Belastung samt physiologischen Stressreaktionen bedeuten. Kernideen der Lebenslaufepidemiologie (i.e. Risikoakkumulation) spielen somit für das Ausmaß einer Stressreaktion eine Rolle (Pearlin 2010) und ermöglichen eine genauere Bestimmung der allostischen Last (McEwen 2012; Shonkoff, Boyce & McEwen 2009). Dies gilt vor allem aufgrund „wiederholter Aktivierung“ oder „fehlender Anpassung“ durch Belastungen über einen verlängerten Zeitraum. Durch die untersuchten beruflichen Karrieren könnten auch zentrale theoretische Komponenten der Arbeitsstressmodelle abgebildet werden, nämlich die Erfahrung von Kontrolle (Anforderungs-Kontroll-Modell) oder von Belohnungen (Modell beruflicher Gratifikationskrisen). Prekäre Arbeit und befristete Verträge schließen beispielsweise auch begrenzte Kontrolle über das eigene Beschäftigungsverhältnis ein. Ähnlich dürften Personen, die dauerhaft in geringqualifizierten Berufen arbeiten, weniger Möglichkeiten zur fachlichen Weiterbildung oder bei der Mitwirkung der Arbeitsgestaltung haben, was letztlich geringe Kontrolle bedeuten kann. Benachteiligte Karrieren ohne Möglichkeiten eines Aufstiegs und mit drohendem Statusverlust bedeuten zugleich, dass Beschäftigte begrenzte Belohnung für erbrachte Verausgabungen erhalten. So können die präsentierten Befunde als Ergänzung bisheriger Arbeitsstressforschung gedeutet werden, indem Kernaspekte existierender Arbeitsstressmodelle aufgegriffen und entlang der Lebenslaufperspektive auf gesamte Karrieren angewendet werden.

Neben der physiologischen Stressreaktion sollten weitere mögliche Erklärungspfade für die Erklärung der Ergebnisse aus den Originalarbeiten nicht unerwähnt bleiben. Zum Beispiel ist es anzunehmen, dass ungünstige Erwerbskarrieren einen indirekten Einfluss auf die Gesundheit über Gesundheitsverhalten haben können, etwa durch unausgewogene Ernährung oder mangelnde Bewegung, oder erhöhter Alkohol- und Tabakkonsum. Weiterhin ist es möglich, dass die untersuchten Arbeitsbedingungen im Erwerbsleben einen Einfluss auf die materielle Situation im Alter haben, beispielsweise geringere Rentenleistungen aufgrund diskontinuierlicher Biographien. Gegen diese Annahme sprechen allerdings die Befunde der Originalarbeiten, dass Zusammenhänge auch dann konstant waren, wenn die Einkommenssituation im Alter berücksichtig wurde (Wahrendorf et al. 2018a; Wahrendorf

2015; Wahrendorf et al. 2013). Um die geschilderten möglichen Erklärungen bzw. Pfade zu beleuchten (physiologische Stressreaktion, Gesundheitsverhalten und materielle Lage) müssen zukünftige Studien auch materielle, verhaltensbezogene und biologische Daten in die Analyse integrieren.[5] Dabei darf es allerdings nicht darum gehen, zu untersuchen, welcher der Pfade wichtiger ist als ein anderer, da diese sich auch untereinander beeinflussen können (z.B. mangelnde Ernährung als Folge eines geringen Einkommen). Eine zusätzliche Untersuchung der Pfade würde letztlich auch ein Indiz für eine kausale Beziehung zwischen Arbeitsbedingungen im Erwerbsleben und Gesundheit im Alter bedeuten.

Dennoch darf, trotz der aufgezeigten Möglichkeiten von Lebenslaufdaten, nicht vergessen werden, dass Selektionsprozesse eine weitere Erklärung für die gefundenen Zusammenhänge sein könnten. So ist es durchaus möglich, dass Personen als Folge schlechter Gesundheit auch eine höhere Wahrscheinlichkeit für diskontinuierlichen berufliche Karrieren haben (Kröger, Pakpahan & Hoffmann 2015). Allerdings schlossen die dargestellten Analysen Personen, die vor oder während der Erwerbsphase krank waren, aus (z.B. schlechte Gesundheit in der Kindheit oder krankheitsbedingte Phase der Erwerbslosigkeit). Das klassische Kohorten-design der Epidemiologie hat hier klare Vorteile, da Erkrankte zu Beginn der Studie ausgeschlossen und Neuerkrankungen im Follow-up untersucht werden können.

4.3 Qualität von Lebenslaufdaten

Die zugrundeliegenden Originalarbeiten zeigen, wie mit Hilfe retrospektiver Interviews, Studien um Lebenslaufdaten ergänzt und damit gesamte berufliche Karrieren und deren Zusammenhänge mit Gesundheit im Alter untersucht werden können. Bei der Bewertung der Befunde muss auch die Qualität dieser Lebenslaufdaten diskutiert werden. Denn die retrospektive Erhebung von Lebenslaufdaten stellt vergleichsweise hohe kognitive Anforderungen an die Befragten. Sie kann mit einer übermäßigen Beanspruchung und Verzerrungen verbunden sein (Sudman, Bradburn & Schwarz 1996), die vor allem Machbarkeit und Praktikabilität bei der Durchführung retrospektiver Interviews und die Qualität erhobener Daten beeinflussen können.

Mit Blick auf die Praktikabilität zeigte sich, dass retrospektive Interviews ein geeignetes Verfahren zur Sammlung von Lebenslaufdaten für alle Teilnehmer einer laufenden Studie sind. Darauf deutet zunächst der Befund, dass in den verwendeten Studien durch

[5] In diese Richtung zielt ein beantragtes DFG-Projekt am Institut zur weiteren Auswertung der CONSTANCE Daten.

retrospektive Interviews jeweils für ein Großteil der Studienteilnehmer Daten zu Berufsbiographien ermittelt werden konnten (Wahrendorf et al. 2018b; Wahrendorf et al. 2018a; Wahrendorf 2015; Wahrendorf & Siegrist 2014; Wahrendorf et al. 2013). Verweigerungen und fehlender Werte waren nicht auffällig bzw. waren nicht systematisch. In einer der zugrundeliegenden Arbeiten (Wahrendorf et al. 2018b) zeigte sich zudem, dass durch ein Record-Linkage eine vergleichsweise kleinere Teilgruppe erreicht werden konnte (67% vs. 97%). Dies weist auf eine mögliche Einschränkung bei der Verknüpfung administrativer Daten im Vergleich zu retrospektiven Interviews hin, da Verwaltungsdaten häufig nur für bestimmte Gruppen verknüpft werden können (in diesem Fall sozialversicherungspflichtig Beschäftigte). Die gute Verfügbarkeit spricht aber auch für Befunde bei denen Interviewer positive Erfahrungen berichten, nämlich dass Teilnehmer die retrospektiven Interviews in der Regel mochten (Belli et al. 2007; Schröder 2011). Hinsichtlich der Praktikabilität retrospektiver Interviews dürfen an dieser Stelle auch methodische Entwicklungen nicht unerwähnt bleiben, da sie eine Erhebung von Lebenslaufdaten in Interviews erleichtern. Dazu zählt vor allem der Einsatz sogenannter „calendar interviews“ (Belli et al. 2007; Blane 1996; Drasch & Matthes 2011; Belli 1998; Axinn, Pearce & Ghimire 1999; Freedman et al. 1988). In diesen Interviews hilft ein Kalender mit unterschiedlichen Dimensionen (z.B. Arbeit, Partnerschaft und Kinder) den Befragten, sich zu erinnern. Im Vergleich zu herkömmlichen face-to-face Interviews sind Kalender-Interviews zudem deutlich kürzer und stellen sicher, dass keine unlogische Sequenzen berichtet werden. Kalender-Interviews werden in zunehmend vielen internationalen Alternsstudien eingesetzt (Schröder 2011; Scholes et al. 2009; Kendig et al. 2014)., einschließlich der zugrundeliegenden SHARE Studie.

Neben der guten Verfügbarkeit von Lebenslaufdaten aus retrospektiven Interviews liefert die vorliegende Schrift auch Hinweise auf deren Qualität. Zentral war dazu der Vergleich selbstberichteter Erwerbsbiographien mit administrativen Daten (Wahrendorf et al. 2018b), bei dem mit Hilfe der Sequenzanalyse das Ausmaß der Übereinstimmung bestimmt wurde. Das Ergebnis zeigte, dass die selbst-berichteten Sequenzen durchschnittlich zu 80% mit der Sequenz der Verwaltungsdaten übereinstimmten. Dieser Befund entspricht den Ergebnissen anderer Studien zum Vergleich von Daten aus retrospektiven Interview mit weiteren Datenquellen (Bilgen & Belli 2010; Belli, Agrawal & Bilgen 2012; Berney & Blane 1997; Jivraj et al. 2017). Die Ergebnisse erweitern den Forschungsstand aber, da nicht nur einzelne Merkmale (z.B. Renteneintritt) (Korbmacher 2014) oder aggregierte Daten verglichen wurden (z.B. Anteil an Arbeitslosen in einem Jahr verglichen mit offiziellen Arbeitslosenzahlen) (Havari & Mazzona 2011; Berney & Blane 1997), sondern die Übereinstimmung gesamter Berufssequenzen auf Basis der Sequenzanalyse analysiert wurde. Ein weiteres Indiz für die

Qualität ist die bereits oben erwähnte geringe Anzahl an fehlenden Werten. Retrospektive Interviews ermöglichen auch, dass Daten, die sich auf unterschiedliche Zeitpunkte beziehen, in vergleichbarer Form erhoben werden, ohne dass sich Fragebögen im Verlauf der Studie ändern oder die Teilnehmer im Verlauf der Studie die Studienteilnahme verweigern oder ausscheiden.

4.4 Fazit

Insgesamt erweitern die Originalarbeiten dieser Schrift die Forschung zu sozialen Determinanten der Gesundheit im höheren Lebensalter. Sie betonen vor allem die Möglichkeiten einer Ausweitung bisheriger statischer Konzepte von Arbeitsstress und den Nutzen einer Lebenslaufperspektive bei der Untersuchung der Auswirkungen arbeitsbezogener Belastungen über den Lebenslauf. Für ein vertieftes Verständnis der Determinanten der Gesundheit im Alter sollten frühe Ursachen von erwerbsbezogenen Belastungen und die Kumulation von Belastungen im Erwerbsleben berücksichtigt werden. Hierzu liefert die Lebenslaufperspektive wichtige konzeptionelle Impulse. Obwohl weitere Forschung nötig bleibt, zeigen die Arbeiten wie die wachsende Anzahl von Studien mit retrospektiven Lebenslaufdaten in Kombination mit der Sequenzanalyse einen Beitrag zur Ausweitung arbeitsepidemiologischer Forschung leisten kann. In Anbetracht der Herausforderungen alternder Gesellschaften und der Veränderungen heutiger Arbeitswelten scheint dies nützlicher denn je.

5 Literaturverzeichnis

Abbott A. (2001). *Time Matters. On Theory and Method*. Chicago: University of Chicago Press.

Åhlin J. K., Westerlund H., Griep Y., & Hanson L. L. M. (2018). "Trajectories of job demands and control: risk for subsequent symptoms of major depression in the nationally representative Swedish Longitudinal Occupational Survey of Health (SLOSH)." *International Archives of Occupational and Environmental Health* 91:263-272.

Aisenbrey S., & Fasang A. E. (2010). "New Life for Old Ideas: The 'Second Wave' of Sequence Analysis Bringing the 'Course' Back Into the Life Course." *Sociological Methods & Research* 38:652-654.

Axinn W. G., Pearce L. D., & Ghimire D. (1999). "Innovations in life history calendar applications." *Social Science Research* 28:243-264.

Bambra C. (2011). *Work, worklessness, and the political economy of health*. Oxford: Oxford University Press.

Barker D. J. (1990). "The fetal and infant origins of adult disease." *BMJ* 301:1111.

Bartley M. (2005). "Job insecurity and its effect on health." *Journal of Epidemiology & Community Health* 59:718-719.

Bartley M. (2016). *Health Inequality: An Introduction to Concepts, Theories and Methods*: John Wiley & Sons.

Belli R. (1998). "The structure of autobiographical memory and the event history calendar: potential improvements in the quality of retrospective reports in surveys." *Memory* 6:383-406.

Belli R., Smith L. M., Andreski P. M., & Agrawal S. (2007). "Methodological Comparisons Between CATI Event History Calendar and Standardized Conventional Questionnaire Instruments." *Public Opinion Quarterly* 71:603-622.

Belli R. F., Agrawal S., & Bilgen I. (2012). "Health status and disability comparisons between CATI calendar and conventional questionnaire instruments." *Quality & Quantity* 46:813-828.

Bellingrath S., & Kudielka B. M. (2016). "Psychobiological pathways from work stress to reduced health: Naturalistic and experimental studies on the ERI model." Pp. 145-170, *Work Stress and Health in a Globalized Economy: The Model of Effort-Reward Imbalance*. Springer.

Benach J., & Muntaner C. (2007). "Precarious employment and health: developing a research agenda." *Journal of Epidemiology & Community Health* 61:276-277.

Benach J., Vives A., Amable M., Vanroelen C., Tarafa G., & Muntaner C. (2014). "Precarious employment: understanding an emerging social determinant of health." *Annual Review of Public Health* 35:229-253.

Bennett R., & Waterhouse P. (2018). "Work and family transitions and the self-rated health of young women in South Africa." *Social Science & Medicine* 203:9-18.

Benson R., Glaser K., Corna L. M., Platts L. G., Di Gessa G., Worts D., Price D., McDonough P., & Sacker A. (2017). "Do work and family care histories predict health in older women?" *The European Journal of Public Health* 27:1010-1015.

Bentley R. J., Kavanagh A., Krnjacki L., & LaMontagne A. D. (2015). "A Longitudinal Analysis of Changes in Job Control and Mental Health." *American Journal of Epidemiology* 182:328-334.

Berney L. R., & Blane D. B. (1997). "Collecting retrospective data: Accuracy of recall after 50 years judged against historical records." *Social Science & Medicine* 45:1519-1525.

Bilgen I., & Belli R. F. (2010). "Comparison of Verbal Behaviors between Calendar and Standardized Conventional Questionnaires." *Journal of Official Statistics* 26:481-505.

Blane D. B. (1996). "Collecting retrospective data: Development of a reliable method and a pilot study of its use." *Social Science & Medicine* 42:751-757.

Bonde J. P. E. (2008). "Psychosocial factors at work and risk of depression: A systematic review of the epidemiological evidence." *Occupational and Environmental Medicine* 65:438-445.
Börsch-Supan A., Brandt M., Hunkler C., Kneip T., Korbmacher J., Malter F., Schaan B., Stuck S., Zuber S., & Team o. b. o. t. S. C. C. (2013). "Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE)." *International Journal of Epidemiology* 42:992-1001.
Brückner H., & Mayer K. U. (2005). "De-Standardization of the Life Course: What it Might Mean? And if it Means Anything, Whether it Actually Took Place?" *Advances in Life Course Research* 9:27-53.
Burr H., Pohrt A., Rugulies R., Holtermann A., & Hasselhorn H. M. (2017). "Does age modify the association between physical work demands and deterioration of self-rated general health?" *Scandinavian Journal of Work, Environment & Health* 43:241-249.
Caspi A., Wright B. R. E., Moffitt T. E., & Silva P. A. (1998). "Early failure in the labor market: Childhood and adolescent predictors of unemployment in the transition to adulthood." *American Sociological Review* 63:424-451.
Castagné R., Garès V., Karimi M., Chadeau-Hyam M., Vineis P., Delpierre C., & Kelly-Irving M. (2018). "Allostatic load and subsequent all-cause mortality: which biological markers drive the relationship? Findings from a UK birth cohort." *European Journal of Epidemiology* 33:441-458.
Chandola T., Britton A., Brunner E., Hemingway H., Malik M., Kumari M., Badrick E., Kivimäki M., & Marmot M. (2008). "Work stress and coronary heart disease: what are the mechanisms?" *European Heart Journal* 29:640-648.
Chandola T., Brunner E., & Marmot M. (2006). "Chronic stress at work and the metabolic syndrome: Prospective study." *British Medical Journal* 332:521-524.
Chandola T., Heraclides A., & Kumari M. (2010). "Psychophysiological biomarkers of workplace stressors." *Neuroscience & Biobehavioral Reviews* 35:51-57.
Cuitún Coronado J., Chandola T., & Steptoe A. (2018). "Allostatic Load and Effort-Reward Imbalance: Associations over the Working-Career." *International Journal of Environmental Research and Public Health* 15:191.
Dannefer D. (2003). "Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 58:S327-S337.
Donders N. C., Bos J. T., Van der Velden K., & Van der Gulden J. W. (2012). "Age differences in the associations between sick leave and aspects of health, psychosocial workload and family life: a cross-sectional study." *BMJ Open* 2:e000960.
Dragano N. (2018). "Arbeitsstress als Risikofaktor für kardiovaskuläre Erkrankungen." *Aktuelle Kardiologie* 7:368-372.
Dragano N., Siegrist J., Nyberg S. T., Lunau T., Fransson E. I., Alfredsson L., Bjorner J. B., Borritz M., Burr H., & Erbel R. (2017). "Effort–reward imbalance at work and incident coronary heart disease: A multicohort study of 90,164 individuals." *Epidemiology* 28:619.
Dragano N., & Wahrendorf M. (2014). "Consistent health inequalities in Europe: the importance of labour market disadvantage." *Journal of Epidemiology & Community Health* 68:293-294.
Drasch K., & Matthes B. (2011). "Improving retrospective life course data by combining modularized self-reports and event history calendars: experiences from a large scale survey." *Quality & Quantity* 47:817-838.
Eddy P., Heckenberg R., Wertheim E. H., Kent S., & Wright B. J. (2016). "A systematic review and meta-analysis of the effort-reward imbalance model of workplace stress with indicators of immune function." *Journal of Psychosomatic Research* 91:1-8.
Eddy P., Wertheim E. H., Hale M. W., & Wright B. J. (2018). "A systematic review and meta-analysis of the effort-reward imbalance model of workplace stress and hypothalamic-pituitary-adrenal axis measures of stress." *Psychosomatic Medicine* 80:103-113.

Elder G. H., Johnson M. K., & Crosnoe R. (2003). "The emergence and development of life course theory." Pp. 3-19 in Jeylan T Mortimer & Michael J Shanahan Hrsg., *Handbook of the life course*. New York: Kluwer Academic.

Elovainio M., Forma P., Kivimäki M., Sinervo T., Sutinen R., & Laine M. (2005). "Job demands and job control as correlates of early retirement thoughts in Finnish social and health care employees." *Work and Stress* 19:84-92.

Elovainio M., Kivimaki M., Ek E., Vahtera J., Honkonen T., Taanila A., Veijola J., & Jarvelin M. R. (2007). "The effect of pre-employment factors on job control, job strain and psychological distress: a 31-year longitudinal study." *Social Science & Medicine* 65:187-199.

Engels M., Weyers S., Moebus S., Jöckel K., Erbel R., Pesch B., Behrens T., Dragano N., & Wahrendorf M. (2019). "Gendered work-family trajectories and depression at older age." *Aging & Mental Health*.

Epel E. S., Crosswell A. D., Mayer S. E., Prather A. A., Slavich G. M., Puterman E., & Mendes W. B. (2018). "More than a feeling: a unified view of stress measurement for population science." *Frontiers in Neuroendocrinology*.

Ferraro K. F., & Shippee T. P. (2009). "Aging and Cumulative Inequality: How Does Inequality Get Under the Skin?" *Gerontologist* 49:333-343.

Ferrie J. E., Virtanen M., Jokela M., Madsen I. E., Heikkilä K., Alfredsson L., Batty G. D., Bjorner J. B., Borritz M., & Burr H. (2016). "Job insecurity and risk of diabetes: a meta-analysis of individual participant data." *Canadian Medical Association Journal*:cmaj. 150942.

Fink G. (2016). "In retrospect: eighty years of stress." *Nature* 539:175.

Freedman D., Thornton A., Camburn D., Alwin D., & Young-demarco L. (1988). "The life history calendar: a technique for collecting retrospective data." *Sociological Methodology* 18:37-68.

George L. (2014). "Taking Time Seriously: A Call to Action in Mental Health Research." *Journal of Health and Social Behavior* 55:251-264.

Gilbert-Ouimet M., Brisson C., Vezina M., Milot A., & Blanchette C. (2012). "Repeated exposure to effort-reward imbalance, increased blood pressure, and hypertension incidence among white-collar workers: effort-reward imbalance and blood pressure." *Journal of Psychosomatic Research* 72:26-32.

Gilbert-Ouimet M., Trudel X., Brisson C., Milot A., & Vézina M. (2014). "Adverse effects of psychosocial work factors on blood pressure: systematic review of studies on demand-control-support and effort-reward imbalance models." *Scandinavian Journal of Work, Environment & Health* 40:109-132.

Götz S., Hoven H., Müller A., Dragano N., & Wahrendorf M. (2018). "Age differences in the association between stressful work and sickness absence among full-time employed workers: evidence from the German socio-economic panel." *International Archives of Occupational and Environmental Health* 91:479-496.

Hansen Å. M., Larsen A. D., Rugulies R., Garde A. H., & Knudsen L. E. (2009). "A review of the effect of the psychosocial working environment on physiological changes in blood and urine." *Basic & clinical pharmacology & toxicology* 105:73-83.

Harvey S. B., Modini M., Joyce S., Milligan-Saville J. S., Tan L., Mykletun A., Bryant R. A., Christensen H., & Mitchell P. B. (2017). "Can work make you mentally ill? A systematic meta-review of work-related risk factors for common mental health problems." *Occupational and Environmental Medicine* 74:301-310.

Havari E., & Mazzona F. (2011). "Can we trust older people's statements on their childhood circumstances? Evidence from SHARELIFE." Pp., *SHARE Working Paper Series* Mannheim: Mannheim Research Institute for the Economics of Ageing.

Havranek E. P., Mujahid M. S., Barr D. A., Blair I. V., Cohen M. S., Cruz-Flores S., Davey-Smith G., Dennison-Himmelfarb C. R., Lauer M. S., Lockwood D. W., Rosal M., & Yancy C. W. (2015). "Social Determinants of Risk and Outcomes for Cardiovascular Disease." *A Scientific Statement From the American Heart Association* 132:873-898.

Head J., Kivimäki M., Siegrist J., Ferrie J. E., Vahtera J., Shipley M. J., & Marmot M. G. (2007). "Effort–reward imbalance and relational injustice at work predict sickness absence: The Whitehall II study." *Journal of Psychosomatic Research* 63:433-440.
Hintsa T., Kouvonen A., McCann M., Jokela M., Elovainio M., & Demakakos P. (2015). "Higher effort-reward imbalance and lower job control predict exit from the labour market at the age of 61 years or younger: evidence from the English Longitudinal Study of Ageing." *Journal of Epidemiology & Community Health* 69:543-549.
Hobfoll S. E. (1989). "Conservation of resources: A new attempt at conceptualizing stress." *American Psychologist* 44:513.
Hoven H., Dragano N., Blane D., & Wahrendorf M. (2017). "Early Adversity and Late Life Employment History—A Sequence Analysis Based on SHARE." *Work, Aging and Retirement* 4:238-250.
Jivraj S., Goodman A., Ploubidis G. B., & de Oliveira C. (2017). "Testing comparability between retrospective life history data and prospective birth cohort study data." *The Journals of Gerontology: Series B*.
Juvani A., Oksanen T., Salo P., Virtanen M., Kivimäki M., Pentti J., & Vahtera J. (2014). "Effort-reward imbalance as a risk factor for disability pension: the Finnish Public Sector Study." *Scandinavian Journal of Work, Environment & Health* 40:266-277.
Kalleberg A. L. (2009). "Precarious Work, Insecure Workers: Employment Relations in Transition." *American Sociological Review* 74:1-22.
Karasek R., & Theorell T. (1990). *Healthy Work*. New York: Basic Books.
Kendig H., Byles J. E., O'Loughlin K., Nazroo J. Y., Mishra G., Noone J., Loh V., & Forder P. M. (2014). "Adapting data collection methods in the Australian Life Histories and Health Survey: a retrospective life course study." *BMJ Open* 4.
Kim T. J., & von dem Knesebeck O. (2015). "Is an insecure job better for health than having no job at all? A systematic review of studies investigating the health-related risks of both job insecurity and unemployment." *BMC public health* 15:985.
Kivimäki M., Batty G. D., Ferrie J. E., & Kawachi I. (2014). "Cumulative meta-analysis of job strain and CHD." *Epidemiology* 25:464-465.
Kivimäki M., Nyberg S. T., Batty G. D., Fransson E. I., Heikkila K., Alfredsson L., Bjorner J. B., Borritz M., Burr H., Casini A., Clays E., De Bacquer D., Dragano N., Ferrie J. E., Geuskens G. A., Goldberg M., Hamer M., Hooftman W. E., Houtman I. L., Joensuu M., Jokela M., Kittel F., Knutsson A., Koskenvuo M., Koskinen A., Kouvonen A., Kumari M., Madsen I. E., Marmot M. G., Nielsen M. L., Nordin M., Oksanen T., Pentti J., Rugulies R., Salo P., Siegrist J., Singh-Manoux A., Suominen S. B., Vaananen A., Vahtera J., Virtanen M., Westerholm P. J., Westerlund H., Zins M., Steptoe A., Theorell T., & Consortium I. P.-W. (2012). "Job strain as a risk factor for coronary heart disease: a collaborative meta-analysis of individual participant data." *The Lancet* 380:1491-1497.
Kivimäki M., & Steptoe A. (2018). "Effects of stress on the development and progression of cardiovascular disease." *Nature Reviews Cardiology* 15:215.
Kivimäki M., Virtanen M., Kawachi I., Nyberg S. T., Alfredsson L., Batty G. D., Bjorner J. B., Borritz M., Brunner E. J., Burr H., Dragano N., Ferrie J. E., Fransson E. I., Hamer M., Heikkila K., Knutsson A., Koskenvuo M., Madsen I. E., Nielsen M. L., Nordin M., Oksanen T., Pejtersen J. H., Pentti J., Rugulies R., Salo P., Siegrist J., Steptoe A., Suominen S., Theorell T., Vahtera J., Westerholm P. J., Westerlund H., Singh-Manoux A., & Jokela M. (2015). "Long working hours, socioeconomic status, and the risk of incident type 2 diabetes: a meta-analysis of published and unpublished data from 222 120 individuals." *Lancet Diabetes Endocrinol* 3:27-34.
Korbmacher J. M. (2014). *New challenges for interviewers when innovating social surveys: linking survey and objective data*. Munich: Dissertation, LMU Munich.
Kouvonen A., Kivimäki M., Cox S. J., Poikolainen K., Cox T., & Vahtera J. (2005a). "Job strain, effort-reward imbalance, and heavy drinking: a study in 40,851 employees." *Journal of Occupational & Environmental Medicine* 47:503-513.

Kouvonen A., Kivimäki M., Virtanen M., Pentti J., & Vahtera J. (2005b). "Work stress, smoking status, and smoking intensity: an observational study of 46,190 employees." *Journal of Epidemiology & Community Health* 59:63-69.
Kröger H., Pakpahan E., & Hoffmann R. (2015). "What causes health inequality? A systematic review on the relative importance of social causation and health selection." *The European Journal of Public Health* 25:951-960.
Kuh D., & Ben-Shlomo Y. (1997). "Introduction: A lifecourse approach to the aetielogy of chronic disease " Pp. 3-14 in D. Kuh & Y. Ben-Shlomo Hrsg., *A lifecourse approach to chronic disease epidemiology*. Oxford: Oxford Univerity Press.
Kuh D., & Ben-Shlomo Y. (2004). *A life course approach to chronic disease epidemiology*: Oxford University Press.
Kuh D., Ben Shlomo Y., Lynch J., Hallqvist J., & Power C. (2003). "Life course epidemiology." *Journal of Epidemiology & Community Health* 57:778-783.
Kuh D., Cooper R., Hardy R., Richards M., & Ben-Shlomo Y. (2014). *A life course approach to healthy ageing*. Oxford, United Kingdom ; New York, NY, United States of America: Oxford University Press.
Kuh D., Head J., Hardy R., & Wadsworth M. (1997). "The influence of education and family background on women's earnings in midlife: evidence from a British national birth cohort study." *British Journal of Sociology of Education* 18:385-405.
Kuh D., & Wadsworth M. (1991). "Childhood Influences on Adult Male Earnings in a Longitudinal-Study." *British Journal of Sociology* 42:537-555.
Kuntz-Hehner S., & Angerer P. (2018). "Psychokardiologische Grundlagen: Wie schädigt Stress das Herz-Kreislauf-System?" *Aktuelle Kardiologie* 7:351-356.
Lacey R., Sacker A., Bell S., Kumari M., Worts D., McDonough P., Kuh D., & McMunn A. (2017). "Work-family life courses and BMI trajectories in three British birth cohorts." *International Journal of Obesity* 41:332.
Lacey R., Stafford M., Sacker A., & McMunn A. (2015a). "Work-Family Life Courses and Subjective Wellbeing in the MRC National Survey of Health and Development (the 1946 British birth cohort study)." *Journal of Population Ageing*:1-21.
Lacey R. E., Kumari M., Sacker A., Stafford M., Kuh D., & McMunn A. (2016). "Work-Family Life Courses and Metabolic Markers in the MRC National Survey of Health and Development." *PloS one* 11:e0161923.
Lacey R. E., Sacker A., Kumari M., Worts D., McDonough P., Booker C., & McMunn A. (2015b). "Work-family life courses and markers of stress and inflammation in mid-life: evidence from the National Child Development Study." *International Journal of Epidemiology* 45:1247-1259.
Lazarus R. S. (1966). *Psychological stress and the coping process*. New York: McGraw-Hill.
Lazarus R. S., & DeLongis A. (1983). "Psychological stress and coping in aging." *American Psychologist* 38:245.
Lundberg O. (2008). "Commentary: Politics and public health - some conceptual considerations concerning welfare state characteristics and public health outcomes." *International Journal of Epidemiology* 37:1105-1108.
Madsen I. E., Nyberg S. T., Hanson L. M., Ferrie J. E., Ahola K., Alfredsson L., Batty G. D., Bjorner J. B., Borritz M., & Burr H. (2017). "Job strain as a risk factor for clinical depression: systematic review and meta-analysis with additional individual participant data." *Psychological medicine* 47:1342-1356.
Mc Munn A. (2017). "Gender differences in the health effects of psychosocial factors." Pp. 215-235 in M. Kivimäki, G David Batty, I. Kawachi & A. Steptoe Hrsg., *The Routledge International Handbook of Psychosocial Epidemiology*. London: Routledge.
McEwen B. S. (2012). "Brain on stress: How the social environment gets under the skin." *Proceedings of the National Academy of Sciences* 109:17180-17185.
McKetta S., Prins S. J., Platt J., Bates L. M., & Keyes K. (2018). "Social sequencing to determine patterns in health and work-family trajectories for US women, 1968–2013." *SSM-population health* 6:301-308.

McMunn A., Lacey R. E., Kumari M., Worts D., McDonough P., & Sacker A. (2016). "Work-family life courses and metabolic markers in mid-life: evidence from the British National Child Development Study." *Journal of Epidemiology & Community Health* 70:481-487.

Merton R. K. (1968). "The Matthew Effect in Science: The reward and communication systems of science are considered." *Science* 159:56-63.

Messing K., Punnett L., Bond M., Alexanderson K., Pyle J., Zahm S., Wegman D., Stock S. R., & de Grosbois S. (2003). "Be the fairest of them all: Challenges and recommendations for the treatment of gender in occupational health research." *American Journal of Industrial Medicine* 43:618-629.

Mortensen J., Dich N., Lange T., Alexanderson K., Goldberg M., Head J., Kivimäki M., Madsen I. E., Rugulies R., & Vahtera J. (2017). "Job strain and informal caregiving as predictors of long-term sickness absence: a longitudinal multi-cohort study." *Scandinavian Journal of Work Environment & Health* 43:5-14.

Ndjaboue R., Brisson C., Talbot D., & Vézina M. (2017). "Chronic exposure to adverse psychosocial work factors and high psychological distress among white-collar workers: A 5-year prospective study." *Journal of Psychosomatic Research* 94:56-63.

Ndjaboué R., Brisson C., Vézina M., Blanchette C., & Bourbonnais R. (2014). "Effort–reward imbalance and medically certified absence for mental health problems: a prospective study of white-collar workers." *Occupational and Environmental Medicine* 71:40-47.

Payne S., & Doyal L. (2010). "Older women, work and health." *Occupational Medicine* 60:172-177.

Pearlin L. I. (2010). "The Life Course and the Stress Process: Some Conceptual Comparisons." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 65B:207-215.

Ponomarenko V. (2016). "Cumulative disadvantages of non-employment and non-standard work for career patterns and subjective well-being in retirement." *Advances in Life Course Research* 30:133-148.

Power C., & Hertzman C. (1997). "Social and biological pathways linking early life and adult disease." *British medical bulletin* 53:210-221.

Power C., & Matthews S. (1997). "Origins of health inequalities in a national population sample." *The Lancet* 350:1584-1589.

Reinhardt J. D., Wahrendorf M., & Siegrist J. (2013). "Socioeconomic position, psychosocial work environment and disability in an ageing workforce: a longitudinal analysis of SHARE data from 11 European countries." *Occupational and Environmental Medicine* 70:156-163.

Richter M., Günther S., & Herke M. (2016). "Lebenslaufforschung in der Epidemiologie und den Sozialwissenschaften. Gemeinsam einsam?" *Gesundheitswesen*.

Roth G. A., Abate D., Abate K. H., Abay S. M., Abbafati C., Abbasi N., Abbastabar H., Abd-Allah F., Abdela J., & Abdelalim A. (2018). "Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017." *The Lancet* 392:1736-1788.

Rugulies R., Aust B., & Madsen I. E. (2017). "Effort–reward imbalance at work and risk of depressive disorders. A systematic review and meta-analysis of prospective cohort studies." *Scandinavian Journal of Work, Environment & Health* 43:294-306.

Sabbath E. L., Guevara I. M., Glymour M. M., & Berkman L. F. (2015a). "Use of life course work-family profiles to predict mortality risk among US women." *American Journal of Public Health* 105:e96-e102.

Sabbath E. L., Mejía-Guevara I., Noelke C., & Berkman L. F. (2015b). "The long-term mortality impact of combined job strain and family circumstances: A life course analysis of working American mothers." *Social Science & Medicine* 146:111-119.

Sackmann R., & Wingens M. (2003). "From Transitions to trajectories. Sequence types." Pp. 93-115 in W.R. Heinz & V.W. Marshall Hrsg., *Social Dynamics of the Life Course. Transitions, Institutions, and Interrelations*. New York: Aldine de Gruyter.

Sapolsky R. M. (2004). *Why zebras don't get ulcers: The acclaimed guide to stress, stress-related diseases, and coping-now revised and updated*: Holt paperbacks.
Schnall P. L., Schwartz J. E., Landsbergis P. A., Warren K., & Pickering T. G. (1998). "A longitudinal study of job strain and ambulatory blood pressure: results from a three-year follow-up." *Psychosomatic Medicine* 60:697-706.
Scholes S., Medina J., Cheshire H., Cox K., Hacker E., & Lessof C. (2009). *Living in the 21st century: older people in England. The 2006 English Longitudinal Study of Ageing Technical Report*. London: National Centre for Social Research.
Schröder M. (2011). *Retrospective Data Collection in the Survey of Health, Ageing and Retirement in Europe. SHARELIFE Methodology*. Mannheim: Mannheim Research Institute for the Economics of Aging.
Shonkoff J. P., Boyce W. T., & McEwen B. S. (2009). "Neuroscience, molecular biology, and the childhood roots of health disparities: building a new framework for health promotion and disease prevention." *Jama* 301:2252-2259.
Shultz K. S., Wang M., Crimmins E. M., & Fisher G. G. (2010). "Age Differences in the Demand-Control Model of Work Stress: An Examination of Data From 15 European Countries." *Journal of Applied Gerontology* 29:21-47.
Siegrist J. (1996). "Adverse health effects of high-effort/low-reward conditions." *Journal of Occupational Health Psychology* 1:27-41.
Siegrist J. (2005). "Social reciprocity and health: new scientific evidence and policy implications." *Psychoneuroendocrinology* 30:1033-1038.
Siegrist J. (2015). "Robert Merton: Occupational Roles, Social Status and Health Inequalities." Pp. 222-235 in F. Collyer Hrsg., *The Palgrave Handbook of Social Theory in Health, Illness and Medicine*. New York: Palgrave Macmillan.
Siegrist J., & Wahrendorf M. (2016). *Work Stress and Health in a Globalized Economy: The Model of Effort-Reward Imbalance*. Heidelberg: Springer.
Stone J., Evandrou M., Falkingham J., & Vlachantoni A. (2015). "Women's economic activity trajectories over the life course: implications for the self-rated health of women aged 64+ in England." *Journal of Epidemiology & Community Health* 69:873-879.
Stringhini S., Zaninotto P., Kumari M., Kivimäki M., Lassale C., & Batty G. D. (2017). "Socio-economic trajectories and cardiovascular disease mortality in older people: the English Longitudinal Study of Ageing." *International Journal of Epidemiology* 47:36-46.
Studer M., & Ritschard G. (2016). "What matters in differences between life trajectories: a comparative review of sequence dissimilarity measures." *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 179:481-511.
Sudman S., Bradburn N. M., & Schwarz N. (1996). *Thinking about answers : the application of cognitive processes to survey methodology*. San Francisco: Jossey-Bass Publishers.
Theorell T., Hammarström A., Aronsson G., Bendz L. T., Grape T., Hogstedt C., Marteinsdottir I., Skoog I., & Hall C. (2015). "A systematic review including meta-analysis of work environment and depressive symptoms." *BMC public health* 15:738.
Trudel X., Brisson C., Milot A., Masse B., & Vézina M. (2016). "Adverse psychosocial work factors, blood pressure and hypertension incidence: repeated exposure in a 5-year prospective cohort study." *Journal of Epidemiology & Community Health* 70:402-408.
Turner R. J., Wheaton B., & Lloyd D. A. (1995). "The Epidemiology of Social Stress." *American Sociological Review* 60:104-125.
Vanhoutte B., & Nazroo J. (2016). "Life-history data." *Public Health Research & Practice* 26.
Vanhoutte B., Wahrendorf M., & Prattley J. (2018). "Sequence Analysis of Life History Data." Pp. 1-19 in Pranee Liamputtong Hrsg., *Handbook of Research Methods in Health Social Sciences*. Singapore: Springer Singapore.
Vineis P., Avendano-Pabon M., Barros H., Chadeau-Hyam M., Costa G., Dijmarescu M., Delpierre C., D'Errico A., Fraga S., & Giles G. (2017). "The biology of inequalities in health: the LIFEPATH project." *Longitudinal and Life Course Studies* 8:417-449.
Virtanen M., Jokela M., Nyberg S. T., Madsen I. E., Lallukka T., Ahola K., Alfredsson L., Batty G. D., Bjorner J. B., Borritz M., Burr H., Casini A., Clays E., De Bacquer D., Dragano

N., Erbel R., Ferrie J. E., Fransson E. I., Hamer M., Heikkila K., Jockel K. H., Kittel F., Knutsson A., Koskenvuo M., Ladwig K. H., Lunau T., Nielsen M. L., Nordin M., Oksanen T., Pejtersen J. H., Pentti J., Rugulies R., Salo P., Schupp J., Siegrist J., Singh-Manoux A., Steptoe A., Suominen S. B., Theorell T., Vahtera J., Wagner G. G., Westerholm P. J., Westerlund H., & Kivimäki M. (2015). "Long working hours and alcohol use: systematic review and meta-analysis of published studies and unpublished individual participant data." *BMJ* 350:g7772.

Wahrendorf M. (2015). "Previous employment histories and quality of life in older ages: sequence analyses using SHARELIFE." *Ageing & Society* 35:1928-1959.

Wahrendorf M. (2018). "Stressoren in Kindheit und Jugend als Prädiktoren kardiovaskulärer Erkrankungen – die Lebenslaufperspektive." *Aktuelle Kardiologie* 7:357-362.

Wahrendorf M., & Blane D. (2015). "Does labour market disadvantage help to explain why childhood circumstances are related to quality of life at older ages? Results from SHARE." *Aging & Mental Health* 19:584-594.

Wahrendorf M., Blane D., Bartley M., Dragano N., & Siegrist J. (2013). "Working conditions in mid-life and mental health in older ages." *Advances in Life Course Research* 18:16-25.

Wahrendorf M., & Chandola T. (2016). "A life course perspective on work stress and health." Pp. 46-66 in J Siegrist & M Wahrendorf Hrsg., *Work Stress and Health in a Globalized Economy: The Model of Effort-Reward Imbalance*. Heidelberg: Springer.

Wahrendorf M., Hoven H., Goldberg M., Zins M., & Siegrist J. (2018a). "Adverse employment histories and health functioning: the CONSTANCES study." *International Journal of Epidemiology*.

Wahrendorf M., Marr A., Antoni M., Pesch B., Jöckel K.-H., Lunau T., Moebus S., Arendt M., Brüning T., Behrens T., & Dragano N. (2018b). "Agreement of self-reported and administrative data on employment histories in a German cohort study: a sequence analysis." *European Journal of Population*.

Wahrendorf M., Sembajwe G., Zins M., Berkman L., Goldberg M., & Siegrist J. (2012). "Long-term effects of psychosocial work stress in midlife on health functioning after labor market exit—results from the GAZEL study." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 67:471-480.

Wahrendorf M., & Siegrist J. (2014). "Proximal and distal determinants of stressful work: framework and analysis of retrospective European data." *BMC Public Health* 14:849-861.

Wahrendorf M., Zaninotto P., Hoven H., Head J., & Carr E. (2018c). "Late Life Employment Histories and Their Association With Work and Family Formation During Adulthood: A Sequence Analysis Based on ELSA." *The Journals of Gerontology: Series B* 73:1263-1277.

Willis S. L., & Martin M. (2005). *Middle adulthood : a lifespan perspective*. Thousand Oaks, Calif. ; London: Sage Publications.

Willis S. L., Martin M., & Rocke C. (2010). "Longitudinal perspectives on midlife development: stability and change." *European Journal of Ageing* 7:131-134.

Worts D., Corna L., Sacker A., McMunn A., & McDonough P. (2016). "Understanding older adults' labour market trajectories: a comparative gendered life course perspective." *Longitudinal and Life Course Studies* 7:347-367.

6 Anhang Originalarbeiten

1. **Wahrendorf M.**, Hoven H., Goldberg M., Zins M., & Siegrist J. (2018). "Adverse employment histories and health functioning: the CONSTANCES study." *International Journal of Epidemiology*: online first.

   Impact factor: 8.36

International Journal of Epidemiology, 2018, 1–13
doi: 10.1093/ije/dyy235
Original article

Original article

Adverse employment histories and health functioning: the CONSTANCES study

Morten Wahrendorf,[1]* Hanno Hoven,[1] Marcel Goldberg,[2,3] Marie Zins[2,3] and Johannes Siegrist[4]

[1]Centre for Health and Society, Institute of Medical Sociology, Medical Faculty, University of Düsseldorf, Düsseldorf, Germany, [2]INSERM, Population-Based Epidemiological Cohorts Unit, UMS 011, Villejuif, France, [3]Paris Descartes University, Paris, France and [4]Senior Professorship on Work Stress Research, Medical Faculty, University of Düsseldorf, Düsseldorf, Germany

*Corresponding author. Centre for Health and Society, Institute of Medical Sociology, Medical Faculty, University of Düsseldorf, Universitätsstrasse 1, 40225 Düsseldorf, Germany. E-mail: wahrendorf@uni-duesseldorf.de

Editorial decision 19 September 2018; Accepted 4 October 2018

Abstract

Background: With changing employment histories in European labour markets, occupational health research needs to be supplemented by an approach that integrates adverse characteristics of entire employment histories, in terms of precarious, discontinued and disadvantaged employment careers. We analyse associations of adverse employment histories and six measures of health functioning, including affective, physical and cognitive functioning.

Methods: We use baseline data from the CONSTANCES study with detailed retrospective data on previous employment histories that are linked to current health functioning among people aged 45–60 years (men = 15 134; women = 16 584). The following career characteristics are assessed (all referring to careers between ages 25 and 45 years): number of jobs with temporary contracts, number of job changes, number of unemployment periods, years out of work, mode occupational position and lack of job promotion. The measures of health functioning range from depressive symptoms, standing balance, walking speed, lung function, to verbal memory and semantic fluency.

Results: For both men and women, multilevel regressions (participant nested in health-examination centre) revealed that adverse employment histories are associated with poor health functioning later on, in particular persistent disadvantage in terms of low occupational position, repeated periods of unemployment and weak labour-market ties (years out of work). Findings remain consistent after excluding respondents who had a health-related career interruption or already retired before age 45 years and, additionally, after adjusting for age, partnership and education.

Conclusion: Findings call for increased intervention efforts among more disadvantaged groups of the labour market at early-career stages.

Key words: employment histories, work stress, life course, health functioning

Key Messages

- Current work-stress research needs to be supplemented by an approach that considers adverse characteristics of entire employment histories, in terms of precarious, discontinued and disadvantaged employment over the course of an extended time period.
- Adverse employment histories at early-career stages (between ages 25 and 45 years) are associated with poor health functioning later on, in particular continuous low occupational position, repeated periods of unemployment and weak labour-market ties over time.
- Findings call for increased intervention efforts among more disadvantaged groups of the labour market at early-career stages.

Introduction

Research has established solid evidence on the impact of work stress on health, mostly based on theoretical models, such as the demand–control and the effort–reward imbalance models, and their empirical tests in the frame of occupational cohort studies.[1,2] Yet, despite this important progress, one critique of this line of research maintains that these are static models, failing to grasp the dynamic aspects of current work and employment arrangements characterized by increased flexibility, insecurity, differentiation and fragmentation.[3–5] Similarly, in most studies, work stress was assessed only once and linked to future health risks without taking into account its chronicity.[6,7] Other studies using repeated assessment of stressful work, though, document an increased effect on health.[8–10]

In line with the life-course perspective,[11,12] recent studies started to extend the timeframe and to study whole employment histories in relation to health.[13–15] Studying employment histories (collected prospectively or retrospectively) enables the researcher to analyse risk accumulation, in terms both of repeated exposure at different time points and of exposure duration, together with information on whole patterns of employment histories and changes.[8] Whereas this extension is expected to enrich the prediction of health, one important challenge remains to be resolved: how can this empirical information be reconciled with the need of theoretical concepts and, more specifically, with core theoretical notions of work-stress models? The present paper addresses this challenge by studying career characteristics that prevent workers from meeting basic material and psychosocial needs at work that are at the core of prevailing work-stress models, such as job security, control and reward.[16,17] Thereby, the following career characteristics deserve special attention: (i) precarious careers, such as temporary contracts and repeated job changes; (ii) discontinuous working careers, such as involuntary interruptions (e.g. episodes of unemployment) and weak labour-market attachments (e.g. years out of work); (iii) cumulative disadvantages, such as disadvantaged occupational positions and lack of job promotions. In all these instances—albeit to a different degree—options of security, continuity and personal development at work are restricted, and there are few opportunities of exercising control and autonomy, and of receiving reward and recognition for one's accomplishments. To illustrate, in case of precarious careers, temporary jobs and repeated job changes are expected to be accompanied by irregular income, whereas job tasks of temporary jobs may be unusually demanding and hazardous, leading to an imbalance between high efforts spent and low rewards received in turn, thus reinforcing a sense of continued reward frustration. Or, in the case of cumulative disadvantages, we may assume that people who work for a longer period in lower-grade or unskilled occupations without job promotion have restricted opportunities to develop new skills and are excluded from organizational participation, thus restricting the experience of personal control at work. It is therefore likely that repeated stress responses of participants who work under these circumstances compromise their adaptive bodily systems, thus promoting the initiation and progression of disease, and a premature loss of health functioning.[12] This latter assumption has been supported by numerous recent studies showing that chronic stress promotes the dysregulation of core physiological systems across the life course, resulting in a state of allostatic load (AL).[18–20]

In the present study, our aim is to investigate the relationships between the adverse career characteristics mentioned that occurred between the ages of 25 and 45 years and distinct measures of health functioning later on that were proposed for use in large-scale population-based studies on healthy ageing.[12]

Methods

Data source

We use data from the French CONSTANCES project.[21,22] CONSTANCES is a population-based cohort study with a focus on occupational and environmental epidemiology. It started in 2012 to include up to 200 000 adults aged

18–69 years and recruitment is still ongoing. The sample is based on 85% of the French population, consisting of all individuals who are covered by the French General Health Insurance Fund (CNAMTS). This includes all salaried workers, professionally active or retired, and their family (approximately 50 million people in France). Self-employed and agricultural workers are only part of the study if they are insured through a family member; otherwise, they are not part because they belong to different health-insurance organizations. Data collection took place in 22 national Health Screening Centres (HSCs) throughout the country. Each HSC provides advanced medical equipment and experience in collecting data for epidemiological studies.[22] To recruit the participants, eligible persons were randomly invited to undergo a health examination at their HSC. Data used in this study were collected by either self-administered questionnaires (including retrospective information on employment histories) or as part of the health examinations at baseline (including health functioning), meeting high-quality standards,[23] including trained study nurses and Standard Operations Procedures (SOPs). The study was approved by bodies regulating ethical data collection in France [Comité Consultatif pour le Traitement des Informations Relatives à la Santé (CCTIRS); Commission Nationale Informatique et Liberté (CNIL)] and all participants signed an informed consent.

Study population

Our study relies on a sub-sample of men and women aged 45–60 years who were working at least once between ages 25 and 45 years (initial sample: 33 048 participants). This sub-sample meets our study aim because these participants had employment histories with potential change or stability. Furthermore, between ages 45 and 60 years, early signs of reduced health functioning become manifest, thus enabling us to study their variations.[12] To minimize the effect of ill health causing both specific employment histories (e.g. periods of unemployment) and the report of poor health later on, two additional restrictions are necessary. First, we excluded people with a health-related career interruption prior to age 45 years (3.8% of the initial sample, 1265 participants). Second, respondents who retired prior to age 45 years (probably due to health reasons) were not included (additional 65 participants). This resulted in a final study sample of 31 718 respondents (16 584 women and 15 134 men) at the time of this study.

Measures

Adverse employment histories

As part of the self-administered questionnaire at baseline, respondents provide detailed retrospective information on each job they had (starting with the first job until the moment of the interview) and on potential career interruptions (lasting 6 months or longer). Information on jobs includes the starting and ending dates, contract type, working time and an open question for details on the executed profession. Similarly, in case of an interruption, respondents specified the timing (begin and end) and gave information on the reasons (e.g. health, unemployment, housework). By combining these data, we can provide a detailed description of whole employment histories for each individual in terms of an annual description of the employment situation between ages 25 and 45 years (employment sequence), thus covering 21 years of the working career. To illustrate the richness of information evolving from these data, Figure 1 gives examples of resulting individual sequences (8 out of 31 718) using contract type as job detail and four possible employment situations ['paid work (permanent contract)', 'paid work (temporary contract)', 'unemployed', 'not working (incl. housework)']. Each sequence is presented as a horizontal line and each colour represents a specific situation. We see that the first three sequences belong to participants who either constantly worked in permanent (Participants 1 and 2) or temporary jobs (Participant 3). In the remaining cases, histories also include career interruptions, due to either unemployment or episodes of not working (including housework) or both.

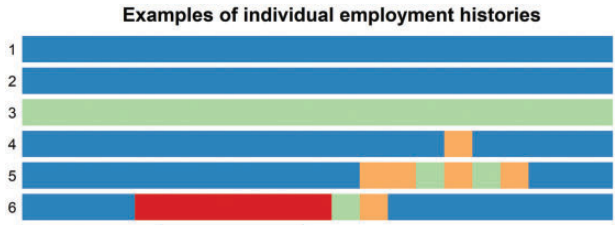


Figure 1. Examples of individual employment histories.

Based on individual employment sequences, we then ascertained the following six career characteristics: (i) number of jobs with temporary contract and (ii) number of job changes as available indicators of 'precarious careers', (iii) number of unemployment interruptions and (iv) years out of work as available indicators of 'involuntary interruptions', (v) the mode occupational position between ages 25 and 45 years and (vi) lack of job promotion as indicators of 'cumulative disadvantages'.

The *mode occupational position* is based on the longest-held position between 25 and 45 years and measured

according to the European Socio-Economic Classification scheme (ESeC)[24] {with an average length of 15.8 years in our sample [standard deviation (SD) = 5.3]}. To classify respondents into ESeC, we relied on the national French classification scheme ['Professions et catégories socioprofessionnelles' (PCS)] and grouped jobs according to the conversion table of the French National Institute of Statistics and Economic Studies.[25] In contrast to the PCS, the ESeC classification is comparative across Europe and provides a higher level of differentiation than the PCS. The theoretical foundations of the ESeC builds on the Erikson Goldthorpe Portocarero (EGP) class scheme (for details, see[24]). We adopted a version with seven different classes, where self-employed and agricultural workers were grouped into one class (because of small numbers resulting from the sample strategy). For the same reason, higher-grade blue-collar workers were combined with higher-grade white-collar workers.[26] If the longest position was unknown (e.g. when participants provided information that could not be recoded or if information was missing), people were grouped into an additional category. In the infrequent case that participants had two or more mode positions (1.5% of all cases), we prioritized the most recent one. *Lack of promotion* was measured if participants had no upward mobility during the observation period (based on occupational position) and also we ascertained whether participants were promoted but had a downward mobility thereafter (i.e. up- and downward mobility process). *Unemployment interruptions* measure the number of interruptions due to unemployment. By *years out of work*, we count the number of years without paid work (three categories). Finally, the *number of temporary jobs* was included (three categories). Details on each variable, including categories and their distributions, are shown in Table 1.

Health functioning

We use six measures of health functioning, all considered important measures of healthy ageing,[12,18] that cover the domains of affective, physical and cognitive functioning. Affective functioning is measured by a self-administrated questionnaire with the 20-item Centre for Epidemiologic Studies Depression Scale (CES-D),[27] with a sum score ranging from 0 to 60. We used sex-specific thresholds for elevated depressive symptoms (women: 20, men: 16), as validated against clinical diagnoses for the French population.[28] All remaining measures are part of the medical examinations. A walking speed test measured the time taken to walk a distance of 3 m at normal speed (using walking aids if required).[29] Unreasonable values (below 1 second; 97 participants, 0.4% of all cases) were removed and we calculated cm/sec for the analyses. As a test of standing balance, a leg-raise test (or commonly called 'flamingo' test) ascertained whether study members successfully could raise one leg for 30 seconds from a standing position (with eyes open) or not.[30] For lung function, forced expiratory volume (FEV) in 1 second was determined with a standard hand-held Vitalograph spirometer using the highest of three measurements.[31] Cognitive functioning was measured in terms of verbal memory as part of the free and cued selective reminding test (FCSRT),[32] where study participants have to memorize a list of 16 words and thereafter to recall words based on free and cued recall (repeated three times). For the analyses, we used the free-recall score, which was shown to best predict dementia.[33] In addition, a semantic fluency test was used where participants named as many animals as possible within 60 seconds.[34] A correlation matrix of all health measures is presented in Table 2.

Additional variables

Alongside sex and age, we also included a variable measuring at which screening centre the data were collected, partnership situation, the current labour-market status (in paid work or not), current income and participants' educational level. The latter is measured according to the International Standard Classification of Educational Degrees (ISCED-2011) that we regroup into 'low' (pre-primary, primary or lower-secondary education), 'medium' (upper-secondary or post-secondary education) and 'high' (first and second stages of tertiary education). Income is based on the total monthly household income that we adjusted according to number of household members and then grouped into tertiles ('low', 'medium', 'high') for the final study sample. In case respondents refused to answer the income question, a distinct category ('answer refused') is used. For partnership, we measure whether the respondent lives with a partner or not (regardless of marital status).

Analytical strategy

All analyses are conducted for men and women separately and we start with a sample description followed by a table to study pairwise correlation of all measures of health functioning (Pearson's r). Then we estimate a series of hierarchical regression models with individuals nested in screening centres (multilevel models), to allow an accurate adjustment for centre in our study. Each career characteristic is linked with each measure of health functioning. We either use multilevel Poisson regression models to estimate relative risks in case of binary outcomes[35] or multilevel linear regressions for continuous outcomes.[36] Before estimation, all continuous outcomes were tested for normal

Table 1. Sample description: observations (No.) and percentage (Col. %) or mean and standard deviation (SD), by sex ($n = 31\,718$)

		Men		Women	
	Categories or range	No.	Col. % or mean (SD)	No.	Col. % or mean (SD)
Age	45–60	15 134	52.7 (4.5)	16 584	52.6 (4.5)
Partnership[a]	Living with partner	11 910	80.5	11 761	72.4
	Living as single	2889	19.5	4492	27.6
Education[b]	Low	1470	9.9	1620	9.9
	Medium	6213	41.9	5948	36.5
	High	7129	48.1	8736	53.6
Current employment situation	In paid work	12 526	82.8	13 497	81.4
	Not in paid work	2608	17.2	3087	18.6
Current income[c]	Low income	4714	32.3	5321	33.4
	Medium income	4867	33.3	5106	32.1
	High income	4441	30.4	4677	29.4
	Answer refused	587	4.0	815	5.1
Number of temporary jobs	No temporary job	12 963	85.7	13 306	80.2
	1 temporary job	1882	12.4	2701	16.3
	2+ temporary jobs	289	1.9	577	3.5
Number of job changes	No job change	4165	27.5	5394	32.5
	1 or 2 job changes	6427	42.5	7027	42.4
	3+ job changes	4542	30.0	4163	25.1
Number of unemployment periods	No unemployment period	13 311	88.0	13 861	83.6
	1 unemployment period	1450	9.6	2116	12.8
	2+ unemployment periods	373	2.5	607	3.7
Years out of work	No years out of work	9921	65.6	7992	48.2
	1–5 years out of work	3727	24.6	4421	26.7
	6+ years out of work	1486	9.8	4171	25.2
Mode occupational position	Large employers, higher managers and professionals	2341	15.5	1448	8.7
	Lower managers and professionals	3021	20.0	5607	33.8
	Intermediate employee	2442	16.1	4055	24.5
	Small employers and self-employed	302	2.0	209	1.3
	Lower-grade white-collar workers	472	3.1	1538	9.3
	Skilled workers	1796	11.9	268	1.6
	Semi- or unskilled workers	1128	7.5	621	3.7
	Main position unknown	3632	24.0	2838	17.1
Lack of promotion	Promotion	3247	21.5	2682	16.2
	No promotion	11 297	74.6	13 456	81.1
	Promotion with return	590	3.9	446	2.7
Depressive symptoms	Not elevated	11 730	77.51	12 510	75.43
	Elevated	2457	16.23	2922	17.62
Standing balance	Not failed	10 846	94.2	11 615	92.2
	Failed	662	5.8	986	7.8
Walking speed (cm/sec)	26–300	10 547	129.7 (26.2)	11 527	125.8 (26.9)
Lung function (FEV)	1.0–6.7	11 198	3.6 (0.6)	12 108	2.6 (0.5)
Verbal memory	0–48	11 410	32.0 (5.3)	12 631	34.7 (4.8)
Semantic fluency	0–55	11 601	23.9 (6.1)	12 757	24.0 (5.9)

[a]666 participants had missing values for partnership (2.1%).
[b]602 participants had missing values for education (1.9%).
[c]1190 participants had missing values for income (3.7%).

distribution and walking speed was log-transformed to decrease skewness. Next, we standardized all continuous outcomes to enable comparisons. Because of multiple outcomes, we adopted a Bonferroni corrected *p*-value of <0.0083 (0.05 divided by six outcomes) indicating strong evidence for an association. All models were adjusted for age, age square, as well as for two potential confounders: partnership situation and education. The sample of the

Table 2. Pairwise correlations of all measures of health functioning for men (lower-left triangle) and women (upper-right triangle)

	Depressive symptoms	Standing balance	Walking speed	Lung function	Verbal memory	Semantic fluency
Depressive symptoms[a]	1.000	0.079	–0.063	–0.058	–0.074	–0.084
Standing balance[b]	0.083	1.000	–0.119	–0.120	–0.093	–0.093
Walking speed	–0.046	–0.083	1.000	0.122	0.085	0.062
Lung function	–0.076	–0.099	0.136	1.000	0.087	0.080
Verbal memory	–0.057	–0.078	0.074	0.091	1.000	0.343
Semantic fluency	–0.069	–0.081	0.065	0.075	0.376	1.000

[a]Depressive symptoms: 0 = not elevated; 1 = elevated.
[b]Standing balance: 0 = not failed; 1 = failed.

multivariable analysis varied according to the outcome under study, because medical examination data were available for a lower proportion of participants than was the case for questionnaire data, ranging between $n = 21\,560$ (walking speed) and $n = 29\,164$ (depressive symptoms).

Results

The sample includes slightly more women than men (16 584 vs 15 134), both with a mean age of 53 years and currently employed in more than 80% of the cases. The majority have worked in lower managerial and professional occupations (men and women) and the proportion of those who have had at least one episode of unemployment is above 10% for both sexes. Most participants were working full-time for between 25 and 45 years, and more so men. Most participants changed their job once or twice (42% for both men and women) and most participants (above 80%) had no temporary work contract between ages 25 and 45 years. Most of the respondents did not move to a higher occupational position during the observation period. Based on our definition of elevated depressive symptoms (sex-specific cut-points), levels were similar between sexes, whereas men performed generally better than women in case of physical functioning (balance test and walking speed) but slightly worse in case of cognitive functioning (memory test). Correlations between measures of health functioning were generally low in all cases, with the highest values between verbal memory and sematic fluency ($r = 0.38$ for men; $r = 0.34$ for women).

Concerning our main research question, the associations between adverse career characteristics and health functioning, Table 3 presents the results for men and Table 4 for women. Results can be summarized as follows. First, participants who mainly worked in a disadvantaged occupational position between ages 25 and 45 years (especially lower-grade white-collar workers and semi- or unskilled workers) had poorer health functioning later on. This holds true for men and women and for each measure of health functioning. Second, periods of unemployment are related to lower walking speed (men and women), to reduced lung functioning (FEV) and specifically to elevated levels of depressive symptoms. Similarly, and third, weak labour-market attachment (in terms of years out of work) is related to poorer health functioning, in particular for men. Fourth, turning to lack of promotion and temporary employment, there was an association with depressive symptoms (men and women) but not with the remaining outcomes. Fifth, in case of lack of promotion, we observe an association with depressive symptoms and lung function for male participants who experienced upward mobility and a downward process thereafter. Finally, it is worth noting that participants with an unknown mode of occupational position had no particular health profiles, thus indicating that the latter category did not represent a group with systematic associations.

In additional analyses, we pooled the entire sample and included for each of the six indicators of health functioning an interaction between career characteristics and sex (presented online in Supplementary Table 1, available as Supplementary data at *IJE* online). Overall, we found some indication that associations were stronger for men in case of depressive symptoms (four out of six p-values below 0.05), lung function (three out of six) and lower semantic fluency (two out of six), but results for the remaining health measures suggested that relationships were by and large similar for men and women.

Discussion

This study analysed associations of three types of adverse employment histories experienced between ages 25 and 45 years (precarious work, discontinued work, cumulative disadvantage), with six complementary indicators of health functioning at later age, i.e. between 45 and 60 years. We linked retrospectively assessed data on employment histories to current measures of health functioning (both collected at baseline screening) in a large cohort study from

Table 3a. Association between career characteristics and health functioning for men: relative risks or unstandardized coefficients, confidence intervals and *p*-values

		Depressive symptoms			Standing balance			Walking speed		
		RR	CI (95%)	*p*-value	RR	CI (95%)	*p*-value	*b*	CI (95%)	*p*-value
Number of temporary jobs	No temporary job (ref.)	–			–			–		
	1 temporary job	1.23	(1.13, 1.34)	<0.001	1.03	(0.79, 1.35)	0.825	–0.05	(–0.10, 0.00)	0.069
	2+ temporary jobs	1.71	(1.34, 2.19)	<0.001	1.15	(0.63, 2.12)	0.651	–0.03	(–0.16, 0.10)	0.614
Number of job changes	No change (ref.)	–			–			–		
	1 or 2 changes	1.05	(0.99, 1.12)	0.108	0.79	(0.68, 0.91)	0.001	0.00	(–0.04, 0.04)	0.999
	3+ changes	1.06	(0.94, 1.20)	0.324	0.94	(0.77, 1.15)	0.541	0.02	(–0.02, 0.07)	0.320
Number of unemployment periods	No unemployment period (ref.)	–			–			–		
	1 unemployment period	1.41	(1.30, 1.54)	<0.001	1.12	(0.91, 1.38)	0.291	–0.04	(–0.10, 0.02)	0.195
	2+ unemployment periods	1.68	(1.47, 1.93)	<0.001	1.06	(0.64, 1.77)	0.810	–0.12	(–0.23,–0.00)	0.045
Years out of work	No years out of work (ref.)	–			–			–		
	1–5 years out of work	1.27	(1.17, 1.37)	<0.001	1.08	(0.92, 1.27)	0.356	–0.05	(–0.10,–0.01)	0.014
	6+ years out of work	1.67	(1.52, 1.82)	<0.001	1.69	(1.34, 2.15)	0	–0.14	(–0.21,–0.08)	<0.001
Mode occupational position	Large employers, higher managers and professionals (ref.)	–			–			–		
	Lower managers and professionals	1.06	(0.92, 1.23)	0.388	1.57	(1.15, 2.13)	0.005	–0.05	(–0.11, 0.01)	0.111
	Intermediate employee	1.04	(0.92, 1.17)	0.557	1.61	(1.22, 2.13)	<0.001	–0.01	(–0.07, 0.06)	0.819
	Small employers and self-employed	1.02	(0.83, 1.24)	0.866	2.17	(1.47, 3.21)	<0.001	–0.08	(–0.21, 0.06)	0.247
	Lower-grade white-collar workers	1.40	(1.13, 1.72)	0.002	3.17	(2.37, 4.23)	<0.001	–0.11	(–0.23, 0.00)	0.055
	Skilled workers	1.28	(1.09, 1.52)	0.004	2.55	(1.82, 3.57)	<0.001	–0.13	(–0.20,–0.05)	<0.001
	Semi- or unskilled workers	1.26	(1.08, 1.46)	0.003	2.77	(2.30, 3.34)	<0.001	–0.2	(–0.29,–0.12)	<0.001
	Main position unknown	1.11	(0.98, 1.26)	0.102	1.88	(1.39, 2.56)	<0.001	–0.06	(–0.12, 0.00)	0.058
Lack of promotion	Promotion (ref.)	–			–			–		
	No promotion	1.01	(0.92, 1.10)	0.903	1.16	(0.99, 1.35)	0.068	0.00	(–0.04, 0.04)	0.925
	Promotion with return	1.27	(1.01, 1.60)	0.041	1.22	(0.86, 1.74)	0.257	–0.08	(–0.17, 0.02)	0.107

Models are based on multilevel models (individuals nested in health-examination centre) and calculated separately for each career characteristic, adjusted for age, age square, partnership situation and education. Respondents who retired or had a health-related career interruption prior age 45 years are excluded from the analyses.

Table 3b. Association between career characteristics and health functioning for men: unstandardized coefficients, confidence intervals and *p*-values

		Lung function			Verbal memory			Semantic fluency		
		b	CI (95%)	*p*-value	*b*	CI (95%)	*p*-value	*b*	CI (95%)	*p*-value
Number of temporary jobs	No temporary job (ref.)	–			–			–		
	1 temporary job	–0.06	(–0.10,–0.01)	0.013	0.01	(–0.04, 0.07)	0.684	–0.01	(–0.07, 0.04)	0.609
	2+ temporary jobs	–0.01	(–0.12, 0.10)	0.850	0.00	(–0.14, 0.14)	0.992	–0.03	(–0.16, 0.11)	0.707
Number of job changes	No change (ref.)	–			–			–		
	1 or 2 changes	–0.02	(–0.05, 0.02)	0.337	0.01	(–0.04, 0.05)	0.783	–0.03	(–0.07, 0.02)	0.204
	3+ changes	–0.03	(–0.07, 0.01)	0.194	0.06	(0.01, 0.11)	0.018	0.02	(–0.03, 0.07)	0.442
Number of unemployment periods	No unemployment period (ref.)	–			–			–		
	1 unemployment period	–0.03	(–0.08, 0.02)	0.222	0.03	(–0.03, 0.09)	0.388	–0.08	(–0.14,–0.02)	0.011
	2+ unemployment periods	–0.09	(–0.19, 0.01)	0.070	–0.01	(–0.13, 0.11)	0.832	–0.04	(–0.15, 0.08)	0.541
Years out of work	No years out of work (ref.)	–			–			–		
	1–5 years out of work	–0.06	(–0.10,–0.03)	<0.001	0.00	(–0.04, 0.05)	0.882	–0.08	(–0.13,–0.04)	<0.001
	6+ years out of work	–0.18	(–0.24,–0.13)	<0.001	–0.06	(–0.13, 0.01)	0.073	–0.27	(–0.34,–0.21)	<0.001
Mode occupational position	Large employers, higher managers and professionals (ref.)	–			–			–		
	Lower managers and professionals	–0.04	(–0.09, 0.01)	0.105	–0.05	(–0.11, 0.01)	0.090	0.02	(–0.04, 0.08)	0.494
	Intermediate employee	–0.07	(–0.12,–0.01)	0.018	–0.05	(–0.12, 0.01)	0.124	–0.08	(–0.14,–0.01)	0.026
	Small employers and self-employed	–0.12	(–0.23,–0.01)	0.037	–0.21	(–0.35,–0.07)	0.004	–0.08	(–0.22, 0.06)	0.258
	Lower-grade white-collar workers	–0.22	(–0.31,–0.12)	<0.001	–0.16	(–0.29,–0.04)	0.008	–0.33	(–0.45,–0.21)	<0.001
	Skilled workers	–0.14	(–0.21,–0.08)	<0.001	–0.31	(–0.39,–0.24)	<0.001	–0.26	(–0.34,–0.19)	<0.001
	Semi- or unskilled workers	–0.23	(–0.30,–0.16)	<0.001	–0.37	(–0.46,–0.28)	<0.001	–0.34	(–0.43,–0.25)	<0.001
	Main position unknown	–0.06	(–0.11,–0.01)	0.014	–0.14	(–0.20,–0.08)	<0.001	–0.07	(–0.13,–0.01)	0.021
Lack of promotion	Promotion (ref.)	–			–			–		
	No promotion	–0.06	(–0.09,–0.02)	0.002	–0.03	(–0.07, 0.01)	0.175	0.03	(–0.02, 0.07)	0.242
	Promotion with return	–0.17	(–0.25,–0.09)	<0.001	0.01	(–0.09, 0.11)	0.841	0.16	(0.06, 0.25)	0.002

Models are based on multilevel models (individuals nested in health-examination centre) and calculated separately for each career characteristic, adjusted for age, age square, partnership situation and education. Respondents who retired or had a health-related career interruption prior age 45 years are excluded from the analyses.

Table 4a. Association between career characteristics and health functioning for women: relative risks or unstandardized coefficients, confidence intervals and *p*-values

		Depressive symptoms			Standing balance			Walking speed		
		RR	CI (95%)	*p*-value	RR	CI (95%)	*p*-value	*b*	CI (95%)	*p*-value
Number of temporary jobs	No temporary job (ref.)	–			–			–		
	1 temporary job	1.04	(0.98, 1.11)	0.186	1.31	(1.16, 1.49)	<0.001	–0.06	(–0.11,–0.02)	0.008
	2+ temporary jobs	1.24	(1.10, 1.40)	<0.001	1.33	(0.92, 1.93)	0.132	–0.07	(–0.17, 0.03)	0.171
Number of job changes	No change (ref.)	–			–			–		
	1 or 2 changes	1.03	(0.96, 1.10)	0.371	1.00	(0.92, 1.08)	0.957	–0.03	(–0.07, 0.01)	0.160
	3+ changes	1.13	(1.05, 1.22)	0.002	1.16	(0.97, 1.38)	0.112	–0.01	(–0.06, 0.04)	0.721
Number of unemployment periods	No unemployment period (ref.)	–			–			–		
	1 unemployment period	1.21	(1.11, 1.31)	<0.001	1.20	(0.97, 1.47)	0.090	–0.06	(–0.11,–0.00)	0.043
	2+ unemployment periods	1.37	(1.17, 1.61)	<0.001	1.73	(1.39, 2.16)	<0.001	–0.12	(–0.22,–0.02)	0.014
Years out of work	No years out of work (ref.)	–			–			–		
	1–5 years out of work	1.06	(0.97, 1.16)	0.204	1.00	(0.86, 1.16)	0.962	–0.07	(–0.11,–0.03)	<0.001
	6+ years out of work	1.41	(1.31, 1.51)	<0.001	1.53	(1.34, 1.75)	<0.001	–0.11	(–0.15,–0.06)	<0.001
Mode occupational position	Large employers, higher managers and professionals (ref.)	–			–			–		
	Lower managers and professionals	0.94	(0.79, 1.12)	0.498	1.29	(0.95, 1.74)	0.108	0.02	(–0.05, 0.09)	0.580
	Intermediate employee	1.18	(1.05, 1.33)	0.007	1.46	(1.08, 1.98)	0.014	–0.05	(–0.13, 0.02)	0.160
	Small employers and self-employed	1.36	(1.08, 1.71)	0.008	1.66	(1.01, 2.74)	0.046	–0.10	(–0.27, 0.08)	0.272
	Lower-grade white-collar workers	1.36	(1.13, 1.62)	<0.001	2.36	(1.70, 3.28)	<0.001	–0.17	(–0.26,–0.08)	<0.001
	Skilled workers	1.14	(0.91, 1.43)	0.243	1.65	(1.08, 2.53)	0.022	–0.03	(–0.18, 0.12)	0.710
	Semi- or unskilled workers	1.45	(1.24, 1.70)	<0.001	2.85	(1.73, 4.72)	<0.001	–0.25	(–0.37,–0.14)	<0.001
	Main position unknown	1.14	(0.99, 1.31)	0.07	1.53	(1.23, 1.90)	<0.001	–0.04	(–0.11, 0.04)	0.323
Lack of promotion	Promotion (ref.)	–			–			–		
	No promotion	0.91	(0.86, 0.97)	0.002	1.12	(0.95, 1.32)	0.168	0.03	(–0.01, 0.08)	0.157
	Promotion with return	1.00	(0.86, 1.17)	0.994	1.11	(0.65, 1.89)	0.709	–0.04	(–0.16, 0.08)	0.521

Models are based on multilevel models (individuals nested in health-examination centre) and calculated separately for each career characteristic, adjusted for age, age square, partnership situation and education. Respondents who retired or had a health-related career interruption prior age 45 years are excluded from the analyses.

Table 4b. Association between career characteristics and health functioning for women: unstandardized coefficients, confidence intervals and *p*-values

		Lung function			Verbal memory			Semantic fluency		
		b	CI (95%)	*p*-value	*b*	CI (95%)	*p*-value	*b*	CI (95%)	*p*-value
Number of temporary jobs	No temporary job (ref.)	–			–			–		
	1 temporary job	–0.03	(–0.05, 0.00)	0.064	0.01	(–0.03, 0.05)	0.603	–0.04	(–0.08, 0.01)	0.120
	2+ temporary jobs	–0.03	(–0.09, 0.02)	0.252	–0.12	(–0.21,–0.04)	0.004	–0.09	(–0.19,–0.00)	0.044
Number of job changes	No change (ref.)	–			–			–		
	1 or 2 changes	0.01	(–0.01, 0.04)	0.293	0.04	(0.00, 0.08)	0.026	0.02	(–0.02, 0.05)	0.413
	3+ changes	0.01	(–0.02, 0.04)	0.461	0.04	(–0.00, 0.08)	0.070	0.03	(–0.02, 0.07)	0.247
Number of unemployment periods	No unemployment period (ref.)	–			–			–		
	1 unemployment period	–0.01	(–0.04, 0.02)	0.645	0.01	(–0.04, 0.05)	0.788	–0.02	(–0.07, 0.03)	0.404
	2+ unemployment periods	–0.08	(–0.13,–0.03)	0.002	–0.08	(–0.16, 0.00)	0.057	–0.09	(–0.18,–0.00)	0.039
Years out of work	No years out of work (ref.)	–			–			–		
	1–5 years out of work	–0.01	(–0.03, 0.02)	0.683	–0.01	(–0.05, 0.02)	0.486	–0.02	(–0.06, 0.02)	0.419
	6+ years out of work	–0.05	(–0.08,–0.03)	<0.001	–0.02	(–0.06, 0.02)	0.377	–0.08	(–0.12,–0.03)	<0.001
Mode occupational position	Large employers, higher managers and professionals (ref.)	–			–			–		
	Lower managers and professionals	–0.03	(–0.07, 0.01)	0.114	–0.09	(–0.15,–0.03)	0.002	–0.04	(–0.10, 0.02)	0.207
	Intermediate employee	–0.07	(–0.11,–0.03)	0.002	–0.22	(–0.29,–0.16)	<0.001	–0.26	(–0.33,–0.19)	<0.001
	Small employers and self-employed	–0.09	(–0.19, 0.00)	0.057	–0.22	(–0.37,–0.07)	0.004	–0.24	(–0.39,–0.08)	0.003
	Lower-grade white-collar workers	–0.15	(–0.20,–0.09)	<0.001	–0.32	(–0.40,–0.24)	<0.001	–0.34	(–0.43,–0.26)	<0.001
	Skilled workers	–0.11	(–0.20,–0.02)	0.012	–0.27	(–0.40,–0.14)	<0.001	–0.24	(–0.39,–0.10)	<0.001
	Semi- or unskilled workers	–0.08	(–0.15,–0.01)	0.027	–0.46	(–0.56,–0.35)	<0.001	–0.51	(–0.63,–0.40)	<0.001
	Main position unknown	–0.05	(–0.10,–0.01)	0.015	–0.14	(–0.20,–0.07)	<0.001	–0.17	(–0.24,–0.10)	<0.001
Lack of promotion	Promotion (ref.)	–			–			–		
	No promotion	0.01	(–0.01, 0.04)	0.289	0.00	(–0.04, 0.04)	0.939	0.01	(–0.04, 0.05)	0.776
	Promotion with return	0.00	(–0.07, 0.06)	0.933	–0.02	(–0.12, 0.08)	0.686	0.02	(–0.09, 0.13)	0.749

Models are based on multilevel models (individuals nested in health-examination centre) and calculated separately for each career characteristic, adjusted for age, age square, partnership situation and education. Respondents who retired or had a health-related career interruption prior age 45 years are excluded from the analyses.

France (the CONSTANCES study). Taken together, two main results are obvious. First, we observed a large number of associations in the expected direction, where 'cumulative disadvantage' (especially continued disadvantaged occupational position) demonstrated most consistent associations, followed by two indicators of 'discontinued employment' (number unemployment periods and years out of work). With regard to 'precarious work', the cumulative number of jobs with temporary contracts showed some, but less consistent, relationships. Second, overall associations between career characteristics and health functioning were similar for men and women, although their strength varied in some cases (i.e. stronger associations for men in cases of depressive symptoms and lung function). To our knowledge, this is one of the first studies to analyse associations of different indicators of adverse employment histories up to age 45 years with a comprehensive set of indicators of health functioning at later age among men and women.

Overall, these findings are concordant with previous research, specifically studies that investigate repeated exposure to stress at work or job insecurity in conjunction with health[9,10,37–41] and studies that linked socio-economic disadvantages across the life course to continued activation of stress-response mechanisms and functional measures of healthy ageing.[18,20] Yet, by specifying adverse characteristics of employment histories on the basis of stress-theoretical notions of work-stress models over an extended time period of the life course (between ages 25 and 45 years), this study adds to existing research. Specifically, we confirm the importance of extending the rather static concepts of stressful work that received the main attention in recent research on this topic and of studying the burden of work-related disease in a life-course perspective.[8,12] In addition, by using and comparing different measures of health functioning, we find support that potential variations of the links between career characteristics and health also depend on the outcome under study and may be restricted to mental-health outcomes (stronger for men).

Nevertheless, besides the psychobiological stress response, further potential mechanisms and explanations for the observed associations must be mentioned: e.g. it is likely that the career characteristics under study indirectly affect health through the impact they have on material circumstances at older ages (e.g. low pension level due to discontinuous working careers). Yet, in additional analyses (presented online in Supplementary Tables 2 and 3, available as Supplementary data at *IJE* online), estimates of career characteristics are generally attenuated, but remain statistically significant after including income as a potential mediator, suggesting that the reported associations can only partly be explained by income. In addition, as an alternative explanation, we also need to consider selection into adverse employment histories, where people with poor health are e.g. more likely to have episodes of unemployment. Albeit we excluded people who reported an episode of sickness between ages 25 and 45 years, this selection cannot be excluded. Finally, to substantiate our findings, future studies need to include markers that allow the investigation of psychobiological stress responses in more detail, such as inflammatory markers.[20]

Our study has several strengths, including a large study sample, high-quality standards of data collection through standardized procedures and trained study nurses, detailed data on employment histories and a comprehensive assessment of health-functioning measures that are commonly used in large-scale population-based studies.[12] Using a comprehensive assessment is also in line with the recommendation to move away from a disease-oriented definition of health to objective indicators that focus on the maintenance of physical and mental capacity and functioning among older people.[42] Despite these strengths, the study has several limitations. First, the core measures of our study—career characteristics between ages 25 and 45 years—were collected retrospectively. We thus need to consider a potential recall bias, with a tendency to reduce complexity,[43] or to report details rosier than they were, particularly in case of unfavourable events.[44,45] Compared with prospective data collection, though, our retrospective data make sure that information (referring to different time points) are comparable throughout time and they do not to produce missing data due to panel attrition. There is also increasing support that retrospective data, in particular when asking about socio-demographic conditions[46] and employment histories,[47–49] provide reliable and valid information. Second, albeit the measure of the career characteristics was guided by theoretical models of work stress, we may ask whether some of the derived measures could be elaborated on more extensively. For example, in case of lack of promotion, information on the class of origin and the lengths spent in different positions without job promotion may be of interest. Similarly, future studies could apply methods of sequence analysis to summarize and regroup employment sequences with similar patterns into types of employment histories.[13–15]

In conclusion, our findings support the notion that long-term exposure to adverse material and psychosocial employment conditions, including the experience of interruptions and discontinuities, may weaken physical, affective and cognitive health functioning later on. If confirmed by further results, these findings call for increased intervention efforts among more disadvantaged groups of the labour market in early stages of labour-market participation.

Supplementary data

Supplementary data are available at *IJE* online.

Funding

This work was supported by funding from the German research foundation [Deutsche Forschungsgemeinschaft (DFG), project numbers: SI 236/15–1 and WA 3065/4–1]. The CONSTANCES Cohort Study was supported and funded by the Caisse nationale d'assurance maladie des travailleurs salariés (CNAMTS). The CONSTANCES Cohort Study is an 'Infrastructure nationale en Biologie et Santé' and benefits from a grant from ANR (ANR-11-INBS-0002). CONSTANCES is also partly funded by MSD, AstraZeneca and Lundbeck.

Acknowledgements

The authors thank the CNAMTS and the 'Centres d'examens de santé' of the French Social Security, which are collecting a large part of the data, as well as the 'Caisse nationale d'assurance vieillesse', ClinSearch, Asqualab and Eurocell in charge of the data quality control.

Conflict of interest: None declared.

References

1. Rugulies R, Aust B, Madsen IE. Effort–reward imbalance at work and risk of depressive disorders. A systematic review and meta-analysis of prospective cohort studies. *Scand J Work Environ Health* 2017;**43**:294–306.
2. Steptoe A, Kivimaki M. Stress and cardiovascular disease. *Nat Rev Cardiol* 2012;**9**:360–70.
3. Kalleberg AL. Precarious work, insecure workers: employment relations in transition. *Am Sociol Rev* 2009;**74**:1–22.
4. Brückner H, Mayer KU. De-standardization of the life course: what it might mean? And if it means anything, whether it actually took place? *Adv Life Course Res* 2005;**9**:27–53.
5. George L. Taking time seriously: a call to action in mental. *J Health Soc Behav* 2014;**55**:251–64.
6. Kivimäki M, Jokela M, Nyberg ST *et al*. Long working hours and risk of coronary heart disease and stroke: a systematic review and meta-analysis of published and unpublished data for 603838 individuals. *Lancet* 2015;**386**:1739–46.
7. Kivimaki M, Nyberg ST, Batty GD *et al*. Job strain as a risk factor for coronary heart disease: a collaborative meta-analysis of individual participant data. *Lancet* 2012;**380**:1491–97.
8. Wahrendorf M, Chandola T, A life course perspective on work stress and health. In: Siegrist J, Wahrendorf M (eds). *Work Stress and Health in a Globalized Economy: The Model of Effort-Reward Imbalance*. Heidelberg: Springer, 2016, pp. 46–66.
9. Cuitún Coronado J, Chandola T, Steptoe A. Allostatic load and effort-reward imbalance: associations over the working-career. *Int J Environ Res Public Health* 2018;**15**:191.
10. Chandola T, Brunner E, Marmot M. Chronic stress at work and the metabolic syndrome: prospective study. *BMJ* 2006;**332**:521.
11. Elder GH, Johnson MK, Crosnoe R. The emergence and development of life course theory. In: Mortimer JT, Shanahan MJ (eds). *Handbook of the Life Course*. New York: Kluwer Academic, 2003, pp. 3–19.
12. Kuh D, Karunananthan S, Bergman H, Cooper R. A life-course approach to healthy ageing: maintaining physical capability. *Proc Nutr Soc* 2014;**73**:237–48.
13. Lacey RE, Sacker A, Kumari M *et al*. Work-family life courses and markers of stress and inflammation in mid-life: evidence from the National Child Development Study. *Int J Epidemiol* 2016;**45**:1247–59.
14. Sabbath EL, Guevara IM, Glymour MM, Berkman LF. Use of life course work-family profiles to predict mortality risk among US women. *Am J Public Health* 2015;**105**:e96–102.
15. Wahrendorf M, Blane D, Bartley M, Dragano N, Siegrist J. Working conditions in mid-life and mental health in older ages. *Adv Life Course Res* 2013;**18**:16–25.
16. Siegrist J, Wahrendorf M. *Work Stress and Health in a Globalized Economy: The Model of Effort-Reward Imbalance*. Heidelberg: Springer, 2016.
17. Karasek R, Theorell T. *Healthy Work*. New York: Basic Books, 1990.
18. Vineis P, Avendano-Pabon M, Barros H *et al*. The biology of inequalities in health: the LIFEPATH project. *Longit Life Course Stud* 2017;**8**:417–49.
19. McEwen BS. Brain on stress: how the social environment gets under the skin. *Proc Natl Acad Sci USA* 2012;**109**:17180–85.
20. Castagné R, Garès V, Karimi M *et al*. Allostatic load and subsequent all-cause mortality: which biological markers drive the relationship? Findings from a UK birth cohort. *Eur J Epidemiol* 2018;**33**:441–58.
21. Goldberg M, Carton M, Descatha A *et al*. CONSTANCES: a general prospective population-based cohort for occupational and environmental epidemiology: cohort profile. *Occup Environ Med* 2017;**74**:66–71.
22. Zins M, Goldberg M. The French CONSTANCES population-based cohort: design, inclusion and follow-up. *Eur J Epidemiol* 2015;**30**:1317–28.
23. Ruiz F, Goldberg M, Lemonnier S *et al*. High quality standards for a large-scale prospective population-based observational cohort: CONSTANCES. *BMC Public Health* 2016;**16**:877.
24. Rose D, Harrison E. The European socio-economic classification: a new social class schema for comparative European research. *Eur Soc* 2007;**9**:459–90.
25. Brousse C, Monso O, Wolff L. Is prototype ESeC relevant a classification to depict employment relations in France? *Insee, Institut national de la statistique et des études économiques: Direction des Statistiques Démographiques et Sociales, Working Paper No. F0705*, 2007.
26. Harrison E, Rose D. *The European Socio-Economic Classification (ESeC) User Guide*. Colchester: Institute for Social and Economic Research, 2006.
27. Radloff LS. The CES-D scale: a self report depression scale for research in the general population. *Appl Psychol Meas* 1977;**1**: 385–401.
28. Morin A, Moullec G, Maiano C, Layet L, Just J-L, Ninot G. Psychometric properties of the Center for Epidemiologic Studies Depression Scale (CES-D) in French clinical and nonclinical adults. *Rev Epidemiol Sante Publique* 2011;**59**:327–40.
29. Graham JE, Ostir GV, Kuo Y-F, Fisher SR, Ottenbacher KJ. Relationship between test methodology and mean velocity in timed walk tests: a review. *Arch Phys Med Rehabil* 2008;**89**: 865–72.
30. Lin MR, Hwang HF, Hu MH, Wu HDI, Wang YW, Huang FC. Psychometric comparisons of the timed up and go, one-leg stand,

functional reach, and Tinetti balance measures in community-dwelling older people. *J Am Geriatr Soc* 2004;**52**:1343–48.
31. Miller MR, Hankinson J, Brusasco V *et al*. Standardisation of spirometry. *Eur Respir J* 2005;**26**:319–38.
32. Grober E, Merling A, Heimlich T, Lipton RB. Free and cued selective reminding and selective reminding in the elderly. *J Clin Exp Neuropsychol* 1997;**19**:643–54.
33. Grober E, Sanders AE, Hall C, Lipton RB. Free and cued selective reminding identifies very mild dementia in primary care. *Alzheimer Dis Assoc Disord* 2010;**24**:1–90.
34. Borkowski JG, Benton AL, Spreen O. Word fluency and brain damage. *Neuropsychologia* 1967;**5**:135–40.
35. Zou G. A modified Poisson regression approach to prospective studies with binary data. *Am J Epidemiol* 2004;**159**:702–06.
36. Rabe-Hesketh S, Skrondal A. *Multilevel and Longitudinal Modeling Using Stata*. College Station, TX: Stata Press, 2005.
37. Gilbert-Ouimet M, Brisson C, Vezina M, Milot A, Blanchette C. Repeated exposure to effort-reward imbalance, increased blood pressure, and hypertension incidence among white-collar workers: effort-reward imbalance and blood pressure. *J Psychosom Res* 2012;**72**:26–32.
38. Trudel X, Brisson C, Milot A, Masse B, Vézina M. Adverse psychosocial work factors, blood pressure and hypertension incidence: repeated exposure in a 5-year prospective cohort study. *J Epidemiol Community Health* 2016;**70**: 402–08.
39. Bentley RJ, Kavanagh A, Krnjacki L, LaMontagne AD. A longitudinal analysis of changes in job control and mental health. *Am J Epidemiol* 2015;**182**:328–34.
40. Bartley M. Job insecurity and its effect on health. *J Epidemiol Community Health* 2005;**59**:718–19.
41. Kim TJ, von Dem Knesebeck O. Is an insecure job better for health than having no job at all? A systematic review of studies investigating the health-related risks of both job insecurity and unemployment. *BMC Public Health* 2015;**15**:985.
42. World Health Organization. *World Report on Disability*. Geneva: WHO Press, 2011.
43. Rubin DC, Baddeley AD. Telescoping is not time compression—a model of the dating of autobiographical events. *Mem Cognit* 1989;**17**:653–61.
44. Krinsley KE, Gallagher JG, Weathers FW, Kutter CJ, Kaloupek DG. Consistency of retrospective reporting about exposure to traumatic events. *J Trauma Stress* 2003;**16**:399–409.
45. Manzoni A, Vermunt JK, Luijkx R, Muffels R. Memory bias in retrospectively collected employment careers: a model-based approach to correct for measurement error. *Sociol Methodol* 2010;**40**:39–73.
46. Berney LR, Blane DB. Collecting retrospective data: accuracy of recall after 50 years judged against historical records. *Soc Sci Med* 1997;**45**:1519–25.
47. Baumgarten M, Siemiatycki J, Gibbs GW. Validity of work histories obtained by interview for epidemiologic purposes. *Am J Epidemiol* 1983;**118**:583–91.
48. Bourbonnais R, Meyer F, Theriault G. Validity of self reported work history. *Br J Ind Med* 1988;**45**:29–32.
49. Wahrendorf M, Marr A, Antoni M *et al*. Agreement of self-reported and administrative data on employment histories in a German Cohort Study: a sequence analysis. *Eur J Popul* 2018; doi: 10.1007/s10680-018-9476-2.

2. **Wahrendorf M.**, Marr A., Antoni M., Pesch B., Jöckel K.-H., Lunau T., Moebus S., Arendt M., Brüning T., Behrens T., & Dragano N. (2018). "Agreement of self-reported and administrative data on employment histories in a German cohort study: a sequence analysis." *European Journal of Population*: online first.

   Impact-Faktor: 1.28

Eur J Population
https://doi.org/10.1007/s10680-018-9476-2

Agreement of Self-Reported and Administrative Data on Employment Histories in a German Cohort Study: A Sequence Analysis

Morten Wahrendorf[1] · Anja Marr[2] · Manfred Antoni[3] · Beate Pesch[4] · Karl-Heinz Jöckel[2] · Thorsten Lunau[1] · Susanne Moebus[2] · Marina Arendt[2] · Thomas Brüning[4] · Thomas Behrens[4] · Nico Dragano[1]

Received: 24 January 2017 / Accepted: 23 February 2018

Abstract Collecting life course data is increasingly common in social and epidemiological research, either through record linkage of administrative data or by collecting retrospective interview data. This paper uses data on employment histories collected through both strategies, compares the attained samples, and investigates levels of agreements of individual histories. We use data from the German Heinz Nixdorf Recall Study with information on employment histories collected retrospectively from 2011 until 2014 ($N = 3059$). Administrative data from the German Institute for Employment Research (IAB) were linked to the survey data. After comparing respondents who provide self-reported histories with the subsample of the ones for which administrative data were available, we investigate the agreement of individual employment histories from the two sources (between 1975 and 2010) using sequence analyses. Almost all participants provided survey data on employment histories (97% of the sample), linkage consent was given by 93%, and administrative data were available for 63% of the participants. People with survey data were more likely to be female, to have a higher education, and to work self-employed and in the tertiary sector. The agreement of individual employment

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10680-018-9476-2) contains supplementary material, which is available to authorized users.

✉ Morten Wahrendorf
wahrendorf@uni-duesseldorf.de

[1] Centre for Health and Society, Institute for Medical Sociology, Faculty of Medicine, University of Düsseldorf, Universitätsstrasse 1, 40225 Düsseldorf, Germany

[2] Institute for Medical Informatics, Biometry, and Epidemiology, Faculty of Medicine, University Duisburg-Essen, Essen, Germany

[3] Institute for Employment Research (IAB), Nuremberg, Germany

[4] Institute for Prevention and Occupational Medicine of the German Social Accident Insurance (IPA), Institute of the Ruhr University Bochum, Bochum, Germany

Published online: 21 March 2018

histories is high and similar across time, with a median level of agreement of 89%. Slightly lower values exist for women and people working in the tertiary sector, both having more complex histories. No differences exist for health-related factors. In conclusion, it is likely that missing consent and failed record linkage lead to sample differences; yet, both strategies provide comparable and reliable life course data.

Keywords Comparison · Survey data · Administrative data · Employment histories · Sequence analysis

1 Introduction

There is increasing interest in understanding the impact of life course conditions on later outcomes, for example of work and employment on health in older ages (Kuh et al. 2003; Dannefer 2003; Vanhoutte and Nazroo 2015; Blane et al. 2016). The interest, hereby, is not only to know whether a person once worked in a job under specific conditions during their working life, but also to collect data on complete employment histories. Yet, data to answer these questions are rare and require detailed information. An attempt to overcome this limitation in existing studies is to collect information retrospectively, with generally two approaches: first, by linking administrative data on employment histories to existing survey data (data linkage), or second, by asking respondents to recall their employment histories. Extensive literature describes the advantages and disadvantages of both strategies (Belli et al. 2007; Manzoni et al. 2010; Korbmacher and Schroeder 2013; Herzog et al. 2007; Giele and Elder 1998; Antoni and Seth 2012). Survey data rely on the ability and willingness to recall previous employment histories, with a tendency to simplify and reduce complexity (Rubin and Baddeley 1989; Sudman et al. 1996; Solga 2001). Administrative data, in turn, usually require respondent's consent (consent that is usually not given by all respondents), and additionally, the data are not always available for each respondent of the study, such that linkage is possible for part of the sample only (Jenkins et al. 2006; Korbmacher and Schroeder 2013; Sakshaug and Antoni 2017). Yet, while previous studies have used either of these two approaches, hardly any studies provide both types of data. As such, direct comparisons of recalled data with administrative records are still limited. These comparisons help to illustrate the differences, advantages and disadvantages of both strategies. Such knowledge is instrumental because it is relevant for studies aiming at collecting life history data.

Using data from a German cohort study (Heinz Nixdorf Recall Study), with data on recalled and administrative employment histories (in terms of annual information on employment circumstances between 1975 and 2010 (36 time points)), we have three objectives: First, we contrast respondents who provide survey data on recalled histories and those for whom administrative data are available, in terms of socio-demographic, health and work-related characteristics. Thus, we ask if collecting data via record linkage or via survey data leads to selective samples. Because of

required consent, and because employment information is only available for episodes as a salaried employee in the administrative data we expect a smaller sample, dominated by people who worked as salaried employees in the case of administrative data. As a second aim, we compare entire histories for those who provide information from both sources and investigate how similar these histories are. In addition to conventional methods (e.g., testing overlaps for each year between 1975 and 2010 separately), this is done on the basis of sequences analysis (Studer and Ritschard 2016; Aisenbrey and Fasang 2010). In doing so, we do not investigate if singular reported jobs match between the two sources, but rather contrast entire employment histories from the two sources and, as a third aim, investigate if levels of agreement depend on socio-demographic, health and work-related variables (including job sectors). Here, we may assume that agreements are generally higher for men or job sectors for which employment histories are less complex. Our study adds to the literature by providing evidence on possible sample selectivity, and more importantly, by investigating agreements of recalled and administrative employment histories.

2 Methods

2.1 Sample

We use data from the Heinz Nixdorf Recall (Risk Factors, Evaluation of Coronary Calcium and Lifestyle) study (HNR study), a prospective cohort study conducted in three cities of the German Ruhr area (Schmermund et al. 2002). The HNR study was originally designed to investigate and evaluate established and new predictors of coronary heart diseases, including social and occupational risk factors. The baseline sample of men and women aged 45 to 75 years is drawn via probability simple random selection (stratified by cities) based upon mandatory local registries. Data are collected at the Examination Centre located at the University Clinic in Essen, using self-administrated questionnaires, computer-assisted personal interviews (CAPI) and clinical examinations. The collection meets high-quality standards, including trained interviewers and standardized procedures. Baseline data collection was 2000–2003, with two subsequent waves (follow-ups) in 2006–08 (wave 2) and 2011–2014 (wave 3). At the onset of the study, the response rate was 56%, with a total sample size of 4818 respondents (Stang et al. 2005). The attrition rate between baseline and the second wave is 10%, and data from wave 3 are available for 3059 respondents. In contrast to wave one and two, the interview of wave 3 also includes a retrospective questionnaire collecting data on previous employment histories. The interview also collects all necessary information and consent for linkage of administrative data. This serves the aim to collect life history data, and to develop and explore different strategies of gaining retrospective information in the frame of epidemiological surveys. Approval for the study was obtained from the ethical commission of the Medical Faculty at the University of Duisburg-Essen. More details of the study can be found in other literature (Schmermund et al. 2002).

2.2 Self-Reported Employment Histories

The third wave collects information on previous employment histories based on CAPI. In preparation for the interview, respondents were asked to make brief notes on each job of their working lives (lasting 6 month or longer). This served as reminder to collect the following details in the interview: the year when a job started and ended, working hours, job sector, working contract (permanent vs. fixed-term employment), the employment status (self-employed or salaried employment), and an open question about the job title with a brief description of the job task (as a basis to recode and classify jobs). As a result, we can derive individual employment sequences with annual information on the individual employment situation for each year of age between the age they were when they started their first job and the time of data collection (often more than 50 years). Among those who were interviewed in wave 3 (3059 respondents) 97% provided self-reported data on employment histories (2983 respondents).

2.3 Administrative Employment Histories

The administrative data of the Institute for Employment Research ("IAB") are based on employment records from the German Federal Employment Agency ("Bundesagentur für Arbeit") (Antoni et al. 2016). Each person who has at least one job episode as salaried employee (involving social security contributions) is part of these records. Records rely on the mandatory German notification scheme (so-called DEÜV-notification procedure as established in the year 1973), obliging each employer since 1975 to give information on their employees at least once a year (as a basis to calculate pension and unemployment entitlements). The yearly recorded information contains, among others, the precise date when a job started and ended, a title of the occupation (based on a national classification scheme), information on working hours (part-time vs. full-time job), and whether the work is part of vocational training. People who never worked as a salaried employee, or those who were always self-employed or worked as a civil servant, do not appear in the records. Also, even if someone appears in the data, but once worked self-employed or as a civil servant, this latter job episode is not recorded.

To enable record linkage, the HNR study applied strict rules of data protection: Respondents were first informed about the planned linkage and asked for written consent in the interview as well as additional information necessary for record linkage (Social Security number (SSN), name, date of birth and last employer). The forms with linkage identifiers were stored securely at the study center and delivered to the IAB on a regular basis, where staff members entered this information into a database. Then IAB staff derived administrative data in an iterative procedure: If a valid SSN was available, the respondent's administrative record could be drawn directly. In the case that respondents did not provide a valid SSN, the linkage was based on alternative procedures, for example, according to birth date or name or both (see Sakshaug et al. (2017) for an exemplary record linkage application with IAB data). Thereafter, the extracted and de-identified data on employment histories were delivered back to the study center in Essen, where it was merged with the self-

reported data. Procedures were approved by the review boards of the German Ministry of Labour and Social Affairs. Data are available from 1975 to 2010 (36 years), and we can again derive individual employment sequences. Among those who were interviewed in wave 3 (3059 respondents), administrative data are available for 63% (1927 respondents). This is due to missing consent (valid consent was available for 2836 respondents (93%) out of 3059 respondents) and also due to failed record linkage (linkage was possible for 2202 (78%) out of 2836 respondents with consent). This is below other linkage rates of the IAB (Sakshaug et al. 2017) and may have different reasons: In addition to insufficient information for linkage (e.g., invalid SSN), it is also possible that respondents (with consent and sufficient information) still had no records in the IAB employment data. Also, even if linkage was possible, it is not guaranteed that administrative data on employment histories were available for the observation period. For example, if people were self-employed or worked as civil servants between 1975 and 2010, or ended their last job as a salaried worker before 1975, data on employment histories were not available. These groups still show up in the administrative records if they once held a job that was subject to social security contributions, but had no data that could be matched to survey data. Because of a rather old sample in our study (55 or older), the proportion of the latter groups may be comparatively high. In sum, this leads to 1927 people with available information on administrative employment histories.

2.4 Measures

Employment histories: an important step is to create harmonized measures on employment sequences in the two sources. This involves state definitions (i.e. employment situations) and equal sequence lengths. Concerning sequence length, sequences between 1975 and 2010 are available in both sources on a yearly basis. With regard to states, both sources allow us to distinguish three employment situations: (1) full-time employed "*E*", (2) part-time employed "*e*" and (3) not employed "*n*". The two first states are used for an episode as a salaried employee. For the survey data, full time is assumed if respondents reported that their employment was "full-time (35 h or more)", and part-time work was assumed otherwise. Following the notification scheme for the administrative data, full-time work is recorded if the contracted hour corresponds to the standard working hours, while part-time work consists of large part-time (18 h or more) and small part-time (less than 18 h) (Antoni et al. 2016). Not employed accounts for any existing gaps between job episodes, including domestic work, unemployment or retirement, but also episodes as a self-employed worker or civil servant. For these aspects, information from both sources is not sufficiently comparable, in particular because periods are only recorded in the administrative data if social benefits are involved (e.g., unemployment benefits).

Additional variables: in addition to sex and age, we include education, two work-related factors (main employment status and main job sector during working life) and two measurements of current health (depressive symptoms and physical inactivity), all taken from survey data.

We distinguish three levels of education according to the International Standard Classification of Educational Degrees (ISCED-97): 'low' (pre-primary, primary or lower secondary education), 'medium' (secondary or post-secondary education), and 'high' (first and second stage of tertiary education). Age (at wave three) is grouped into "55 to 64", "65 to 74" and "75 years or older". The two work-related factors refer to the longest job during working life in the survey data (because it is available for the whole sample, irrespective of availability of administrative data). With regard to employment status, "self-employed", and salaried "employees" are distinguished. The six following categories describe the job sector: "Public service", "Industry/Mining", "Craft and trade", "Sale", "Other services", and "Other sectors". To measure depressive symptoms, we use a binary indicator of increased depressive symptoms, based on the German 15 four-point Likert scaled item version of the Centre for Epidemiological Studies Depression (CES-D) Scale. Increased symptoms are defined as scoring 18 or higher on the sum score (Hautzinger and Bailer 1993), and—in case information is missing in wave 3—we imputed information from prior waves (7% of the cases). Physical inactivity was assessed by a question on whether the respondent reported no involvement in any physical activity within the last 4 weeks.

2.5 Statistical Analysis

We first describe socio-demographic and health-related characteristics of the total sample, and for the parts without and with linked administrative data (all characteristics coming from the survey data). Then, we present trajectory indicators of the employment histories in the two sources (each coming from the respective data source). This includes the average years spent in each state, number of spells and an indicator to describe the general complexity within histories: the "turbulence" (Elzinga and Liefbroer 2007). Higher values refer to more complex histories, and "1" being the least complex history (single state throughout whole observation period). Furthermore, we created "chronograms" for histories from the survey data and from the administrative data, displaying the proportion of each employment situation by year.

We then compare agreements of employment histories and therefore restrict analyses to those with information from both sources (n = 1927). At first, we compare the annual level of agreement. Specifically, we compute Cohen's kappa for each year individually, separately for the three states. This allows us to study if agreements vary across time, and whether agreements are more likely for specific states. Cohen's kappa is commonly used to test agreement for nominal scales (Cohen 1960). In contrast to simple percent agreement (measuring the proportion of agreement), Cohen's kappa also accounts for the possibility that an agreement is simply down to chance. Kappa usually ranges between 0 and 1. Values between 0.41 and 0.60 are considered a moderate agreement, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement. Second, we apply sequence analyses and conduct pairwise comparisons of entire individual employment sequences (Abbott 1995; Aisenbrey and Fasang 2010; Studer and Ritschard 2016). The same approach was adopted in previous studies comparing information on prospectively collected

survey data and administrative data (Huber and Schmucker 2009; Manzoni et al. 2010). In contrast to annual Cohen's kappa, this compares entire sequences from 1975 till 2010 (36 years) and is not restricted to annual comparisons. We calculate two alternative distance measures. The first measure simply counts the number of necessary substitutions to make one sequence equal to the other, often referred to as "naïve distance" or "traditional hamming distance" (with substitution costs = 1). As a result, the calculated distance is equal to the number of years where employment situations are different. As an alternative, we apply optimal matching (OM). This is the most common approach within sequence analyses and has an important feature for our analyses (see Halpin (2012) or Studer and Ritschard (2016) for an overview of distance measures). In contrast to the naïve distance, OM can recognize similarities between two sequences that are only shifted by some years, because it also allows for alignments ("insertion" and "deletion") when comparing the two sequences (with "indel costs" set to 0.5 in our case[1]). This distance may be more appropriate for our analyses, because some participants may just report the timing of specific episodes incorrectly (but recall the order of their employment histories correctly). In Sect. 3, we show the mean, standard deviation, median and interquartile range by covariates, and a histogram of both measures is presented in Appendix. Finally, we estimate linear regression models (ordinary lease square (OLS) regressions) with each distance as a dependent variable and present estimates of two types of regression models. In model 1, all covariates (socio-demographic, health and work-related factors) are included simultaneously, and model 2 additionally includes the trajectory indicators (based on the administrative histories).[2] By comparing both models, we can explore the degree to which the association between covariates and distances is due to characteristics of the histories. For ease of interpretation, we use non-transformed distances and present unstandardized estimates. Estimates for transformed distances (square root), though, can be found in Appendix (Supplemental Table 1), and we replicated findings based on Poisson or Tobit regression models (with 0 as lower and 36 as upper limit). Calculations and graphs are based on the SADI package in Stata (Halpin 2014), and the TraMineR package in R is used for calculating distances (Gabadinho et al. 2011; Studer and Ritschard 2016).

3 Results

In Table 1, we see that the subsample of people with linked administrative data (right column) is more likely to be male, are slightly younger, and have lower levels of education than the total sample of those with survey data (left column). Those who provide survey data are more likely to be self-employed and tended to work in the public service sector, while people with administrative data rather worked in the primary sector (particularly industry and mining). These latter findings are notably

[1] This corresponds to the default setting, where indel costs are half as large as substitution costs. As a test of robustness, we conducted supplementary analyses with different values.

[2] Due to multicollinearity we did not include the indicator of turbulence.

Table 1 Comparison of total sample and parts with and without linked administrative data: observations (No.) and frequencies in percentage (Col. %), or mean and standard deviation (SD)

Variables	Total (n = 2983)		Without linked adm. data (n = 1056)		With linked adm. data (n = 1927)	
	No.	Col. %	No.	Col. %	No.	Col. %
Sex						
Male	1472	49.3	443	41.9	1029	53.4
Female	1511	50.7	613	58.1	898	46.6
Total	2983	100.0	1056	100.0	1927	100.0
Age						
55–64 years	1023	34.3	292	27.6	731	37.9
65–74 years	1246	41.8	424	40.2	822	42.7
75 years or older	714	23.9	340	32.2	374	19.4
Total	2983	100.0	1056	100.0	1927	100.0
Education						
Low	1671	56.1	521	49.5	1150	59.7
Medium	586	19.7	190	18.0	396	20.6
High	722	24.2	342	32.5	380	19.7
Total	2979	100.0	1053	100.0	1926	100.0
Employment status[a]						
Self-employed	247	8.4	126	12.3	121	6.4
Employee	2682	91.6	900	87.7	1782	93.6
Total	2929	100.0	1026	100.0	1903	100.0
Job sector[a]						
Industry/mining	676	23.1	146	14.3	530	27.9
Public service	748	25.6	364	35.5	384	20.2
Craft and trade	300	10.2	95	9.3	205	10.8
Sale	560	19.1	194	18.9	366	19.2
Other services	420	14.3	131	12.8	289	15.2
Other sectors	223	7.6	94	9.2	129	6.8
Total	2927	100.0	1024	100.0	1903	100.0
Physical inactivity						
Yes	1154	38.7	416	39.4	738	38.3
No	1829	61.3	640	60.6	1189	61.7
Total	2983	100.0	1056	100.0	1927	100.0
Depressive symptoms						
Yes	198	6.6	51	4.8	147	7.6
No	2785	93.4	1005	95.2	1780	92.4
Total	2983	100.0	1056	100.0	1927	100.0

[a]According to longest job in survey data

obvious if we contrast people with linked administrative data to those who provided survey data only (middle column). This is to be expected (because those who were continuously self-employed or civil servants are not part of the administrative data). Health-related factors are similar for the different groups, both in terms of depressive symptoms and physical inactivity.

Table 2 compares some summary measures of the employment histories for the two sources. We see that the average years spent in full-time employment is comparatively lower in the employment histories from the survey data, particularly for those who provided survey data only (14 years). Furthermore, average years spent in non-employment are higher in the survey data. In addition, the average number of changes between different employment situations (number of spells) and the turbulence are higher in histories from the administrative data than in the survey data. Persons perhaps reduce the complexity of recalled biographies in the self-reported histories case.

Figure 1 shows the percentage of each occupational situation for each year of observation for the two sources. The observed patterns are very similar: Rates of full-time employment are above 50% between 1975 and 1995 and decrease thereafter. In the administrative data there is a small sudden increase in part-time employment in 1999. This is due to a change in the notification procedure in 1999, when marginal employments (jobs with very low wages) started being counted as part-time jobs as well (before not counted as job at all).

Figure 2 limits the analyses to respondents with data from the two sources (1927 respondents) and investigates levels of agreement in terms of kappa values. Because these are calculated for each year separately, they allow us to study if agreements vary across time. Two findings must be mentioned: First, agreements are only slightly higher in more recent years. Second, levels of agreement are substantial for full-time employment and non-employment (mean kappa of 0.68 in the case of full-time employment and 0.65 for non-employment), but are rather moderate for part-time work (mean kappa 0.45). Perhaps people report more hours within survey data—even if contracted hours are part time.

Table 3 presents the calculated distances between the individual histories (see Sect. 2 for details) according to covariates under study (Table 1). A histogram of both measures can be found in Appendix (Supplemental Fig. 1). Both distances range from 0 to 36, with most people having a score of four or lower. Hence, most people have 4 or less years (out of 36 years) that are different in the two sources. An additional finding is that—although OM distances allow for alignment when comparing the sequences—values for the naïve distances and OM distances turn out to be very similar. This indicates that the timing of episodes matches well in the two sources. When comparing the distances by covariates, we see smaller distances for men, older age groups, those with lower education, and among people without increased depressive symptoms. Furthermore, distances are lower if people were employees in their main occupation or if they worked in the industry or mining sector. These latter findings are additionally investigated in multivariable analyses, where all covariates are included simultaneously to predict distances, and where model 2 explores if these findings are due to trajectory indicators. Results are presented in Table 4.

Table 2 Summary measures of employment histories from survey data and from administrative data

Variables	Survey data (n = 2983)		Adm. data (n = 1927)	
	Mean	(SD)	Mean	(SD)
Duration (years) in…				
Not employed	14.90	(12.23)	14.19	(9.99)
Part-time employed	3.80	(8.20)	4.04	(6.45)
Full-time employed	17.30	(13.41)	17.77	(11.48)
Number of spells	2.22	(1.18)	3.80	(2.18)
Turbulence	4.01	(2.53)	5.65	(2.42)

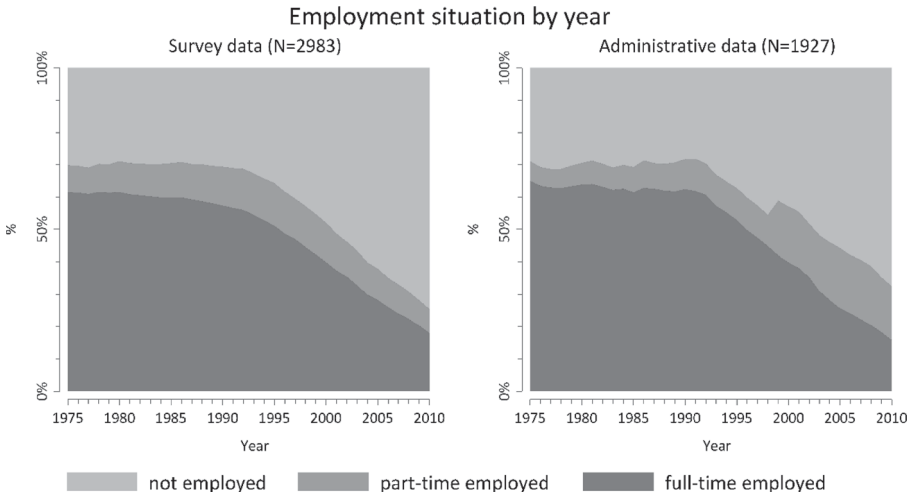


Fig. 1 Employment situation by year (chronogram) for survey and administrative data

In sum, findings are similar to those above, but reveal three important insights: Firstly, once all covariates are considered in model 1, there are no associations for age. Probably, this is due to confounding effects, because particular sectors may be more likely for younger people. Secondly, model 1 again reveals that distances are most pronounced for women and people that mainly work in the craft and trade sector, and for those in other services and sectors not classified (other sectors). The third observation worth noting is that the regression coefficients are generally attenuated, once we include the trajectory indicators in model 2, and that they become nonsignificant in case of women. This result indicates that higher distances for women are largely due to longer time spent in non-employment or part-time employment, and to a higher number of spells—all factors that are related to higher distances. Findings remained unchanged using transformed distances (square root), as presented in Appendix (Supplemental Table 1).

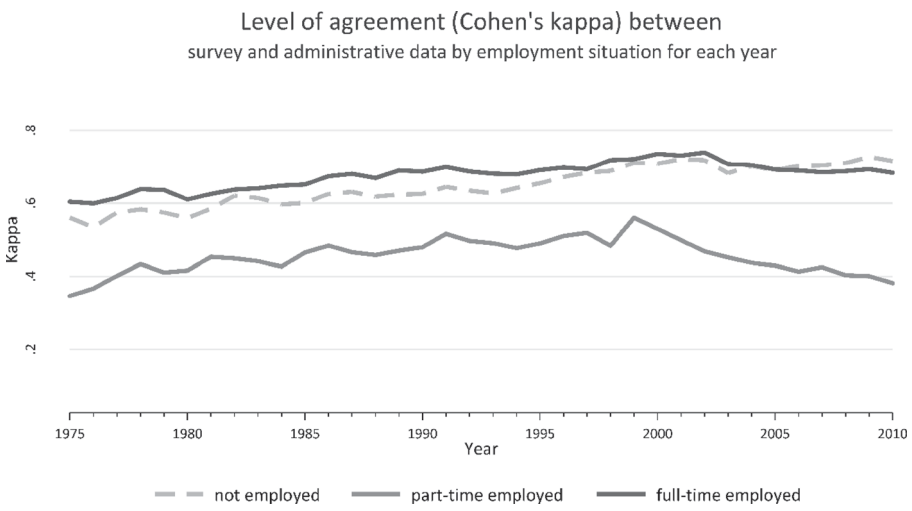


Fig. 2 Annual levels of agreement between survey and administrative data by employment situation: Cohen's kappa

4 Discussion

This paper compares two strategies to gain information on previous employment histories in the German HNR cohort study, either retrospectively in the frame of an interview (survey data), or via record linkage of administrative data from the German Institute for Employment Research (IAB). In the analysis, we first compare respondents with self-reported survey data and with administrative data. Then, we investigate the agreement of self-reported survey data and administrative data (covering 36 years of working life), and finally, we test if the agreement depends on socio-demographic, health and work-related factors. In accordance to these three objectives, the main findings are as follows:

We find important sample differences, both in terms of sample sizes and sample compositions. Almost all participants of the cohort study gave retrospective information on employment histories (97%). Administrative data, in contrast, were available for a smaller number of respondents (63%). The lower number of people with administrative data exists because not every respondent gave consent for record linkage and because linkage was not possible for some respondents, for example due to invalid SSN or because data were not available in the administrative data—even if consent was given (e.g., for self-employed). This finding is in line with previous studies (Korbmacher and Schroeder 2013), and it underlines the importance of interviewer training to foster the respondents' trust in confidentiality when asking for consent. In addition, it shows that linkage of administrative data is complex and includes various stages at which selection can occur (even if consent is given). It must be noted, though, that selections due to missing consent and unsuccessful linkage only occur if administrative data have to be linked with survey data. As such, administrative data may be easier to work with if there is no need to

Table 3 Differences between self-reported and administrative employment histories by covariates: mean, standard deviation (SD), median and interquartile range (n = 1927)

Variables	Naïve distance				OM distance			
	Mean	(SD)	Median	IQR	Mean	(SD)	Median	IQR
Sex								
Male	5.3	(7.0)	2.0	6.0	4.9	(6.6)	2.0	6.0
Female	9.6	(8.6)	7.0	13.0	8.9	(8.2)	6.0	13.0
Age								
55–64 years	7.7	(8.4)	4.0	9.0	7.1	(8.0)	4.0	9.0
65–74 years	7.5	(8.0)	5.0	10.0	7.0	(7.6)	4.0	10.0
75 years or older	6.2	(7.7)	2.0	9.0	5.7	(7.0)	2.0	9.0
Education								
Low	7.2	(8.0)	4.0	10.0	6.6	(7.4)	3.5	10.0
Medium	7.4	(8.3)	4.0	10.0	7.0	(8.0)	4.0	10.0
High	7.5	(8.3)	5.0	9.5	7.1	(8.0)	4.0	9.5
Employment status								
Self-employed	8.0	(7.9)	5.0	9.0	7.5	(7.7)	5.0	9.0
Employee	7.2	(8.0)	4.0	10.0	6.6	(7.6)	4.0	10.0
Job sector[a]								
Industry/mining	4.7	(5.9)	2.0	5.0	4.3	(5.5)	2.0	5.0
Public service	7.7	(8.9)	4.0	10.0	7.2	(8.5)	4.0	10.0
Craft and trade	7.8	(8.7)	4.0	11.0	7.1	(7.9)	4.0	11.0
Sale	8.2	(7.6)	6.0	11.0	7.5	(7.2)	5.0	11.0
Other services	8.8	(9.0)	6.0	12.0	8.2	(8.6)	5.0	12.0
Other sectors	9.1	(8.4)	7.0	12.0	8.6	(8.1)	6.0	12.0
Physical inactivity								
Yes	7.2	(8.0)	4.0	10.0	6.6	(7.5)	4.0	10.0
No	7.4	(8.2)	4.0	10.0	6.9	(7.7)	4.0	10.0
Depressive symptoms								
Yes	9.1	(8.6)	6.0	12.0	8.3	(8.1)	6.0	12.0
No	7.2	(8.1)	4.0	9.0	6.7	(7.6)	4.0	9.0
Total	7.3	(8.1)	4.0	10.0	6.8	(7.7)	4.0	10.0

[a]According to longest job in survey data

link it with survey data. The high number of people providing survey data shows that retrospective data collections in interviews are a practical way to gather life history data. This corresponds to findings reporting positive experiences of interviewers and that respondents usually like retrospective interviews (Belli et al. 2007; Schröder 2011). Hence, our study suggests that an imperfect linkage of survey data with administrative data on employment histories can lead to smaller samples. At this point, we must also note that self-reported data on employment histories are available for a longer time frame in our study (for each single job of the

Table 4 Results of multivariate analyses predicting naïve and optimal matching (OM) distances: unstandardized regression coefficients (*b*) with levels of significance, standard errors (SE) and confidence intervals (CI 95%) (n = 1902)

Variables	Naïve distance						OM distance					
	Model 1			Model 2			Model 1			Model 2		
	b	(SE)	CI 95%	*b*	(SE)	CI 95%	*b*	(SE)	CI 95%	*b*	(SE)	CI 95%
Sex												
Male (ref.)	–						–			–		
Female	3.91***	(0.40)	[3.13,4.68]	0.69	(0.44)	[− 0.16,1.55]	3.58***	(0.37)	[2.85,4.31]	0.75	(0.42)	[− 0.07,1.57]
Age												
55–64 years (ref.)	–						–			–		
65–74 years	0.15	(0.40)	[− 0.63,0.93]	− 0.27	(0.38)	[− 1.02,0.47]	0.17	(0.38)	[− 0.56,0.91]	− 0.26	(0.36)	[− 0.97,0.45]
75 years or older	− 0.62	(0.50)	[− 1.60,0.37]	− 1.45**	(0.50)	[− 2.44,− 0.46]	− 0.64	(0.47)	[− 1.57,0.28]	− 1.53**	(0.48)	[− 2.47,− 0.58]
Education												
Low (ref.)	–						–			–		
Medium	− 0.12	(0.46)	[− 1.02,0.78]	0.44	(0.43)	[− 0.41,1.28]	0.09	(0.43)	[− 0.76,0.95]	0.58	(0.41)	[− 0.23,1.38]
High	1.01*	(0.48)	[0.06,1.96]	0.58	(0.46)	[− 0.32,1.47]	1.06*	(0.46)	[0.16,1.96]	0.69	(0.44)	[− 0.17,1.55]
Employment status												
Self-employed	0.05	(0.76)	[− 1.43,1.53]	− 1.66*	(0.73)	[− 3.09,− 0.23]	0.09	(0.71)	[− 1.30,1.50]	− 1.51*	(0.70)	[− 2.88,− 0.14]
Employee (ref.)	–						–					
Job sector[a]												
Industry/mining (ref.)	–			–			–			–		
Public service	1.44**	(0.54)	[0.38,2.49]	0.97	(0.51)	[− 0.03,1.96]	1.41**	(0.51)	[0.41,2.41]	1.02*	(0.48)	[0.07,1.97]
Craft and trade	2.91***	(0.65)	[1.64,4.18]	2.18***	(0.61)	[1.00,3.37]	2.60***	(0.61)	[1.40,3.80]	1.98***	(0.58)	[0.84,3.11]
Sale	1.61**	(0.56)	[0.52,2.71]	0.90	(0.52)	[− 0.13,1.92]	1.47**	(0.53)	[0.43,2.51]	0.85	(0.50)	[− 0.14,1.83]

Table 4 continued

Variables	Naïve distance						OM distance					
	Model 1			Model 2			Model 1			Model 2		
	b	(SE)	CI 95%	*b*	(SE)	CI 95%	*b*	(SE)	CI 95%	*b*	(SE)	CI 95%
Other services	2.61***	(0.59)	[1.44,3.78]	1.97***	(0.56)	[0.88,3.06]	2.43***	(0.56)	[1.33,3.54]	1.90***	(0.53)	[0.85,2.94]
Other sectors	2.69***	(0.78)	[1.16,4.22]	2.02**	(0.73)	[0.59,3.45]	2.69***	(0.74)	[1.24,4.14]	2.08**	(0.70)	[0.71,3.45]
Physical inactivity												
Yes	0.04	(0.37)	[− 0.68,0.76]	− 0.16	(0.34)	[− 0.84,0.51]	− 0.01	(0.35)	[− 0.69,0.67]	− 0.19	(0.33)	[− 0.84,0.45]
No (ref.)	–			–			–			–		
Depressive symptoms												
Yes	0.97	(0.67)	[− 0.35,2.29]	0.68	(0.63)	[− 0.55,1.92]	0.79	(0.64)	[− 0.45,2.04]	0.55	(0.60)	[− 0.63,1.73]
No (ref.)	–			–			–			–		
Duration (years) in…[b]												
Not employed				0.18***	(0.02)	[0.14,0.22]				0.17***	(0.02)	[0.14,0.21]
Part-time employed				0.19***	(0.03)	[0.13,0.25]				0.17***	(0.03)	[0.11,0.22]
Full-time employed (ref.)				–						–		
Number of spells[b]				0.95***	(0.08)	[0.79,1.11]				0.77***	(0.08)	[0.62,0.92]
Constant	3.70***	(0.50)	[2.73,4.67]	− 0.79	(0.54)	[− 1.85,0.27]	3.40***	(0.47)	[2.48,4.31]	− 0.42	(0.52)	[− 1.43,0.60]
R^2	0.09			0.21			0.09			0.19		
N	1902			1902			1902			1902		

[a]According to longest job in survey data, [b]based on administrative histories; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

career, including when self-employed), while information from administrative data is available for employees and from 1975 onwards only (for East Germany since 1991).

Concerning sequence differences between both sources, two main findings exist: The first is that self-reported employment histories are less complex than in the administrative records, with a smaller number of spells and less years spent in full-time employment. This could be due to individual response styles, in particular the tendency to simplify sequences and to underreport periods of unemployment in interviews (Manzoni et al. 2010), but also due to higher levels of precision in the administrative data. The second main finding is that levels of agreement are generally high, and that this is true across the entire period covered (between 1975 and 2010). Possibly, people recall periods of employment with high accuracy, even job episodes that are long ago (at least on a yearly basis). Most people have only 4 or less years (out of 36 years) that are different in the two sources, which correspond to a median level of agreement of 89% of all years.

In the matter of whether levels of agreement differ by specific factors, we found differences for sex (lower for women) and for job sectors, but no such differences for age or health. Compared to industry and mining sectors, differences are higher for people who mainly worked in the tertiary sectors, such as the craft and trade sectors, or the service sector.[3] These differences by job sectors and sex are weakened in multivariable models (and become nonsignificant in the case of sex), once the number of spells and durations spent in non-employment and part-time employment are included. This indicates that women (and partly those working in the tertiary sectors) probably have more complex employment histories marked by frequent spell changes and longer time spent in non-employment and part-time employment (Widmer and Ritschard 2009), and this explains higher disagreements.

We need, however, to consider some limitations. Firstly, the used administrative data on employment histories rely on the mandatory German notification scheme, and recording procedures do differ between countries and sources of administrative data, each leading to different samples and recorded information. Thus, our results may not necessarily apply to other contexts. Secondly, the emphasis of our analyses is on entire employment sequences and individual comparisons based on sequence analyses. Thereby—to enable comparisons—we must focus on a relatively rough classification and three states of occupational situations (full-time employed, part-time employed and not employed). We could, therefore, not include information on periods of self-employment or on the reason for non-employment (e.g., home or family work). Similarly, we may include additional information when defining the employment situation (e.g., job title or a job classification). In doing so, however, the use of sequence analysis becomes very complex, because the number of possible sequences grows extensively with number of states. In that case, a simple comparison of provided information (irrespective of timing, duration and sequencing) may be more appropriate. Finally, although the interviews are conducted by trained interviewers, and respondents are prepared when retrospective data are

[3] The predicted percentage of sequence agreement between survey and administrative data for the different job sectors under study is summarized in the Appendix (Supplemental Figure 2).

collected, a calendar interview may have provided more accurate information (Belli et al. 2007; Berney and Blane 1997).

In conclusion, this study links information on individual employment histories from two different sources: survey and administrative data. We show that both strategies lead to different samples. In case studies which have descriptive purposes, this may be problematic for the generalizability of findings based on administrative data. It may, however, play a minor role when testing associations between aspects of employment histories and health outcome—often an important objective of occupational cohort studies (Batty et al. 2014). In terms of agreements between survey and administrative data, we found high levels, and a clear indication that both strategies provide reliable data on employment histories.

Acknowledgements This research was conducted in the frame of a research project "Occupational health research in epidemiological Cohort studies" (AeKo) supported by the German Social Accident Insurance (DGUV, Project Number: FP295). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interests.

References

Abbott, A. (1995). Sequence-analysis—New methods for old ideas. *Annual Review of Sociology, 21,* 93–113. https://doi.org/10.1146/annurev.soc.21.1.93.

Aisenbrey, S., & Fasang, A. E. (2010). New life for old ideas: the 'second wave' of sequence analysis bringing the 'course' back into the life course. *Sociological Methods & Research, 38*(4), 652–654. https://doi.org/10.1177/0049124110373134.

Antoni, M., Ganzer, A., & Vom Berge, P. (2016). *Sample of integrated labour market biographies (SIAB) 1975–2014. FDZ Datenreport, 04/2016 (en)*. Nuremberg: IAB.

Antoni, M., & Seth, S. (2012). ALWA-ADIAB—Linked individual survey and administrative data for substantive and methodological research. *Schmollers Jahrbuch, 132*(1), 141–146. https://doi.org/10.3790/schm.132.1.141.

Batty, G. D., Shipley, M., Tabak, A., Singh-Manoux, A., Brunner, E., Britton, A., et al. (2014). Generalizability of occupational cohort study findings. *Epidemiology, 25*(6), 932–933. https://doi.org/10.1097/EDE.0000000000000184.

Belli, R., Smith, L. M., Andreski, P. M., & Agrawal, S. (2007). Methodological comparisons between CATI event history calendar and standardized conventional questionnaire instruments. *Public Opinion Quarterly, 71*(4), 603–622. https://doi.org/10.1093/poq/nfm045.

Berney, L. R., & Blane, D. B. (1997). Collecting retrospective data: Accuracy of recall after 50 years judged against historical records. *Social Science and Medicine, 45*(10), 1519–1525. https://doi.org/10.1016/S0277-9536(97)00088-9.

Blane, D., Akinwale, B., Landy, R., Matthews, K., & Wahrendorf, M. (2016). What can the life course approach contribute to an understanding of longevity risk? *Longitudinal and Life Course Studies, 7*(2), 165–173.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20*(1), 37–46.

Dannefer, D. (2003). Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *Journals of Gerontology Series B-Psychological Sciences and Social Sciences, 58*(6), S327–S337.

Elzinga, C. H., & Liefbroer, A. C. (2007). De-standardization of family-life trajectories of young adults: A cross-national comparison using sequence analysis. *European Journal of Population/Revue européenne de Démographie, 23*(3), 225–250. https://doi.org/10.1007/s10680-007-9133-7.

Gabadinho, A., Ritschard, G., Muller, N. S., & Studer, M. (2011). Analyzing and visualizing state sequences in R with TraMineR. *Journal of Statistical Software, 40*(4), 1–37. https://doi.org/10.18637/jss.v040.i04.

Giele, J. Z., & Elder, G. H., Jr. (1998). *Methods of life course research: Qualitative and quantitative approaches*. London: Sage.

Halpin, B. (2012). *Sequence analysis of life-course data: A comparison of distance measures*. UL Dept of Sociology Working Paper WP2012-02. http://www.ul.ie/sociology/pubs/wp2012-02.pdf. Accessed 7 March 2018.

Halpin, B. (2014). *SADI: Sequence analysis tools for stata* (Working Paper WP 2014-03). Limerick: Department of Sociology, University of Limerick. Accessed 7 Mar 2018.

Hautzinger, M., & Bailer, M. (1993). *Allgemeine depressionsskala - ADS. Manual*. Weinheim: Beltz.

Herzog, T. N., Scheuren, F., & Winkler, W. E. (2007). *Data quality and record linkage techniques*. New York; London: Springer.

Huber, M., & Schmucker, A. (2009). Identifying and explaining inconsistencies in linked administrative and survey data: The case of German employment biographies. *Historical Social Research, 34*(3), 230–241.

Jenkins, S. P., Cappellari, L., Lynn, P., Jäckle, A., & Sala, E. (2006). Patterns of consent: Evidence from a general household survey. *Journal of the Royal Statistical Society: Series A (Statistics in Society), 169*(4), 701–722. https://doi.org/10.1111/j.1467-985X.2006.00417.x.

Korbmacher, J. M., & Schroeder, M. (2013). Consent when linking survey data with administrative records: The role of the interviewer. *Survey Research Methods, 7*(2), 115–131.

Kuh, D., Ben Shlomo, Y., Lynch, J., Hallqvist, J., & Power, C. (2003). Life course epidemiology. *Journal of Epidemiology and Community Health, 57*(10), 778–783.

Manzoni, A., Vermunt, J. K., Luijkx, R., & Muffels, R. (2010). Memory bias in retrospectively collected employment careers: A model-based approach to correct for measurement error. *Sociological Methodology, 40*(40), 39–73. https://doi.org/10.1111/j.1467-9531.2010.01230.x.

Rubin, D. C., & Baddeley, A. D. (1989). Telescoping is not time compression—A model of the dating of autobiographical events. *Memory & Cognition, 17*(6), 653–661. https://doi.org/10.3758/Bf03202626.

Sakshaug, J. W., & Antoni, M. (2017). Errors in linking survey and administrative data. In P. P. Biemer, E. de Leeuw, S. Eckman, B. Edwards, F. Kreuter, L. E. Lyberg, N. C. Tucker & B. T. West (Eds.), *Total survey error in practice* (pp. 557–573). New York: Wiley.

Sakshaug, J., Antoni, M., & Sauckel, R. (2017). The quality and selectivity of linking federal administrative records to respondents and nonrespondents in a general population sample survey of Germany. *Survey Research Methods, 11*(1), 63–80. https://doi.org/10.18148/srm/2017.v11i1.6718.

Schmermund, A., Mohlenkamp, S., Stang, A., Gronemeyer, D., Seibel, R., Hirche, H., et al. (2002). Assessment of clinically silent atherosclerotic disease and established and novel risk factors for predicting myocardial infarction and cardiac death in healthy middle-aged subjects: Rationale and design of the Heinz Nixdorf RECALL Study. *American Heart Journal, 144*(2), 212–218. https://doi.org/10.1067/mhj.2002.123579.

Schröder, M. (2011). *Retrospective Data Collection In The Survey Of Health, Ageing And Retirement in Europe. SHARELIFE methodology*. Mannheim: Mannheim Research Institute for the Economics of Aging.

Solga, H. (2001). Longitudinal surveys and the study of occupational mobility: Panel and retrospective design in comparison. *Quality & Quantity, 35*(3), 291–309. https://doi.org/10.1023/A:1010387414959.

Stang, A., Moebus, S., Dragano, N., Beck, E. M., Möhlenkamp, S., Schmermund, A., et al. (2005). Baseline recruitment and analyses of nonresponse of the Heinz Nixdorf recall study: Identifiability of phone numbers as the major determinant of response. *European Journal of Epidemiology, 20*(6), 489–496. https://doi.org/10.1007/s10654-005-5529-z.

Studer, M., & Ritschard, G. (2016). What matters in differences between life trajectories: A comparative review of sequence dissimilarity measures. *Journal of the Royal Statistical Society: Series A (Statistics in Society), 179*(2), 481–511. https://doi.org/10.1111/rssa.12125.

Sudman, S., Bradburn, N. M., & Schwarz, N. (1996). *Thinking about answers: The application of cognitive processes to survey methodology*. San Francisco: Jossey-Bass Publishers.

Vanhoutte, B., & Nazroo, J. (2015). Life course pathways to later life wellbeing: A comparative study of the role of socio-economic position in England and the U.S. *Journal of Population*. https://doi.org/10.1007/s12062-015-9127-x.

Widmer, E. D., & Ritschard, G. (2009). The de-standardization of the life course: Are men and women equal? *Advances in Life Course Research, 14*(1–2), 28–39. https://doi.org/10.1016/j.alcr.2009.04.001.

3. Götz S., Hoven H., Müller A., Dragano N., & **Wahrendorf M.** (2018). "Age differences in the association between stressful work and sickness absence among full-time employed workers: evidence from the German socio-economic panel." *International Archives of Occupational and Environmental Health* 91:479-496.

   Impact-Faktor: 2.15

International Archives of Occupational and Environmental Health (2018) 91:479–496
https://doi.org/10.1007/s00420-018-1298-3

ORIGINAL ARTICLE

Age differences in the association between stressful work and sickness absence among full-time employed workers: evidence from the German socio-economic panel

Simon Götz[1] · Hanno Hoven[1] · Andreas Müller[2] · Nico Dragano[1] · Morten Wahrendorf[1]

Received: 31 May 2017 / Accepted: 20 February 2018 / Published online: 28 February 2018

Abstract

Purpose We aim to extend current knowledge on associations between stressful work and sickness absence, first, by studying associations between ERI and sickness absence among full-time employees from various occupations, and second, by investigating if associations vary by age.

Methods We use data from four waves of the German socio-economic panel (GSOEP), collected among men and women between 2006 and 2012, with 9418 observations. Stressful work is measured with a short form of the ERI questionnaire. We investigate an imbalance between effort and reward (ER ratio) as well as the two main components ("high effort" and "low reward"). Sickness absence is measured by self-reported number of sickness days (assessed the following year). After descriptive analyses, we estimate a series of multivariable regressions, including tests for interactions between age and work stress.

Results Each of the three indicators of stressful work is related to higher number of sickness days, with except of "high effort" in case of men. Findings remain significant after adjusting for social position (income, education and occupational class) and health. In addition, for both men and women, associations were slightly higher among older workers, though interactions did not reach statistical significance.

Conclusion Our findings support that stressful work is linked to sickness absence across a wide spectrum of jobs with varying incomes and educational levels, and also that associations are slightly more pronounced among older workers.

Keywords Work stress · Effort–reward imbalance · Sickness absence · Age differences · GSOEP

Introduction

Sickness-related absence from work is a major concern of today's labour markets and ageing workforces in Europe. For example, according to Eurofound, the average rate of sickness absence in the European Union varies between 3 and 6% (Eurofound 2010). This has considerable consequences for companies and national health policies, as it decreases productivity and increases costs for health insurances. Studying predictors of sickness absence, therefore, is important, as it helps to identify factors related to sickness absence and to develop workplace health interventions.

Studies from several countries have identified different factors that are related to sickness-related absence from work (Beemsterboer et al. 2009; Harrison and Martocchio 1998), including sociodemographic factors and psychosocial working conditions. When it comes to sociodemographic factors, for example, findings show that older workers have generally more days of sickness absence than younger workers (Donders et al. 2012; Taimela et al. 2007). Studies also highlight that patterns and reasons for sickness absence differ between women and men, with levels being generally higher among women—a finding that may be related to differing significance of the work role (Casini

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s00420-018-1298-3) contains supplementary material, which is available to authorized users.

✉ Simon Götz
simon.goetz@hhu.de

[1] Institute of Medical Sociology, Centre for Health and Society, Medical Faculty, University of Duesseldorf, Universitaetsstrasse 1, 40225 Duesseldorf, Germany

[2] Institute of Psychology, Work and Organizational Psychology, University of Duisburg-Essen, Universitätsstrasse 2, 45141 Essen, Germany

et al. 2013; Krantz and Lundberg 2006; Messing et al. 2003; Siegrist et al. 2006; Sterud 2014). Stressful working conditions are another factor related to sickness absence, mainly because of their health-related consequences. This was shown by various occupational cohort studies. Thereby, measures of stressful work range from established theoretical models, such as job strain (Ala-Mursula et al. 2005; Mortensen et al. 2017), effort–reward imbalance (Ala-Mursula et al. 2005; Derycke et al. 2013; du Prel et al. 2015; Fahlén et al. 2009; Lidwall 2016; Schreuder et al. 2010) or relational injustice (Head et al. 2007), to single stressors at work (Brussig and Ahlers 2007). Yet, despite this consistent evidence linking work stress to sickness absence, studies are generally based on rather homogenous occupational cohorts, such as nurses (Farquharson et al. 2012; Schreuder et al. 2010), transport operators (Cunradi et al. 2005), teachers (Derycke et al. 2013), university employees (Donders et al. 2012) or civil servants (Head et al. 2007). Similarly, most cohorts are recruited during midlife, and thus, older workers are clearly underrepresented in existing studies. This focus on midlife and on homogenous occupational groups, however, has at least two consequences for scientific knowledge about the association between stressful work and sickness absence.

First, more studies are needed that establish the links between work stress and sickness absence across various occupational groups that cover a wide spectrum of jobs with varying incomes and educational levels. This would help to rule out that associations between stressful work and sickness absence are due to cohort specific characteristics. For example, options and regulations for sickness absence may differ between various occupations, and thus, the links between work stress and sickness absence may vary as well. Therefore, the first aim of the present study is to investigate links between stressful work and sickness absence among the full-time employees from various occupations based on a general population survey.

Second, because of demographic changes and ageing workforces in Europe, it is necessary to extend studies to older workers. This, notably, not just concerns the general question if the overall level of sickness absence differs by age, but also the more specific question if the association between stressful work and sickness absence varies by age. In fact, there is evidence that the impact of stressful work differs depending on the period, or life stage, at which it occurs (Burr et al. 2017; Donders et al. 2012; Payne and Doyal 2010; Sampaio and Augusto 2012; Shultz 2010). Notably, this is in line with an important principle of life course research, which is to consider the timing of an exposure to understand its health-related consequences in more details (Ben-Shlomo and Kuh 2002; Wahrendorf and Chandola 2016). Older persons, for example, may be more vulnerable to work stress, because the ageing process is accompanied by changing coping capabilities and resources (Hobfoll 1989; Lazarus and DeLongis 1983), as well as changes of the physiological system. Older people, therefore, may be more likely to turn sick in case of stressful work, as well as they may take longer to recover. In that case, the association between stress and sickness absence would be more pronounced for older workers. A stronger association for older workers though could also have indirect reasons, because younger workers have possibly different motivations to work than older workers. For example, younger workers may face higher pressure to develop strong ties to the labour market, and therefore, they are more likely to continue working compared to their older counterparts, even if conditions at work are poor. There are, however, also reasons why associations between stress at work and sickness absence could be less pronounced for older workers than for younger workers. For example, older workers may face more difficulties to find a new job in case of job loss, and therefore, they are probably more likely to tolerate adverse conditions than younger workers.

Overall, there are numerous, and partly divergent assumptions on how associations between work stress and sickness absence may differ by age, but evidence on this is lacking. The second aim of this study, thus, is to compare links between work stress and sickness absence between different age groups. In sum, this leads to the following research questions:

(1) Is stressful work associated to sickness-related absence from work for men and women?
(2) If so, does the association between stressful work and sickness-related absence from work differ by age for men and women?

Methods

Data

We base our study on the German socio-economic panel (GSOEP) (Schupp et al. 2016). GSOEP is the largest panel study in Germany, based on a random sample of private households. It started 1984 in western Germany with 12,245 respondents from 5921 households with on-going waves of data collection ever since. Data is collected for each household member aged 18 or older, using paper and pencil interviews (PAPI), computer assisted personal interviews (CAPI) and self-completion questionnaires. The response rate in wave 1 was 62%, and the attrition rate between wave 1 and wave 2 was 14% (for more information

see: Kroh et al. 2017). In 1990, eastern Germany joined the study. Furthermore, additional subsamples were added in the course of the study to maintain the population representation and to increase the sample size (especially in 2000). At present, GSOEP provides representative data for more than 20,000 adult men and women in Germany taken from nearly 11,000 households. Besides sociodemographic characteristics, this includes information on individual living conditions, work and employment, income, health and sickness-related absence from work. (For more information on the GSOEP data see: Wagner et al. 2007). One of the main advantages of the GSOEP is the longitudinal nature of the information, where information on work stress (available in 2006 and 2011) can be linked to number of sickness days, as collected the year after (2007 and 2012, respectively). For the present study, we focused on men and women aged 18–65 years in the year of work stress assessment (33,648 observations) and applied the following sample restrictions: First, we excluded those who were not working and had no information on sickness absence for the year after (12,994 observations). Second, we excluded those who were working in part-time (5719 observations), because part-time workers often not work five days the week, making comparisons of days in sickness absence with full-time workers impossible. Third, we excluded people who either were in vocational training or in military service (850 observations), because employment relations and salary regulations are different for these groups. Fourth, people who changed their job during the observation period were also excluded (981 observations), because the association between work stress and sickness absence days is unclear. Fifth, we excluded people who were self-employed (1677 observations), as self-employed workers are not automatically qualified for statutory sick pay in case of sickness. Sixth, we decided to exclude people who were permanently sick (with more than 200 days of sickness absence, 57 observations), since they hardly participated on the labour market. Finally, among these remaining 11,370 observations, we restricted the sample to those with complete information on all variables under study (excluding another 1952 observations), with no indication of systematic missings. In sum, this results in a final sample of 9418 observations (person-year observations) with complete data on all study variables (based on 7193 individuals, each observed on average in 1.3 observation periods).

Measures

Work stress

Work stress is measured by the short version of the ERI questionnaire, as validated by a previous study for the GSOEP (Siegrist et al. 2009). The ERI model identifies stressful work in terms of an imbalance between high efforts spent at work and low rewards received in turn (Siegrist and Wahrendorf 2016). The short version of the questionnaire includes three items for effort and seven items for reward. Items for effort refer to perceived psychological demands at work, and reward includes salary, esteem, job security and career opportunities. Each item is listed in Supplementary Table S1. In GSOEP, items are rated on a five-point scale, ranging from 'disagree', via 'agree, and I am somewhat distressed', to 'agree, and I am very distressed'. For the analyses, we followed established procedures and created sum-scores for effort and reward, as well as we calculate the ratio between effort and reward (adjusted for number of items). On this basis, we first create two binary indicators for each of the two main components. Specifically, to identify elevated levels of work stress, people who belonged to the highest tertile of the effort-scale were classified as "high effort" and those in the lowest tertile of the reward scale as "low reward" (in both cases tertiles are based on the total sample in work). Then, effort–reward imbalance was calculated by dividing the sum score of the 'effort' items (nominator) through the sum score of the 'reward' items (adjusted for number of items; denominator). This results in a sum score where higher values are related to higher levels of work stress. For the analyses, an imbalance was assumed in case values are higher than 1 (labelled as "ER ratio > 1"). In sum, this leads to three different binary indicators of stressful work. More details on psychometric properties for GSOEP (Siegrist et al. 2009) and on the conceptual basis are fully described elsewhere (Siegrist 2016).

Sickness days

To measure sickness-related absence from work, the present study relies on the total number of days of absence from work. More specifically, in the year following the assessment of work stress respondents answered an open question on how many days they were not able to work because of illness in the previous year. In contrast to other approaches focusing on number of absence episodes, this reflects the total absence duration in 1 year (possibly based on several episodes) (Steel 2003).

Age groups

We distinguish four age groups for the analyses, each covering a distinct phase in the life course (Willis and Martin 2005). The first group, "Job starters" (Age 18 till a 29), covers the period where people make first experiences on the labour market. Next, "early midlife" (age 30–45)

and "late midlife" (age 46–57) refer to the main phase of working life, accompanied by increasing responsibilities at work and parenthood, and progressing ageing processes. Lastly, "older working life" (58–65 years) represents those who approach the end of working life.

Additional measures

We also include two sociodemographic measures (partnership and number of young children), three indicators of the respondent's social position (education, income and occupational position), and self-rated health. In the case of partnership, we use a binary indicator of whether the respondents live with a partner (regardless of the marital status). The number of young children (aged 14 or younger) is regrouped into "none", "1" and "2 or more". As an indicator of education, we use the total years spent in full-time education. Income is based on the monthly household income that we adjusted for household size in accordance with the OECD equivalent-scale (Burniaux et al. 1998), and thereafter regrouped into income tertiles ("high", "medium" and "low"). Occupational position is measured according to the Erikson–Goldthorpe–Portocarero scheme (EGP scheme) (Erikson and Goldthorpe 1992). This scheme classifies occupations into seven classes based on specific aspects under which a person performs work on the labour market, or more specifically, "employment relations". For the analyses, occupations were regrouped into four categories: "upper service class" (EGP I), "lower service class" (EGP II), "routine non-manuals workers" (EGP III, IVab), and "skilled and unskilled manual workers" (EGP IVc, V, VI, VII). Self-rated health was measured by a single question ("How would you describe your current health?") with five categories ranging from "very good" to "bad". Answers were dichotomized into "good or better" and "less than good". An overview of all measures is presented in Table 1.

Table 1 Sample description: observations (No.) and percentage (%) or mean and standard deviation (SD): $n = 9418$

	Range or categories	No. or (mean)	% or (SD)
Sex	Male	6257	66.4
	Female	3161	33.6
Age groups	Job starters (18–29)	1036	11.0
	Early midlife (30–45)	3894	41.3
	Late midlife (46–57)	3511	37.3
	Older working life (58–65)	977	10.4
Sickness days	Range: 0–200 days	(9.1)	(20.0)
High effort	Yes	2714	28.8
	No	6704	71.2
Low reward	Yes	3639	38.6
	No	5779	61.4
ER ratio > 1	Yes	1391	14.8
	No	8027	85.2
Occupational position	Higher service class	1739	18.5
	Lower service class	2721	28.9
	Routine non-manuals	1682	17.9
	Skilled and unskilled manual workers	3276	34.8
Years in job	Range: 0–50 years	(13.6)	(10.5)
Income	High	4606	48.9
	Medium	3369	35.8
	Low	1443	15.3
Education years	Range: 7–18 years	(12.9)	(2.8)
Number of children < 14	None	6923	73.5
	1	1347	14.3
	2 or more	1148	12.2
Partnership	Living with partner	7937	84.3
	Living as single	1481	15.7
Self-rated health	Good or better	5457	57.9
	Less than good	3961	42.1
Total		9418	100.0

Table 2 High levels of stress at work (in percent) and sickness days [mean values, standard deviation, median and interquartile range (IQR)] by covariates: $n = 9418$

	High efforts	Low reward	ER ratio > 1	Sickness days			
	%	%	%	Mean (SD)		Median	IQR
Sex							
Male	28.1	37.0	13.8	8.6	(19.6)	2	10
Female	30.3	41.8	16.7	10.3	(20.8)	4	10
Age groups							
Job starters (18–29)	22.4	30.2	9.7	7.3	(15.3)	4	8
Early midlife (30–45)	29.0	40.8	15.5	8.0	(18.1)	3	10
Late midlife (46–57)	31.4	40.9	16.3	10.0	(21.2)	3	10
Older working life (58–65)	25.4	30.8	11.5	12.5	(25.9)	3	14
Occupational position							
Higher service class	37.8	30.9	15.1	6.6	(15.5)	2	6
Lower service class	30.8	37.5	15.1	8.7	(18.6)	3	10
Routine non-manuals	30.1	40.6	16.0	9.0	(20.0)	3	10
Skilled and unskilled manual workers	21.7	42.6	13.7	10.9	(22.9)	3	11
Income							
High	32.8	34.0	14.0	8.4	(18.7)	3	10
Medium	26.8	42.7	15.7	9.8	(20.8)	3	10
Low	20.9	43.9	15.1	10.0	(22.0)	3	10
Number of children < 14							
None	29.1	38.5	14.8	9.7	(21.1)	3	10
1	29.0	41.4	16.2	8.9	(19.1)	3	10
2 or more	26.8	36.3	12.6	6.5	(12.9)	3	8
Partnership							
Living with partner	29.2	38.7	14.7	9.1	(20.4)	3	10
Living as single	26.9	38.4	15.3	9.2	(19.9)	3	10
Self-rated health							
Good or better	23.4	31.0	9.7	5.8	(13.4)	2	6
Less than good	36.2	49.2	21.8	13.7	(25.8)	5	14
Total	28.8	38.6	14.8	9.1	(20.0)	3	10

Analytical strategy

We start with a basic sample description (Table 1). Thereafter, Table 2 explores how the three measures of work stress and number of sickness days are distributed by covariates. We also report tests of significance based on Chi-square, Wilcoxon–Mann–Whitney, or Kruskal–Wallis tests. Then, a first picture of the associations between work stress and sickness absence, and their variations by age, is presented in Table 3. Specifically, we show the mean number and the median of sickness days for each age group separately, including confidence intervals (95%), interquartile ranges (IQR) and tests of significance (Wilcoxon–Mann–Whitney test). In this case (and in later multivariable regressions), analyses consider sex differences and are conducted for men and women separately (Casini et al. 2013; Messing et al. 2003).

Next, we estimate a series of multivariable regression models using sickness days as dependent variable—again for each age group separately, as well as for all ages (Table 4). Importantly, these models consider the hierarchical structure of our data, that is, that some observations (level 1) are not independent, as they come from the same respondent nested in different survey years (level 2). In these models, the constant is allowed to vary within individuals (also called random intercept model for longitudinal data or "random-effect model" for panel data) (Andreß et al. 2013; Giesselmann and Windzio 2012). Unlike a "fixed-effect model" for panel data, this allows to include time constant predictors (e.g. education, income and occupational position). In addition, models are both presented for non-transformed (for ease of interpretation) and transformed sickness days, because sickness days were not normally distributed. For this, we compared different transformations

Table 3 Sickness days by stress at work: divided by age groups for men and women: mean, standard deviation (SD), 95% CI, median (Med) and *p* values (based on Wilcoxon–Mann–Whitney test)

	Job starters (18–29)					Early midlife (30–45)					Late midlife (46–57)					Older working life (58–65)					All age Groups				
	Mean	(SD)	[95% CI]	Med	*p*	Mean	(SD)	[95% CI]	Med	*p*	Mean	(SD)	[95% CI]	Med	*p*	Mean	(SD)	[95% CI]	Med	*p*	Mean	(SD)	[95% CI]	Med	*p*
Women																									
High effort					0.670					0.022					< 0.001					0.072					< 0.001
Yes	10.4	(24.7)	[5.9–14.9]	5		12.3	(25.1)	[9.7–14.8]	5		14.1	(25.8)	[11.5–16.7]	5		18.7	(33.1)	[11.4–26.0]	7		13.3	(26.1)	[11.6–15.0]	5	
No	7.7	(13.5)	[6.3–9.1]	4		8.5	(17.0)	[7.4–9.7]	4		9.8	(19.9)	[8.4–11.2]	4		10.3	(19.6)	[7.5–13.1]	3		9.0	(17.8)	[8.2–9.8]	4	
Low reward					0.012					< 0.001					< 0.001					0.216					< 0.001
Yes	10.4	(21.1)	[7.2–13.6]	5		12.4	(24.5)	[10.3–14.5]	5		14.6	(26.9)	[12.3–16.9]	5		16.7	(30.6)	[10.2–23.2]	5		13.3	(25.6)	[11.9–14.7]	5	
No	7.2	(13.8)	[5.7–8.7]	4		7.6	(15.1)	[6.4–8.7]	3		8.5	(16.8)	[7.1–9.8]	3		10.9	(21.1)	[7.8–14.1]	4		8.1	(16.2)	[7.4–8.9]	3	
ER ratio > 1					0.785					0.003					< 0.001					0.017					< 0.001
Yes	11.0	(25.3)	[4.6–17.4]	5		14.0	(25.8)	[10.4–17.5]	5		17.0	(29.7)	[13.1–20.9]	5		24.4	(38.7)	[12.3–36.4]	10		15.7	(28.7)	[13.2–18.2]	5	
No	8.0	(15.3)	[6.5–9.4]	5		8.8	(18.3)	[7.6–9.9]	4		9.9	(19.7)	[8.6–11.1]	4		10.8	(20.8)	[8.1–13.5]	3		9.2	(18.6)	[8.5–10.0]	4	
Men																									
High effort					0.106					0.701					0.129					0.333					0.510
Yes	5.5	(13.7)	[3.0–8.0]	2		7.6	(18.8)	[6.3–9.0]	2		9.5	(18.6)	[8.1–10.8]	3		14.1	(29.6)	[9.6–18.7]	4		8.8	(19.8)	[7.9–9.8]	2	
No	6.6	(13.7)	[5.3–7.9]	3		7.1	(16.5)	[6.4–7.9]	3		9.4	(21.6)	[8.3–10.5]	2		11.8	(25.3)	[9.7–13.9]	2		8.5	(19.5)	[7.9–9.0]	2	
Low reward					0.122					< 0.001					< 0.001					0.015					< 0.001
Yes	6.1	(8.3)	[4.7–7.4]	4		9.5	(20.3)	[8.3–10.7]	4		11.0	(20.8)	[9.7–12.4]	4		15.2	(28.2)	[11.4–19.1]	5		10.4	(20.9)	[9.5–11.3]	4	
No	6.5	(15.2)	[5.0–8.0]	2		5.8	(14.6)	[5.1–6.6]	2		8.4	(20.6)	[7.3–9.4]	2		11.1	(25.5)	[8.9–13.4]	2		7.5	(18.6)	[6.9–8.1]	2	
ER ratio > 1					0.816					< 0.001					0.001					0.006					< 0.001
Yes	5.0	(8.5)	[2.5–7.4]	3		11.1	(24.4)	[8.8–13.5]	5		11.5	(21.4)	[9.3–13.7]	4		18.6	(34.0)	[10.6–26.5]	5		11.6	(23.7)	[10.0–13.2]	5	
No	6.5	(14.1)	[5.3–7.7]	3		6.6	(15.5)	[6.0–7.3]	2		9.0	(20.6)	[8.1–10.0]	2		11.7	(25.3)	[9.7–13.6]	2		8.1	(18.8)	[7.6–8.6]	2	

Table 4 Association between stress at work and sickness days

	Job starters (18–29)			Early midlife (30–45)			Late midlife (46–57)			Older working life (58–65)			All age groups		
	b	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*
Women															
High effort															
Model 1	2.95	[−0.49–6.40]	0.093	3.87	[1.52–6.23]	0.001	4.38	[1.70–7.05]	0.001	8.47	[2.12–14.80]	0.009	4.19	[2.61–5.77]	< 0.001
Model 2	2.96	[−0.50–6.42]	0.093	4.31	[1.95–6.66]	< 0.001	4.96	[2.29–7.64]	< 0.001	8.89	[2.48–15.30]	0.007	4.65	[3.07–6.24]	< 0.001
Model 3	2.55	[−0.59–5.69]	0.111	3.33	[0.97–5.69]	0.006	3.26	[0.58–5.94]	0.017	7.43	[1.26–13.60]	0.018	3.32	[1.74–4.90]	< 0.001
Low reward															
Model 1	3.28	[0.16–6.39]	0.039	4.24	[2.04–6.43]	< 0.001	6.10	[3.59–8.62]	< 0.001	5.73	[−0.58–12.10]	0.075	5.04	[3.57–6.51]	< 0.001
Model 2	3.22	[0.21–6.23]	0.036	4.06	[1.87–6.25]	< 0.001	5.80	[3.29–8.31]	< 0.001	6.14	[−0.19–12.50]	0.057	4.85	[3.38–6.32]	< 0.001
Model 3	2.52	[−0.48–5.52]	0.099	3.19	[1.01–5.37]	0.004	4.39	[1.88–6.90]	0.001	3.34	[−2.82–9.51]	0.288	3.56	[2.09–5.02]	< 0.001
ER ratio > 1															
Model 1	3.54	[−1.07–8.15]	0.133	5.16	[2.24–8.09]	0.001	7.18	[3.95–10.4]	< 0.001	13.4	[5.35–21.40]	0.001	6.26	[4.32–8.20]	< 0.001
Model 2	3.22	[−1.36–7.79]	0.169	5.30	[2.39–8.22]	< 0.001	7.35	[4.13–10.6]	< 0.001	13.7	[5.68–21.70]	0.001	6.40	[4.46–8.33]	< 0.001
Model 3	3.74	[−0.91–8.39]	0.115	3.70	[0.76–6.63]	0.014	5.43	[2.20–8.66]	0.001	10.3	[2.40–18.10]	0.011	4.56	[2.63–6.50]	< 0.001
Men															
High effort															
Model 1	−1.27	[−4.21–1.66]	0.394	0.46	[−1.00–1.91]	0.536	−0.08	[−1.91–1.75]	0.931	2.47	[−2.11–7.05]	0.291	0.28	[−0.80–1.37]	0.608
Model 2	−1.16	[−4.02–1.70]	0.427	1.01	[−0.45–2.46]	0.175	0.41	[−1.43–2.24]	0.664	3.84	[−0.73–8.41]	0.099	0.86	[−0.23–1.95]	0.123
Model 3	−1.47	[−4.34–1.40]	0.315	0.33	[−1.12–1.78]	0.654	−0.76	[−2.59–1.07]	0.415	2.44	[−2.07–6.96]	0.289	−0.059	[−1.15–1.03]	0.916
Low reward															
Model 1	−0.19	[−2.97–2.58]	0.891	3.53	[2.19–4.86]	< 0.001	2.50	[0.77–4.23]	0.005	3.67	[−0.60–7.95]	0.092	2.88	[1.87–3.90]	< 0.001
Model 2	−0.60	[−3.24–2.05]	0.657	3.03	[1.69–4.37]	< 0.001	2.14	[0.41–3.88]	0.015	2.85	[−1.40–7.10]	0.188	2.46	[1.44–3.48]	< 0.001
Model 3	−1.12	[−3.81–1.57]	0.414	2.17	[0.82–3.53]	0.002	1.11	[−0.62–2.84]	0.210	1.07	[−3.15–5.29]	0.620	1.44	[0.42–2.45]	0.006
ER ratio > 1															
Model 1	−1.66	[−6.08–2.77]	0.463	4.43	[2.59–6.27]	< 0.001	2.34	[0.00–4.68]	0.050	6.20	[−0.29–12.7]	0.061	3.33	[1.92–4.75]	< 0.001
Model 2	−1.81	[−6.17–2.56]	0.417	4.19	[2.36–6.03]	< 0.001	2.38	[0.05–4.71]	0.045	6.51	[0.09–12.90]	0.047	3.33	[1.92–4.74]	< 0.001
Model 3	−2.66	[−7.06–1.75]	0.237	3.14	[1.29–4.98]	0.001	1.13	[−1.19–3.45]	0.340	4.70	[−1.64–11.00]	0.146	2.09	[0.68–3.49]	0.004

Results of multivariable linear regression analyses predicting number of sickness days: regression coefficients (*b*), 95% confidence intervals [95% CI] and *p* values (*p*)

The presented estimates (*b*) correspond to the adjusted mean differences between those with and without stress. All estimations are based on random effect models accounting for year of data collection. Model 1 adjusts for partnership, years in current job and number of children living in the household (and age in case of all age groups). Model 2 is additionally adjusted for occupational position, education and income. Model 3 additionally includes self-rated health

and decided to adopt a square root transformation (Stoto and Emerson 1983). In sum, we present estimates of three regression models, estimated for each measure of work stress separately (maximum likelihood estimation). Model 1 presents estimates that are adjusted for partnership situation, years in job and number of young children. After checking for potential multicollinearity, model 2 adds education, income and occupational position, and thus, looks if associations remain consistent after accounting for social position. Model 3 then includes health to investigate a possible mediation via health (or confounding). Based on these regression models, we can already compare the effect sizes between the age groups. Then, to formally test interactions between work stress and age groups, we use the total sample and include interaction terms between work stress and each age group into the model. We hereby rely on model 2 (adjusting for sociodemographic factors and social position) and do not include health as potential mediator (or intermediate variable on the causal path between work stress and sickness absence) to avoid overadjustment. By comparing models without and with interactions on the basis of a likelihood-ratio test, we test for significant interactions (Mitchell 2012).

At last, to summarize our main findings, we predict days of sickness absence based on multivariable regression models for each age group by levels of work stress (as exemplified by ER ratio > 1), and show predicted values in Fig. 1. All calculations and the graph are produced with Stata 14.

Results

Descriptive findings

The sample described in Tables 1 and 2 explores links between work stress and sickness days. Overall, the sample includes more men than women, and most workers belong to the two middle age groups ("early midlife" and "late midlife"). Respondents spent on average about 13 years in full-time education. Most respondents work in the lower service class or as manual worker (skilled or unskilled), live in a partnership, and are in good health. About 15% of the sample has an ER ratio above 1. The overall mean score of sickness days is 9.1 (with a standard deviation of 20.0). As we see in Table 2, medians of sickness days are generally smaller than the mean values, pointing to a right skewed distribution of sickness days.

Distribution of work stress and sickness days by covariates

We see that work stress and sickness days vary by covariates under study: Men both have lower levels of work stress and fewer sickness days than women. In case of age, there is a positive association with sickness days, where number of days is higher in older age groups. Work stress, however, has an inverse u-shape association with age, with lower levels of work stress among youngest and oldest worker and higher values in the two middle age-categories (for each indicator of work stress). Turning to income and occupational position, it is worth noting that only low reward follows a social

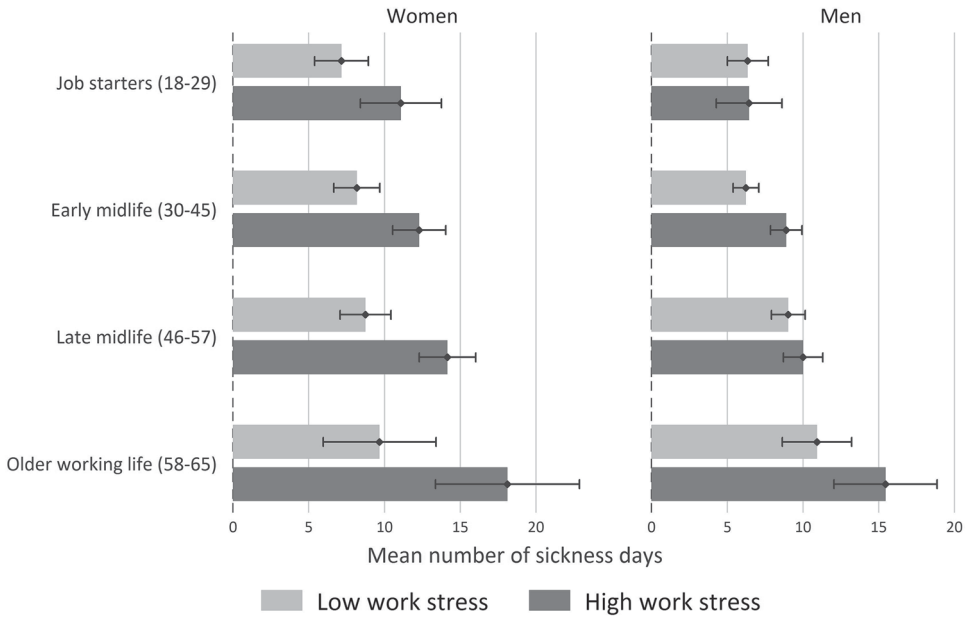


Fig. 1 Predicted number of sickness days by work stress (ER ratio > 1) and age groups for women and men with 95% confidence intervals. Predicted scores are adjusted for partnership, years in current job, number of children living in the household, occupational position, education and income (Model 2 in Table 4)

gradient (where working conditions are better for people with an advantaged social position). In case of sickness days, however, a disadvantaged occupational position is related to more sickness days. Finally, we see that days of sickness absence and levels of work stress are higher amongst people with poor health. In all cases, the reported associations are statistically significant, with p values below 0.05 (not reported in Table 2).

Association between work stress and sickness days

Table 3 shows that sickness days are generally related to levels of work stress, not only in the total sample, but also within each age group. Yet, a closer look reveals three interesting findings: First, differences in sickness days appear somewhat larger for women than for men. Second, for women all indicators of work stress are clearly related to sickness days, while a relation between high effort and sickness days is not apparent for men. Third, it seems that differences are slightly more pronounced among older age groups (for men and women).

Table 4 presents results of the multivariable regressions based on non-transformed sickness days, and the results for transformed sickness days (square root) are presented in Table 5. For each of the indicators of work stress, three models with different adjustment sets were estimated. Since we present unstandardized coefficients (denoted as "b"), the estimates in Table 4 correspond to the adjusted mean differences in sickness days between those with and those without work stress. In sum, findings confirm the results from above and suggest that the reported associations are statistically significant (specifically for all age groups combined). Besides, four points are worth being noted: First, coefficients remain almost unchanged after accounting for social position in Model 2, thus, suggesting that links between work stress and sickness absence are not confounded by social position. Second, albeit coefficients remain statistically significant in most cases after inclusion of self-related health in model 3, estimates are generally attenuated. This suggests that parts of the association between work stress and sickness absence are due to poor health, but also that there is an independent effect. Third, when comparing estimates between the four age groups, they are somewhat higher in the oldest age group. Fourth, findings are consistent for non-transformed and transformed sickness days. Fig. 1 summarizes main findings, where days of sickness absence are predicted based on Model 2 in Table 4.

To formally test interactions between work stress and age groups, Table 6 (for non-transformed sickness days) and Table 7 (transformed sickness days) again investigates if work stress is linked to sickness absence across all ages (former Model 2), and then includes interactions between work stress and age groups (Model 2a). Two observations deserve attention: First, we again see that each measure of work stress is linked to increased number of sickness days, except of high effort in case of men. Second, once we include interactions in model 2 (indicating the difference in effects of work stress to the youngest age group), we observe that interactions are highest for the oldest age group, yet, they do not reach statistical significance. Thus, while effects tend to be higher for older workers, we cannot fully rule out that our findings of higher estimates in older groups are due to random errors. Again, findings are consistent for non-transformed and transformed sickness days.

Discussion

This study used data from the GSOEP, collected among employed men and women in Germany, and investigated how stress at work (measured in terms of effort–reward imbalance and its two main components) is linked to subsequent number of sickness days (assessed 1 year later). In addition, the study compared associations of stress at work and sickness days between different age groups. According to these two research questions, two major findings result from our analyses: First, we found clear support that stressful work is linked to a higher number of sickness days. Yet, while this was true for each of the studied indicators in case of women (high effort, low reward and ER ratio > 1), we found no association for high effort in case of men. Importantly, associations persisted after accounting for three indicators of social position (education, income and occupational position), and additionally, they remained significant after adjusting for individual health at baseline. The second major finding was that associations were generally stronger amongst older worker, both for men and women. In analyses testing formally for effect modification, though, interactions between age and stress at work did not attained statistical significance.

Overall, our findings are in line with previous studies, specifically studies linking a effort–reward imbalance with sickness absence (Ala-Mursula et al. 2005; Derycke et al. 2013; du Prel et al. 2015; Fahlén et al. 2009; Lidwall 2016; Schreuder et al. 2010), but they also refine and add to existing knowledge in several ways:

First, by investigating associations among German full-time employees from various occupations and analysing sickness days in the year following the assessment of stress at work (1-year follow-up period), we extend existing evidence that was so far restricted to cross-sectional findings (du Prel et al. 2015) or to homogeneous

Table 5 Association between stress at work and sickness days

	Job starters (18–29)			Early midlife (30–45)			Late midlife (46–57)			Older working life (58–65)			All age groups		
	b	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*
Women															
High effort															
Model 1	0.20	[−0.20, 0.59]	0.325	0.41	[0.14, 0.68]	0.003	0.56	[0.27, 0.86]	<0.001	0.81	[0.12, 1.49]	0.021	0.44	[0.27, 0.62]	<0.001
Model 2	0.18	[−0.21, 0.58]	0.367	0.45	[0.18, 0.72]	0.001	0.62	[0.33, 0.92]	<0.001	0.87	[0.17, 1.57]	0.014	0.48	[0.31, 0.66]	<0.001
Model 3	0.05	[−0.34, 0.44]	0.814	0.30	[0.04, 0.57]	0.027	0.39	[0.10, 0.69]	0.009	0.68	[0.02, 1.34]	0.042	0.31	[0.13, 0.48]	0.001
Low reward															
Model 1	0.46	[0.10, 0.82]	0.013	0.60	[0.35, 0.85]	<0.001	0.72	[0.44, 1.00]	<0.001	0.41	[−0.28, 1.10]	0.240	0.61	[0.45, 0.78]	<0.001
Model 2	0.44	[0.09, 0.80]	0.015	0.59	[0.34, 0.84]	<0.001	0.70	[0.42, 0.98]	<0.001	0.58	[−0.11, 1.26]	0.101	0.60	[0.44, 0.76]	<0.001
Model 3	0.31	[−0.05, 0.67]	0.086	0.46	[0.21, 0.71]	<0.001	0.50	[0.23, 0.71]	<0.001	0.21	[−0.45, 0.87]	0.532	0.43	[0.27, 0.59]	<0.001
ER ratio > 1															
Model 1	0.11	[−0.43, 0.64]	0.699	0.60	[0.26, 0.93]	<0.001	0.82	[0.46, 1.17]	<0.001	1.30	[0.43, 2.17]	0.003	0.66	[0.44, 0.87]	<0.001
Model 2	0.07	[−0.47, 0.61]	0.795	0.61	[0.28, 0.94]	<0.001	0.84	[0.48, 1.19]	<0.001	1.37	[0.50, 2.24]	0.002	0.67	[0.45, 0.88]	<0.001
Model 3	−0.17	[−0.71, 0.36]	0.528	0.38	[0.05, 0.71]	0.023	0.57	[0.22, 0.92]	0.002	0.91	[0.07, 1.75]	0.033	0.42	[0.21, 0.64]	<0.001
Men															
High effort															
Model 1	−0.30	[−0.68, 0.08]	0.126	0.02	[−0.16, 0.19]	0.844	0.09	[−0.12, 0.30]	0.387	0.31	[−0.18, 0.79]	0.213	0.04	[−0.08, 0.17]	0.491
Model 2	−0.32	[−0.70, 0.07]	0.106	0.08	[−0.09, 0.26]	0.344	0.14	[−0.07, 0.35]	0.184	0.44	[−0.03, 0.92]	0.070	0.11	[−0.02, 0.23]	0.094
Model 3	−0.38	[−0.77, 0.00]	0.051	−0.01	[−0.18, 0.16]	0.921	−0.02	[−0.23, 0.18]	0.825	0.29	[−0.18, 0.75]	0.232	−0.02	[−0.14, 0.11]	0.811
Low reward															
Model 1	0.13	[−0.23, 0.49]	0.471	0.53	[0.37, 0.69]	<0.001	0.46	[0.26, 0.66]	<0.001	0.50	[0.06, 0.94]	0.027	0.47	[0.35, 0.58]	<0.001
Model 2	0.11	[−0.24, 0.47]	0.536	0.48	[0.32, 0.64]	<0.001	0.43	[0.23, 0.63]	<0.001	0.41	[−0.03, 0.84]	0.069	0.43	[0.31, 0.54]	<0.001
Model 3	0.03	[−0.33, 0.39]	0.861	0.36	[0.20, 0.52]	<0.001	0.28	[0.09, 0.48]	0.005	0.19	[−0.25, 0.62]	0.394	0.29	[0.18, 0.41]	<0.001
ER ratio > 1															
Model 1	−0.17	[−0.76, 0.41]	0.565	0.56	[0.34, 0.78]	<0.001	0.39	[0.13, 0.66]	0.004	0.83	[0.15, 1.50]	0.016	0.46	[0.30, 0.63]	<0.001
Model 2	−0.19	[−0.77, 0.40]	0.529	0.54	[0.32, 0.76]	<0.001	0.39	[0.13, 0.66]	0.004	0.84	[0.18, 1.50]	0.013	0.46	[0.30, 0.63]	<0.001
Model 3	−0.33	[−0.93, 0.26]	0.270	0.40	[0.18, 0.62]	<0.001	0.21	[−0.05, 0.47]	0.115	0.62	[−0.04, 1.27]	0.064	0.30	[0.14, 0.46]	<0.001

Results of multivariable linear regression analyses predicting square rooted sickness days: regression coefficients (*b*), 95% confidence intervals [95% CI] and *p* values (*p*)

All estimations are based on random effect models accounting for year of data collection. Model 1 is adjusted for partnership–years in current job and number of children living in the household (and age in case of all age groups). Model 2 is additionally adjusted for occupational position, education and income. Model 3 additionally includes self-rated health

Table 6 Interactions between stress at work and age group on sickness days

	High effort			Low reward			ER ratio > 1		
	b	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*
Women									
Model 2 [without interactions]									
High stress	4.65	[3.07–6.24]	< 0.001	4.85	[3.38–6.32]	< 0.001	6.40	[4.46–8.33]	< 0.001
Model 2a (with interactions)									
High stress (main effect)	3.14	[− 1.12–7.41]	0.149	2.98	[− 0.84–6.79]	0.126	3.12	[− 2.48–8.72]	0.275
High stress early midlife [30–45]	1.05	[− 3.89–5.99]	0.677	1.57	[− 2.89–6.02]	0.491	2.00	[− 4.37–8.38]	0.538
High stress late midlife [46–57]	1.60	[− 3.35–6.54]	0.526	2.71	[− 1.77–7.19]	0.235	4.10	[− 2.27–10.5]	0.207
High stress older working life [58–65]	5.61	[− 1.18–12.40]	0.105	2.82	[− 3.61–9.26]	0.390	10.2	[1.47–19.0]	0.022
p values of LR-test comparing model 1 and 2	0.403			0.658			0.097		
Men									
Model 2 (without interactions)									
High stress	0.86	[− 0.23–1.95]	0.123	2.46	[1.44–3.48]	< 0.001	3.33	[1.92–4.74]	< 0.001
Model 2a (with interactions)									
High stress (main effect)	− 1.05	[− 5.03–2.94]	0.607	− 0.72	[− 4.42–2.99]	0.704	− 1.32	[− 7.44–4.81]	0.673
High stress early midlife (30–45)	2.02	[− 2.28–6.32]	0.357	3.75	[− 0.25–7.75]	0.066	5.51	[− 0.95–12.0]	0.094
High stress late midlife (46–57)	1.52	[− 2.81–5.86]	0.491	2.71	[− 1.34–6.76]	0.189	3.42	[− 3.09–9.92]	0.304
High stress older working life (58–65)	4.29	[− 0.94–9.53]	0.108	4.75	[− 0.10–9.60]	0.055	8.74	[0.97–16.50]	0.028
p values of LR-test comparing model 1 and 2	0.391			0.196			0.074		

Results of multivariable linear regression analyses regression coefficients (*b*), 95% confidence intervals [95% CI] and *p* values (*p*)

Model 2 corresponds to Model 2 in Table 4 (all age groups). All estimations are based on random effect models accounting for year of data collection, and are adjusted for partnership, years in current job, number of children living in the household, occupational position, education and income

occupational cohorts (Cunradi et al. 2005; Derycke et al. 2013; Donders et al. 2012; Farquharson et al. 2012; Head et al. 2007; Schreuder et al. 2010). Our results suggest that the associations between effort–reward imbalance and sickness days exist across a wide spectrum of jobs with varying incomes and educational levels. A next step would be to explore if the associations (albeit existing across different jobs) vary by occupational groups. To our knowledge, however, no such study exists so far [but only studies that investigate if social position moderates the association between work stress and health (Kuper et al. 2002; Rugulies et al. 2012)].

Second, we found that associations between work stress and sickness absence are slightly higher among older workers. This again extends existing knowledge, which at this point—to the best of our knowledge—is restricted to one cross-sectional study (Donders et al. 2012). However, in this study, the measure of work stress was not based on an explicit theoretical model and the sample was rather selective (employees of a Dutch university). The finding of a slightly stronger relationship for older people may have different reasons. Yet, it is premature to draw far-reaching conclusions about age per se. Rather, our study underlines that age is more than a chronological ageing process. In fact, it is a highly individualized process that incorporates changes of the physiological system and of socioemotional motivations (Carstensen et al. 1999), and resources (Hobfoll 1989), both with relevance for stress processing among older workers and the extent to which a person may feel a desire of being in control at work (Matschinger et al. 1986). Furthermore, the older people are, the more important it is to study stress processing in the light of previous live courses (Lazarus and DeLongis 1983). Specifically, coping skills may be less developed for people who have spent most of their life course in disadvantaged social and economic circumstances. For these people, chronic stress exposure could lead over time to deficient cognitive, emotional and social developments of core capabilities and coping skills (McEwen 2012), leaving them with higher vulnerability to chronic stress at work. Along these lines, future studies may not only study age differences of the associations between work stress and sickness days, but additionally consider factors

Table 7 Interactions between stress at work and age group on sickness days

	High effort			Low reward			ER ratio > 1		
	b	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*
Women									
Model 2 (without interactions)									
High stress	0.48	[0.31, 0.66]	< 0.001	0.60	[0.44, 0.76]	< 0.001	0.67	[0.45, 0.88]	< 0.001
Model 2a (with interactions)									
High stress (main effect)	0.22	[− 0.26, 0.69]	0.371	0.43	[0.01, 0.85]	0.045	0.09	[− 0.53, 0.71]	0.781
High stress early midlife (30–45)	0.21	[− 0.34, 0.75]	0.456	0.16	[− 0.33, 0.65]	0.528	0.48	[− 0.22, 1.19]	0.180
High stress late midlife (46–57)	0.34	[− 0.20, 0.89]	0.220	0.26	[− 0.24, 0.75]	0.311	0.72	[0.01, 1.43]	0.046
High stress older working life [58–65]	0.62	[− 0.13, 1.37]	0.108	0.092	[− 0.62, 0.80]	0.801	1.18	[0.21, 2.15]	0.017
p values of LR-test comparing model 1 and 2	0.387			0.770			0.081		
Men									
Model 2 (without interactions)									
High stress	0.11	[− 0.018, 0.23]	0.094	0.43	[0.31, 0.54]	< 0.001	0.46	[0.30, 0.63]	< 0.001
Model 2a (with interactions)									
High stress (main effect)	− 0.32	[0.77, 0.14]	0.175	0.10	[− 0.32, 0.53]	0.631	0.16	[0.86, 0.55]	0.662
High stress early midlife (30–45)	0.38	[− 0.11, 0.88]	0.126	0.37	[− 0.09, 0.82]	0.115	0.69	[− 0.05, 1.43]	0.069
High stress late midlife (46–57)	0.47	[− 0.03, 0.97]	0.064	0.30	[− 0.17, 0.76]	0.209	0.51	[− 0.23, 1.26]	0.178
High stress older working life (58–65)	0.72	[0.12, 1.32]	0.019	0.45	[− 0.10, 1.01]	0.110	1.15	[0.26, 2.05]	0.011
p values of LR-test comparing model 1 and 2	0.119			0.377			0.052		

Results of multivariable linear regression analyses predicting square rooted sickness days: regression coefficients (b), 95% confidence intervals [95% CI] and *p* values (*p*)

Model 2 corresponds to Model 2 in Table 5 (all age groups). All estimations are based on random effect models accounting for year of data collection, and are adjusted for partnership, years in current job, number of children living in the household, occupational position, education and income

from previous stages of the life course (Ben-Shlomo and Kuh 2002; Elder and Johnson 2002) as well as individual coping strategies and resources (Endler and Parker 1990; Scheibe and Zacher 2013).

Furthermore, because we found that high effort was not related to sickness absence for men (but for women), our study points to interesting sex differences. Perhaps, men who report a high level of effort feel very committed to their work [with a high "motivation to attend" (Steers and Rhodes 1978)], and therefore, they are less likely to be absent from work. Or, on a more conceptual level, this finding underlines that theoretical models of work stress should not focus on the level of psychological demands only, at least for men. Another reason, however, could simply be different response styles between men and women (i.e. social desirability) that trigger men to report a higher level of efforts at work than they actually have. Or, another explanation of why high effort does not lead to sickness absence in case of men, could be that men are more likely to recover from high efforts than women, because of traditional gender roles in the division of paid and unpaid work, leaving women with higher responsibilities beyond work (Casini et al. 2013; Laaksonen et al. 2008). At this point, an interesting question for future studies would again be if associations between work stress and sickness absence vary by occupational position, since coping skills, motivation and resources are probably more developed in advantaged positions.

Finally, because the association between work stress and sickness absence remained significant after accounting for individual health, our study raises the question what other pathways may underlay the observed association (besides health). Researchers, for example, have suggested that it is not only the low "ability to attend" that explains why stressful work leads to higher sickness days, but also that the "motivation to attend" matters as well (Steers and Rhodes 1978). In that case, for example, a stressful workplace may lead to a low motivation among employers, who in turn decide to avoid the stressful working environment (regardless of their health status).

Despite several strengths of our study (large study sample, theory-based assessment of stress at work, 1-year follow up), we have to consider several limitations. First, the measurement of work stress was restricted to one

time point only. Because every person may be exposed to stress at some point in his or her life course, this not only includes people who are chronically stressed at work, but also people who are only occasionally stressed. As such, more comprehensive measures of work stress would be desirable, for example, repeated exposures or a measure that consider exposure duration as well. Second, our study was restricted to people who were full-time employed, and thus, we excluded an important fraction of todays' labour market in Germany, that is, part-time employees, as well as employers and self-employed people. However, because self-employed people are not automatically eligible for statutory sick pay in Germany, they may represent a specific group of workers who deserve attention in another study. Third, some may argue that self-reported data on sickness absence (as used in our study) are prone to recall bias and less reliable than administrative records. Studies comparing both types of data, though, generally found high levels of agreement between both sources (Ferrie et al. 2005; Voss et al. 2008), as well as we maintain that self-reported data have many advantages compared with register data (e.g. they also include sickness absence that is not "officially" recorded). Fourth, we also must consider that sickness days were not normally distributed. Therefore, our multivariable analyses were additionally performed for transformed sickness days (square root) and we included nonparametric tests when studying bivariate associations. Also, three types of sensitivity analyses were additionally conducted (not shown): We replicated our main findings using both log-transformation of sickness days and negative binomial regressions. Furthermore, we performed all analyses with an alternative binary outcome measuring long-term sickness absence (30 days or more). Again, results were similar to the one reported and further supported our findings. As fifth limitation, we must consider that our analysis is based on data from Germany collected in 2006 and 2011, thus, we need to ask if results apply to today's workforce or to other countries with different regulations for sickness benefits. Yet, at least for Germany, national regulations have not changed since 2006, including period with continued salary and benefit generosity. Sixth, the study did not consider the reason for sickness absence, for example, whether it was due to musculoskeletal disorders, accident, or to mental health problems. Indeed, we could ask if findings differ by reasons of sickness absence. Yet, GSOEP does not collect information on sickness absence reasons, and to investigate these questions in more detail, we clearly need larger sample sizes allowing meaningful analyses of subgroups. Finally, since the analyses excluded people who were not working at baseline, we may have excluded people who were in long-term sickness absence at baseline. It is, therefore, likely that we both underestimated the level of sickness absence and the association between work stress and sickness absence. Another limitation is that our analysis relies on one of the established work stress models only. Other measures of work stress, however, are not available in the data (Karasek et al. 1998).

In sum, this study shows that work stress, as measured in terms of effort–reward imbalance, is linked to higher number of sickness absence, and that these effects of work stress on sickness absence tend to be higher among older workers. One implication is that policies aiming at increasing the workability of older workers should aim at creating age-friendly workplaces, and pay particular attention to older workers. A second, rather conceptual implication is that future studies on age-differences need to recognize that age represents a complex category that involves numerous, often varying experiences from previous life courses.

Acknowledgements This study was conducted in the frame of the german initiative "labour market participation at older ages" which is financed by the "fund for the future" of the Ministry of Innovation, Science and Research, North Rhine-Westphalia, Germany from 2016 to 2018. The authors are responsible for the content of the publication. Further support comes from the German Research Foundation (Deutsche Forschungsgemeinschaft) (project number: WA 3065/3 – 1).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Appendix: Sensitivity analyses

See Tables 8, 9 and 10.

Table 8 Association between stress at work and sickness days

	Job starters (18–29)			Early midlife (30–45)			Late midlife (46–57)			Older working life (58–65)			All age groups		
	b	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*	*b*	[95% CI]	*p*
Women															
High effort															
Model 1	0.07	[−0.17, 0.31]	0.581	0.20	[0.04, 0.36]	0.012	0.31	[0.14, 0.48]	<0.001	0.34	[−0.05, 0.72]	0.084	0.22	[0.12, 0.32]	<0.001
Model 2	0.04	[−0.21, 0.28]	0.765	0.22	[0.06, 0.37]	0.007	0.34	[0.17, 0.50]	<0.001	0.40	[0.02, 0.79]	0.042	0.23	[0.13, 0.33]	<0.001
Model 3	−0.06	[−0.31, 0.18]	0.617	0.13	[−0.02, 0.29]	0.092	0.21	[0.05, 0.37]	0.013	0.30	[−0.07, 0.66]	0.110	0.13	[0.035, 0.23]	0.008
Low reward															
Model 1	0.28	[0.06, 0.50]	0.011	0.35	[0.20, 0.49]	<0.001	0.38	[0.22, 0.53]	<0.001	0.16	[−0.22, 0.54]	0.397	0.34	[0.24, 0.43]	<0.001
Model 2	0.27	[0.05, 0.49]	0.016	0.34	[0.20, 0.49]	<0.001	0.37	[0.22, 0.53]	<0.001	0.25	[−0.13, 0.64]	0.192	0.33	[0.24, 0.42]	<0.001
Model 3	0.18	[−0.04, 0.40]	0.100	0.27	[0.13, 0.41]	<0.001	0.26	[0.11, 0.42]	0.001	0.051	[−0.31, 0.41]	0.786	0.23	[0.14, 0.33]	<0.001
ER ratio > 1															
Model 1	−0.06	[−0.38, 0.27]	0.738	0.31	[0.11, 0.50]	0.002	0.41	[0.21, 0.61]	<0.001	0.54	[0.06, 1.02]	0.028	0.32	[0.19, 0.44]	<0.001
Model 2	−0.09	[−0.42, 0.23]	0.571	0.31	[0.12, 0.50]	0.001	0.42	[0.22, 0.62]	<0.001	0.64	[0.16, 1.13]	0.010	0.32	[0.20, 0.44]	<0.001
Model 3	−0.26	[−0.58, 0.06]	0.117	0.18	[−0.01, 0.37]	0.061	0.27	[0.07, 0.47]	0.007	0.39	[−0.08, 0.85]	0.104	0.18	[0.06, 0.30]	0.003
Men															
High effort															
Model 1	−0.22	[−0.47, 0.02]	0.068	−0.00	[−0.11, 0.10]	0.934	0.08	[−0.04, 0.20]	0.192	0.17	[−0.09, 0.43]	0.187	0.03	[−0.05, 0.10]	0.500
Model 2	−0.24	[−0.48, 0.01]	0.056	0.03	[−0.07, 0.14]	0.546	0.10	[−0.02, 0.23]	0.090	0.24	[−0.01, 0.50]	0.064	0.06	[−0.02, 0.13]	0.121
Model 3	−0.28	[−0.52, −0.03]	0.026	−0.02	[−0.12, 0.08]	0.691	0.01	[−0.11, 0.13]	0.889	0.16	[−0.10, 0.41]	0.227	−0.01	[−0.08, 0.06]	0.755
Low reward															
Model 1	0.13	[−0.10, 0.35]	0.265	0.32	[0.22, 0.41]	<0.001	0.30	[0.18, 0.41]	<0.001	0.28	[0.04, 0.52]	0.021	0.29	[0.22, 0.36]	<0.001
Model 2	0.12	[−0.10, 0.35]	0.279	0.29	[0.19, 0.39]	<0.001	0.28	[0.17, 0.39]	<0.001	0.23	[−0.00, 0.47]	0.053	0.27	[0.20, 0.34]	<0.001
Model 3	0.08	[−0.15, 0.31]	0.505	0.23	[0.13, 0.32]	<0.001	0.20	[0.09, 0.31]	0.001	0.11	[−0.12, 0.35]	0.348	0.19	[0.13, 0.26]	<0.001
ER ratio > 1															
Model 1	−0.08	[−0.45, 0.29]	0.661	0.31	[0.18, 0.44]	<0.001	0.24	[0.09, 0.40]	0.002	0.48	[0.11, 0.84]	0.010	0.27	[0.18, 0.37]	<0.001
Model 2	−0.09	[−0.46, 0.28]	0.636	0.30	[0.17, 0.44]	<0.001	0.24	[0.09, 0.39]	0.002	0.47	[0.12, 0.83]	0.009	0.27	[0.18, 0.37]	<0.001
Model 3	−0.18	[−0.55, 0.20]	0.355	0.22	[0.09, 0.35]	0.001	0.13	[−0.02, 0.29]	0.079	0.35	[−0.00, 0.70]	0.052	0.18	[0.09, 0.27]	<0.001

Results of multivariable linear regression analyses predicting log transformed sickness absence [log (sickness absence + 1): regression coefficients (*b*), 95% confidence intervals [95% CI] and *p* values (*p*)]

All estimations are based on random effect models accounting for year of data collection. Model 1 is adjusted for partnership- years in current job and number of children living in the household (and age in case of all age groups). Model 2 is additionally adjusted for occupational position, education and income. Model 3 additionally includes self-rated health

Table 9 Association between stress at work and sickness days

	Job starters (18–29)			Early midlife (30–45)			Late midlife (46–57)			Older working life (58–65)			All age groups		
	IRR	[95% CI]	*p*	IRR	[95% CI]	*p*	IRR	[95% CI]	*p*	IRR	[95% CI]	*p*	IRR	[95% CI]	*p*
Women															
High effort															
Model 1	1.32	[0.98, 1.78]	0.068	1.20	[1.04, 1.38]	0.013	1.30	[1.13, 1.50]	< 0.001	1.80	[0.99, 3.25]	0.053	1.21	[1.11, 1.33]	< 0.001
Model 2	1.36	[1.00, 1.84]	0.050	1.20	[1.04, 1.38]	0.014	1.32	[1.14, 1.52]	< 0.001	1.62	[0.90, 2.91]	0.105	1.21	[1.11, 1.33]	< 0.001
Model 3	1.25	[0.92, 1.69]	0.161	1.13	[0.98, 1.30]	0.104	1.18	[1.02, 1.37]	0.025	1.39	[0.79, 2.46]	0.253	1.12	[1.02, 1.22]	0.018
Low reward															
Model 1	1.39	[1.06, 1.84]	0.018	1.36	[1.19, 1.56]	< 0.001	1.39	[1.21, 1.60]	< 0.001	0.79	[0.44, 1.44]	0.442	1.35	[1.24, 1.46]	< 0.001
Model 2	1.39	[1.05, 1.84]	0.021	1.36	[1.19, 1.55]	< 0.001	1.39	[1.21, 1.60]	< 0.001	1.09	[0.61, 1.97]	0.770	1.34	[1.23, 1.46]	< 0.001
Model 3	1.33	[1.01, 1.75]	0.045	1.28	[1.12, 1.46]	< 0.001	1.25	[1.08, 1.44]	0.002	0.76	[0.42, 1.36]	0.354	1.23	[1.13, 1.34]	< 0.001
ER ratio > 1															
Model 1	1.50	[0.98, 2.29]	0.059	1.27	[1.07, 1.50]	0.007	1.41	[1.20, 1.67]	< 0.001	1.82	[0.87, 3.78]	0.109	1.29	[1.15, 1.43]	< 0.001
Model 2	1.59	[1.04, 2.45]	0.033	1.26	[1.06, 1.49]	0.008	1.41	[1.19, 1.68]	< 0.001	1.85	[0.91, 3.74]	0.089	1.28	[1.15, 1.42]	< 0.001
Model 3	1.37	[0.86, 2.17]	0.186	1.15	[0.97, 1.36]	0.115	1.23	[1.04, 1.46]	0.018	1.30	[0.63, 2.68]	0.484	1.13	[1.01, 1.26]	0.028
Men															
High effort															
Model 1	0.79	[0.60, 1.03]	0.080	1.00	[0.90, 1.12]	0.963	1.10	[0.98, 1.23]	0.118	1.88	[1.24, 2.83]	0.003	1.04	[0.97, 1.11]	0.307
Model 2	0.78	[0.59, 1.01]	0.063	1.04	[0.93, 1.16]	0.523	1.11	[0.99, 1.25]	0.069	1.86	[1.24, 2.78]	0.003	1.06	[0.99, 1.14]	0.093
Model 3	0.74	[0.56, 0.97]	0.031	0.97	[0.87, 1.09]	0.645	1.01	[0.90, 1.13]	0.859	1.48	[0.99, 2.22]	0.058	0.99	[0.92, 1.06]	0.723
Low reward															
Model 1	1.15	[0.91, 1.45]	0.246	1.38	[1.25, 1.52]	< 0.001	1.31	[1.18, 1.46]	< 0.001	1.72	[1.22, 2.42]	0.002	1.33	[1.24, 1.42]	< 0.001
Model 2	1.16	[0.92, 1.47]	0.214	1.36	[1.23, 1.50]	< 0.001	1.31	[1.18, 1.46]	< 0.001	1.63	[1.17, 2.28]	0.004	1.31	[1.23, 1.40]	< 0.001
Model 3	1.11	[0.87, 1.42]	0.393	1.27	[1.15, 1.41]	< 0.001	1.21	[1.08, 1.35]	0.001	1.06	[0.75, 1.51]	0.738	1.22	[1.14, 1.30]	< 0.001
ER ratio > 1															
Model 1	0.95	[0.64, 1.40]	0.780	1.34	[1.17, 1.52]	< 0.001	1.25	[1.09, 1.44]	0.002	1.54	[1.16, 2.05]	0.003	1.30	[1.19, 1.42]	< 0.001
Model 2	0.92	[0.61, 1.37]	0.665	1.35	[1.19, 1.54]	< 0.001	1.26	[1.09, 1.45]	0.002	1.53	[1.15, 2.03]	0.003	1.31	[1.20, 1.43]	< 0.001
Model 3	0.82	[0.54, 1.24]	0.353	1.23	[1.08, 1.41]	0.002	1.13	[0.98, 1.31]	0.082	1.07	[0.64, 1.79]	0.808	1.18	[1.08, 1.29]	< 0.001

Results of multivariable negative-binominal regression analyses predicting number of sickness days: incidence rate ratios (IRR), 95% confidence intervals [95% CI] and *p* values (*p*)

All estimations are based on random effect models accounting for year of data collection. Model 1 is adjusted for partnership–years in current job and number of children living in the household (and age in case of all age groups). Model 2 is additionally adjusted for occupational position, education and income. Model 3 additionally includes self-rated health

Table 10 Association between stress at work and long-term sickness absence (> 29 days)

	Job starters (18–29)			Early midlife (30–45)			Late midlife (46–57)			Older working life (58–65)			All age groups		
	OR	[95% CI]	*p*	OR	[95% CI]	*p*	OR	[95% CI]	*p*	OR	[95% CI]	*p*	OR	[95% CI]	*p*
Women															
High effort															
Model 1	1.24	[0.53, 2.90]	0.622	2.25	[1.18, 4.30]	0.014	1.85	[1.12, 3.06]	0.016	2.93	[0.74, 11.6]	0.126	2.00	[1.43, 2.81]	< 0.001
Model 2	1.27	[0.56, 2.88]	0.561	2.92	[1.36, 6.26]	0.006	2.11	[1.26, 3.54]	0.005	4.03	[0.73, 22.2]	0.109	2.27	[1.60, 3.23]	< 0.001
Model 3	1.04	[0.45, 2.40]	0.931	2.20	[1.12, 4.30]	0.021	1.57	[0.97, 2.53]	0.066	3.40	[0.48, 24.2]	0.221	1.75	[1.24, 2.48]	0.001
Low reward															
Model 1	1.85	[0.79, 4.30]	0.155	2.23	[1.28, 3.88]	0.004	2.16	[1.33, 3.51]	0.002	2.37	[0.66, 8.56]	0.188	2.22	[1.61, 3.07]	< 0.001
Model 2	1.89	[0.92, 3.90]	0.084	2.28	[1.26, 4.14]	0.007	2.07	[1.26, 3.39]	0.004	3.09	[0.68, 14.1]	0.145	2.17	[1.56, 3.01]	< 0.001
Model 3	1.56	[0.74, 3.29]	0.242	1.73	[1.00, 3.00]	0.051	1.58	[0.99, 2.53]	0.053	2.07	[0.42, 10.4]	0.374	1.69	[1.22, 2.34]	0.002
ER ratio > 1															
Model 1	3.26	[0.30, 35.1]	0.329	2.33	[1.24, 4.40]	0.009	2.74	[1.53, 4.88]	0.001	5.26	[0.82, 33.7]	0.080	2.80	[1.92, 4.10]	< 0.001
Model 2	4.35	[0.48, 39.0]	0.190	2.65	[1.32, 5.33]	0.006	2.88	[1.60, 5.19]	< 0.001	7.83	[0.66, 92.3]	0.102	2.98	[2.02, 4.40]	< 0.001
Model 3	6.83	[0.36, 129.0]	0.200	1.89	[0.97, 3.70]	0.063	2.06	[1.20, 3.53]	0.008	4.75	[0.46, 49.3]	0.191	2.18	[1.48, 3.22]	< 0.001
Men															
High effort															
Model 1	0.95	[0.30, 2.96]	0.926	1.13	[0.76, 1.67]	0.555	1.13	[0.78, 1.62]	0.521	1.44	[0.87, 2.40]	0.156	1.17	[0.92, 1.49]	0.191
Model 2	0.96	[0.29, 3.14]	0.942	1.29	[0.86, 1.93]	0.214	1.23	[0.85, 1.78]	0.281	1.65	[0.98, 2.79]	0.061	1.32	[1.04, 1.68]	0.025
Model 3	0.88	[0.27, 2.87]	0.836	1.11	[0.74, 1.67]	0.622	1.00	[0.66, 1.49]	0.982	1.45	[0.85, 2.47]	0.174	1.11	[0.87, 1.42]	0.399
Low reward															
Model 1	0.51	[0.14, 1.78]	0.290	1.85	[1.28, 2.67]	0.001	1.78	[1.25, 2.52]	0.001	1.72	[1.07, 2.75]	0.025	1.76	[1.41, 2.21]	< 0.001
Model 2	0.43	[0.12, 1.57]	0.200	1.66	[1.15, 2.41]	0.007	1.70	[1.19, 2.43]	0.003	1.66	[1.03, 2.68]	0.038	1.64	[1.31, 2.05]	< 0.001
Model 3	0.39	[0.11, 1.40]	0.147	1.35	[0.93, 1.97]	0.116	1.49	[1.01, 2.19]	0.045	1.40	[0.85, 2.29]	0.182	1.37	[1.09, 1.72]	0.008
ER ratio > 1															
Model 1	0.69	[0.088, 5.38]	0.722	1.90	[1.23, 2.95]	0.004	1.56	[1.01, 2.43]	0.047	1.96	[1.04, 3.69]	0.038	1.75	[1.31, 2.32]	< 0.001
Model 2	0.65	[0.081, 5.26]	0.688	1.83	[1.18, 2.84]	0.007	1.59	[1.02, 2.48]	0.040	2.04	[1.07, 3.90]	0.030	1.75	[1.32, 2.32]	< 0.001
Model 3	0.57	[0.069, 4.66]	0.599	1.46	[0.93, 2.28]	0.100	1.31	[0.81, 2.10]	0.270	1.71	[0.88, 3.32]	0.111	1.41	[1.06, 1.88]	0.018

Results of multivariable logistic regression analyses predicting long-term sickness absence (30 days or more): odds ratios (OR), 95% confidence intervals [95% CI] and *p* values (*p*)

All estimations are based on random effect models accounting for year of data collection. Model 1 is adjusted for partnership years in current job and number of children living in the household (and age in case of all age groups). Model 2 is additionally adjusted for occupational position, education and income. Model 3 additionally includes self-rated health

References

Ala-Mursula L, Vahtera J, Linna A, Pentti J, Kivimaki M (2005) Employee worktime control moderates the effects of job strain and effort-reward imbalance on sickness absence: the 10-town study. J Epidemiol Community Health 59(10):851–857. https://doi.org/10.1136/jech.2004.030924

Andreß H-J, Golsch K, Schmidt AW (2013) Applied panel data analysis for economic and social surveys. Springer, New York

Beemsterboer W, Stewart R, Groothoff J, Nijhuis F (2009) A literature review on sick leave determinants (1984–2004). Int J Occup Med Environ Health 22(2):169–179. https://doi.org/10.2478/v10001-009-0013-8

Ben-Shlomo Y, Kuh D (2002) A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. Int J Epidemiol 31(2):285–293. https://doi.org/10.1093/ije/31.2.285

Brussig M, Ahlers E (2007) Krankheitsbedingte Fehlzeiten älterer Arbeitnehmer und Arbeitnehmerinnen im betrieblichen Kontext. Industrielle Beziehungen/Ger J Ind Relat 14(4):357–378

Burniaux J-M, Dang T-T, Fore D, Förster MF, Mira D'Ercole M, Oxley H (1998) Income distribution and poverty in selected OECD countries. OECD Econ Dep Work Pap 189:101. https://doi.org/10.1787/730801800603

Burr H, Pohrt A, Rugulies R, Holtermann A, Hasselhorn HM (2017) Does age modify the association between physical work demands and deterioration of self-rated general health? Scand J Work Environ Health. https://doi.org/10.5271/sjweh.3625

Carstensen LL, Isaacowitz DM, Charles ST (1999) Taking time seriously: a theory of socioemotional selectivity. Am Psychol 54(3):165. https://doi.org/10.1037/0003-066X.54.3.165

Casini A, Godin I, Clays E, Kittel F (2013) Gender difference in sickness absence from work: a multiple mediation analysis of psychosocial factors. Eur J Public Health 23(4):635–642. https://doi.org/10.1093/eurpub/cks183

Cunradi CB, Greiner BA, Ragland DR, Fisher J (2005) Alcohol, stress-related factors, and short-term absenteeism among urban transit operators. J Urban Health 82(1):43–57. https://doi.org/10.1093/jurban/jti007

Derycke H, Vlerick P, van de Ven B, Rots I, Clays E (2013) The impact of effort–reward imbalance and learning motivation on teachers' sickness absence. Stress Health 29(1):14–21. https://doi.org/10.1002/smi.2416

Donders NC, Bos JT, van der Velden K, Van Der Gulden JW (2012) Age differences in the associations between sick leave and aspects of health, psychosocial workload and family life: a cross-sectional study. BMJ Open. https://doi.org/10.1136/bmjopen-2012-000960

du Prel J-B, March S, Schröder H, Peter R (2015) Berufliche Gratifikationskrisen und Arbeitsunfähigkeit in Deutschland. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz 58(9):996–1004. https://doi.org/10.1007/s00103-015-2207-5

Elder GH,J, Johnson MK (2002) The Life Course and Aging: Challenges, Lessons, and New Directions. In: Setterston RA Jr (ed) Invitation to the life course: toward new understandings of later life, part 2. Baywood, Amityville, pp 49–81

Endler NS, Parker JD (1990) Multidimensional assessment of coping: a critical evaluation. J Pers Soc Psychol 58(5):844. https://doi.org/10.1037/0022-3514.58.5.844

Erikson R, Goldthorpe JH (1992) The constant flux: a study of class mobility in industrial societies. Oxford University Press, USA

Eurofound (2010) Absence from work: European foundation for the improvement of living and working conditions. Eurofound, Dublin

Fahlén G, Goine H, Edlund C, Arrelöv B, Knutsson A, Peter R (2009) Effort-reward imbalance, "locked in" at work, and long-term sick leave. Int Arch Occup Environ Health 82(2):191–197. https://doi.org/10.1007/s00420-008-0321-5

Farquharson B, Allan J, Johnston D, Johnston M, Choudhary C, Jones M (2012) Stress amongst nurses working in a healthcare telephone-advice service: relationship with job satisfaction, intention to leave, sickness absence, and performance. J Adv Nurs 68(7):1624–1635. https://doi.org/10.1111/j.1365-2648.2012.06006.x

Ferrie JE, Kivimaki M, Head J, Shipley MJ, Vahtera J, Marmot MG (2005) A comparison of self-reported sickness absence with absences recorded in employers' registers: evidence from the Whitehall II study. Occup Environ Med 62(2):74–79. https://doi.org/10.1136/oem.2004.013896

Giesselmann M, Windzio M (2012) Regressionsmodelle zur Analyse von Paneldaten. Lehrbuch. Springer, Wiesbaden

Harrison DA, Martocchio JJ (1998) Time for absenteeism: a 20-year review of origins, offshoots, and outcomes. J Manag 24(3):305–350. https://doi.org/10.1177/014920639802400303

Head J, Kivimäki M, Siegrist J, Ferrie JE, Vahtera J, Shipley MJ, Marmot MG (2007) Effort–reward imbalance and relational injustice at work predict sickness absence: the Whitehall II study. J Psychosom Res 63(4):433–440. https://doi.org/10.1016/j.jpsychores.2007.06.021

Hobfoll SE (1989) Conservation of resources. A new attempt at conceptualizing stress. Am Psychol 44(3):513–524. https://doi.org/10.1037/0003-066X.44.3.513

Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B (1998) The job content questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. J Occup Health Psychol 3(4):322–355. https://doi.org/10.1037/1076-8998.3.4.322

Krantz G, Lundberg U (2006) Workload, work stress, and sickness absence in Swedish male and female white-collar employees. Scand J Public Health 34(3):238–246. https://doi.org/10.1080/14034940500327372

Kroh M, Kühne S, Siegers R, Deutsches Institut für Wirtschaftsforschung Berlin/Projektgruppe Das Sozio-Ökonomische Panel (2017) Documentation of sample sizes and panel attrition in the German socio–economic panel (SOEP) (1984 until 2015). SOEP survey papers, 408: Series C—data documentations (Datendokumentationen). DIW Berlin/SOEP, Berlin

Kuper H, Singh-Manoux A, Siegrist J, Marmot M (2002) When reciprocity fails: Effort–reward imbalance in relation to coronary heart disease and health functioning within the Whitehall II study. Occup Environ Med 59(11):777–784. https://doi.org/10.1136/oem.59.11.777

Laaksonen M, Martikainen P, Rahkonen O, Lahelma E (2008) Explanations for gender differences in sickness absence: evidence from middle-aged municipal employees from Finland. Occup Environ Med 65(5):325–330. https://doi.org/10.1136/oem.2007.033910

Lazarus RS, DeLongis A (1983) Psychological stress and coping in aging. Am Psychol 38(3):245–254. https://doi.org/10.1037/0003-066X.38.3.245

Lidwall U (2016) Effort-reward imbalance, overcommitment and their associations with all-cause and mental disorder long-term sick leave—a case-control study of the Swedish working population. Int J Occup Med Environ Health 29(6):973. https://doi.org/10.13075/ijomeh.1896.00712

Matschinger H, Siegrist J, Siegrist K, Dittmann KH (1986) Type A as a coping career—toward a conceptual and methodological redefinition. In: Schmidt TH, Dembrovski TM, Blümchen T (eds) Biological and psychological factors in cardiovascular disease. Springer, Berlin, pp 104–126

McEwen BS (2012) Brain on stress: how the social environment gets under the skin. Proc Natl Acad Sci USA 109(Supplement 2):17180–17185. https://doi.org/10.1073/pnas.1121254109

Messing K, Punnett L, Bond M, Alexanderson K, Pyle J, Zahm S, Wegman D, Stock SR, Grosbois S de (2003) Be the fairest of them all: challenges and recommendations for the treatment of gender in occupational health research. Am J Ind Med 43(6):618–629. https://doi.org/10.1002/ajim.10225

Mitchell MN (2012) Interpreting and visualizing regression models using stata. Stata Press, College Station

Mortensen J, Dich N, Lange T, Alexanderson K, Goldberg M, Head J, Kivimaki M, Madsen IE, Rugulies R, Vahtera J, Zins M, Rod NH (2017) Job strain and informal caregiving as predictors of long-term sickness absence: a longitudinal multi-cohort study. Scand J Work Environ Health 43(1):5–14. https://doi.org/10.5271/sjweh.3587

Payne S, Doyal L (2010) Older women, work and health. Occup Med (Lond) 60(3):172–177. https://doi.org/10.1093/occmed/kqq030

Rugulies R, Aust B, Madsen IEH, Burr H, Siegrist J, Bültmann U (2012) Adverse psychosocial working conditions and risk of severe depressive symptoms. Do effects differ by occupational grade? Eur J Public Health 23(3):415–420. https://doi.org/10.1093/eurpub/cks071

Sampaio RF, Augusto VG (2012) Aging and work: a challenge for the rehabilitation schedule. Braz J Phys Ther 16(2):94–101. https://doi.org/10.1590/S1413-35552012000200003

Scheibe S, Zacher H (2013) A lifespan perspective on emotion regulation, stress, and well-being in the workplace. In: Perrewé PL, Rosen CC, Halbesleben JRB (eds) The role of emotion and emotion regulation in job stress and well being. Emerald Group Publishing Limited, Bingley, pp 163–193

Schreuder JAH, Roelen CAM, Koopmans PC, Moen BE, Groothoff JW (2010) Effort–reward imbalance is associated with the frequency of sickness absence among female hospital nurses: a cross-sectional study. Int J Nurs Stud 47(5):569–576. https://doi.org/10.1016/j.ijnurstu.2009.10.002

Schupp J, Goebel J, Kroh M, Schröder C, Bartels C, Erhardt K, Fedorets A, Grabka M, Giesselmann M, Krause P, Kuehne S, Richter D, Siegers R, Schmelzer P, Schmitt C, Schnitzlein D, Wenzig K, German Institute for Economic Research (2016) Socio-Economic Panel (SOEP), data from 1984–2015. https://doi.org/10.5684/soep.v32

Shultz KS (2010) Age differences in the demand-control model of work stress: an examination of data from 15 European countries. J Appl Gerontol 29(1):21. https://doi.org/10.1177/0733464809334286

Siegrist J (2016) A theoretical model in the context of economic globalization. In: Siegrist J, Wahrendorf M (eds) Work stress and health in a globalized economy: the model of effort-reward imbalance. Springer, Cham, pp 3–19

Siegrist J, Wahrendorf M (eds) (2016) Work stress and health in a globalized economy: the model of effort-reward imbalance. Springer, Cham

Siegrist K, Rödel A, Hessel A, Brähler E (2006) Psychosoziale Arbeitbelastungen, Arbeitsunfähigkeit und gesundheitsbezogenes Wohlbefinden: Eine empirische Studie aus der Perspektive der Geschlechterforschung (Psychosocial workload, sick leave, and health-related well being: an empirical study from the perspective of gender research). Gesundheitswesen 68(08/09):526–534. https://doi.org/10.1055/s-2006-927073

Siegrist J, Wege N, Puhlhofer F, Wahrendorf M (2009) A short generic measure of work stress in the era of globalization: effort-reward imbalance. Int Arch Occup Environ Health 82(8):1005–1013. https://doi.org/10.1007/s00420-008-0384-3

Steel RP (2003) Methodological and operational issues in the construction of absence variables. Hum Resour Dev Rev. 13(2):243–251. https://doi.org/10.1016/S1053-4822(03)00015-9

Steers RM, Rhodes SR (1978) Major influences on employee attendance: a process model. J Appl Psychol 63(4):391. https://doi.org/10.1037/0021-9010.63.4.391

Sterud T (2014) Work-related gender differences in physician-certified sick leave: a prospective study of the general working population in Norway. Scand J Work Environ Health 40(4):361–369. https://doi.org/10.5271/sjweh.3427

Stoto MA, Emerson JD (1983) Power transformations for data analysis. Sociol Methodol 14:126–168. https://doi.org/10.2307/270905

Taimela S, Laara E, Malmivaara A, Tiekso J, Sintonen H, Justen S, Aro T (2007) Self-reported health problems and sickness absence in different age groups predominantly engaged in physical work. Occup Environ Med 64(11):739–746. https://doi.org/10.1136/oem.2006.027789

Voss M, Stark S, Alfredsson L, Vingard E, Josephson M (2008) Comparisons of self-reported and register data on sickness absence among public employees in Sweden. Occup Environ Med 65(1):61–67. https://doi.org/10.1136/oem.2006.031427

Wagner GG, Frick JR, Schupp J (2007) The German socio-economic panel study (SOEP)—evolution, scope and enhancements. SSRN J. https://doi.org/10.2139/ssrn.1028709

Wahrendorf M, Chandola T (2016) A life course perspective on work stress and health. In: Siegrist J, Wahrendorf M (eds) Work stress and health in a globalized economy: the model of effort-reward imbalance. Springer, Cham, pp 43–66

Willis SL, Martin M (2005) Middle adulthood: a lifespan perspective. Sage, Thousand Oaks

4. **Wahrendorf M.** (2015). "Previous employment histories and quality of life in older ages: sequence analyses using SHARELIFE." *Ageing & Society* 35:1928-1959.

   Impact-Faktor: 1.23

Ageing & Society **35**, 2015, 1928–1959.
doi:10.1017/S0144686X14000713

Previous employment histories and quality of life in older ages: sequence analyses using SHARELIFE

MORTEN WAHRENDORF*

ABSTRACT

This article summarizes previous employment histories and studies associations between types of histories and quality of life in older ages. Retrospective information from the Survey of Health, Ageing and Retirement in Europe (SHARE) was used and the occupational situation for each age between 30 and 65 of 4,808 men and 4,907 women aged 65 or older in Europe was considered. Similar histories were regrouped using sequence analyses, and multi-level modelling was applied to study associations with quality of life. To avoid reverse causality, individuals with poor health prior to or during their working life were excluded. Men's employment histories were dominated by long periods of paid employment that ended in retirement ('regular' histories). Women's histories were more diverse and also involved domestic work, either preceding regular careers ('mixed' histories) or dominating working life ('home-maker' histories). The highest quality of life was found among women with mixed histories and among men with regular histories and late retirement. In contrast, retirement between 55 and 60 (but not earlier) and regular histories ending in unemployment or domestic work (for men only) were related to lower quality of life, as well as home-maker histories in the case of women. Findings remain significant after controlling for social position, partnership and parental history, as well as income in older ages. Results point to the importance of continuous employment for health and wellbeing, not only during the working life, but also after labour market exit.

KEY WORDS – sequence analysis, employment histories, lifecourse, SHARE, quality of life.

Introduction

Social inequalities in health and wellbeing at older ages are well documented (*e.g.* Avendano *et al.* 2009; Banks *et al.* 2006; Knesebeck *et al.* 2007; McMunn *et al.* 2006), but the explanations proposed so far are less

* International Centre for Life Course Studies in Society and Health (ICLS), Research Department of Epidemiology and Public Health, University College London, UK.

convincing. In particular, the question how conditions during earlier stages of the lifecourse, such as work and employment, help to explain inequalities in older age is still unclear (Elder and Johnson 2002; Siegrist and Marmot 2006), as most existing studies are restricted to working populations. This, with some noticeable exceptions (Breeze *et al.* 2001; Melchior *et al.* 2006; Platts *et al.* 2013; Wahrendorf *et al.* 2013; Westerlund *et al.* 2009; Wiggins *et al.* 2007), contrasts sharply with the increasing importance of the lifecourse in social epidemiology (Blane 2006; Power and Kuh 2006), and also with the importance of working conditions for health during mid-life (Marmot, Siegrist and Theorell 2006). It can be assumed that older people with poor health and low wellbeing in later life had particular employment histories and thereby more disadvantaged working conditions that had effects beyond working life.

Links between working conditions and health are well established for midlife and there are several reasons why specific types of employment histories may be accompanied by favourable working conditions with long-term consequences for health and wellbeing. First, work (and in particular continued employment) is the major determinant of financial circumstances after retirement (Bartley and Plewis 2002; Cambois and Jusot 2011; Kahn and Pearlin 2006; Schröder 2013; Smith *et al.* 1997), through its role in the level at which a pension will be set. Second, in most countries the employment record influences access to good standards of medical care in later life (van Doorslaer, Koolman and Jones 2004). Continued work and employment also play a major part in access to favourable housing conditions (Schikowski *et al.* 2008). Further, people with continued employment usually experience lower levels of occupational hazards as compared to people with precarious employment (Eurofound 2012), where levels of physical and chemical hazards are higher. Links between these exposures at work and health are well established (Arndt *et al.* 2005; Schwatka, Butler and Rosecrance 2012), and recent evidence shows their long-term consequences for wellbeing in later life (Platts *et al.* 2013). The employment history may also be related to health-risk behaviours (Domenighetti, D'Avanzo and Bisig 2000; Ferrie *et al.* 1998), in particular, in the case of unstable careers of men (Head, Stansfeld and Siegrist 2004; Messing *et al.* 2003).

In addition to these rather plausible mechanisms, work (and in particular continued employment) provides important options to meet basic psycho-social needs, such as a sense of belonging to a social network (Berkman and Glass 2000; Krause 2004), a sense of control and autonomy (Haidt and Rodin 1999) and a sense of reward (Siegrist 2005). These aspects are at the core of existing theoretical models of work stress (*see* Siegrist 2009 for a detailed description), and their relation with health

and wellbeing during working life is well established (*e.g.* Antoniou and Cooper 2005; Schnall, Dobson and Rosskam 2009; Siegrist and Marmot 2004; Stansfeld and Candy 2006; Steptoe and Kivimaki 2012). Recent findings illustrate their long-term consequences for wellbeing after labour market exit (Wahrendorf *et al.* 2012, 2013). It thus may be assumed that continuous employment promotes opportunities of meeting psycho-social needs, while precarious and unstable careers may be accompanied by the recurrent experience of psycho-social stress, with adverse consequences for health and wellbeing (Chandola, Brunner and Marmot 2006; Wahrendorf *et al.* 2013). Notably, research shows that employment histories and levels of exposure (but also their health-related effects) differ between men and women (Messing *et al.* 2003). Men tend to work in sectors with more strenuous jobs and different levels of exposures (*e.g.* higher levels of physical exposures) and in higher-skilled occupational positions compared to women (Eurofound 2012). Furthermore, some studies show that health-related effects of stressful working conditions are particularly great for men (Stansfeld *et al.* 1999; Wahrendorf *et al.* 2013), suggesting a higher significance of the work role for men compared to women, or the availability of alternative roles (*e.g.* family) among women. For these reasons, the following analyses will be conducted for men and women separately.

Aside the above-mentioned small number of studies linking working conditions with health and wellbeing beyond working life, a second shortcoming of current knowledge refers to the measurement of work-related factors. In most studies, information about work and employment is restricted to one single time-point, which is then linked with later outcomes (*e.g.* Kivimaki *et al.* 2012). This neither considers the length of a specific state (*e.g.* length of unemployment) nor does it take into account when this period occurred within the working life, with probably different consequences for wellbeing (*e.g.* beginning *versus* end of working life). This conflicts with an important idea of the lifecourse perspective, which is not to isolate single events from larger histories (Elder, Johnson and Crosnoe 2003; Sackmann and Wingens 2003), but to consider both length and embeddedness in larger time-frames. It is thus important to consider employment histories as a whole, and thus, to integrate information about length and timing.

Taken together, studies studying long-term consequences of work and employment conditions are still rare and the measurement of work-related factors needs to be improved, by considering entire employment histories rather than single events only. Along these lines, this paper follows two aims. First, to summarise employment histories of men and women in their entirety using annual information on occupational situation from age 30 to 65. To do so, sequence analyses are applied (Abbott 1995;

Aisenbrey and Fasang 2010), which allow an in-depth description of entire employment histories (*see* 'Measurements' within the Methods section for details) and then similar histories may be regrouped into empirically distinct clusters.

As a second aim, associations between employment histories and quality of life after labour market exit will be analysed. It is assumed that people with histories of continuous paid employment (ending in late retirement) have higher quality of life after labour market exit as compared to people with unstable histories, not only through better material circumstances in later life, but also by offering opportunities for fulfilling non-material needs. Because of previously documented differences between men and women, this may be particularly the case for men. To avoid the risk that existing findings are attributable to reverse causation (where poor health leads to disadvantaged employment histories and to poorer quality of life in later life), analyses are restricted to individuals without poor health prior to and during their working life, and a number of important confounders in the analyses are considered (*e.g.* social position prior to working life and family arrangements).

Methods

Data sources

Data from the third wave of the Survey of Health, Ageing and Retirement in Europe (SHARE) were used, where information on employment histories has been collected (Börsch-Supan *et al.* 2011), together with information on quality of life assessed in Wave 2. SHARE is the first cross-national research project collecting data on a variety of sociological, economic and health-related topics among older adults in Europe. The survey started in 2004–05 in 11 countries (Sweden, Denmark, Germany, Netherlands, Belgium, France, Switzerland, Austria, Italy, Spain and Greece), with on-going waves of data collection at two-year intervals. Two new countries joined SHARE in wave two (Czech Republic and Poland). In each country, samples consist of a probability household sample, with individuals aged 50 years or older plus their (possibly younger) partners being interviewed using Computer Assisted Personal Interviews (CAPI). New cohorts (so called 'refreshers') are added subsequently to maintain population representation. In contrast to Waves 1 and 2, the third wave of SHARE was conducted as a distinct survey to collect retrospective data on respondents' lifecourse (also called SHARELIFE). This included detailed information on employment histories. With regard to survey participation, response rates of SHARE are generally above average compared to other European Surveys (Börsch-Supan and

Jürges 2005). At study onset, the household response rates were 61 per cent for the total sample ranging from 81 per cent in France to 39 per cent in Switzerland, with rates above 50 per cent in eight countries. With respect to attrition between Waves 2 and 3, the percentage of respondents lost varied between 34 per cent (Austria) and 14 per cent (Switzerland), with rates below 20 per cent in seven countries (Schröder 2011). Details about the entire SHARE project are available at www.share-project.org. By using data from the third wave, it is possible to analyse previous employment histories across 13 European countries, ranging from Northern Europe (Denmark, Sweden), Western Europe (Germany, Netherlands, Belgium, France, Switzerland, Austria), Southern Europe (Italy, Spain and Greece) to Eastern Europe (Czech Republic and Poland).

Subjects

The analyses focus on employment histories from age 30 to 65, thus excluding men and women below 65 at Wave 3. This restriction serves the aim of exploring the relevance of previous employment histories for the post-employment period of life.

Furthermore, three important restrictions were necessary to avoid the studied career sequences being biased and to minimise the effect of ill-health causing both specific employment histories and the report of poor wellbeing in later life. First, people who had difficulties in responding to the retrospective questionnaire or that reported themselves as 'retired' before the age of 45 were not considered. Second, people that reported 'poor self-reported health' during childhood were not included either, because they may have both specific employment histories and impaired health in later life. Third, all men and women who reported a period of 'long-term sickness absence' during working ages (lasting six months or longer between the ages of 15 and 65) or who stated having been ill or with disabilities most or all of their working lives were not part of the sample either (irrespective of any labour market involvement).

To study associations between career sequences and quality of life (not collected in SHARELIFE), data were further linked with Wave 2 data (2006–07). This resulted in a sample of 3,914 women and 3,836 men (N=7,750) with full available data on both waves and a sample with full data on employment histories for 4,907 women and 4,808 men (N=9,715).

Measurements

The life-grid approach. The third wave of SHARE contains a detailed module on individual employment history. In this module, information is collected

retrospectively on an annual basis using the so-called 'life-grid approach', where data collection is supported by a graphical representation of the respondent's life. The lifegrid is filled in the course of the interview, resulting in information for each age of the respondent. In addition to employment histories, it also covers individuals' partnership and children history. To help the respondents to fill the life grid, the interview starts with events that they are very likely to remember (birth dates of children). From there the lifecourse is reconstructed bit by bit, where it is also possible to switch from one dimension to another during the interview to facilitate data collection (*e.g.* job start before or after the birth of the first child). Furthermore, in case a respondent is not sure about a date, so-called 'landmark events' (prominent events) are available for each year (*e.g.* before or after death of J. F. Kennedy). The life-grid method was developed first for use in the Boyd Orr Cohort as a self-completion questionnaire (Blane 1996) with subsequent development of a CAPI version by the UK National Centre for Social Research (Scholes *et al.* 2009) which was adopted for SHARELIFE (Schröder 2011). Several advantages of this method were described compared to prospective data collections. On the one hand, retrospective data collection is a fast and less expensive method for obtaining longitudinal information. On the other hand, the life-grid approach assures that comparable information (referring to different time-points) is collected, without missing data due to drop-out during follow-up periods of a prospective survey. Certainly, in some cases the collection for each age prevents a nuanced inspection (*e.g.* precise date of retirement). In addition, recall bias is one disadvantage as opposed to prospective data collection (specifically when asking about previous attitudes or emotions). Yet, studies show that the accuracy of recalled information is high when asking about socio-demographic conditions (Berney and Blane 1997; Havari and Mazzona 2011) and there is good reason to believe that the measurement of previous employment histories is reliable as well (Baumgarten, Siemiatycki and Gibbs 1983; Bourbonnais, Meyer and Theriault 1988).

Employment histories. In SHARELIFE, the employment module collects, on an annual basis, details on each job a respondent had during his or her working career and on each period when the respondent was not employed (if the respective period lasted six months or longer). Information on jobs includes the starting and ending date, an indicator of the occupational position (first digit of the International Classification of Occupation (ISCO)) and whether the job was part-time or full-time. Information on periods when the respondent was not in paid employment for six months or longer includes a description of the situation, including retirement, domestic work, unemployment, full-time education or a period

of sickness absence. By combining these data, a detailed description of previous employment histories for each individual aged 65 or older, in terms of the occupational situation for each year of age between 30 and 65, can be provided. For the purpose of the analyses, existing information on gaps, jobs and retirement were considered, and distinguished between five states: (1) work full-time 'W', (2) work part-time 'w', (3) domestic work 'D', (4) unemployed 'U' and (5) retired 'R'. Given that the number of possible sequences grows rapidly with the number of states, this helps to focus and simplify the measurement as far as possible, without losing the information of interest (only 1% that were still in full-time education at the age of 30 were lost). Full-time work was assumed if a person was in paid employment 35 hours or longer during the week (part-time less than 35 hours). By combining two common criteria to define retirement (Ekerdt and Deviney 1990), 'retired' was measured in terms of labour market exit, when respondents left their last gainful job, and when they consider themselves as 'retired from work'. In contrast to other measures of retirement (*e.g.* receiving state pension), this may be less confounded by country-specific policies.

Quality of life in older ages. To capture wellbeing, a measure of quality of life specifically designed for early old age was used, which is widely used in international ageing surveys, the CASP-12 questionnaire. One of the innovations of SHARE is the inclusion of this measure – a psychometrically validated short version of the original 19 item version (CASP-19) (Hyde *et al.* 2003; Wiggins *et al.* 2008). An important characteristic of this instrument is that it does not focus on respondents' self-evaluation of quality of life. Rather, it refers to the existing literature of ageing and identifies aspects that are thought to be specific to quality of life in early old age (Hyde *et al.* 2003), first, the new opportunities of the third age compared to former stages in life (Laslett 1996), and second, the literature of Giddens (1991) and the role of older people in a rapidly changing society. On this basis, four domains are used: control (C), autonomy (A), self-realisation (S) and pleasure (P). The experience of these aspects (over the past four weeks) is measured with 12 questionnaire items (three for each domain) which are scored on a four-point Likert scale. A summary measure of the 12 items is used to assess quality of life in this study where the total sum score ranges from 12 to 48, with higher scores indicating better quality of life. Psychometric properties of CASP-19 are fully described elsewhere (Hyde *et al.* 2003).

Additional variables. In addition to age and sex, a number of additional individual measures were included, mainly as control variables in analyses testing associations between employment histories and later quality of life.

First, two measures of respondents' social position before or at the beginning of his or her working career were used, one measuring the occupational position of the main breadwinner at the age of ten, and another describing respondents' own occupational position held between ages 20 and 30. In both cases, occupational positions were assessed according to the ten main occupational groups of the ISCO. For the analyses, previous procedures (Wahrendorf, Dragano and Siegrist 2013; Wahrendorf *et al.* 2013) were followed, and groups were reduced to the four different skill levels representing the broad hierarchical structure of ISCO (very low: first skill level; low: second skill level, high: third skill level; very high: fourth skill level). In the case of the second indicator (occupational position between 20 and 30), the available skill levels for each year were summed up and divided by the number of years in employment and respondents were regrouped to the four skills levels (by rounding up or down the resulting score). If respondents had not been working, they were categorised as 'not employed'. A second set of indicator relates to the circumstances during working life: respondents' partnership (co-habitation), parental situation (children) and number of job changes. In the case of parental history, four-categorical variable was used based on the age at the birth of the first child (or adoption of the first child), categorised into 'no child', 'first child before 25', 'first child between 25 and 30' and 'any child after 30'. With regards to living arrangements, information was combined on whether the respondents lived with a partner at the age of 30 and 50 (without considering the marital status), resulting in a four categorical variable. Job changes were regrouped into 'never in paid employment', 'no changes', 'one change' and 'two or more changes'. Finally, income was included to investigate to what extent an association between working career and quality of life can be explained by current financial circumstances. Information is based on the total annual household income composed of the sum of different income components that were assessed in Wave 2. In cases where income components were missing, information was obtained through imputation (Paccagnella and Weber 2005). To adjust for household size, the value of income was divided in accordance with the Organisation for Economic Co-operation and Development equivalent-scale and thereafter categorised into country-specific ter Otiles (low income, medium income, high income). An overview of all used variables is provided in Table 1.

Statistical analyses

Two sets of analyses were conducted. The first set investigated employment histories for men and women using sequence analyses. The second set tested

TABLE 1. *Sample description for men and women*

	Male		Female	
Variables and categories or range	Mean or %	SD or frequency	Mean or %	SD or frequency
N	4,808		4,907	
Age: 65–100	73.89	6.59	74.44	7.05
CASP (Wave 2): 12–48	37.44	6.07	36.21	6.63
Childhood social position:				
Very low	18.28	829	19.45	903
Low	71.00	3,219	69.37	3,221
High	3.55	161	4.03	187
Very high	7.17	325	7.15	332
Early adulthood social position:				
Not employed	2.25	108	13.06	641
Very low	17.22	828	22.21	1,090
Low	57.70	2,774	53.23	2,612
High	12.52	602	4.38	215
Very high	10.32	496	7.11	349
Partner:				
Co-habiting at 30 and 50	78.56	3,777	84.37	4,140
Co-habiting at 30 but not 50	1.50	72	3.02	148
Not co-habiting at 30 but at 50	15.33	737	6.60	324
Not co-habiting at 30 and 50	4.62	222	6.01	295
Children:				
No children	11.42	549	11.78	578
First child before 25	18.85	906	45.60	2,237
First child between 25 and 29	40.45	1,944	30.43	1,493
First child at 30 or older	29.28	1,407	12.19	598
Job changes:				
Never in paid employment	0.04	2	5.16	253
No change	55.12	2,650	57.65	2,829
One change	25.77	1,239	22.70	1,114
Two or more changes	19.07	917	14.49	711
Income (Wave 2):				
High	30.41	1,295	25.64	1,129
Medium	37.27	1,587	37.19	1,638
Low	32.32	1,376	37.17	1,637
Country:				
Sweden	7.72	371	7.72	379
Denmark	7.05	339	8.05	395
Germany	8.15	392	7.70	378
Netherlands	6.84	329	7.09	348
Belgium	11.09	533	10.78	529
France	8.34	401	9.58	470
Switzerland	4.89	235	4.83	237
Austria	3.64	175	4.46	219
Italy	10.69	514	8.23	404
Spain	8.07	388	8.60	422
Greece	11.54	555	8.64	424
Czech Republic	6.84	329	8.95	439
Poland	5.14	247	5.36	263

Note: SD: standard deviation.

associations between employment histories and quality of life in older ages using multi-level regression models.

With regard to the first set, this began with a general overview of employment histories for men and women, by listing the average years spent in the five different occupational situations (cumulative state duration), the mean number of spells (consecutive runs of the same occupational situation) and an indicator to describe the general heterogeneity of employment histories (Shannon's relative entropy) (Shannon 1948; Widmer and Ritschard 2009), based on the cumulated duration in the different states. In addition, Figure 1 presents the prevalence of occupational situations by age (so-called chronograms). Next, individual sequences were compared and the differences of each single sequence to another were calculated, again for men and women separately. To this aim, several techniques or 'distance measures' exist, where differences are calculated in terms of specific 'costs' to turn one sequence into another. These costs increase by substituting one state with another (substitution cost) or deleting and/or inserting one state into a sequence (indel costs) (*see* Halpin 2012 for an overview of different approaches). For the analyses, Lesnard's dynamic hamming distances were used (Lesnard 2010). This considers the time dimension or 'calendar' in the data, where specific occupational situations and the transitions from one state to another vary over time (*e.g.* lower probability of moving from full-time employment to retirement in younger years). More specifically, 'costs' are defined on the basis of transition rates for each time-point (age) separately (and not defined and fixed by the researcher) (Abbott and Tsay 2000; Aisenbrey and Fasang 2010). As a test of robustness, supplementary analyses were conducted and results were compared to alternative distance measures (optimal matching and traditional hamming). After calculating the distances, cluster analysis (Ward's linkage) was used to regroup similar sequences. Different cluster solutions were compared and it was decided to present a ten-cluster solution both for men and women in the results. This allowed identification of meaningful clusters (construct validity) and direct comparisons between men and women. Clusters are presented in Table 3, where frequencies and a measure of homogeneity (mean distance to the cluster centre) are presented for each cluster. In addition, a Pseudo R^2 is listed describing the extent to which the chosen cluster solution explains variations between sequences (Studer *et al.* 2011). In addition, Figure 2 presents the so-called 'medoid sequence' for each cluster, which is the sequence closest to the cluster centre. All calculations and figures were done with STATA and the 'sadi' package developed by Brendan Halpin, and the 'sq' package (Brzinsky-Fay, Kohler and Luniak 2006).

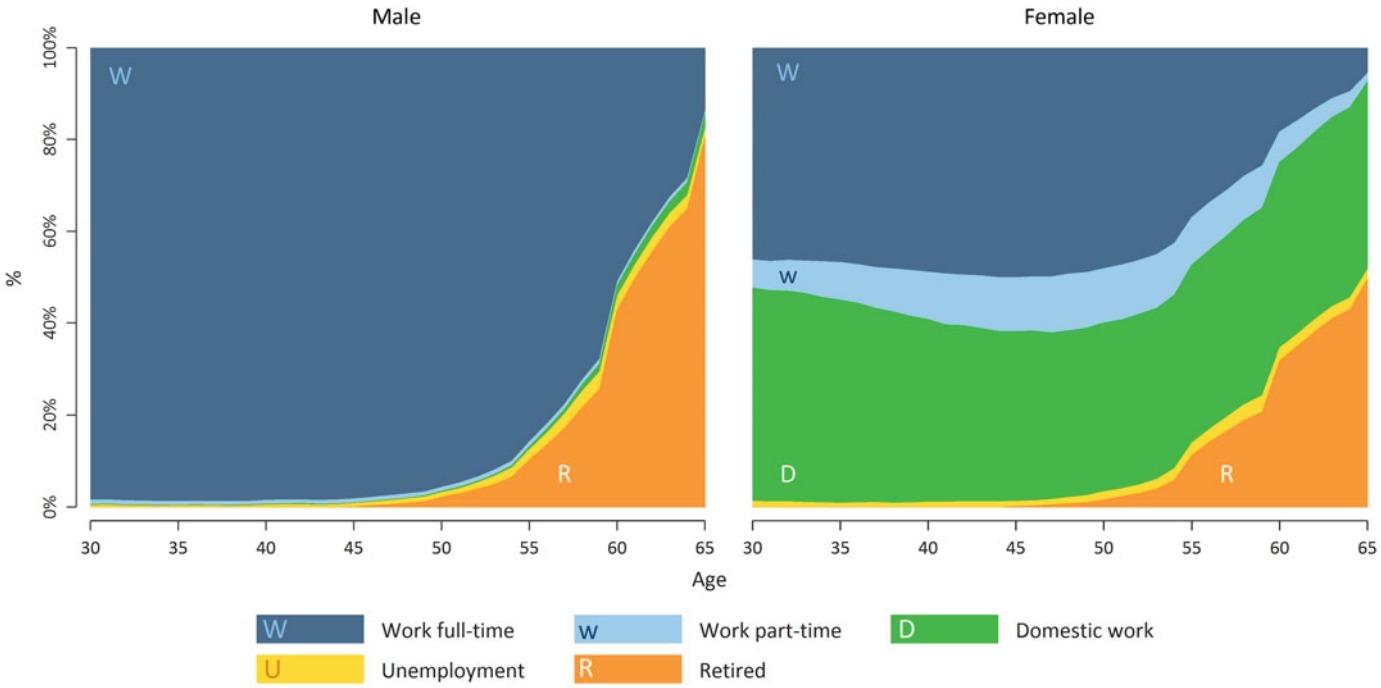


Figure 1. Employment situation by age for men (N=4,808) and women (N=4,907).

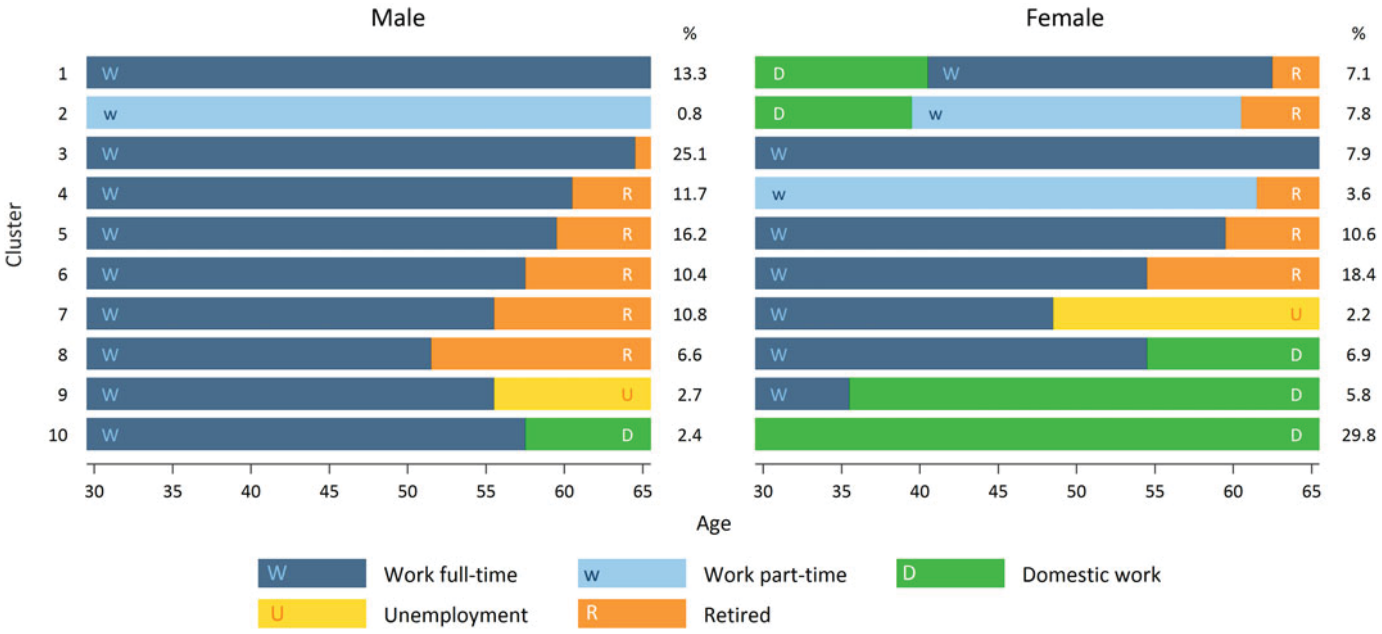


Figure 2. Prototypes of employment histories for men (N=4,808) and women (N=4,907) and frequencies (%). *Note*: Based on ten-cluster solutions calculated for men and women separately.

In the second set of analyses, the associations between employment histories and quality of life in older ages were tested. For this, multi-level linear regression models (random intercept) to predict quality of life were calculated, with individuals (level 1) nested within countries (level 2) (Skrondal and Rabe-Hesketh 2010). Employment histories were included as categorical variables, where cluster membership was broken down in a set of dummy variables. Using multi-level modelling allows for accurate adjustment for country affiliation, because the constant is allowed to vary across countries. This is important for the analyses, because of previously reported variations of quality of life between countries (Knesebeck *et al.* 2007). In addition, it offers the opportunity to study variations in quality of life between and within countries. Likelihood ratio tests were performed comparing the multi-level models to ordinary linear regression (ordinary least-squares) and revealed better model fits in all cases. In addition to the empty model, results of three consecutive models are presented. The empty model contains a constant term only whose function is the estimation of the distribution of variance between each level. Model 1 includes career sequences and adjusts for age, age square and the two indicators of previous social position. Model 2 additionally includes lifecourse factors. Finally, in Model 3, current income is included. The respective tables present estimated regression coefficients together with standard errors and level of statistical significance. For the random components the variability parameter between and within countries is estimated. In addition, the log likelihood, the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) statistics are given, and the proportional reduction of variance explained at each level ($R^2$1, $R^2$2) is reported using Pseudo R^2 statistics (Snijders and Bosker 1994). These later measures allow quantification of the extent to which variations in quality of life at each level can be explained by the considered variables. Again, all calculations were done with STATA 12 based on the 'xtmixed' procedure.

Results

Descriptive findings

There were slightly more women participating (N=4,907) than men (N=4,808), with a mean age of 74 years for both sexes at the time of the SHARELIFE interview. The average number of observations across countries was 377 for women and 370 for men, with smallest number for both sexes in Austria (219 women and 175 men). The large majority lived in a partnership throughout adulthood, had their first child in early adulthood (before 30), and had one or two jobs during their working life (*see* Table 1 for details).

TABLE 2. *General characteristics of working career sequences for men and women*

	Male		Female	
	Mean	SD	Mean	SD
N	4,808		4,907	
Average duration (years):				
Full-time work	30.23	5.36	14.22	13.41
Part-time work	0.34	3.02	3.32	8.00
Domestic work	0.26	1.72	14.41	15.16
Unemployment	0.51	2.36	0.65	3.42
Retirement	4.68	4.22	3.40	4.51
Average number of spells	1.99	0.62	2.20	1.12
Shannons' entropy	0.53	0.33	0.64	0.52

Note: SD: standard deviation.

TABLE 3. *Prevalence of ten-cluster solutions and measures of homogeneity for men and women*

	Male			Female		
Cluster	N	%	Homogeneity	N	%	Homogeneity
1	640	13.31	0.004	350	7.13	0.381
2	36	0.75	0.141	382	7.78	0.422
3	1,208	25.12	0.040	385	7.85	0.045
4	564	11.73	0.013	175	3.57	0.169
5	779	16.20	0.010	518	10.56	0.070
6	500	10.40	0.074	903	18.40	0.142
7	519	10.79	0.035	108	2.20	0.454
8	317	6.59	0.084	338	6.89	0.243
9	130	2.70	0.203	284	5.79	0.400
10	115	2.39	0.184	1,464	29.83	0.062
Total	4,808			4,907		
Pseudo R^2	0.744			0.721		

Table 2 gives a first description of employment histories between ages 30 and 65. During this period (lasting 36 years) men spent on average 30.2 years in full-time work and women 14.2 years. For both sexes, time spent in part-time work was very low, with slightly higher values for women (3.3 years). Notably, while women spent most of their time in domestic work (14.4 years), men spent almost no time in this state (0.3 years). Overall, the mean time spent in retirement ranged from 4.7 years for men to 3.4 years for women. Both sexes spent less than a year in unemployment throughout their working life. However, given that only significant spells were recorded

(six months or longer), this may be underestimated. With regard to the reported standard deviations, the average numbers of distinct spells and Shannons' entropy, findings indicate that employment histories are more diverse between women and more similar between men. This is also apparent in Figure 1, which displays the percentage of persons in the five states by age. In the case of men, high rates of full-time employment and increasing rates of retirement in later ages are mainly observed, while rates of part-time employment and domestic work are apparent for women throughout all ages. Next, results of the sequence analyses comparing individual sequences as a whole and regrouping similar sequences into clusters are presented.

Types of employment histories

Which types of employment histories can be distinguished among men and among women? Figure 2 gives answers to this question, presenting prototypes for the identified clusters and the prevalence of cluster membership for men and women separately. In addition, Table 3 informs how homogeneous or similar the sequences are within each cluster and to what extent the ten-cluster solutions allow their variations to be explained. Chronograms of the clusters can be found in Figures 3 and 4 for men and women, respectively.

Clusters for men can be summarised as follows: clusters are very homogeneous and the ten-cluster solution explains almost three-quarters of the variations between employment histories (Pseudo R^2: 0.74). Notably, as can be seen in Figure 2, for men all clusters start with a long spell of employment and clusters are characterised by one or two states only. For instance, in the first two clusters the employment spell lasts until the end of the observed period. In these cases cluster membership differs according to full-time employment (cluster 1) or part-time employment (cluster 2). For most clusters the long periods of employment (full-time) end in retirement (clusters 3–8), where the moment of retirement matters for cluster membership, with latest retirement in cluster 3 (at 65 or shortly before) and earliest retirement in cluster 8 (before 55). In contrast, members of the two remaining clusters have been in unemployment (cluster 9) or domestic work (cluster 10) at the end of their employment history. These two latter clusters (together with cluster 2 of a constant part-time employment) may be seen as exceptional employment histories, because the large majority of men (more than 94%) belong to one of the 'regular' employment histories, with a long period of full-time employment, that either lasts till the end (cluster 1) or is followed by retirement (clusters 3–8). Turning to the career sequences of women, the picture is not as simple and sequences are different and more

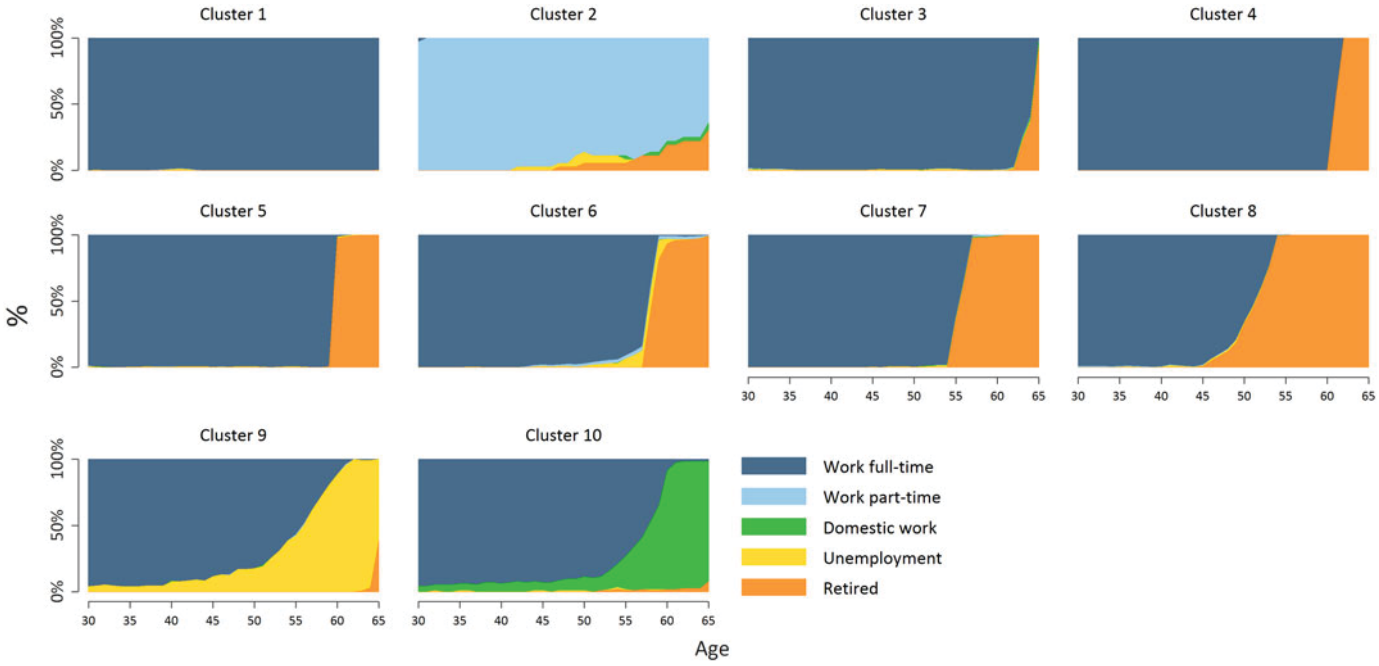


Figure 3. Employment situation by age and cluster for men (N=4,808).

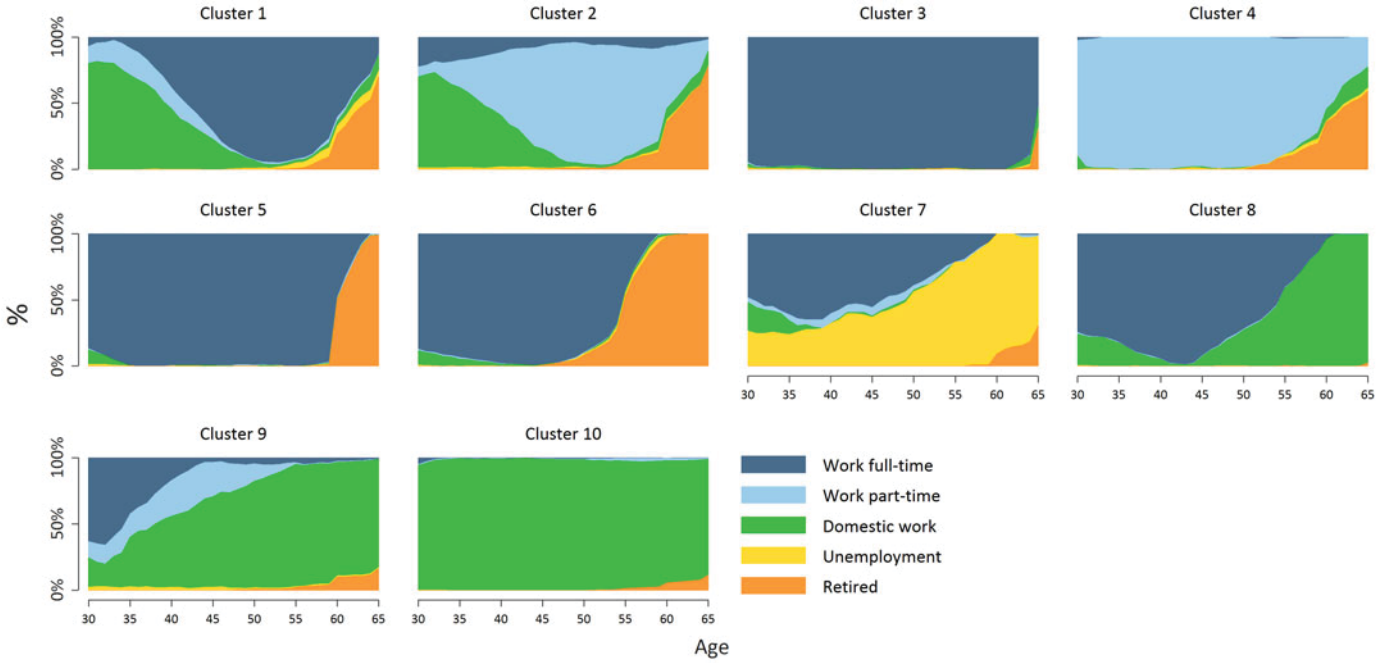


Figure 4. Employment situation by age and cluster for women (N=4,907).

diverse; though the cluster solution again allows explanation of almost three-quarters of the differences between women (Pseudo R^2: 0.72). Importantly (in contrast to male histories), not all sequences start with a long period of paid employment, but women in clusters 1 and 2 have a period of domestic work at the beginning, which is followed by employment (either full-time (cluster 1) or part-time (cluster 2)) and retirement after the age of 60. These later clusters may be called 'mixed' histories. Clusters 3–6 correspond to the 'regular' histories described above for men (employment at the beginning, ending in retirement). Though, these types of sequences only cover around 40 per cent of women's employment histories (94% in the case of men). In the remaining four clusters, there can be observed a sequence of full-time employment that does not end in retirement but in a period of unemployment (cluster 7) or in domestic work (cluster 8). Finally, clusters 9 and 10 are clearly dominated by domestic work, either preceded by a short period of full-time employment (cluster 9) or throughout the working life (cluster 10). These two later clusters, or 'home-maker' histories, cover about 35 per cent of women's employment histories.

Associations between previous employment histories and quality of life in older ages

To study the second research question (associations between employment histories and quality of life), the results of the multi-level models testing effects on quality of life for men (Table 4) and for women (Table 5) using respective clusters of employment histories as independent variables (broken into dummies) are examined.

Before turning to the associations between cluster membership and quality of life, the results for the random parameters of the multi-level models are described briefly. For both men and women, variations of quality of life are more pronounced within countries than between countries. Respective intra-class correlations (ICC) indicate that more than three-quarters of the total variance of quality of life can be attributed to the individual level (ICC for men: 0.18, women: 0.24). In other words, less than 25 per cent of total differences in quality of life are related to differences between countries.

Three observations deserve attention in the case of men (Table 4). First, men with a continuous full-time employment during working life (reference category) had the highest quality of life amongst all clusters. Similar quality of life was found among men with a long spell of full-time employment and retirement after the age of 60 (clusters 3 and 4). Second, while men with retirement between 55 and 60 had significantly lower quality of life after 65, no support that retirement prior to the age of 55 was negatively associated

TABLE 4. *Multi-level estimates for quality of life (CASP): regression coefficients and standard errors (SE) for men*

	Empty		Model 1		Model 2		Model 3	
			b	SE	*b*	SE	*b*	SE
Fixed parameters:								
Cluster:								
1			Ref.		Ref.		Ref.	
2			−1.33	0.98	−1.34	0.98	−1.24	0.97
3			−0.46	0.30	−0.46	0.30	−0.40	0.29
4			−0.08	0.35	−0.09	0.35	−0.11	0.35
5			−0.79*	0.33	−0.79*	0.33	−0.69*	0.33
6			−0.73*	0.37	−0.73*	0.37	−0.64	0.37
7			−0.81*	0.37	−0.78*	0.37	−0.77*	0.37
8			−0.46	0.43	−0.44	0.43	−0.45	0.43
9			−1.49*	0.59	−1.44*	0.59	−1.19*	0.59
10			−1.65**	0.62	−1.71**	0.62	−1.38*	0.62
Random parameters:								
Level 1: within country	5.48***	0.06	5.34***	0.06	5.32***	0.06	5.29***	0.06
Level 2: between country	2.59***	0.52	2.50***	0.50	2.51***	0.50	2.57***	0.51
Statistics:								
$R^2$1 (level 1)			0.051		0.055		0.066	
$R^2$2 (level 2)			0.073		0.063		0.018	
Log likelihood	−11,994.23		−11,892.85		−11,885.38		−11,863.85	
AIC	23,994.46		23,827.70		23,830.77		23,791.71	
BIC	24,013.22		23,959.00		24,018.33		23,991.78	

Notes: N=3,836. Model 1: adjusted for age, age square and previous social position (occupational position of main breadwinner at age ten and occupational position between 20 and 30). Model 2: Model 1 plus lifecourse factors (job changes, co-habitation and children).
Model 3: Model 2 plus current income. Ref.: reference category. AIC: Akaike Information Criterion. BIC: Bayesian Information Criterion.
Significance levels: * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

TABLE 5. *Multi-level estimates for quality of life (CASP): regression coefficients and standard errors for women*

	Empty		Model 1		Model 2		Model 3	
			b	SE	*b*	SE	*b*	SE
Fixed parameters:								
Cluster:								
1			Ref.		Ref.		Ref.	
2			−0.25	0.47	−0.36	0.47	−0.26	0.47
3			−1.50**	0.48	−1.34**	0.49	−1.23*	0.49
4			−1.27*	0.59	−1.24*	0.60	−1.15	0.59
5			−0.84	0.45	−0.74	0.46	−0.77	0.46
6			−1.25**	0.44	−1.17**	0.45	−1.19**	0.45
7			−1.79*	0.71	−1.71*	0.71	−1.46*	0.71
8			−0.94	0.49	−0.83	0.50	−0.68	0.50
9			−1.46**	0.52	−1.35*	0.53	−1.25*	0.53
10			−1.09**	0.39	−1.04*	0.43	−0.89*	0.43
Random parameters:								
Level 1: within country	5.80***	0.07	5.62***	0.06	5.61***	0.06	5.56***	0.06
Level 2: between country	3.27***	0.65	3.02***	0.60	2.99***	0.60	3.06***	0.61
Statistics:								
$R^2$1 (level 1)			0.060		0.065		0.080	
$R^2$2 (level 2)			0.149		0.164		0.123	
Log likelihood	−12,464.13		−12,342.23		−12,331.63		−12,300.57	
AIC	24,934.26		24,726.46		24,723.26		24,665.15	
BIC	24,953.08		24,858.17		24,911.43		24,865.86	

Notes: N=3,914. Model 1: adjusted for age, age square and previous social position (occupational position of main breadwinner at age ten and occupational position between 20 and 30). Model 2: Model 1 plus lifecourse factors (job changes, co-habitation and children). Model 3: Model 2 plus current income. Ref.: reference category. AIC: Akaike Information Criterion. BIC: Bayesian Information Criterion.
Significance levels: * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

with later quality of life was found. Third, that a working career of full-time employment ending in unemployment or domestic work was associated with poor quality of life (slightly stronger in the case of domestic work) was strongly supported.

The picture is different in the case of women and three important observations are made. First, quality of life was best amongst females in clusters 1 and 2 (mixed histories) and significantly lower if women were continuously employed full-time or had a long period of employment ending in retirement (clusters 4–6). Second, while women who ended up unemployed (after a long spell of full-time employment) had significantly lower quality of life, no such association was found in the case of domestic work (in contrast to men). The third observation is that if histories of women were dominated by domestic work (home-maker histories), they had significantly lower values in quality of life in older ages compared to clusters 1 and 2 (mixed histories).

For both men and women, reported associations were significant after controlling for respondents' social position prior to age 30 (Model 1), as well as variables related to partnership history (co-habitation) and parental history (Model 2). In addition, when including current income in Model 3, it can be seen that estimates are generally attenuated, though remain statistically significant. Importantly, this indicates that the reported association between employment histories and quality of life can only partly be explained by current income circumstances.

Turning back to the random parameters, the Pseudo R^2 statistics of the final model suggest for both men and women that all variables included in the analyses explain in the present sample up to 8 per cent of the variation at the individual level. In additional analyses, the variance explained just by the used clusters of employment histories (not reported in the table) was estimated, which was close to 1 per cent for men and women. This is comparable to the variance explained by current income when being included in Model 3. Regarding the country level, no substantive reduction in the case of men was found, but around a 15 per cent reduction in between-country variations in the case of women. This latter finding suggests that differences between countries in the quality of older women's lives can to some extent be explained by different previous employment histories.

Discussion

This paper investigated previous employment histories and the quality of life of older Europeans aged 65 or older. By using sequence analysis, first employment histories spanning from age 30 to 65 were described and then

similar career sequences were regrouped into clusters. Secondly, the associations between previous employment histories and the quality of life at older ages were tested.

The main findings can be summarised as follows. With regards to the first research question, there was solid evidence that the employment histories of women were different and more diverse compared to those of men. For men, careers were dominated by long spells of employment in the first half of their career. In most cases (95% of men's careers) this period either ended in retirement or lasted till 65. In other words, at age 30 most men had started to work and ended sooner or later in retirement (regular histories), with the only exception of a few men ending up in unemployment or domestic work at the end of their career (5%). In the case of women, regular histories accounted for less than half of the cases (40%) and were supplemented by two notable career patterns, with women either involved in domestic work before having a long spell of employment ending in retirement (15%, mixed histories), or where women's careers were dominated by domestic work throughout their working life (35%, home-maker histories). Finally, as for men, a few cases showed a long spell of employment ending either in unemployment or domestic work (10%). The use of sequence analysis made it possible to derive these types of employment histories empirically and helped to identify differences between men and women.

The second set of findings concerns the association between employment histories and quality of life (the second research question). It became apparent that specific types of employment histories are associated with lower quality of life in later life. In the case of men, it was found that men with regular employment histories and late retirement (after 60) had the highest quality of life in later life. In contrast, men who retired earlier had significantly lower quality of life, with the notable exception of those who retired prior to 55. Poor quality of life was found among those who ended up in unemployment or, in particular, in domestic work. In the case of women, the best quality of life was found among those with a period of domestic work followed by employment and late retirement (mixed histories), whilst continued employment with late retirement (regular histories) had an even lower quality of life. Additionally, women had significantly lower quality of life in later life if their previous employment histories were dominated by domestic work only (home-maker histories). In other words, women whose employment histories were either dominated by employment or by domestic work had a lower quality of life in later life. Finally, women had a lower quality of life for if they ended up in unemployment (similar to men), but not in domestic work (different to men) after a long period of employment. Importantly, all associations remained stable after adjusting for social position prior to working career and lifecourse factors (as well as age and

job changes). Further, associations were still statistically significant after the inclusion of current income.

In sum, the findings show that continuous employment histories are more likely to be associated with later quality of life – an association that was particularly pronounced in the case of men. This association could only partly be explained by current income in the analyses.

Discussion of results

How do these findings fit into the existing literature? At the descriptive level of employment histories, the findings are in line with previous findings that showed that working conditions and labour market involvements vary between men and women (Eurofound 2012; Lyberaki, Tinios and Papadoudis 2013). By considering and describing entire working histories rather than single-point measures or single characteristics (*e.g.* length of full-time employment), the results add to existing research. In particular, a greater complexity of employment histories in the case of women was found, agreeing with the existing literature (Macmillan 2005; Widmer and Ritschard 2009).

With regard to the investigated associations between employment histories and quality of life, the results support previous findings of an increased risk of mental disorders among older people who previously had adverse work and employment conditions, either in terms of poor psychosocial working conditions (Stansfeld and Candy 2006; Stansfeld *et al.* 2012; Wahrendorf *et al.* 2013) or general labour market disadvantage. Yet, in contrast to previous findings, the present results were not based on single-point measures or on specific characteristics of employment history (*e.g.* involuntary job losses, frequent job changes or periods of unemployment) (Bambra and Eikemo 2009; Bartley, Ferrie and Montgomery 2006; Schröder 2013; Thomas, Benzeval and Stansfeld 2005; Wahrendorf *et al.* 2013). Rather, the focus was on entire employment histories where length and embeddedness of five different occupational situations were explicitly considered. As such, the results supplement previous findings and underline the importance of continuous employment for health and wellbeing in later life, at least for men. Further, the results underline that working conditions and their health-related consequences do differ between men and women (Messing *et al.* 2003; Stansfeld *et al.* 1999).

Limitations and further research

When interpreting these findings, several aspects for possible extensions and limitations must be discussed. First, the result of a higher significance of the

work role for men compared to women requires elucidation of circumstances during the working life in more detail, in particular for women. Women may have had other significant roles beyond work as well (*e.g.* family) with equivalent importance for their wellbeing (Moen, Dempster-McClain and Williams 1992). Similarly, they may have had specific jobs during their working career (*i.e.* lower-skilled occupational positions), which may explain why long phases of full-time employment were not associated with higher quality of life in the case of women. Future analyses may thus combine other histories (*e.g.* family histories) with employment histories (Aassve, Billari and Piccarreta 2007) and include measures of occupational position. There is increasing evidence that women who integrate both employment and domestic work are healthier in later life compared to women who focus on either work or on domestic work only (McMunn, Bartley and Kuh 2006). Second, although the multi-level analyses indicate that the individual level matters more than the country level, important country differences exist that are related to work and employment conditions and to their associations with later wellbeing. In fact, a growing body of research investigates whether health differences between countries (*e.g.* the 'health disadvantage' of the United States of America; Avendano and Kawachi 2011) can be explained through particular social and labour market policies that shape individuals' working life, and which in turn exert effects on wellbeing (Börsch-Supan *et al.* 2011; Dragano, Siegrist and Wahrendorf 2011; Gallie 2007). Future analyses may address this question in more detail, in particular to elaborate on policy measures and societal circumstances shaping employment histories, including cultural values, gender specificities and the significance assigned to employment (and family) in each country (*e.g.* more pronounced 'male breadwinner' system in 'bismarckian' welfare states or higher importance of the family in southern countries; Crompton 2006). Similarly, one may also ask to what extent the present results are restricted to the sample under study (born between 1908 and 1943) only, and future analyses could additionally compare associations between different cohorts (*e.g.* baby-boomers compared to the war generation).

Another question is how do the results help to explain inequalities of health and wellbeing in later life. In this regard, it is surely necessary to extend the conducted analyses in two ways. First, albeit quality of life may be seen as an indicator that does not merely focus on the absence of disease or infirmity, and thus may follow the World Health Organization definition of health, future analyses may, on the one hand, invest other dimensions of health as well (*e.g.* disability and chronic diseases); or, on the other hand, the different dimensions of quality of life included in this study may be analysed more specifically. In fact, additional analyses (not shown in detail) reveal

that the reported effects of employment histories in this study were particularly pronounced in the case of the two dimensions of the CASP questionnaire that were related to a sense of self for older people, in terms of self-realisation and pleasure (Giddens 1991). Second, although adjustments were made in the analyses for social position during childhood and prior to the invested working career, the question as to what extent employment histories mediate an association between social position and health need to be explored in more detail. In that respect, the complex interrelations between social position over the lifecourse and specific types of employment histories (*e.g.* more continuous careers among high occupational positions) need further investigation or specific work and employment conditions need to be considered when defining occupational states (*e.g.* job industry, work stress or occupational position itself). In doing so, however, the use of sequence analysis (and its interpretation) becomes very complex, since the number of possible sequences grows extensively with the number of states (Brzinsky-Fay, Kohler and Luniak 2006). Thus, while the possibility of summarising entire employment histories must be considered as an important strength of sequence analyses, the identified types (and the used cluster variables in the regression analyses) may nevertheless bypass relevant aspects of the histories with relevance to quality of life in older ages. These ideas are further supported by the result that all the variables under study only explained a small proportion of the variance at the individual level (8%) and that only a minor part (1%) could be attributed to the employment histories as they were captured by the typologies in the analyses.

Three final limitations must be mentioned at the methodological level. First, while it was decided to use the factual transition rates to calculate the distances between each individual sequence in the analyses, other distance measures may have produced different results (Halpin 2012). Yet, additional analyses using two alternative distance measures (optimal matching and traditional hamming with different substitution and indel costs) showed similar results. Second, since data were available on an annual basis only and spells were recorded if they lasted at least six months, the diversity of employment histories (number of distinct spells) may have been underestimated, including the occurrence of short spells (*e.g.* spells of short-term unemployment). Third, albeit the sample was restricted to individuals without poor health problems prior to and during their working life, health selection cannot be ruled out as a partial explanation of the results, where healthier people have longer spells of employment and better quality of life in later life. Similarly, the definition of retirement used does not consider sources of income after leaving the labour market, and thus, one may assume that some of those who retired early did so in poor health and received

disability benefits. Yet, when considering income sources in additional analyses, no disability retirement in the sample was found. In addition, few would argue that early retirement due to disability is the dominating factor explaining the results, in particular for women, where the best quality of life was notably not found among those with continuous employment during their working life. Because a rather healthy sample was chosen, there may even have been an underestimation of the prevalence of unfavourable employment histories with less stable working careers in the case of men and conservative estimates of the association between employment histories and quality of life.

These limitations are balanced by several strengths. First, the SHARE study meets high-quality standards of data collection, specifically a vigorously controlled study protocol, the application of validated questionnaires (*e.g.* CASP), and the observation of standard procedures of translating the measures into different languages and of collecting and controlling the data (Börsch-Supan and Jürges 2005). Second, as far as known, this is the first study that uses sequence analyses to investigate employment histories and their relation to quality of life in older ages. This approach enabled the complexity of employment histories to be reduced in a meaningful way and to derive specific types of employment histories. Third, a theoretically grounded approach helped to understand and explain the findings.

In conclusion, the results of this study allowed new insights in the description of employment histories and existing differences between men and women. Furthermore, the results support that previous employment histories are associated with quality of life in older ages, pointing to the importance of a continuous employment history for later quality of life, in particular in the case of men.

Acknowledgements

This paper uses data from SHARELIFE release 1, as of 24 November 2010, or SHARE release 2.5.0, as of 24 May 2011. The SHARE data collection has been primarily funded by the European Commission through the Fifth Framework programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the Sixth Framework programme (projects SHARE-I3, RII-CT-2006-062193, COMPARE, CIT5-CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the Seventh Framework programme (SHARE-PREP, 211909 and SHARE-LEAP, 227822). Additional funding from the US National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064, IAG BSR06-11, R21 AG025169) as well as from various national sources is gratefully acknowledged (*see* www.share-project.org for a full list of funding

institutions). The present research is indebted heavily to members of the ESRC International Centre for Life Course Studies in Society and Health, in particular David Blane, Melanie Bartley, Rebecca Lacey, Anne McMunn and Amanda Sacker. This research was conducted in the frame of a post-doctoral fellowship of the German Research Foundation (Deutsche Forschungsgemeinschaft), Germany (project number Wa 3065/1-1).

References

Aassve, A., Billari, F. C. and Piccarreta, R. 2007. Strings of adulthood: a sequence analysis of young British women's work–family trajectories. *European Journal of Population–Revue Europeenne De Demographie*, **23**, 3/4, 369–8.

Abbott, A. 1995. Sequence-analysis – new methods for old ideas. *Annual Review of Sociology*, **21**, 93–113.

Abbott, A. and Tsay, A. 2000. Sequence analysis and optimal matching methods in sociology – review and prospect. *Sociological Methods & Research*, **29**, 1, 3–33.

Aisenbrey, S. and Fasang, A. E. 2010. New life for old ideas: the 'second wave' of sequence analysis bringing the 'course' back into the life course. *Sociological Methods & Research*, **38**, 4, 652–4.

Antoniou, A. S. and Cooper, C. 2005. *Research Companion to Organizational Health Psychology*. Edward Elgar Publishers, Cheltenham, UK.

Arndt, V., Rothenbacher, D., Daniel, U., Zschenderlein, B., Schuberth, S. and Brenner, H. 2005. Construction work and risk of occupational disability: a ten year follow up of 14,474 male workers. *Occupational and Environmental Medicine*, **62**, 8, 559–66.

Avendano, M., Glymour, M. M., Banks, J. and Mackenbach, J. P. 2009. Health disadvantage in US adults aged 50 to 74 years: a comparison of the health of rich and poor Americans with that of Europeans. *American Journal of Public Health*, **99**, 3, 540–8.

Avendano, M. and Kawachi, I. 2011. Invited commentary: the search for explanations of the American health disadvantage relative to the English. *American Journal of Epidemiology*, **173**, 8, 866–9.

Bambra, C. and Eikemo, T. A. 2009. Welfare state regimes, unemployment and health: a comparative study of the relationship between unemployment and self-reported health in 23 European countries. *Journal of Epidemiology and Community Health*, **63**, 2, 92–8.

Banks, J., Marmot, M., Oldfield, Z. and Smith, J. P. 2006. Disease and disadvantage in the United States and in England. *Journal of the American Medical Association*, **295**, 17, 2037–45.

Bartley, M., Ferrie, J. and Montgomery, S. M. 2006. Health and labour market disadvantage: unemployment, non-employment, and job insecurity. In Marmot, M. and Wilkinson, R. (eds), *Social Determinants of Health*. Oxford University Press, Oxford, 78–96.

Bartley, M. and Plewis, I. 2002. Accumulated labour market disadvantage and limiting long-term illness: data from the 1971–1991 Office for National Statistics' Longitudinal Study. *International Journal of Epidemiology*, **31**, 2, 336–41.

Baumgarten, M., Siemiatycki, J. and Gibbs, G. W. 1983. Validity of work histories obtained by interview for epidemiologic purposes. *American Journal of Epidemiology*, **118**, 4, 583–91.

Berkman, L. F. and Glass, T. A. 2000. Social Integration, Social Networks, Social Support, and Health. In Berkman, L. F. and Kawachi, I. (eds), *Social Epidemiology*. Oxford University Press, Oxford, 137–173.

Berney, L. R. and Blane, D. B. 1997. Collecting retrospective data: accuracy of recall after 50 years judged against historical records. *Social Science & Medicine*, **45**, 10, 1519–25.

Blane, D. B. 1996. Collecting retrospective data: development of a reliable method and a pilot study of its use. *Social Science & Medicine*, **42**, 5, 751–7.

Blane, D. 2006. The life course, the social gradient, and health. In Marmot, M. and Wilkinson, R. (eds), *Social Determinants of Health*. Oxford University Press, Oxford, 54–77.

Börsch-Supan, A., Brandt, M., Hank, K. and Schröder, M. 2011. *The Individual and the Welfare State. Life Histories in Europe*. Springer, Berlin.

Börsch-Supan, A. and Jürges, H. 2005. *The Survey of Health, Aging and Retirement in Europe– Methodology*. Mannheim Research Institute for the Economics of Ageing, Mannheim, Germany.

Bourbonnais, R., Meyer, F. and Theriault, G. 1988. Validity of self reported work history. *British Journal of Industrial Medicine*, **45**, 1, 29–32.

Breeze, E., Fletcher, A. E., Leon, D. A., Marmot, M. G., Clarke, R. J. and Shipley, M. J. 2001. Do socioeconomic disadvantages persist into old age? Self-reported morbidity in a 29-year follow-up of the Whitehall Study. *American Journal of Public Health*, **91**, 2, 277–83.

Brzinsky-Fay, C., Kohler, U. and Luniak, M. 2006. Sequence analysis with Stata. *Stata Journal*, **6**, 4, 435–60.

Cambois, E. and Jusot, F. 2011. Contribution of lifelong adverse experiences to social health inequalities: findings from a population survey in France. *European Journal of Public Health*, **21**, 5, 667–73.

Chandola, T., Brunner, E. and Marmot, M. 2006. Chronic stress at work and the metabolic syndrome: prospective study. *British Medical Journal*, **332**, 7540, 521–4.

Crompton, R. 2006. *Employment and the Family: The Reconfiguration of Work and Family Life in Contemporary Societies*. Cambridge University Press, Cambridge.

Domenighetti, G., D'Avanzo, B. and Bisig, B. 2000. Health effects of job insecurity among employees in the Swiss general population. *International Journal of Health Services*, **30**, 3, 477–90.

Dragano, N., Siegrist, J. and Wahrendorf, M. 2011. Welfare regimes, labour policies and unhealthy psychosocial working conditions: a comparative study with 9917 older employees from 12 European countries. *Journal of Epidemiology and Community Health*, **65**, 9, 793–9.

Ekerdt, D. J. and Deviney, S. 1990. On defining persons as retired. *Journal of Aging Studies*, **4**, 3, 211–29.

Elder, G. H. and Johnson, M. K. 2002. The life course and aging: challenges, lessons, and new directions. In Settersten, R. (ed.), *Invitation to the Life Course: Toward New Understandings of Later Life, Part II*. Baywood, New York, 49–81.

Elder, G. H., Johnson, M. K. and Crosnoe, R. 2003. The emergence and development of life course theory. In Mortimer, J. T. and Shanahan, M. J. (eds), *Handbook of the life course*. Kluwer Academic, New York, 3–19.

Eurofound 2012. *Fifth European Working Conditions Survey*. Publications Office of the European Union, Luxembourg.

Ferrie, J. E., Shipley, M. J., Marmot, M. G., Stansfeld, S. and Davey Smith, G. 1998. The health effects of major organisational change and job insecurity. *Social Science & Medicine*, **46**, 2, 243–54.

Gallie, D. 2007. *Employment Regimes and Quality of Work*. Oxford University Press, Oxford.
Giddens, A. 1991. *Modernity and Self-identity: Self and Society in the Late Modern Age*. Polity Press, Cambridge.
Haidt, J. and Rodin, J. 1999. Control and efficacy as interdisciplinary bridges. *Review of General Psychology*, **3**, 4, 317–37.
Halpin, B. 2012. *Sequence Analysis of Life-course Data: A Comparison of Distance Measures*. University of Limerick Department of Sociology Working Paper WP2012-02. Available online at http://www.ul.ie/sociology/pubs/wp2012-02.pdf [Accessed 16 January 2014].
Havari, E. and Mazzona, F. 2011. Can we trust older people's statements on their childhood circumstances? Evidence from SHARELIFE. SHARE Working Paper Series 05-2011, Mannheim Research Institute for the Economics of Ageing, Mannheim, Germany.
Head, J., Stansfeld, S. A. and Siegrist, J. 2004. The psychosocial work environment and alcohol dependence: a prospective study. *Occupational and Environmental Medicine*, **61**, 3, 219–24.
Hyde, M., Wiggins, R. D., Higgs, P. and Blane, D. B. 2003. A measure of quality of life in early old age: the theory, development and properties of a needs satisfaction model (CASP-19). *Aging & Mental Health*, **7**, 3, 186–94.
Kahn, J. R. and Pearlin, L. I. 2006. Financial strain over the life course and health among older adults. *Journal of Health and Social Behavior*, **47**, 1, 17–31.
Kivimaki, M., Nyberg, S. T., Batty, G. D., Fransson, E. I., Heikkila, K., Alfredsson, L., Bjorner, J. B., Borritz, M., Burr, H., Casini, A., Clays, E., De Bacquer, D., Dragano, N., Ferrie, J. E., Geuskens, G. A., Goldberg, M., Hamer, M., Hooftman, W. E., Houtman, I. L., Joensuu, M., Jokela, M., Kittel, F., Knutsson, A., Koskenvuo, M., Koskinen, A., Kouvonen, A., Kumari, M., Madsen, I. E., Marmot, M. G., Nielsen, M. L., Nordin, M., Oksanen, T., Pentti, J., Rugulies, R., Salo, P., Siegrist, J., Singh-Manoux, A., Suominen, S. B., Vaananen, A., Vahtera, J., Virtanen, M., Westerholm, P. J., Westerlund, H., Zins, M., Steptoe, A., Theorell, T. and Consortium, I. P.-W. 2012. Job strain as a risk factor for coronary heart disease: a collaborative meta-analysis of individual participant data. *Lancet*, **380**, 9852, 1491–7.
Knesebeck, O. v. d., Wahrendorf, M., Hyde, M. and Siegrist, J. 2007. Socio-economic position and quality of life among older people in 10 European countries: results of the SHARE study. *Ageing & Society*, **27**, 2, 269–84.
Krause, N. 2004. Stressors arising in highly valued roles, meaning in life, and the physical health status of older adults. *Journals of Gerontology: Psychological Sciences and Social Sciences*, **59B**, 5, 287–97.
Laslett, P. 1996. *A Fresh Map of Life*. Macmillan, London.
Lesnard, L. 2010. Setting cost in optimal matching to uncover contemporaneous socio-temporal patterns. *Sociological Methods & Research*, **38**, 3, 389–419.
Lyberaki, A., Tinios, P. and Papadoudis, G. 2013. Retrospective explanation of older women's lifetime work involvement: individual paths around social norms. *Advances in Life Course Research*, **18**, 1, 26–45.
Macmillan, R. 2005. *The Structure of the Life Course: Standardized? Individualized? Differentiated?* Elsevier JAI, Amsterdam.
Marmot, M., Siegrist, J. and Theorell, T. 2006. Health and the psychosocial environment at work. In Marmot, M. and Wilkinson, R. (eds), *Social Determinants of Health*. Oxford University Press, Oxford, 97–130.
McMunn, A., Bartley, M. and Kuh, D. 2006. Women's health in mid-life: life course social roles and agency as quality. *Social Science & Medicine*, **63**, 6, 1561–72.

McMunn, A., Breeze, E., Goodman, A. and Nazroo, J. 2006. Social determinants of health in older age. In Marmot, M. and Wilkinson, R. (eds), *Social Determinants of Health*. Oxford University Press, Oxford, 267–98.

Melchior, M., Berkman, L. F., Kawachi, I., Krieger, N., Zins, M., Bonenfant, S. and Goldberg, M. 2006. Lifelong socioeconomic trajectory and premature mortality (35–65 years) in France: findings from the GAZEL Cohort Study. *Journal of Epidemiology and Community Health*, **60**, 11, 937–44.

Messing, K., Punnett, L., Bond, M., Alexanderson, K., Pyle, J., Zahm, S., Wegman, D., Stock, S. R. and de Grosbois, S. 2003. Be the fairest of them all: challenges and recommendations for the treatment of gender in occupational health research. *American Journal of Industrial Medicine*, **43**, 6, 618–29.

Moen, P., Dempster-McClain, D. and Williams, R. M. Jr. 1992. Successful aging: a life-course perspective on women's multiples roles and resilience. *American Journal of Sociology*, **97**, 6, 1612–38.

Paccagnella, O. and Weber, G. 2005. Income imputation. In Börsch-Supan, A., Brugiavini, A., Jürges, H., Mackenbach, J., Siegrist, J. and Weber, G. (eds), *Health, Ageing and Retirement in Europe. First Results from the Survey of Health, Ageing and Retirement in Europe*. Mannheim Research Institute for the Economics of Ageing, Mannheim, Germany, 357–8.

Platts, L. G., Netuveli, G., Webb, E., Zins, M., Goldberg, M., Blane, D. and Wahrendorf, M. 2013. Physical occupational exposures during working life and quality of life after labour market exit: results from the GAZEL study. *Aging & Mental Health*, **17**, 6, 697–706.

Power, C. and Kuh, D. 2006. Life course development of unequal health. In Siegrist, J. and Marmot, M. (eds), *Social Inequalities in Health: New Evidence and Policy Implications*. Oxford University Press, Oxford, 27–53.

Sackmann, R. and Wingens, M. 2003. From transitions to trajectories. Sequence types. In Heinz, W. R. and Marshall, V. W. (eds), *Social Dynamics of the Life Course. Transitions, Institutions, and Interrelations*. Aldine de Gruyter, New York, 93–115.

Schikowski, T., Sugiri, D., Reimann, V., Pesch, B., Ranft, U. and Kramer, U. 2008. Contribution of smoking and air pollution exposure in urban areas to social differences in respiratory health. *BMC Public Health*, **8**, 179.

Schnall, P., Dobson, M. and Rosskam, E. 2009. *Unhealthy Work: Causes, Consequences, Cures*. Baywood, Amityville, New York.

Scholes, S., Medina, J., Cheshire, H., Cox, K., Hacker, E. and Lessof, C. 2009. *Living in the 21st century: older people in England. The 2006 English Longitudinal Study of Ageing Technical Report*. National Centre for Social Research, London.

Schröder, M. 2011. *Retrospective Data Collection in the Survey of Health, Ageing and Retirement in Europe. SHARELIFE Methodology*. Mannheim Research Institute for the Economics of Ageing, Mannheim, Germany.

Schröder, M. 2013. Jobless now, sick later? Investigating the long-term consequences of involuntary job loss on health. *Advances in Life Course Research*, **18**, 1, 5–15.

Schwatka, N. V., Butler, L. M. and Rosecrance, J. R. 2012. An aging workforce and injury in the construction industry. *Epidemiologic Reviews*, **34**, 1, 156–67.

Shannon, C. E. 1948. A mathematical theory of communication. *Bell System Technical Journal*, **27**, 3, 379–423.

Siegrist, J. 2005. Social reciprocity and health: new scientific evidence and policy implications. *Psychoneuroendocrinology*, **30**, 10, 1033–8.

Siegrist, J. 2009. Job control and reward. Effects on well-being. In Cartwright, S. and Cooper, C. (eds), *The Oxford Handbook of Organizational Well-Being*. Oxford University Press, Oxford, 109–32.

Siegrist, J. and Marmot, M. 2004. Health inequalities and the psychosocial environment – two scientific challenges. *Social Science & Medicine*, **58**, 8, 1463–73.
Siegrist, J. and Marmot, M. G. 2006. *Social Inequalities in Health: New Evidence and Policy Implications*. Oxford University Press, Oxford.
Skrondal, A. and Rabe-Hesketh, S. 2010. *Multilevel Modelling*. Sage, Los Angeles.
Smith, G. D., Hart, C., Blane, D., Gillis, C. and Hawthorne, V. 1997. Lifetime socioeconomic position and mortality: prospective observational study. *British Medical Journal*, **314**, 7080, 547.
Snijders, T. and Bosker, R. 1994. Modeled variance in two-level models. *Sociological Methods & Research*, **22**, 3, 342–63.
Stansfeld, S. and Candy, B. 2006. Psychosocial work environment and mental health – a meta-analytic review. *Scandinavian Journal of Work Environment & Health*, **32**, 6, 443–62.
Stansfeld, S. A., Fuhrer, R., Shipley, M. J. and Marmot, M. G. 1999. Work characteristics predict psychiatric disorder: prospective results from the Whitehall II Study. *Occupational & Environmental Medicine*, **56**, 5, 302–7.
Stansfeld, S. A., Shipley, M. J., Head, J. and Fuhrer, R. 2012. Repeated job strain and the risk of depression: longitudinal analyses from the Whitehall II Study. *American Journal of Public Health*, **102**, 12, 2360–6.
Steptoe, A. and Kivimaki, M. 2012. Stress and cardiovascular disease. *Nature Review Cardiology*, **9**, 6, 360–70.
Studer, M., Ritschard, G., Gabadinho, A. and Muller, N. S. 2011. Discrepancy analysis of state sequences. *Sociological Methods & Research*, **40**, 3, 471–510.
Thomas, C., Benzeval, M. and Stansfeld, S. A. 2005. Employment transitions and mental health: an analysis from the British household panel survey. *Journal of Epidemiology and Community Health*, **59**, 3, 243–9.
van Doorslaer, E., Koolman, X. and Jones, A. M. 2004. Explaining income-related inequalities in doctor utilisation in Europe. *Health Economics*, **13**, 7, 629–47.
Wahrendorf, M., Blane, D., Bartley, M., Dragano, N. and Siegrist, J. 2013. Working conditions in mid-life and mental health in older ages. *Advances in Life Course Research*, **18**, 1, 16–25.
Wahrendorf, M., Dragano, N. and Siegrist, J. 2013. Social position, work stress, and retirement intentions: a study with older employees from 11 European countries. *European Sociological Review*, **29**, 4, 792–802.
Wahrendorf, M., Sembajwe, G., Zins, M., Berkman, L., Goldberg, M. and Siegrist, J. 2012. Long-term effects of psychosocial work stress in midlife on health functioning after labor market exit – results from the GAZEL study. *Journals of Gerontology: Psychological Sciences and Social Sciences*, **67B**, 4, 471–80.
Westerlund, H., Kivimaki, M., Singh-Manoux, A., Melchior, M., Ferrie, J. E., Pentti, J., Jokela, M., Leineweber, C., Goldberg, M., Zins, M. and Vahtera, J. 2009. Self-rated health before and after retirement in France (GAZEL): a cohort study. *The Lancet*, **374**, 9705, 1889–96.
Widmer, E. D. and Ritschard, G. 2009. The de-standardization of the life course: are men and women equal? *Advances in Life Course Research*, **14**, 1/2, 28–39.
Wiggins, R. D., Erzberger, C., Hyde, M., Higgs, P. and Blane, D. 2007. Optimal matching analysis using ideal types to describe the lifecourse: an illustration of how histories of work, partnerships and housing relate to quality of life in early old age. *International Journal of Social Research Methodology*, **10**, 4, 259–78.
Wiggins, R. D., Netuveli, G., Hyde, M., Higgs, P. and Blane, D. 2008. The evaluation of a self-enumerated scale of quality of life (CASP-19) in the context of research

on ageing: a combination of exploratory and confirmatory approaches. *Social Indicators Research*, **89**, 1, 61–77.

Accepted 9 June 2014; first published online 18 July 2014

Address for correspondence:
Morten Wahrendorf,
International Centre for Life Course Studies in Society and Health,
Research Department of Epidemiology and Public Health,
University College London, 1–19 Torrington Place,
London WC1E 6BT, UK.

E-mail: m.wahrendorf@ucl.ac.uk

5. **Wahrendorf M.**, & Blane D. (2015). "Does labour market disadvantage help to explain why childhood circumstances are related to quality of life at older ages? Results from SHARE." *Aging & Mental Health* 19:584-594.

   Impact-Faktor: 1.86

Aging & Mental Health, 2015
Vol. 19, No. 7, 584–594, http://dx.doi.org/10.1080/13607863.2014.938604

Routledge
Taylor & Francis Group

Does labour market disadvantage help to explain why childhood circumstances are related to quality of life at older ages? Results from SHARE

Morten Wahrendorf[a]* and David Blane[b]

[a]*Centre for Health and Society, Institute for Medical Sociology, University of Düsseldorf, Düsseldorf, Germany;* [b]*Department of Epidemiology and Public Health, International Centre for Life Course Studies in Society and Health, University College London, London, United Kingdom*

(*Received 28 February 2014; accepted 17 June 2014*)

There is robust evidence that childhood circumstances are related to quality of life in older ages, but the role of possible intermediate factors is less explored. In this paper, we examine to what extent associations between deprived childhood circumstances and quality of life at older ages are due to experienced labour market disadvantage during adulthood. Analyses are based on the Survey of Health Ageing and Retirement in Europe (SHARE), with detailed retrospective information on individual life courses collected among 10,272 retired men and women in 13 European countries (2008–2009). Our assumption is that those who have spent their childhood in deprived circumstances may also have had more labour market disadvantage with negative consequences for quality of life beyond working life. Results demonstrate that advantaged circumstances during childhood are associated with lower levels of labour market disadvantage and higher quality of life in older ages. Furthermore, results of multivariate analyses support the idea that part of the association between childhood circumstances and later quality of life is explained by labour market disadvantage during adulthood.

Keywords: CASP; life course; labour market disadvantage

Introduction

Today's older people will live longer than any previous generation in Europe. In most European countries a 60-year-old woman or man can expect to live another 20 years, and in some of these even longer (Eurostat, 2013). This development is combined with the hope that the prolonged length of life is accompanied by good subjective quality of life. Unfortunately, for many older women and men, longer lives do not lead to this positive scenario, but rather to prolonged periods of morbidity (Wahrendorf, Reinhardt, & Siegrist, 2013) and lower levels of quality of life (Niedzwiedz, Katikireddi, Pell, & Mitchell, 2014; von dem Knesebeck, Wahrendorf, Hyde, & Siegrist, 2007). It has been shown that this is particularly the case for those who experienced less advantaged social and economic circumstances at earlier stages of their life course (Berney et al., 2000; Brandt, Deindl, & Hank, 2012; Mc Munn, Breeze, Goodman, & Nazroo, 2006; von dem Knesebeck et al., 2007 BreezeGoodmanNazroo), including adulthood and childhood social position (for a review see Niedzwiedz, Katikireddi, Pell, & Mitchell, 2012). However, few life course studies address possible pathways and ask what intermediate factors may explain the association between early disadvantage and later quality of life. For instance, those who have spent their childhood in deprived circumstances may also have had particular employment histories and thereby been exposed to more labour market disadvantage over the life course, with long-term consequences for quality of life.

In fact, studies have documented that social position in early life exerts important effects on educational achievements (Duncan, Yeung, Brooks-Gunn, & Smith, 1998), as well as on employment histories and the risk of labour market disadvantage later on. More specifically, research found effects of childhood poverty on youth unemployment (Caspi, Wright, Moffitt, & Silva, 1998), financial difficulties in early and middle adulthood (Kuh, Head, Hardy, & Wadsworth, 1997; Kuh & Wadsworth, 1991), job insecurity (Power & Matthews, 1997) and higher level of psychosocial stress at work (Elovainio et al., 2007). These findings are in line with existing ideas of cumulative disadvantages over the life course, where early disadvantage leads to an accumulation of subsequent disadvantages (Dannefer, 2003; Ferraro & Shippee, 2009). At the same time, there is increasing evidence that work and employment-circumstances over the life course are related to health and quality of life beyond working life, in particular for men. This includes unstable working careers, periods of unemployment and poor psychosocial conditions (Schröder, 2011b; Wahrendorf et al., 2013), as well as physical hazards at work (Platts et al., 2013).

Yet, as most studies are based on prospective cohorts (particularly birth cohorts that have yet to reach old age) the complex interrelations between childhood circumstances, labour market disadvantages and quality of life beyond working life are still relatively unexplored. More specifically, information about employment histories is restricted to either early or middle adulthood (Blane, Wahrendorf, Webb, & Netuveli, 2012), without

*Corresponding author. Email: wahrendorf@uni-duesseldorf.de

information on quality of life beyond work (in the case of birth cohorts), or work-related factors are limited to the recent past without information on childhood circumstances (in the case of occupational cohorts). This leaves a gap of knowledge about longer term effects of adversity in early life on people's occupational careers and, additionally, about their effects on quality of life after labour market exit. An attempt to overcome this limitation is to use retrospective data, asking older men and women who already left the labour market about previous childhood conditions and entire employment history. In fact, there has been important methodological progress in collecting such data (Blane, 1996), and current research has shown promising findings (Börsch-Supan, Brandt, Hank, & Schröder, 2011; Börsch-Supan, Brandt, & Schroder, 2013). For example, one recent study used retrospective information on employment histories to show that education (usually related to social position in early midlife) is associated with higher levels of labour market disadvantage throughout working life, in terms of involuntary job loss, unemployment and a disadvantaged occupational position (Dragano & Wahrendorf, 2014). In this paper, we set out to extend this research by additionally including indicators of early childhood circumstances (Chittleborough, Baum, Taylor, & Hiller, 2006; Galobardes, Lynch, & Davey Smith, 2004), and by studying their links with quality of life after labour market exit.

Aims

Along these lines, the first aim of this article is to study the association between deprived childhood circumstances and quality of life in older ages. Quality of life is measured by a short version of the CASP questionnaire (Hyde, Wiggins, Higgs, & Blane, 2003). Drawing on the literature of ageing (Laslett, 1996) and a theory of human needs (Doyal & Gough, 1991), this measure defines quality of life as the degree to which four human needs are satisfied: control, autonomy, self-realization and pleasure (see 'Methods' section for conceptual details). As a second aim, we study to what extent an association between childhood circumstances and quality of life can be explained by labour market disadvantage over working life. We hypothesize that children growing up in a context of socioeconomic adversity are more likely to face labour market disadvantage over working life and that these conditions enhance the probability of lower quality of life after labour market exit. This assumption follows the existing framework of cumulative disadvantages over the life course, where early advantages or disadvantages shape individual trajectories over the life course and lead to an accumulation of risk factors over the life course, with long-lasting effects on quality of life in later life (Dannefer, 2003; Ferraro & Shippee, 2009).

Taken together we study the two interrelated research questions:

(1) Is there an association between childhood circumstances and quality of life at older ages?

(2) If so, to what extent can this association be explained by labour market disadvantage during adulthood?

Methods

Data sources

We used third wave data from the Survey of Health, Ageing and Retirement in Europe (SHARE), collected during 2008−2009, that we combined with information on quality of life assessed in wave 2 from 2006 to 2007. SHARE is the first cross-national research project collecting data on a variety of sociological, economic and health-related topics among older adults in Europe. The survey started in 2004−2005 in 11 countries (Sweden, Denmark, Germany, the Netherlands, Belgium, France, Switzerland, Austria, Italy, Spain and Greece), with ongoing waves of data collection in two-year intervals. Two new countries joined SHARE in wave 2 (Czech Republic and Poland). In each country, samples consist of a probability household sample, with individuals aged 50 years or older plus their (possibly younger) partners. New cohorts (so-called 'refreshers') are added subsequently to maintain population representation. In contrast to waves 1 and 2, the third wave of SHARE consists in a detailed retrospective assessment of respondents' previous life (also called SHARELIFE) (Börsch-Supan et al., 2013). This includes information on childhood and previous employment histories among those who have left the labour market. With regard to survey participation, response rates of SHARE are generally above average compared to other European surveys (Börsch-Supan & Jürges, 2005). At study onset the household response rates were 61% for the total sample ranging from 81% in France to 39% in Switzerland, with rates above 50% in eight countries. With respect to attrition between waves 2 and 3, the percentage of respondents lost varied between 34% (Austria) and 14% (Switzerland), with rates below 20% in seven countries (Schröder, 2011a). Retrospective data were collected by a lifegrid, where recall and timing of major information is supported by a graphical representation of a respondent's life, filled in during the course of the interview. The method was developed first as a self-completion questionnaire (Blane, 1996), and subsequently transformed into a Computer Assisted Personal Interviews (CAPI) by the UK National Centre for Social Research (Scholes et al., 2009). The latter was adopted for SHARELIFE (Schröder, 2011a). Although recall bias is a disadvantage of data based on retrospective questions, this approach has several advantages. First, it represents a fast and less expensive method to obtain longitudinal information. Second, it guarantees comparable information referring to different time points in respondents' life histories (without missing data due to panel attrition). Third, validation studies revealed high accuracy of recalled information, in particular when asking about socio-demographic conditions (Berney & Blane, 1997; Havari & Mazzona, 2011) and employment histories (Baumgarten, Siemiatycki, & Gibbs, 1983; Bourbonnais, Meyer, & Theriault, 1988). More details about SHARE and its methods are available online (www.share-project.org).

Respondents

In total, 26.836 participants were interviewed at wave 3. For the analyses we considered only people who had left the labour market when measuring quality of life. This serves our aim to study quality of life beyond working life. Furthermore, respondents were only included if they documented an employment history of at least five years. Otherwise, information on previous employment histories was not considered to be of sufficient importance. Moreover, we excluded respondents older than 80 years when answering the lifegrid questionnaire. This restriction helped to avoid a sample bias because people over 80 years may have had more favourable employment histories with later mortality (all analyses were calculated with a sample including people over 80 years as well, but findings remain unchanged). Finally, we excluded respondents when the interviewer documented respondent difficulties in answering the lifegrid questionnaire (about 4% of the total sample). These restrictions resulted in a final sample with full available data of 4808 men and 5463 women ($N = 10{,}271$) born between 1928 and 1947.

Measures

Quality of life in older ages

Quality of life was measured by CASP-12v.1, a short version of the CASP-19 questionnaire. One of the innovations of SHARE was the inclusion of this measure – a psychometrically validated short version of the original 19 item version (CASP-19) (Hyde et al., 2003; Wiggins, Netuveli, Hyde, Higgs, & Blane, 2008). An important characteristic of this instrument is that it does not focus on respondents' self-evaluation of quality of life, nor does it measure quality of life using measures of health as proxies. It rather identifies four domains of human needs (Doyal & Gough, 1991) that are relevant in later life. These needs refer to different strands of the literature on ageing; first, the new opportunities of the third age compared to former stages in life (Laslett, 1996), and second, the literature of Giddens (1991) and the role of older people in a rapidly changing society. The four domains are: control (C), autonomy (A), self-realization (S) and pleasure (P). The experience of these aspects (over the past four weeks) is measured with 12 questionnaire items (three for each domain) which are scored on a four-point Likert scale. A summary measure of the 12 items is used to assess quality of life in this study where the total sum score ranges from 0 to 36, with higher scores indicating better quality of life. In our sample Cronbach's alpha was 0.81 for men and 0.82 for women. Details on psychometric properties of CASP-19 and on its conceptual basis are fully described elsewhere (Higgs, Hyde, Wiggins, & Blane, 2003; Hyde et al., 2003).

Childhood circumstances

This variable is measured by an index combining four binary indicators of adverse socio-economic conditions during childhood. All single measures reflect the respondents' conditions when they were 10 years old. The following items were used, all based on measures of previous studies that assessed the long-term effects of childhood social position on health during adulthood (Chittleborough et al., 2006; Dedman, Gunnell, Smith, & Frankel, 2001; Evans, Kelley, Sikora, & Treiman, 2010; Marsh, 1999). First, we included the occupational position of the main breadwinner, as assessed by the 10 main occupational groups of the International Standard Classification of Occupations (ISCO). As in a previous article (Wahrendorf, Blane, Bartley, Dragano, & Siegrist, 2013), these groups were reclassified according to the different skill levels, representing the broad hierarchical structure of ISCO, which we regrouped into low (first and second skill levels) and high (third and fourth skill levels) occupational positions. Second, respondents were asked to report the number of books at home, using the category 'less than 10 books' as an indicator of social disadvantage (Evans et al., 2010). Third, a measure of overcrowding was generated by combining information on the number of people living in the household with number of available rooms (excluding kitchen, bathrooms and hallways). Overcrowding was coded in all cases where more than one person per room lived in the household (Marsh, 1999). Finally, housing quality was explored, where poor quality was rated when none of the following characteristics was available: fixed bath, cold running water supply, hot running water supply, inside toilet and central heating (Dedman et al., 2001). Based on this information, a five-categorical variable of childhood circumstances was constructed, ranging from 'most advantaged' to 'most disadvantaged'.

Labour market disadvantage

From detailed information on individual employment histories available in SHARELIFE we developed an index of labour market disadvantage, based on the following four items. The first item asked whether an involuntary job loss occurred as a consequence of being laid off. With the second item, involuntary job loss due to plant closure was assessed. Third, we measured the occupational position in respondents' main job, again based on the ISCO classification (which we regrouped into two categories 'low and high occupational position' as described above). With the fourth item an episode of unemployment lasting at least six months was registered. By combining these four items, we defined five possible levels of labour market disadvantage, ranging from 'none', 'mild', 'moderate', 'severe' to 'very severe' disadvantage.

Additional variables

In addition to age and sex, we included functional limitations, education and a variable measuring respondents' partnership history. Functional limitation was measured in the same year when measuring quality of life with the Global Activity Limitation Indicator (GALI) index (Jagger et al., 2010). Education was measured according to the International Standard Classification of Educational

Degrees (ISCED-97) that we regrouped into 'low education' (pre-primary, primary or lower secondary education), 'medium education' (secondary or post-secondary education) and 'high education' (first and second stage of tertiary education). In the case of partnership history, we combined information of whether the respondents lived with a partner at the age of 30 and 50 (without considering the marital status), resulting in a four-categorical variable.

Analyses

All analyses are conducted for men and women separately and we start with a basic sample description (Table 1). Then we present average scores of quality of life (mean CASP score) by childhood circumstances and levels of labour market disadvantage (Figure 1). In these (and subsequent) analyses the two highest levels of labour market disadvantage ('severe' and 'very severe') were combined due to low frequencies, thus, leading to four categories. In the following, we study if deprived childhood circumstances are related to more disadvantaged labour market histories (Figure 2).

We then estimate a series of multilevel linear models using quality of life as dependent variable with individuals (level 1) nested in countries (level 2) (Rabe-Hesketh & Skrondal, 2005). Using multilevel modelling allows for accurate adjustment for country affiliation, because the constant is allowed to vary across countries. This is important for our analyses, because of previously reported country variations of quality of life in SHARE (von dem Knesebeck et al., 2007). In addition, variations of quality of life can be studied at each level separately (within- and between-country variations). In sum, we estimate five different models. The first model contains a constant term only and quantifies the amount of variation of quality of life at each level (empty model). Models 1 and 2 present the adjusted effects for childhood circumstances (Model 1) and levels of labour market disadvantage (Model 2), both included as categorical variables (broken into dummies) and adjusted for sex, age, age square and partnership history. In Model 3 we additionally include labour market disadvantage and study our main research questions, that is, to what degree the association between deprived childhood circumstances and quality of life is explained by labour market disadvantage. In addition, we perform a formal test of mediation for multilevel models (Krull & MacKinnon, 2001) and test the significance of an indirect effect of childhood disadvantages via labour market disadvantage (both treated linear in this case) based on bootstrapping with 5000 replications. In Model

Table 1. Sample description: percentages and frequencies (*N*) or mean scores and standard deviation (SD) for men and women ($N = 10{,}271$).

		Men $N = 4808$		Women $N = 5463$	
Variables	Categories or range	% or (mean)	*N* or (SD)	% or (mean)	*N* or (SD)
CASP	0–36	25.5	(6.1)	24.9	(6.3)
Age	50–80	68.9	(6.3)	66.9	(7.1)
Partner	At 30 and 50	79.3	3812	83.8	4580
	At 30 but not 50	2.7	131	5	273
	Not at 30 but 50	12.9	620	5.9	323
	Not at 30 and 50	5.1	245	5.3	287
Functional limitations	Not limited	57.5	2766	52.5	2876
	Limited	42.5	2042	47.5	2596
Education	Low	46.8	2251	53.0	2898
	Medium	34.1	1638	33.4	1823
	High	19.1	919	13.6	742
Childhood circumstances	Most advantaged	4.8	231	4.5	247
	Advantaged	15.1	724	16.5	902
	Neutral	29.4	1415	33.7	1844
	Disadvantaged	27.3	1312	25.7	1402
	Most disadvantaged	23.4	1126	19.5	1068
Labour market disadvantage	None	23.6	1134	13.6	741
	Mild	57.5	2763	68.5	3742
	Moderate	15.1	726	14.0	766
	Severe	3.3	161	3.5	192
	Very severe	0.5	24	0.4	22

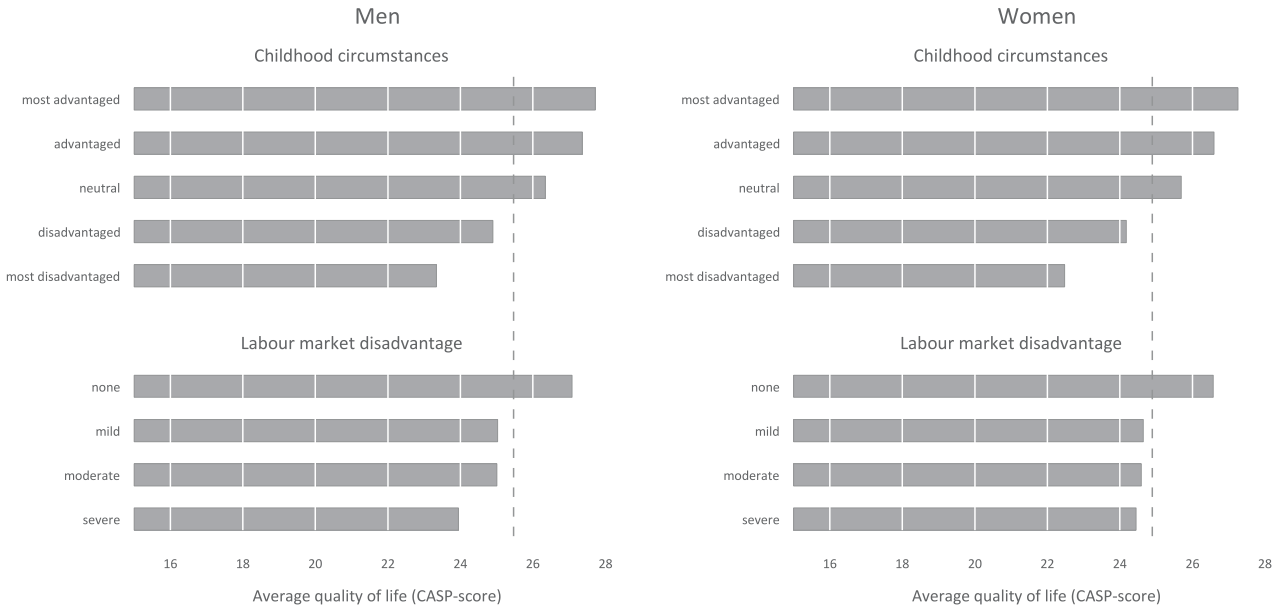


Figure 1. Quality of life by childhood circumstances and labour market disadvantage for men ($N = 4808$) and women ($N = 5463$). Note: Dashed line presents overall averages in quality of life for men and women.

4 we finally include functional limitations and education. Results of multilevel regressions are presented in Table 2 for women and Table 3 for men, where we present the estimated unstandardized regression coefficients, together with standard errors and level of statistical significance. For each model the log likelihood, the AIC (Akaike Information Criterion) and the BIC (Bayesian Information Criterion) statistics are indicated, and the proportional reduction of variance explained at each level (R_1^2, R_2^2) is reported (Snijders & Bosker, 1994).

In a final step, we summarize the main findings of our study for both men and women in Figure 3, where estimates of childhood circumstances are presented – before and after adjustments for labour market disadvantage.

Results

Sample description

Our sample included slightly less men than women (4808 men vs. 5463 women). Men were on average two years older (69 vs. 67 years) at the time of the SHARELIFE interview. Quality of life was slightly better for men as compared to women. No systematic differences between men and women were found for the remaining variables, except for men reporting slightly higher levels of education and being more likely to report functional limitations (see Table 1 for details). Levels of labour market disadvantage were rather low, with less than 1% experiencing very severe disadvantage only. Therefore, subsequent analyses combined the two highest levels of labour market disadvantage.

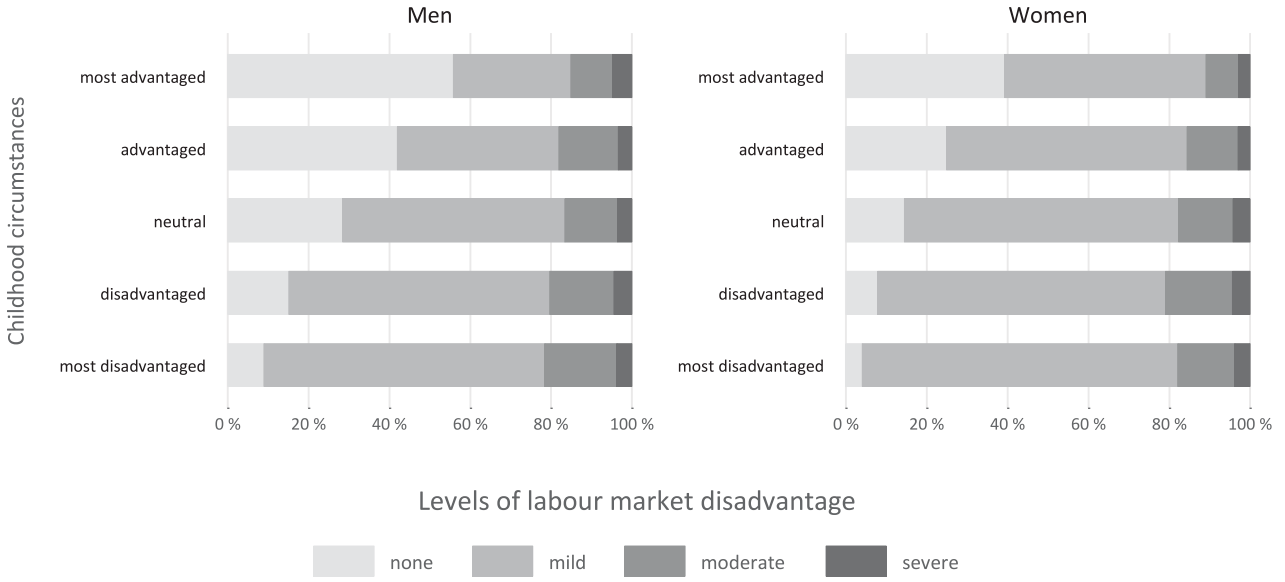


Figure 2. Percentages of labour market disadvantage by childhood circumstances for men ($N = 4808$) and women ($N = 5463$).

Table 2. Multilevel estimates for quality of life in older ages for women: regression coefficients (b) and standard errors (SE) ($N = 5463$).

Model		Empty model		Model 1		Model 2		Model 3		Model 4	
				b	(SE)	b	(SE)	b	(SE)	b	(SE)
Fixed parameters											
Age				1.21***	(0.19)	1.09***	(0.18)	1.14***	(0.19)	0.76***	(0.18)
Age square				−0.01***	(0.00)	−0.01***	(0.00)	−0.01***	(0.00)	−0.01***	(0.00)
Partner	At 30 and 50			–		–		–		–	
	At 30 but not 50			−2.14***	(0.35)	−2.08***	(0.35)	−2.16***	(0.35)	−2.03***	(0.33)
	Not at 30 but 50			−0.95**	(0.32)	−0.84**	(0.32)	−0.96**	(0.32)	−0.89**	(0.30)
	Not at 30 and 50			−1.28***	(0.34)	−1.17***	(0.34)	−1.29***	(0.34)	−1.19***	(0.32)
Childhood circumstances	Most advantaged (ref.)			–				–		–	
	Advantaged			−0.29	(0.40)			−0.11	(0.40)	−0.05	(0.38)
	Neutral			−0.60	(0.38)			−0.27	(0.39)	−0.10	(0.37)
	Disadvantaged			−1.36***	(0.39)			−0.94*	(0.40)	−0.35	(0.38)
	Most disadvantaged			−2.08***	(0.42)			−1.60***	(0.42)	−0.81*	(0.41)
Labour market disadvantage	None (ref.)					–		–		–	
	Mild					−1.52***	(0.23)	−1.23***	(0.23)	−0.54*	(0.24)
	Moderate					−1.67***	(0.29)	−1.37***	(0.30)	−0.72*	(0.30)
	Severe					−2.46***	(0.44)	−2.12***	(0.44)	−1.26**	(0.43)
Functional limitations	Not limited									–	
	Limited									−3.84***	(0.15)
Education	Low									–	
	Medium									0.69***	(0.18)
	High									1.16***	(0.27)
Random parameters											
Level 1: within country		5.69***	(0.05)	5.60***	(0.05)	5.60***	(0.05)	5.58***	(0.05)	5.24***	(0.05)
Level 2: between country		2.67***	(0.53)	2.51***	(0.50)	2.73***	(0.54)	2.54***	(0.50)	2.53***	(0.50)
Statistics											
R_1^2 (level 1)				.033		.033		.039		.152	
R_2^2 (level 2)				.120		−.042		.101		.105	
Log likelihood		−17,284.75		−17,192.64		−17,194.52		−17,174.42		−16,830.68	
AIC		34,575.50		34,409.28		34,411.04		34,378.84		33,697.37	
BIC		34,595.32		34,488.55		34,483.71		34,477.93		33,816.27	

Note: The ICC of the empty model is 0.18. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Table 3. Multilevel estimates for quality of life in older ages for men: regression coefficients (b) and standard errors (SE) ($N = 4808$).

				Model 1		Model 2		Model 3		Model 4	
Model		Empty Model		b	(SE)	b	(SE)	b	(SE)	b	(SE)
Fixed parameters											
Age				1.49***	(0.24)	1.28***	(0.24)	1.33***	(0.24)	0.87***	(0.22)
Age square				−0.01***	(0.00)	−0.01***	(0.00)	−0.01***	(0.00)	−0.01***	(0.00)
Partner	At 30 and 50			–		–		–		–	
	At 30 but not 50			−0.73	(0.49)	−0.53	(0.49)	−0.61	(0.49)	−0.57	(0.46)
	Not at 30 but 50			−0.14	(0.24)	−0.11	(0.24)	−0.14	(0.24)	−0.07	(0.23)
	Not at 30 and 50			−0.99**	(0.36)	−0.87*	(0.36)	−0.90*	(0.36)	−0.89**	(0.34)
Childhood circumstances	Most advantaged (ref.)			–				–		–	
	Advantaged			−0.21	(0.42)			−0.12	(0.41)	−0.10	(0.39)
	Neutral			−0.57	(0.39)			−0.37	(0.39)	−0.29	(0.37)
	Disadvantaged			−1.28**	(0.40)			−0.97*	(0.40)	−0.48	(0.39)
	Most disadvantaged			−1.89***	(0.42)			−1.52***	(0.42)	−0.89*	(0.41)
Labour market disadvantage	None (ref.)					–		–		–	
	Mild					−1.04***	(0.20)	−0.77***	(0.21)	−0.22	(0.21)
	Moderate					−1.32***	(0.27)	−1.04***	(0.27)	−0.58*	(0.26)
	Severe					−2.59***	(0.44)	−2.30***	(0.45)	−1.63***	(0.43)
Functional limitations	Not limited									–	
	Limited									−3.76***	(0.15)
Education	Low										
	Medium									1.07***	(0.19)
	High									1.08***	(0.25)
Random parameters											
Level 1: within country		5.55***	(0.06)	5.49***	(0.06)	5.49***	(0.06)	5.47***	(0.06)	5.14***	(0.05)
Level 2: between country		2.42***	(0.48)	2.16***	(0.43)	2.34***	(0.47)	2.16***	(0.43)	2.10***	(0.42)
Statistics											
R_1^2 (level 1)				.020		.021		.027		.141	
R_2^2 (level 2)				.201		.062		.201		.247	
Log likelihood		−15,085.98		−15,036.44		−15,035.61		−15,019.49		−14,719.39	
AIC		30,177.97		30,096.88		30,093.22		30,068.99		29,474.78	
BIC		30,197.40		30,174.62		30,164.48		30,166.16		29,591.38	

Note: The ICC of the empty model is 0.16. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

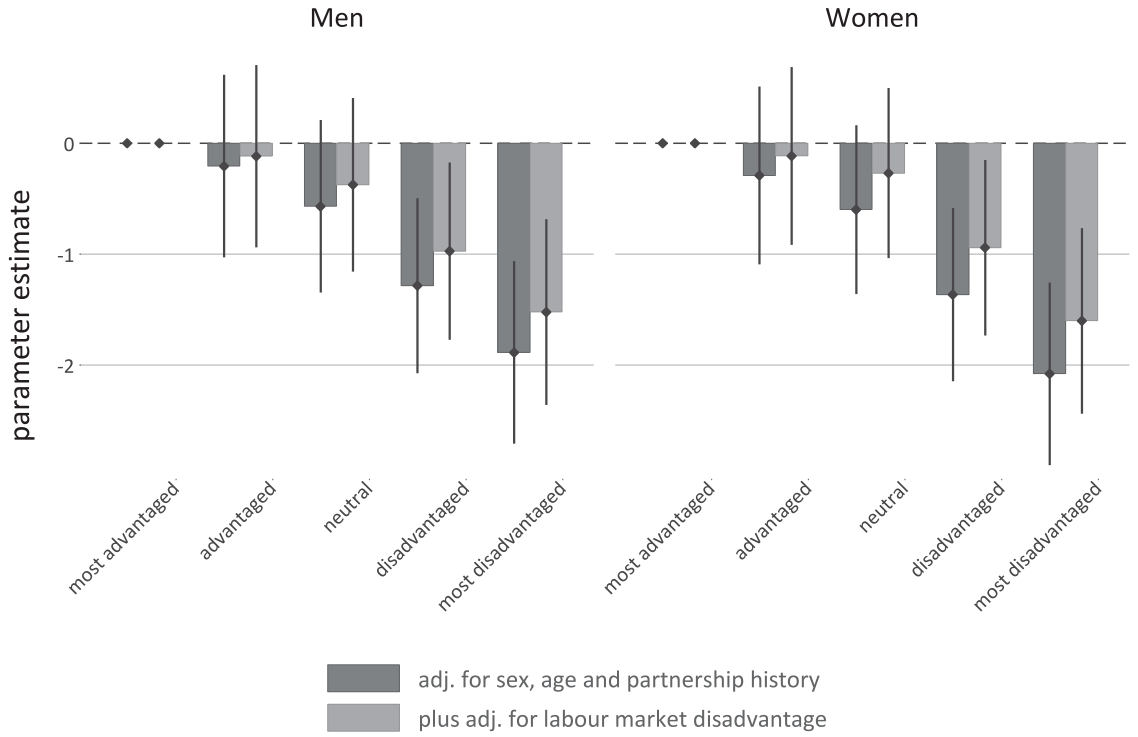


Figure 3. Childhood circumstances and quality of life in older ages: multilevel estimates and confidence intervals (95%) for men ($N = 4808$) and women ($N = 5463$). Note: Estimates are based on Models 1 and 3 from Tables 2 and 3.

Quality of life by childhood circumstances and labour market disadvantage

Figure 1 displays average scores of quality of life by childhood circumstances and labour market disadvantage. In the case of childhood circumstances, for both men and women we observe a clear graded association, with social disadvantage related to lower quality of life at older ages. Similarly, the more men or women experienced labour market disadvantage during working life, the lower is their quality of life after labour market exit.

Childhood circumstances and labour market disadvantage

Are deprived childhood circumstances related to more labour market disadvantage during working life? An answer to this question is given in Figure 2. We see that the labour market disadvantage 'none' is more frequent among men and women with advantaged childhoods. More specifically, more than half the men with the most advantaged childhoods reported no labour market disadvantage (about 40% in the case of women).

Results of multivariate analyses

Results of multilevel analyses are presented for women in Table 2 and for men in Table 3. In both cases, the empty model shows significant variations of the standard deviations at individual and at country level, with an intra-class correlation (ICC) of 0.16 for men and 0.18 for women. This indicates that most of the variations in quality of life are due to differences between individuals rather than countries in our sample.

Turning to the fixed parameter of the two tables, four observations deserve attention. First, for both men and women we see a stepwise decrease of the regression coefficients of childhood circumstances (Model 1) and of labour market disadvantage (Model 2), where deprived circumstances during childhood (or higher levels of labour market disadvantage) are related to lower quality of life after retirement. This confirms findings of Figure 1. Second, we observe that effects of partnership histories on quality of life differ between men and women. Although the quality of life was the best for both men and women if they lived with a partner at the age of 30 and 50 years (reference category), the effect of living without a partner was stronger in the case of women. The third observation worth noting refers to our core research question and Model 3, where childhood circumstances and labour disadvantage are combined into one model. The regression coefficients of childhood circumstances are generally attenuated, but remain significant for the two most deprived categories (again for men and women). According to tests of mediation (not shown in the tables), the indirect effects are significant for both men ($z = -5.26$, $p < 0.001$) and women ($z = -4.69$, $p < 0.001$). This indicates that part of the association between deprived childhood circumstances and quality of life is explained by labour market disadvantage. Finally, when including functional limitation and education in Model 4, coefficients for childhood circumstances are again attenuated and, additionally, the coefficients for labour market disadvantage are reduced. On the one hand, this suggests that functional limitations and educational qualification may

be additional intermediate factors linking childhood adversity and quality of life for both men and women. On the other hand, in the case of education, it is also thinkable that it acts as a confounder, where education (because of its stability over the life course) affects both labour market disadvantage and quality of life in older ages.

With respect to the random parameters, model fits are the best in the final models. In the case of women, the R^2 statistics suggest that the considered variables explain about 15% of the variations at the individual level (14% for men) and 10% between country variations (25% for men).

To summarize our main results, Figure 3 presents a visual summary of the estimated coefficients for childhood circumstances together with confidence intervals – before and after adjustments for labour market disadvantage.

Discussion

In this paper, we studied the association between childhood circumstances and quality of life after labour market exit. In addition, we used detailed information on previous employment histories, and studied the extent to which labour market disadvantage can explain an association. Main findings can be summarized as follows.

With regard to our first research question, we found strong support that deprived childhood circumstances are related to lower quality of life after labour market exit, with a clear gradient for both men and women: the more disadvantaged people's circumstances during childhood, the more likely they are to report lower quality of life in older ages. Similarly, those who grew up in deprived circumstances were more likely to experience higher levels of labour market disadvantage. These findings are in line with previous research (Holland et al., 2000; Kuh et al., 1997; Kuh & Wadsworth, 1991; Niedzwiedz et al., 2012; Power & Matthews, 1997), but two new elements may be added. First, by using different indicators to measure disadvantages during childhood, we were enabled to discover a cumulative impact of childhood deprivation on quality of life. Second, we used information on labour market disadvantage that covered entire employment history and, thus, extended the time frame to entire working careers.

With regard to the second question, associations between childhood social position and quality of life were weakened in multivariate models once labour market disadvantage was introduced. This weakened, yet statistically significant, effect points to a partial mediation, indicating that children who grew up in disadvantageous circumstances were more likely to experience labour market disadvantage; this partly explains their lower quality of life beyond working life. Again, as these analyses were based on detailed information of childhood social position and labour disadvantage throughout working life, this finding adds to existing literature. On a conceptual level, findings are in line with the existing framework of cumulative disadvantages over the life course and its origin during early childhood (Dannefer, 2003; Ferraro & Shippee, 2009).

We found two additional findings. First, we observed that effects of partnership histories on quality of life differ between men and women, where the negative impact of living without partnership during working life appeared more consistent in the case of women. This may indicate a higher importance of partnerships for women (at least in our sample). Second, although the focus of this paper was on labour market disadvantage, we found that educational qualification and functional limitations may be additional intermediate factors on the causal chain linking childhood circumstances and quality of life at older ages. Although these latter findings deserve more detailed analysis, this again supports the idea that childhood adversity leads to cumulative disadvantages during the life course.

When interpreting the results, we must consider the following limitations. First, the data measuring childhood circumstances and labour market disadvantage were assessed retrospectively. This fact carries the risk of systematic reporting bias. For example, information may be positively tuned due to a tendency of harmonizing conflicting retrospective biographical accounts. Yet, a high prevalence of disadvantaged childhood circumstances does not support this argument. Furthermore, the measure of labour market disadvantage was based on specific characteristics of the employment history (rather than self-perceived disadvantage). Finally, a recent study compared information collected in SHARELIFE and historical data at a national level and the results confirmed the validity of the retrospective data (Havari & Mazzona, 2011). Clearly, an additional inclusion of personality characteristics as confounders may have offered a more convincing case of tackling this limitation, but this information was not available in the data. Second, in this study we focussed on labour market disadvantage as one possible intermediate exposure at the structural level (Blane, Kelly-Irving, Errico, Bartley, & Montgomery, 2013) and, thus, we surely may have bypassed other important exposures during adulthood, including behavioural, material or psychosocial exposures (e.g. social support or work stress). Yet, we maintain that labour market disadvantage plays a crucial role, because many of these latter exposures are related to labour market disadvantage (e.g. higher levels of work stress or lower salary in the case of labour market disadvantage). However, future analyses are needed to disentangle these complex interrelations. Similarly, although our findings point to a cumulative impact of deprived childhood circumstances on quality of life, where each single indicator of deprived childhood circumstances is associated with lower quality of life (and with labour market disadvantage) (Dannefer, 2003), future analyses may test each single indicator separately as well. Furthermore, one may ask if our results can be generalized to other generations, because most men and women in our sample (born between 1908 and 1943) grew up under specific circumstances (e.g. 1930s – depression) and had specific employment histories (e.g. Second World War) (Elder, 1998). Therefore, the significance of our results needs to be evaluated in future studies for different generations. Similarly, although our multilevel models did consider country variations of quality of life, we may nevertheless ask if strengths of associations between social

circumstances, labour market disadvantages and quality of life differ between countries. For example, one may assume that existing regulations and national policies may mitigate an effect, for example through policies offering social provision (decommodification), or – maybe even more importantly – through regulations of active labour market policies, as suggested in a recent study (Lunau, Wahrendorf, Dragano, & Siegrist, 2013). If further validated this latter aspect may point to possible policy implications of our findings. Finally, although our overall sample was relatively large, survey participation at study onset was not very high in some countries (e.g. Switzerland) and, thus, we cannot rule out that an unobserved selection bias affects our findings. For example, people with lower quality of life may be less likely to participate and, therefore, we may have overestimated levels of quality of life. Yet, studies showed that SHARE represents general populations quite well (Börsch-Supan & Mariuzzo, 2005), and it seems unlikely that participation rates may affect the reported associations in our study.

These limitations are balanced by important strengths. The SHARE study meets high-quality standards of data collection, specifically a vigorously controlled study protocol and comparable sample procedures in each country. Additionally, the survey uses validated questionnaires that have been translated into different languages following standard procedures (Schröder, 2011a). Finally, to our knowledge, this is the first survey that explicitly tests the complex interrelations between different indicators of childhood circumstances, labour market disadvantage and quality of life in older ages.

In conclusion, this study demonstrates that deprived childhood circumstances are related to lower quality of life in older ages and that this association is partly due to labour market disadvantage during working life. In other words, quality of life in older ages is related to childhood conditions. These conditions shape individuals' life courses and their employment histories. These in turn carry the risk of lower quality of life beyond working life. Furthermore, the study illustrates the value of retrospective data in analysing determinants of quality of life in older age.

Acknowledgements

This paper uses data from SHARELIFE release 1, as of November 24th 2010 or SHARE release 2.5.0, as of May 24th 2011. The SHARE data collection has been primarily funded by the European Commission through the 5th framework programme (project QLK6-CT-2001- 00360 in the thematic programme Quality of Life), through the 6th framework programme (projects SHARE-I3, RII-CT- 2006-062193, COMPARE, CIT5-CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th framework programme (SHARE-PREP, 211909 and SHARE-LEAP, 227822). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064, IAG BSR06-11, R21 AG025169) as well as from various national sources is gratefully acknowledged (see www.share-project.org for a full list of funding institutions).

References

Baumgarten, M., Siemiatycki, J., & Gibbs, G.W. (1983). Validity of work histories obtained by interview for epidemiologic purposes. *American Journal of Epidemiology, 118*(4), 583–591.

Berney, L., Blane, D., Smith, G.D., Gunnell, D.J., Holland, P., & Montgomery, S.M. (2000). Socioeconomic measures in early old age as indicators of previous lifetime exposure to environmental health hazards. *Sociology of Health & Illness, 22*(4), 415–430.

Berney, L.R., & Blane, D.B. (1997). Collecting retrospective data: Accuracy of recall after 50 years judged against historical records. *Social Science & Medicine, 45*(10), 1519–1525.

Blane, D., Kelly-Irving, M., Errico, A., Bartley, M., & Montgomery, S. (2013). Social-biological transitions: How does the social become biological? *Longitudinal and Life Course Studies, 4*(2), 136–146.

Blane, D., Wahrendorf, M., Webb, E., & Netuveli, G. (2012). Life course influences on quality of life at age 50 years: Evidence from the National Child Development Study (1958 British birth cohort study). *Longitudinal and Life Course Studies, 3*(3), 346–358.

Blane, D.B. (1996). Collecting retrospective data: Development of a reliable method and a pilot study of its use. *Social Science & Medicine, 42*(5), 751–757.

Börsch-Supan, A., Brandt, M., Hank, K., & Schröder, M. (2011). *The individual and the welfare state: Life histories in Europe*. Berlin: Springer.

Börsch-Supan, A., Brandt, M., & Schroder, M. (2013). SHARELIFE – one century of life histories in Europe. *Advances in Life Course Research, 18*(1), 1–4.

Börsch-Supan, A., & Jürges, H. (2005). *The survey of health, aging and retirement in Europe – methodology*. Mannheim: Mannheim Research Institute for the Economics of Ageing.

Börsch-Supan, A., & Mariuzzo, F. (2005). Our sample: 50+ in Europe. In A. Börsch-Supan, A. Brugiavini, H. Jürges, J. Mackenbach, J. Siegrist, & G. Weber (Eds.), *Health, ageing and retirement in Europe: First results from the survey of health, ageing and retirement in Europe* (pp. 30–34). Mannheim: Mannheim Research Institute for the Economics of Ageing.

Bourbonnais, R., Meyer, F., & Theriault, G. (1988). Validity of self reported work history. *British Journal of Industrial Medicine, 45*(1), 29–32.

Brandt, M., Deindl, C., & Hank, K. (2012). Tracing the origins of successful aging: The role of childhood conditions and social inequality in explaining later life health. *Social Science & Medicine, 74*(9), 1418–1425.

Caspi, A., Wright, B.R.E., Moffitt, T.E., & Silva, P.A. (1998). Early failure in the labor market: Childhood and adolescent predictors of unemployment in the transition to adulthood. *American Sociological Review, 63*(3), 424–451.

Chittleborough, C.R., Baum, F.E., Taylor, A.W., & Hiller, J.E. (2006). A life-course approach to measuring socioeconomic position in population health surveillance systems. *Journal of Epidemiology & Community Health, 60*(11), 981–992.

Dannefer, D. (2003). Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *The Journals of Gerontology Series B – Psychological Sciences and Social Sciences, 58*(6), S327–S337.

Dedman, D.J., Gunnell, D., Davey Smith, G., & Frankel, S. (2001). Childhood housing conditions and later mortality in the Boyd Orr cohort. *Journal of Epidemiology & Community Health, 55*(1), 10–15.

Doyal, L., & Gough, I. (1991). *A theory of human need*. Basingstoke: Palgrave Macmillan.

Dragano, N., & Wahrendorf, M. (2014). Consistent health inequalities in Europe: The importance of labour market disadvantage. *Journal of Epidemiology & Community Health, 68*(4), 293–294.

Duncan, G.J., Yeung, W.J., Brooks-Gunn, J., & Smith, J.R. (1998). How much does childhood poverty affect the life chances of children? *American Sociological Review, 63*(3), 406−423.

Elder, G.H. (1998). *Children of the great depression: Social change life experience*. Oxford: Westview Press.

Elovainio, M., Kivimaki, M., Ek, E., Vahtera, J., Honkonen, T., Taanila, A., ... Jarvelin, M.R. (2007). The effect of pre-employment factors on job control, job strain and psychological distress: A 31-year longitudinal study. *Social Science & Medicine, 65*(2), 187−199.

Eurostat. (2013). *Europe in figures − Eurostat yearbook 2012*. Luxembourg: European Union. Retrieved from http://ec.europa.eu/eurostat.

Evans, M.D.R., Kelley, J., Sikora, J., & Treiman, D.J. (2010). Family scholarly culture and educational success: Books and schooling in 27 nations. *Research in Social Stratification and Mobility, 28*(2), 171−197.

Ferraro, K.F., & Shippee, T.P. (2009). Aging and cumulative inequality: How does inequality get under the skin? *Gerontologist, 49*(3), 333−343.

Galobardes, B., Lynch, J.W., & Davey Smith, G. (2004). Childhood socioeconomic circumstances and cause-specific mortality in adulthood: Systematic review and interpretation. *Epidemiologic Reviews, 26*, 7−21.

Giddens, A. (1991). *Modernity and self-identity: Self and society in the late modern age*. Cambridge: Polity Press.

Havari, E., & Mazzona, F. (2011, May). *Can we trust older people's statements on their childhood circumstances? Evidence from SHARELIFE*. SHARE Working Paper Series. Mannheim: Mannheim Research Institute for the Economics of Ageing.

Higgs, P., Hyde, M., Wiggins, R., & Blane, D. (2003). Researching quality of life in early old age: The importance of the sociological dimension. *Social Policy and Administration, 37*(3), 239−252.

Holland, P., Berney, L., Blane, D., Smith, G.D., Gunnell, D. J., & Montgomery, S.M. (2000). Life course accumulation of disadvantage: Childhood health and hazard exposure during adulthood. *Social Science & Medicine, 50*(*9*), 1285−95.

Hyde, M., Wiggins, R.D., Higgs, P., & Blane, D.B. (2003). A measure of quality of life in early old age: The theory, development and properties of a needs satisfaction model (CASP-19). *Aging & Mental Health, 7*(3), 186−194.

Jagger, C., Gillies, C., Cambois, E., Van Oyen, H., Nusselder, W., Robine, J.M., & Team, E. (2010). The global activity limitation index measured function and disability similarly across European countries. *Journal of Clinical Epidemiology, 63*(8), 892−899.

Krull, J.L., & MacKinnon, D.P. (2001). Multilevel modeling of individual and group level mediated effects. *Multivariate Behavioral Research, 36*(2), 249−277.

Kuh, D., Head, J., Hardy, R., & Wadsworth, M. (1997). The influence of education and family background on women's earnings in midlife: Evidence from a British national birth cohort study. *British Journal of Sociology of Education, 18*(3), 385−405.

Kuh, D., & Wadsworth, M. (1991). Childhood influences on adult male earnings in a longitudinal-study. *British Journal of Sociology, 42*(4), 537−555.

Laslett, P. (1996). *A fresh map of life*. London: Macmillan.

Lunau, T., Wahrendorf, M., Dragano, N., & Siegrist, J. (2013). Work stress and depressive symptoms in older employees: Impact of national labour and social policies. *BMC Public Health, 13*(1), 1086−1096.

Marsh, A. (1999). *Home sweet home? The impact of poor housing on health*. Bristol: Policy Press.

Mc Munn, A., Breeze, E., Goodman, A., & Nazroo, J. (2006). Social determinants of health in older age. In M. Marmot & R. Wilkinson (Eds.), *Social determinants of health* (pp. 267−298). Oxford: Oxford University Press.

Niedzwiedz, C.L., Katikireddi, S.V., Pell, J.P., & Mitchell, R. (2012). Life course socio-economic position and quality of life in adulthood: A systematic review of life course models. *BMC Public Health, 12*, 628−639.

Niedzwiedz, C.L., Katikireddi, S.V., Pell, J.P., & Mitchell, R. (2014). Socioeconomic inequalities in the quality of life of older Europeans in different welfare regimes. *European Journal of Public Health, 24*(3), 364−370.

Platts, L.G., Netuveli, G., Webb, E., Zins, M., Goldberg, M., Blane, D., & Wahrendorf, M. (2013). Physical occupational exposures during working life and quality of life after labour market exit: Results from the GAZEL study. *Aging & Mental Health, 17*(6), 697−706.

Power, C., & Matthews, S. (1997). Origins of health inequalities in a national population sample. *The Lancet, 350*(9091), 1584−1589.

Rabe-Hesketh, S., & Skrondal, A. (2005). *Multilevel and longitudinal modeling using stata*. College Station, TX: Stata Press.

Scholes, S., Medina, J., Cheshire, H., Cox, K., Hacker, E., & Lessof, C. (2009). *Living in the 21st century: Older people in England. The 2006 English longitudinal study of ageing* (Technical Report). London: National Centre for Social Research.

Schröder, M. (2011a). Retrospective data collection in the survey of health, ageing and retirement in Europe. In *SHARELIFE methodology*. Mannheim: Mannheim Research Institute for the Economics of Aging.

Schröder, M. (2011b). Scar or blemish? Investigating the long-term impact of involuntary job loss on health. In A. Boersch-Supan, M., Brandt, K. Hank, & M. Schröder (Eds.), *The individual and the welfare state: Life histories in Europe* (pp. 191−202). Berlin: Springer.

Snijders, T., & Bosker, R. (1994). Modeled variance in two-level models. *Sociological Methods & Research, 22*(3), 342−363.

von dem Knesebeck, O., Wahrendorf, M., Hyde, M., & Siegrist, J. (2007). Socio-economic position and quality of life among older people in 10 European countries: Results of the SHARE study. *Ageing and Society, 27*(2), 269−284.

Wahrendorf, M., Blane, D., Bartley, M., Dragano, N., & Siegrist, J. (2013). Working conditions in mid-life and mental health in older ages. *Advances in Life Course Research, 18*(1), 16−25.

Wahrendorf, M., Reinhardt, J.D., & Siegrist, J. (2013). Relationships of disability with age among adults aged 50 to 85: Evidence from the United States, England and Continental Europe. *PLoS ONE, 8*(8), e71893−e71903.

Wiggins, R.D., Netuveli, G., Hyde, M., Higgs, P., & Blane, D. (2008). The evaluation of a self-enumerated scale of quality of life (CASP-19) in the context of research on ageing: A combination of exploratory and confirmatory approaches. *Social Indicators Research, 89*(1), 61−77.

6. **Wahrendorf M.**, & Siegrist J. (2014). "Proximal and distal determinants of stressful work: framework and analysis of retrospective European data." *BMC Public Health* 14:849-861.

   Impact-Faktor: 2.26

BMC Public Health

RESEARCH ARTICLE Open Access

Proximal and distal determinants of stressful work: framework and analysis of retrospective European data

Morten Wahrendorf[1*] and Johannes Siegrist[2]

Abstract

Background: While robust evidence on associations of stressful work with health exists, less research is available on determinants of stressful work in terms of respondents' characteristics (proximal factors) and in terms of national labour market policies (distal factors). In this article we analyse proximal (childhood circumstances and labour market disadvantage) and distal determinants (national compensation and integration policies) of stressful work in a comprehensive framework.

Methods: We use data from the third wave of the Survey of Health, Ageing and Retirement in Europe (SHARE), with retrospective information on individual life courses collected among 11181 retired men and women in 13 European countries (2008–2009). To test our hypotheses we estimate multilevel regression models.

Results: Results show that stressful work is related to disadvantaged circumstances during childhood. To some extent this association is explained by labour market disadvantage during adulthood. Additionally, well developed labour market integration policies are related to lower overall levels of stressful work at national level.

Conclusion: This analysis provides first evidence of important determinants of stressful work, both in terms of pre-employment conditions (childhood circumstances) and in terms of contextual macro-social policies.

Background

Occupational health research has established solid evidence on the impact of adverse physical and psychosocial working conditions on health, mainly based on epidemiological cohort studies [1-3]. Results of this research are instrumental in terms of scientific innovations, but also in terms of utility as they can instruct stakeholders to develop measures of promoting healthy work [4]. However, these studies usually focus on populations that were already participating in the labour market at the time when investigations started. As a consequence, processes of selection into paid work and their impact on the quality of work and employment received less attention. To some extent, this shortcoming was overcome with the advent of birth cohort studies and longitudinal investigations of adolescent cohorts. These studies demonstrate that adversity in early life, and specifically disadvantaged childhood circumstances, exert negative effects on employment opportunities and quality of work in early adulthood [5-9]. In addition, disadvantaged childhood circumstances were related to reduced health in midlife, in terms of elevated cardiovascular risk. This effect was partly mediated by exposure to stressful working conditions in early stages of occupational life [10,11]. Yet, due to a relatively short observation period of a majority of birth cohort studies that were initiated in the second half of the last century, there is a lack of knowledge about longer-term effects of adversity in early life on later stages of people's occupational careers, and specifically on the quality of their main job held until retirement. Is it reasonable to assume that stressful work experienced in the main job of people's occupational trajectory can be traced back, to some extent, to adverse childhood conditions?

A second limitation of knowledge about determinants of stressful work in people's occupational careers concerns the potential impact exerted by more distal conditions of national labour and social policies that aim at reducing precarious and unhealthy employment

* Correspondence: wahrendorf@uni-duesseldorf.de
[1]Centre for Health and Society, Institute for Medical Sociology, University of Düsseldorf, 40225 Düsseldorf, Germany
Full list of author information is available at the end of the article

and working conditions. Preliminary evidence indicates that the average level of stressful work among employees of a country is closely associated with the extent to which such policies are implemented. In particular, in countries with well-established active labour market policies lower average levels of stressful work were observed, compared to those in countries with less well developed policies [12,13]. These findings suggest that such distal contextual factors need to be taken into account in a comprehensive analysis of determinants of stressful work [14-16]. Yet, a more comprehensive assessment of such policies is necessary [17]. Among these contextual factors, two types of labour and social policies are of special interest, protective policies that offer social provision to deprived or disabled people through compensation, and integrative policies that promote return to work and maintenance of jobs [18].

In this contribution we set out to address these two shortcomings of current research on determinants of stressful work by linking proximal (i.e. early life adversity) with distal (i.e. national policies) factors within a conceptual framework and to provide an empirical test of these links. At the proximal level of individual life courses, stressful work is thought to result in part from an increased vulnerability of workers who were deprived from those material and psychosocial resources during their childhood that are critical for successful cognitive, emotional, and social development of core capabilities and coping skills [19,20]. This early disadvantage may aggravate their access to the labour market and the acquisition of jobs with good or reasonable quality. Jobs with poor quality confer a high level of stress which in turn affects working people with deficient coping resources in a particularly strong way [19].

In addition, the level of stressful work is influenced by contextual conditions at distant level. As mentioned, specific national labour and social policies are thought to protect workers from exposure to fierce market forces, thereby mitigating the severity of stress at work. Yet, in the absence of such protective and integrative policies vulnerable workers may suffer from further aggravation of their amount of work-related stress. In conclusion, a comprehensive analysis that includes proximal and distal determinants allows for a more accurate assessment of the burden of stressful work than is the case in a majority of prevailing studies that are characterized by a less extensive scope of analysis.

Here, we test this conceptual framework by analysing data from the Survey of Health, Ageing, and Retirement in Europe (SHARE) [21]. This survey provides a detailed retrospective assessment of respondents' previous life [22], thus extending the time window from participants' current situation and recent past to previous stages of their life course, including childhood conditions and information on entire employment histories (see Methods for details). Based on these data we analyse three hypotheses. First, we assume a dose – response relationship between the degree of childhood adversity and the degree of stressful work experienced later on (hypothesis 1). Second, we assume that this association is partly mediated by a disadvantaged access to the labour market (hypothesis 2). Our third hypothesis relates to the contextual factors. Given the fact that SHARE provides data on national policies from 13 European countries we test the assumption that the average level of stressful work among participants in a country is closely related to the extent to which protective and integrative policies are implemented at national level. Less developed policies go along with higher average levels of work-related stress (hypothesis 3).

Methods

Data sources

We used third wave data from the Survey of Health, Ageing and Retirement in Europe (SHARE) collected in 2008–2009. This wave (termed SHARELIFE) is a separate retrospective survey collecting details on participants' life course. It includes details on previous working careers and childhood conditions [23]. Retrospective data are collected with the lifegrid approach, where recall and timing of major information is supported by a graphical representation of respondent's life which is filled during the interview. This method was first developed as a self-completion questionnaire [24], and subsequently transformed into a Computer Assisted Personal Interviews (CAPI) by the UK National Centre for Social Research [25]. This latter method was adopted for SHARELIFE [23]. Despite obvious limitations this retrospective assessment offers several advantages. First, it represents an economic way of collecting longitudinal information. Second, it guarantees comparable information referring to different time points in respondents' life. Furthermore, validation studies revealed high accuracy of recalled information, in particular when asking about socio-demographic conditions [26,27] and employment histories [28,29].

For the present analyses, information is available from 13 European countries, ranging from Scandinavia (Denmark and Sweden), Western Europe (Austria, France, Germany, Switzerland, Belgium and the Netherlands), to Mediterranean countries (Spain, Italy and Greece) and to two Eastern European transition countries (Czech Republic and Poland). More details about SHARE are available online (www.share-project.org).

Subjects

In all countries, the sample selection was based on probability household samples where all people plus their partners were interviewed. In total, 26.836 participants were interviewed at wave 3. In the following

analyses we included all people who already left the labour market at the time of wave three, provided they documented an employment history of at least 5 years. Restricting the sample to people who left the labour market enabled us to compare employment careers over the whole life course. Importantly, we also excluded respondents older than 80 years as the time since last employment was considered too long for accurate retrospective assessment. This restriction reduced a potential sample bias as people over 80 years may have had more favourable working conditions and related increased survival probability. We also excluded respondents with documented difficulties of answering the lifegrid questionnaire (about 4% of the total sample). These restrictions resulted in a final sample with full available data of 5552 men and 5629 women (N = 11181), born between 1928 and 1959.

Measures

Stressful work

Our measure of stressful work represents a sum score of items derived from two scales. With the first scale respondents were asked to assess in retrospect the degree of adversity experienced in the main job of their occupational career (11 items), with a mean length of 24.5 years in our sample. Each item refers to a core dimension of a stressful work environment, as proposed by the demand-control- support model [30] and the effort-reward imbalance model [31]. The second scale contained 5 items where respondents had to evaluate their overall satisfaction with their entire working career, including its potential impact on their health. For both scales an identical response format was applied (4 categories ranging from 'strongly agree' (value 0) to 'strongly disagree' (value 3)). When necessary, items were recoded to achieve uniform coding (higher values indicating more stress at work). Cronbach's alphas were 0.73 (11 items) and 0.63 (5 items) respectively. For the analyses, we constructed a sum score of stressful work with values ranging from 0 (no stress) to 48 (high stress). In addition, we created a binary indicator to identify a critically elevated level of stressful work. To this end, conditions were classified as stressful if respondents reported high work stress (e.g. "agree" or "strongly agree") for at least half of the items of the two scales (i.e. 8 out of 16 items). All items are presented in a supplementary table in the Additional file 1: Table S1.

Childhood circumstances

To measure this variable we combined four binary indicators of disadvantaged childhood circumstances into one index. All indicators refer to respondents' conditions at age 10 and were used in previous studies of long-term effects of childhood adversity on health in later life [32-35]. First, we included an indicator of occupational position of the main breadwinner at respondents' age 10, using ten main occupational groups of the International Standard Classification of Occupations (ISCO). These groups were re-classified according to the different skill-levels, representing the broad hierarchical structure of ISCO, which we regrouped into low (1st and 2nd skill level) and high (3rd and 4th skill level) occupational positions [36]. Second, we used a measure of overcrowding by combining information on number of people living in the household with number of available rooms (excluding kitchen, bathrooms and hallways). Following previous studies, overcrowding was coded in all cases where more than one person per room lived in the household [34]. Third, the reported number of books at home was used, and we created the category 'less than 10 books' as an indicator of childhood adversity [33]. Finally, we measured housing quality and defined poor quality in the absence of any of the following characteristics: fixed bath, cold running water supply, hot running water supply, inside toilet and central heating [35]. Based on this information, five levels of disadvantaged childhood circumstances were defined ranging from "most advantaged" to "most disadvantaged".

Labour market disadvantage

From detailed information on individual employment histories available in SHARELIFE we developed an index of labour market disadvantage, based on the following four items. The first item asked whether an involuntary job loss occurred as a consequence of being laid off. With the second item involuntary job loss due to plant closure was assessed. Third, we measured the occupational position in respondents' main job, again based on the ISCO classification (which we regrouped into two categories 'low and high occupational position' as described above). With the fourth item an episode of unemployment lasting at least 6 months was registered. By combining these four items, we defined an index with five levels of labour market disadvantage, ranging from "none", "mild", "moderate", "severe" to "very severe" disadvantage. A sample description and overview of all individual variables is presented in Table 1.

Policy indicators

We used two indices, developed by OECD, that assess two relevant dimensions of labour market policies in case of threats to employment, in particular due to disability, i.e. compensation policies and integration policies [37,38]. Whilst the compensation (or protection) index is thought to reflect the generosity and accessibility of benefit programmes for the workforce in case of disability, the integration index measures public labour market programs that aim to re-integrate groups of individuals in case of disability. Technically, each index is constructed by the

Table 1 Sample description: percentage and frequencies (N) or mean scores and standard deviation (SD); (N = 11181)

Variables	*Categories or range*	*% or (mean)*	*N or (SD)*
Sex	male	49.7	5552
	female	50.3	5629
Mean age	50 – 80	(67.7)	(6.8)
Retirement age	before 55	33.3	3718
	55 – 59	27.1	3026
	60 or older	39.7	4437
Periods of disability	none	76.9	8549
	one	16.0	1785
	two or more	7.2	802
Job absence due to disability	yes	8.1	910
	no	91.9	10271
Stressful work	yes	15.9	1775
	no	84.1	9406
Mean score stressful work	0 – 48	(19.1)	(6.8)
Childhood circumstances	most advantaged	4.7	522
	advantaged	16.2	1809
	neutral	32.0	3578
	disadvantaged	26.3	2944
	most disadvantaged	20.8	2328
Labour market disadvantage	none	19.7	2204
	mild	63.1	7055
	moderate	14.0	1567
	severe	2.8	315
	very severe	0.4	40

availability and quality of ten policy programmes (e.g.: "sickness benefit level" or "vocational rehabilitation programmes"). These programmes were evaluated by experts for each country separately on a score ranging from 0 to 5 for three years, 1985, 2000 and 2007 [37,38].

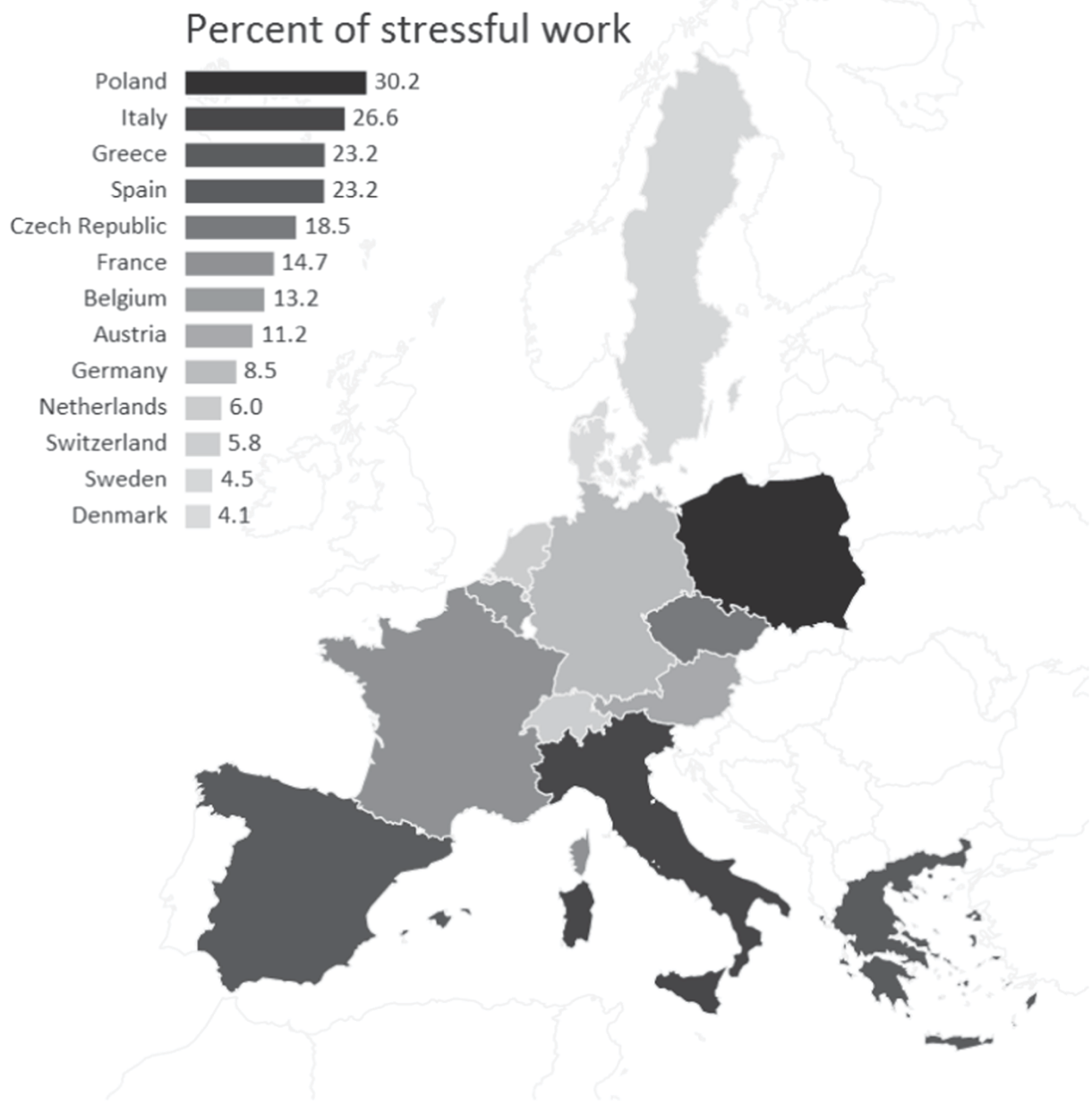
For the analyses, we computed a country mean score for each indicator using data from these three years (with except of Greece and Czech Republic where values were only available for 2007). This temporal extension of information on policy indicators enabled us to relate contextual data to information on stressful work and labour market disadvantage reported during this period. For each country, a respective index varies from a score of zero (poorest policy) to a score of 50 (best policy) (see Additional file 1: Table S2 and [38]).

Additional measures

In addition to age, sex, age of retirement, we included two measures of disability, mainly as control variables in multivariate analyses. First, we account for actual disabilities over the life course and include the number of periods (lasting longer than one year) the respondent reported to be "ill or disabled" (regrouped into 'none', 'one', and 'two or more'). Second, we included a binary indicator measuring whether working life was interrupted due to disability (temporary leave of absence from a job for 6 months or more because of ill health or disability).

Analyses

Following a sample description (Table 1), we present descriptive findings for stressful work in respondents' previous working careers. To allow a detailed inspection of the association of proximate factors with stressful work, the indices of childhood circumstances and labour market disadvantage were included as categorical variables. Country variations are additionally visualized using a geographical map of Europe, where each country is coloured according to existing percentages of critically elevated levels of stressful work (darker colour for higher percentages, Figure 1). In addition, Figure 1 includes a sorted bar chart presenting the percentage of people with stressful work for each country. In Figure 2 we display percentages of stressful work by childhood adversity and labour market disadvantage. Next, to explore associations between distal factors, the two policy indices, and stressful work, two scatterplots are displayed - one for each policy index. Importantly, to account



Note. Darker colours refer to higher percentages

Figure 1 Percent of stressful work across Europe among older men and women (N = 11181).

for population compositions and its effect on work stress (e.g. more jobs in lower occupational positions in a country, and thus, more exposure to stressful work), mean scores of stressful work are adjusted for age, gender and all individual characteristics described above.

To test our core research questions, we then estimate a series of multilevel linear models (random intercept only) using the sum score of stressful work as dependent variable with individuals (level 1) nested in countries (level 2) [39]. Using multilevel modelling allows for accurate adjustment for country affiliation when studying effect sizes of proximal determinants because the constant is allowed to vary across countries. Furthermore, variations of stressful work can be studied at each level separately (within-

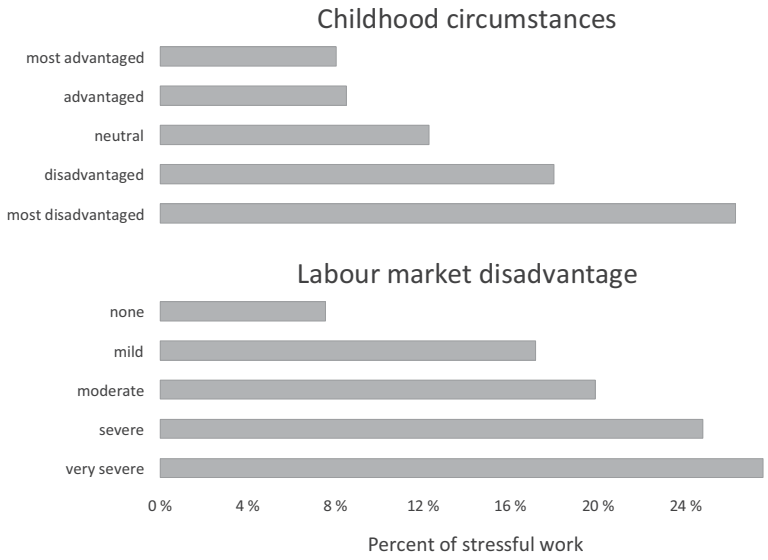


Figure 2 Percent of stressful work by levels of childhood poverty and labour market disadvantage among older men and women (N = 11181).

and between-country variations). In addition, likelihood ratio tests were performed comparing the multilevel models to conventional linear regression models (with country dummies), and these tests revealed better model fits in all cases. In sum, we estimate seven different models: The first model contains a constant term only and quantifies the amount of variation of stressful work at each level (Empty Model). Next, we study the role of the proximal determinants and present results of three models, one for childhood circumstances (Model 1), a second one for labour market disadvantage (Model 2), and a third one combining all proximal predictors (Model 3). Model 4 and 5 each includes one of the distal variables (national policy indices), and a final model includes all variables simultaneously (Full Model). The results presented in Table 2 are given as estimated regression coefficients, together with standard errors and level of statistical significance. For each model the log likelihood, the AIC (Akaike Information Criterion) and the BIC (Bayesian Information Criterion) statistics are indicated (lower values represent better model fit in case of AIC and BIC [40]), and the proportional reduction of variance explained at each level ($R^2$1, $R^2$2) is reported [41]. These latter measures are important because they allow us to quantify the extent to which variations of stressful work at the country-level can be explained by the two policy indices. All analyses were conducted with STATA. Geographical data come from Eurostat, and D3 was used for map projection and data visualization [42].

Results

Sample description

The sample included slightly more women than men (5629 vs. 5552), and the mean age was 68 years at the time of the SHARELIFE interview. The average number of observations across countries was 860, with smallest number in Austria (411) and largest number in Belgium (1237). The majority left the labour market at age 60 or older (40 per cent), and only a minority of respondents reported any period of disability (21 per cent) or job absence due to disability (8 per cent). According to our definition of a critically elevated level of stressful work 16 per cent of the respondents were exposed. Considering childhood circumstances there was a rather high prevalence of adversity, with nearly half of the respondents reporting disadvantaged or very disadvantaged childhood circumstances. Conversely, labour market disadvantage was not frequent as the large majority (over 80 per cent) experienced mild or none disadvantage in their past careers (see Table 1 for details).

Stressful work in European countries

Figure 1 displays country-specific percentages of stressful work and their geographical distribution across Europe. Prevalence is highest in Eastern and Southern Europe, whereas lowest rates are observed in the two Scandinavian countries, together with Switzerland and the Netherlands.

Stressful work and the two proximal determinants

As displayed in Figure 2, childhood circumstances and labour market disadvantage are clearly related to the

Table 2 Multilevel estimates for stressful work: Regression coefficients (b) and standard errors (SE) (N = 11181)

Model		Empty Model		Model 1		Model 2		Model 3		Model 4		Mode
		b	(SE)	b	(SE)	b	(SE)	b	(SE)	b	(SE)	b
Fixed parameters												
Sex	female (ref.)											
	male			0.34**	(0.12)	0.54***	(0.12)	0.45***	(0.12)	0.45***	(0.12)	0.45***
Age				−0.08***	(0.01)	−0.05***	(0.01)	−0.07***	(0.01)	−0.07***	(0.01)	−0.07*
Retirement age	before 55 (ref.)											
	55 – 59			−0.35*	(0.16)	−0.3	(0.16)	−0.28	(0.16)	−0.28	(0.16)	−0.27
	60 or older			−0.52**	(0.16)	−0.41*	(0.16)	−0.35*	(0.16)	−0.35*	(0.16)	−0.34*
Periods of disability	none (ref.)											
	one			1.36***	(0.16)	1.40***	(0.16)	1.35***	(0.16)	1.35***	(0.16)	1.35***
	two or more			1.89***	(0.23)	1.96***	(0.23)	1.85***	(0.23)	1.85***	(0.23)	1.86***
Job absence due to disability	no (ref.)											
	yes			2.03***	(0.22)	1.99***	(0.22)	2.00***	(0.22)	1.99***	(0.22)	1.99***
Childhood circumstances	most advantaged (ref.)											
	advantaged			0.39	(0.31)			0.16	(0.31)	0.16	(0.31)	0.16
	neutral			1.06***	(0.29)			0.65*	(0.29)	0.65*	(0.29)	0.65*
	disadvantaged			1.89***	(0.30)			1.31***	(0.30)	1.31***	(0.30)	1.30***
	most disadvantaged			3.10***	(0.32)			2.44***	(0.32)	2.44***	(0.32)	2.44***
Labour market disadvantage	none (ref.)											
	mild					1.74***	(0.16)	1.35***	(0.16)	1.35***	(0.16)	1.36***
	moderate					2.60***	(0.21)	2.19***	(0.21)	2.19***	(0.21)	2.20***
	severe					3.73***	(0.37)	3.29***	(0.38)	3.29***	(0.38)	3.30***
	very severe					5.52***	(0.99)	5.07***	(0.98)	5.07***	(0.98)	5.09***
Compensation index										−0.28*	(0.13)	
Integration index												−0.28*
Random parameters												
Level 1: within country		6.337***	(0.042)	6.179***	(0.041)	6.171***	(0.041)	6.134***	(0.041)	6.134***	(0.041)	6.134*

Table 2 Multilevel estimates for stressful work: Regression coefficients (b) and standard errors (SE) (N = 11181) *(Continued)*

Level 2: between country	2.376***	(0.470)	1.828**	(0.364)	2.145***	(0.425)	1.862**	(0.371)	1.616*	(0.323)	1.064
Statistics											
$R^2$1 (level 1)			.0491		.0516		.0629		.0629		.0629
$R^2$2 (level 2)			.4076		.1847		.3857		.5374		.7992
Log likelihood	−36540.49		−36256.03		−36243.45		−36174.69		−36172.88		−3616
AIC	73086.98		72540.06		72514.90		72385.37		72383.75		72373.
BIC	73108.95		72642.57		72617.41		72517.17		72522.87		72512.

Note. *p < 0.05; **p < 0.01; ***p < 0.001.

prevalence of stressful work. For both variables, we see a stepwise increase of percentage of stressful work with each level of adversity, with significant results in both cases (Childhood circumstances: chi^2 (4) = 329.35, $p < 0.001$, labour market disadvantage: chi^2 (4) = 164.47, $p < 0.001$).

Stressful work and distal determinants (policy indices)

How are the two macro indicators related to stressful work? Answers are given in Figure 3, where mean scores of stressful work (adjusted for country composition) are plotted against the two policy indices. In case of the compensation index, associations are slightly less pronounced as we observe a group of countries with low compensation scores (low levels of system generosity) and low mean level of stressful work (Austria, France, Belgium) (R^2 = 24.2). In contrast, an almost linear association is observed in case of the integration index where more pronounced integration policies are related to lower mean scores of stressful work (R^2 = 66.5).

Results of multivariate analyses

Results of multilevel analyses testing our research hypotheses are presented in Table 2. The empty model shows significant variations both at the individual and at the country level, with an intra-class correlation (ICC) of 0.12. This indicates that 12 per cent of total variations in stressful work are due to differences between countries.

Turning to the individual predictors and the fixed parameters, findings show that men and those who had no disability during their life generally report less stressful work. The same holds true for older respondents and those retiring later. With regard to our main research questions and the first two models, we observe a stepwise increase of the regression coefficients according to level of disadvantage during childhood (Model 1; hypothesis 1) and level of labour market disadvantage (Model 2). These associations with stressful work are in line with the findings presented in Figure 2. Importantly, when combining these two groups of explanatory variables into one model (Model 3), the regression coefficients of childhood circumstances are generally attenuated, indicating that part of the association between disadvantaged childhood circumstances and stressful working conditions is due to labour market disadvantage (hypothesis 2). Turning to Models 4 and 5, where national policy indices are introduced as distal determinants, we observe a strongly significant regression coefficient in case of integration policies. In case of compensation policies the coefficient was weaker (significant at the 5% level). Coefficients of all individual predictors remain almost unchanged in these models, including the full model. Estimates of the random parameters displayed in Table 2 indicate that the variation of stressful work between countries ($R^2$2: proportional reduction of variance explained at country level) is only moderately explained by country compositions (39 per cent when combining the two proximal determinants 'childhood circumstances and 'labour market disadvantage', Model 3). In contrast, the inclusion of one of the two distal determinants, the index of national integration policies, results in a non-significant standard deviation. In this latter model (Model 5) a proportion as

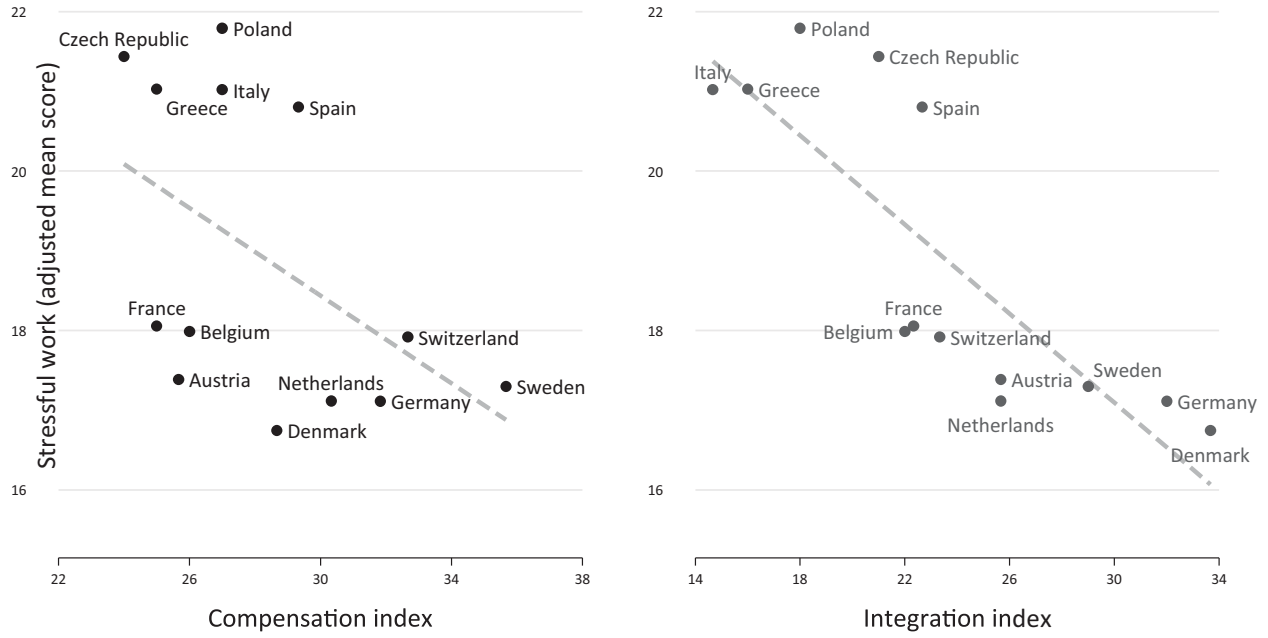


Figure 3 Adjusted mean scores of stressful work among older men and women (N = 11181) and policy indices.

high as 80 per cent of the between-country variation is explained (with a similar result in the Full Model) (hypothesis 3).

Discussion

This contribution used data from 13 European countries based on the SHARE survey and analysed stressful work assessed retrospectively among older men and women (N = 11.193). Our first aim was to analyse associations between a proximal determinant, childhood circumstances, and stressful work. As a second aim, we studied the extent to which labour market disadvantage contributes to the explanation of this association. Third, we explored the effects of distal determinants in terms of national labour and social policies (compensation and integration policies) on stressful work.

With regard to the first hypothesis, we found strong support that adversity during childhood is related to stressful work. This is in line with previous research [5,6,8,9,43], but several aspects of our results deserve special attention. First, the retrospective assessment of stressful work in this study covered a time period that was more extensive than the one explored in other studies. Second, by studying this association across 13 European countries, we extended previous research evidence that was restricted to one or a few countries only. Third, with the results related to our second hypothesis we demonstrated an indirect effect of childhood circumstances on stressful work, partly mediated by disadvantaged labour market access. However, as the former association remained statistically significant after adjustment, it seems likely that this remaining direct effect reflects compromised coping abilities during childhood that aggravate the respondents' vulnerability to chronic stress at work experienced later on [20,44].

With regard to the third research question, we found that levels of stressful work were particularly high in Eastern and Southern countries, followed by Western Europe and lowest in Northern Europe. Notably, this pattern remained virtually unchanged after considering various factors of country composition. Concerning the third hypothesis on distal determinants of stressful work strong support was obvious in case of the summary index of national integration policies, but not in case of the second index, compensation policies. The association of well-developed national integration policies with mean levels of stressful work is in line with some previously reported results [12,13,16,45]. However, our finding adds a new element: By distinguishing between policies related to employment protection (compensation index) and those describing established measures of employment activation (integration index), we used detailed evaluations of two specific types of interventions [17] that take into account a recent shift in emphasis from more passive to more active policies in research on welfare regimes in modern societies [18].

The finding that evidence in favour of our third hypothesis was limited to integration policies needs further consideration. It is possible that integration measures are more closely related to overall levels of stressful work than compensation policies, e.g. due to the fact that they target the needs of employed people who were exposed to precarious work at some stage of their career more closely. Nevertheless, potential protective effects of compensation policies should be explored in further studies. For instance, a recent study found that these latter policies to some extent may mitigate effects of work stress on mental health [46].

Limitations

The following limitations must be considered. First, the data measuring core constructs, childhood circumstances, labour market disadvantage and stressful work, were collected retrospectively among older men and women who were retired at the time of data collection. This carries the risk of systematic reporting bias, where information may be positively tuned due to a tendency of harmonizing conflicting retrospective biographical accounts [47]. Yet, a high prevalence of disadvantaged childhood circumstances (Table 1) and levels of work stress comparable to those collected in samples of still employed people [45] do not support this argument. At the same time, the method of collecting retrospective information via the lifegrid approach was shown to provide accurate information in several areas of people's life histories [26,27,29]. In a detailed study of SHARELIFE data a recent report found a rather convincing degree of accordance between interview data on childhood circumstances and data from official sources [27]. Obviously additional data allowing for bias control due to distinct personality characteristics or attribution styles would have been desirable, but was not available in this study. A second limitation concerns our choice of the two indicators of distal determinants of stressful work. These indicators may not cover relevant labour and social policies to a sufficient extent, and their measurement was rather crude, as information was taken from administrative data sources available from OECD. Certainly, these indices run the risk of bypassing more targeted national developments within single countries, and thus fail to do justice to a rich variation of political and socio-cultural traditions across Europe. Along this argument, the operational measures of the two indices of proximal determinants (childhood adversity and labour market disadvantage) can be criticized for their restricted comprehensiveness. Third, the number of countries included in this analysis was still relatively small when studying variations between countries within multilevel modelling. Extending the range of countries would increase the

robustness of findings. Fourth, we must be cautious when interpreting the statistical significance of results in view of a large sample size. Yet, the consistency of findings and their fit with the theoretical framework support their validity. Finally, any generalization of findings needs to take into account the fact that we studied a distinct age cohort [48].

These limitations are balanced by several strengths. First, the SHARE study meets high quality standards of data collection, specifically a vigorously controlled study protocol, the application of validated questionnaires, the observation of standard procedures of translating the measures into different languages and of collecting and controlling the data [23]. Second, to our knowledge, this is the first study that combines the analysis of proximal and distal determinants of stressful work within a comprehensive study design that applies life history data in the context of a comparative cross-national survey. Third, given the foundation of our measurement of stressful work in established theoretical models of a health-adverse psychosocial work environment, results may point to relevant proximal and distal entry points of intervention measures that aim at reducing stressful work and improving working people's health.

Conclusion

This study demonstrates that distinct proximal (childhood circumstances and labour market disadvantage) and distal factors (national labour market policies supporting integration into paid work) are associated with levels of perceived stressful work during people's occupational career. Our study illustrates the heuristic value of a broader analytical framework, as well as the promise of retrospective data, in analysing determinants of stressful work.

Additional file

Additional file 1: Table S1. Items measuring stressful work. **Table S2.** Policy indexes across countries.

Abbreviations

AIC: Akaike information criterion; BIC: Bayesian information criterion; CAPI: Computer assisted personal interview; ICC: Intra-class correlation; ISCO: International standard classification of occupations; OECD: Organisation for economic co-operation and development; SHARE: Survey of health ageing and retirement in Europe.

Competing interest

The authors declare that they have no competing interests.

Authors' contributions

MW analysed the data and drafted the manuscript. MW and JS jointly designed the statistical analyses, revised the manuscript and wrote the final version. Both authors read and approved the final manuscript.

Acknowledgments

This research was funded as part of the DRIVERS project by the European Community (FP7 2007–2013; grant agreement no 278350 (http://www.health-gradient.eu)). MW was supported by a post-doc fellowship from the German Research Foundation (Deutsche Forschungsgemeinschaft, project number: WA 3065/1-1).

This paper uses data from SHARELIFE release 1, as of November 24th 2010 or SHARE release 2.5.0, as of May 24th 2011. The SHARE data collection has been primarily funded by the European Commission through the 5th framework programme (project QLK6-CT-2001- 00360 in the thematic programme Quality of Life), through the 6th framework programme (projects SHARE-I3, RII-CT- 2006–062193, COMPARE, CIT5-CT-2005-028857, and SHARE-LIFE, CIT4-CT-2006-028812) and through the 7th framework programme (SHARE-PREP, 211909 and SHARE-LEAP, 227822). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04–064, IAG BSR06-11, R21 AG025169) as well as from various national sources is gratefully acknowledged (see http://www.share-project.org for a full list of funding institutions).

We thank the three reviewers for their helpful critical comments.

Author details

[1]Centre for Health and Society, Institute for Medical Sociology, University of Düsseldorf, 40225 Düsseldorf, Germany. [2]Senior Professorship on Work Stress Research, Faculty of Medicine, University of Duesseldorf, 40225 Düsseldorf, Germany.

Received: 6 May 2014 Accepted: 8 August 2014
Published: 15 August 2014

References

1. Schnall P, Dobson M, Rosskam E: *Unhealthy work: causes, consequences, cures.* Baywood: Amityville; 2009.
2. Siegrist J, Marmot MG: *Social inequalities in health : new evidence and policy implications.* Oxford: Oxford University Press; 2006.
3. Bambra C: *Work, worklessness, and the political economy of health.* Oxford: Oxford University Press; 2011.
4. WHO: *WHO healthy workplace framework and model: background and supporting literature and practices*. Geneva: World Health Organization; 2010.
5. Kuh D, Wadsworth M: **Childhood influences on adult male earnings in a longitudinal-study.** *Brit J Sociol* 1991, **42**(4):537–555.
6. Kuh D, Head J, Hardy R, Wadsworth M: **The influence of education and family background on women's earnings in midlife: evidence from a British national birth cohort study.** *Br J Sociol Educ* 1997, **18**(3):385–405.
7. Caspi A, Wright BRE, Moffitt TE, Silva PA: **Early failure in the labor market: Childhood and adolescent predictors of unemployment in the transition to adulthood.** *Am Sociol Rev* 1998, **63**(3):424–451.
8. Elovainio M, Kivimaki M, Ek E, Vahtera J, Honkonen T, Taanila A, Veijola J, Jarvelin MR: **The effect of pre-employment factors on job control, job strain and psychological distress: a 31-year longitudinal study.** *Soc Sci Med* 2007, **65**(2):187–199.
9. Power C, Matthews S: **Origins of health inequalities in a national population sample.** *Lancet* 1997, **350**(9091):1584–1589.
10. Thomas C, Power C: **Do early life exposures explain associations in mid-adulthood between workplace factors and risk factors for cardiovascular disease?** *Int J Epidemiol* 2010, **39**(3):812–824.
11. Hemmingsson T, Lundberg I: **Is the association between low job control and coronary heart disease confounded by risk factors measured in childhood and adolescence among Swedish males 40–53 years of age?** *Int J Epidemiol* 2006, **35**(3):616–622.
12. Dragano N, Siegrist J, Wahrendorf M: **Welfare regimes, labour policies and unhealthy psychosocial working conditions: a comparative study with 9917 older employees from 12 European countries.** *J Epidemiol Community Health* 2011, **65**(9):793–799.
13. Siegrist J, Wahrendorf M: **Quality of work, health and early retirement: European comparisons**. In *The Individual and the Welfare State – Life Histories in Europe.* Edited by Schroeder M, Hank K, Boersch-Supan A. Berlin: Springer; 2010.
14. Puig-Barrachina V, Vanroelen C, Vives A, Martínez JM, Muntaner C, Levecque K, Benach J, Louckx F: **Measuring employment precariousness in the European working conditions survey: The social distribution in Europe.** *Work* 2013, **2013:**2013.

15. Gallie D: *Economic Crisis, Quality of Work and Social Integration: the European Experience: Topline Results from Rounds 2 and 5 of the European Social Survey.* Oxford: Oxford University Press; 2013.
16. Niedhammer I, Sultan-Taïeb H, Chastang J-F, Vermeylen G, Parent-Thirion A: **Exposure to psychosocial work factors in 31 European countries.** *Occup Med* 2012, **62**(3):196–202.
17. Bergqvist K, Yngwe M, Lundberg O: **Understanding the role of welfare state characteristics for health and inequalities - an analytical review.** *BMC Public Health* 2013, **13**(1):1234.
18. Hudson J, Kühner S: **Towards productive welfare? A comparative analysis of 23 OECD countries.** *J Eur Soc Pol* 2009, **19**(1):34–46.
19. Kristenson M: **Socio-Economic Differences In Health: The Role Of Coping.** In *Social Inequalities in Health: New Evidence and Policy Implications.* Edited by Siegrist J, Marmot M. Oxford: Oxford University Press; 2006.
20. Yoshikawa H, Aber JL, Beardslee WR: **The effects of poverty on the mental, emotional, and behavioral health of children and youth implications for prevention.** *Ame Psychol* 2012, **67**(4):272–284.
21. Börsch-Supan A, Brandt M, Hunkler C, Kneip T, Korbmacher J, Malter F, Schaan B, Stuck S, Zuber S, Team obotSCC: **Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE).** *Int J Epidemiol* 2013, **42**(4):992–1001.
22. Börsch-Supan A, Brandt M, Schroder M: **SHARELIFE-One century of life histories in Europe.** *Adv Life Course Res* 2013, **18**(1):1–4.
23. Schröder M: *Retrospective Data Collection in the Survey of Health, Ageing and Retirement in Europe. SHARELIFE Methodology.* Mannheim: Mannheim Research Institute for the Economics of Aging; 2011.
24. Blane DB: **Collecting retrospective data: development of a reliable method and a pilot study of its use.** *Soc Sci Med* 1996, **42**(5):751–757.
25. Scholes S, Medina J, Cheshire H, Cox K, Hacker E, Lessof C: *Living in the 21st century: older people in England. The 2006 English Longitudinal Study of Ageing Technical Report.* London: National Centre for Social Research; 2009.
26. Berney LR, Blane DB: **Collecting retrospective data: accuracy of recall after 50 years judged against historical records.** *Soc Sci Med* 1997, **45**(10):1519–1525.
27. Havari E, Mazzona F: *Can we trust older people's statements on their childhood circumstances? Evidence from SHARELIFE. SHARE Working Paper Series.* Mannheim: Mannheim Research Institute for the Economics of Ageing; 2011.
28. Baumgarten M, Siemiatycki J, Gibbs GW: **Validity of work histories obtained by interview for epidemiologic purposes.** *Am J Epidemiol* 1983, **118**(4):583–591.
29. Bourbonnais R, Meyer F, Theriault G: **Validity of self reported work history.** *Brit J Ind Med* 1988, **45**(1):29–32.
30. Karasek R, Theorell T: *Healthy Work.* New York: Basic Books; 1990.
31. Siegrist J: **Adverse health effects of high-effort/low-reward conditions.** *J Occup Health Psychol* 1996, **1**:27–41.
32. Chittleborough CR, Baum FE, Taylor AW, Hiller JE: **A life-course approach to measuring socioeconomic position in population health surveillance systems.** *J Epidemiol Community Health* 2006, **60**(11):981–992.
33. Evans MDR, Kelley J, Sikora J, Treiman DJ: **Family scholarly culture and educational success: Books and schooling in 27 nations.** *Res Soc Stratification Mobility* 2010, **28**(2):171–197.
34. Marsh A: *Home Sweet Home? : The Impact Of Poor Housing On Health.* Bristol: Policy Press; 1999.
35. Dedman DJ, Gunnell D, Davey Smith G, Frankel S: **Childhood housing conditions and later mortality in the Boyd Orr cohort.** *J Epidemiol Community Health* 2001, **55**(1):10–15.
36. Wahrendorf M, Blane D, Bartley M, Dragano N, Siegrist J: **Working conditions in mid-life and mental health in older ages.** *Adv Life Course Res* 2013, **18**(1):16–25.
37. OECD: *Transforming Disability into Ability: Policies to Promote Work and Income Security for Disabled People.* Paris: OECD Publishing; 2003.
38. OECD: *Sickness, Disability and Work: Breaking the Barriers: A Synthesis of Findings across OECD Countries.* Paris: OECD Publishing; 2010.
39. Rabe-Hesketh S, Skrondal A: *Multilevel and Longitudinal Modeling using Stata.* College Station, Texas: Stata Press; 2005.
40. Raftery AE: **Bayesian model selection in social research.** *Socio Meth* 1995, **25**:111–163.
41. Snijders T, Bosker R: **Modeled variance in two-level models.** *Socio Meth Res* 1994, **22**(3):342–363.
42. Bostock M, Ogievetsky V, Heer J: **D-3: data-driven documents.** *Ieee T Vis Comput Gr* 2011, **17**(12):2301–2309.
43. Holland P, Berney L, Blane D, Smith GD, Gunnell DJ, Montgomery SM: **Life course accumulation of disadvantage: childhood health and hazard exposure during adulthood.** *Soc Sci Med* 2000, **50**(9):1285–1295.
44. McEwen BS: **Brain on stress: How the social environment gets under the skin.** *Proc Natl Acad Sci* 2012, **109**(Supplement 2):17180–17185.
45. Siegrist J, Wahrendorf M: **Quality of work, health, and retirement.** *The Lancet* 2009, **374**(9705):1872–1873.
46. Lunau T, Wahrendorf M, Dragano N, Siegrist J: **Work stress and depressive symptoms in older employees: impact of national labour and social policies.** *BMC Public Health* 2013, **13**(1):1086.
47. Krinsley KE, Gallagher JG, Weathers FW, Kutter CJ, Kaloupek DG: **Consistency of retrospective reporting about exposure to traumatic events.** *J Trauma Stress* 2003, **16**(4):399–409.
48. Elder GH: *Children of the Great Depression: social change life experience.* Oxford: Westview Press; 1998.

doi:10.1186/1471-2458-14-849
Cite this article as: Wahrendorf and Siegrist: **Proximal and distal determinants of stressful work: framework and analysis of retrospective European data.** *BMC Public Health* 2014 **14**:849.

7. **Wahrendorf M.**, Blane D., Bartley M., Dragano N., & Siegrist J. (2013). "Working conditions in mid-life and mental health in older ages." *Advances in Life Course Research* 18:16-25.

   Impact-Faktor: 0.71

Advances in Life Course Research 18 (2013) 16–25

Contents lists available at SciVerse ScienceDirect

Advances in Life Course Research

journal homepage: www.elsevier.com/locate/alcr

Working conditions in mid-life and mental health in older ages

Morten Wahrendorf [a,*], David Blane [a], Mel Bartley [b], Nico Dragano [c], Johannes Siegrist [c]

[a] International Centre for Life Course Studies in Society and Health, Department of Primary Care and Public Health, Imperial College London, UK
[b] International Centre for Life Course Studies in Society and Health, Department of Epidemiology and Public Health, University College London, UK
[c] Institute for Medical Sociology, University of Duesseldorf, University Clinic Duesseldorf, Germany

ARTICLE INFO

Article history:
Received 29 May 2012
Received in revised form 20 October 2012
Accepted 22 October 2012

Keywords:
Depressive symptoms
Mid-life
Working conditions
Life course
SHARELIFE

ABSTRACT

This article illustrates the importance of previous working conditions during mid-life (between 40 and 55) for mental health among older retired men and women (60 or older) across 13 European countries. We link information on health from the second wave (2006–2007) of the Survey of Health, Ageing and Retirement in Europe (SHARE) with information on respondents' working life collected retrospectively in the SHARELIFE interview (2008–2009). To measure working conditions, we rely on core assumptions of existing theoretical models of work stress (the demand–control–support and the effort–reward imbalance model) and distinguish four types of unhealthy working conditions: (1) a stressful psychosocial work environment (as assessed by the two work stress models) (2) a disadvantaged occupational position throughout the whole period of mid-life, (3) experience of involuntary job loss, and (4) exposure to job instability. Health after labour market exit is measured using depressive symptoms, as measured by the EURO-D depression scale. Main results show that men and women who experienced psychosocial stress at work or had low occupational positions during mid-life had significantly higher probabilities of high depressive symptoms during retirement. Additionally, men with unstable working careers and an involuntary job loss were at higher risks to report high depressive symptoms in later life. These associations remain significant after controlling for workers' health and social position prior mid-life. These findings support the assumption that mental health of retirees who experienced poor working conditions during mid-life is impaired.

1. Introduction

Although life expectancy has steadily increased over recent decades in Europe, substantial inequalities in health remain for older men and women (Mc Munn, Breeze, Goodman, & Nazroo, 2006). Thus, for many people recent increases in life expectancy are accompanied by extended periods of morbidity or disability. In a context of rapidly ageing societies, these health inequalities at older ages have significant implications for European social policies. Additional scientific research is needed to identify the determinants of health in older ages. Whereas descriptive evidence of health inequalities in older ages is convincing, the explanations given so far are limited. In particular, core questions remain unanswered, e.g. to what extent do conditions during earlier stages of the life course, such as mid-life working conditions, contribute towards explaining health variations among men and women in later life (Elder & Johnson, 2002; Siegrist & Marmot, 2006)? For instance, it can be assumed that older people with poor

* Corresponding author at: International Centre for Life Course Studies in Society and Health, Department of Primary Care and Public Health, Imperial College London, Charing Cross Campus, St. Dunstans Road, London W6 8RP, UK.
E-mail address: m.wahrendorf@imperial.ac.uk (M. Wahrendorf).

1040-2608/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.alcr.2012.10.004

health experienced more disadvantaged working conditions, and that these conditions may have had an impact on their health later on.

When looking at previous studies concerned with working conditions in mid-life and health, two shortcomings are apparent: first, the analytical time frame of a majority of studies is restricted to a short period of observation, without extension into stages where people are retired (Dragano, Siegrist, & Wahrendorf, 2011; Stansfeld, Fuhrer, Shipley, & Marmot, 1999). This state of the art, with some noticeable exceptions (Melchior et al., 2006; Westerlund et al., 2009), contrasts with recent evidence on the importance of early life and mid-life conditions in explaining health at old age (Blane, 2006; Power & Kuh, 2006). A second weakness of existing studies on work and health concerns the measurement of work-related factors, which is often restricted to one single time point of the working life and which lacks a conceptual basis (particular in case of psychosocial working conditions), thus preventing the comparability and cumulative knowledge of respective findings (for reviews see for example Antoniou & Cooper, 2005).

Current knowledge about a health-adverse psychosocial work environment mainly builds on two theoretical models of work stress, the demand–control–support model (Karasek & Theorell, 1990) and the effort–reward imbalance model (Siegrist, 1996). These models may be helpful in describing unhealthy working conditions throughout mid-life and, thus, to contribute to a better understanding of the afflictions of work on later health (see Section 1.1 for details). In short, to explain health inequalities in older ages there is strong need to consider the life course by including conditions of earlier life, such as working conditions during mid-life. Moreover, a theory-based approach towards measuring mid-life working conditions is needed.

This paper tries to overcome these limitations by using data from two waves of the Survey of Health Ageing and Retirement in Europe (SHARE) containing data from 13 European countries (Börsch-Supan et al., 2005). More specifically, we combine second wave data with information on health (collected in 2006–2007) and retrospective information on individual working life provided in the third wave of SHARE, called SHARELIFE (collected in 2008–2009). In the following paragraphs, we elaborate our theoretical perspective in more detail and describe existing evidence related to our research.

1.1. Theoretical considerations

Mid-life is considered as an important stage of the life course with long-term effects on standard of living and health in later life (Willis & Martin, 2005). This is mainly due to the fact that mid-life is the stage of life where highest levels of individual responsibilities are required (Willis, Martin, & Rocke, 2010). In terms of age, this time can be defined as the period between 40 and 55 years. During mid-life, core social roles (e.g. parenting, work) are acquired and executed, with opportunities of experiencing success and failure in pursuing important goals and in satisfying major material and non-material needs. Among these latter needs a sense of belonging to relevant social networks (Berkman & Glass, 2000), a continued experience of agency and autonomy (Haidt & Rodin, 1999), and a recurrent experience of social recognition for personal achievements (Siegrist, 2005) are of particular importance for health and well-being. In this context, the quality of people's psychosocial work environment is of outstanding significance, given the centrality of work in mid-life. These ideas lie at the core of the two work stress models mentioned above (the demand–control–support and the effort–reward imbalance model). However, their application so far has been mostly restricted to a single measurement point. It was therefore not possible to explore to what extent these models can be used to analyse working conditions and employment trajectories throughout mid-life. In order to define working conditions in mid-life from the perspective of these two models, we briefly describe the models in more detail including recent applications, and then present our research question.

The demand–control–support model was developed by Karasek (1979) and extended by Karasek and Theorell (1990) and by Johnson and Hall (1988). It posits that jobs with high psychological demands, low levels of autonomy and decision latitude (low control) and low social support at work are stressful and adversely affect health. This is due to the fact that these jobs limit the experience of autonomy at work, while exerting continued pressure. As a complementary work stress model, the effort–reward imbalance model (Siegrist, 1996) addresses the work contract and the principle of social reciprocity lying at its core. Rewards received in return to efforts spent at work include money, esteem, and career opportunities (job promotion and job security). The model proposes that the frustration of legitimate rewards (effort–reward imbalance) generates strong negative emotions and psychobiological stress responses with adverse long-term effects on health. Taken together, both work stress models cover different, but equally relevant aspects of the workplace, where lack of control and lack of reward matter most.

Several empirical studies demonstrate the importance of either model for health and well-being in a biopsychosocial perspective, as summarized in a number of systematic reviews using different health outcomes, including stress-related disorders (Nieuwenhuijsen, Bruinvels, & Frings-Dresen, 2010), mental disorders (Schnall, Dobson, & Rosskam, 2009; Stansfeld & Candy, 2006), and coronary heart diseases (Kivimaki et al., 2006; Steptoe & Kivimaki, 2012). In addition, studies indicate that levels of exposures and health-related effects differ between men and women (Messing et al., 2003). For instance, based on the British Whitehall Study, Stansfeld et al. (1999) found that effects of work stress on depressive symptoms are stronger for men compared to women – a result that can be attributed to a higher significance of the work role for men compared to women, as well as to the availability of alternative roles (e.g. family) among women. Furthermore, levels of exposure are different (e.g. higher control and more strenuous jobs for men), because men tend to work longer, in different sectors and generally higher occupational positions (Eurofound, 2007). In this perspective, the

following analyses will be conducted for men and women separately.

In the dataset described below information on core dimensions of these two models is available for the main occupation during mid-life (see Section 2.2 for details). In addition to these data, a new element will be added by using information on individuals' work history during mid-life. More specifically, we delineate working conditions in terms of those psychosocial aspects of the job career that may prevent the continued experience of control and reward during mid-life (Siegrist, 2009). As an example, we maintain that a disadvantaged occupational position throughout mid-life (preventing any upward mobility) elicits recurrent negative emotions and stress reactions due to the continued frustration of experiencing social reward. The feeling of not getting anywhere despite one's efforts may trigger a sense of being locked in a totally unrewarding social environment. Cumulative and chronic experiences of failed promotion prospects and related circumstances of relative deprivation may exert adverse long-term effects on mental and emotional well-being. Similar consequences are expected in case of involuntary job loss and job instability during mid-life, for example discontinued, fragmented working careers or periods of unemployment (Bambra & Eikemo, 2009; Bartley, Ferrie, & Montgomery, 2006; Thomas, Benzeval, & Stansfeld, 2005). We maintain that this approach extends the current research paradigm of occupational epidemiology. Moreover, it highlights how established work stress models can be used to analyse potential long-term effects on health due to specific characteristics of people's work histories.

Taken together, this paper studies associations between working conditions in mid-life and mental health after retirement for men and women. Working conditions will be measured in terms of specific characteristics of the work history and the exposure to psychosocial stress at work, as defined by the effort–reward imbalance and the demand–control model.

2. Methods

2.1. Data sources

For our analyses, we combined second wave data of the Survey of Health, Ageing and Retirement in Europe (SHARE) from 2006 to 2007 with information on health, with third wave data collected in 2008–2009 (SHARELIFE), where mid-life working conditions were assessed retrospectively. SHARE is the first cross-national research project comparing data on health, quality of life, social and socio-economic conditions among older people in European countries (see www.share-project.org for details). By combining these two waves of SHARE, it is possible to analyse associations between working conditions (assessed retrospectively) and health in older ages across 13 European countries, ranging from Scandinavia (Denmark (DK) and Sweden (SE)), Central Europe (Austria (AT), France (FR), Germany (DE), Switzerland (CH), Belgium (BE), and the Netherlands (NL)), Mediterranean countries (Spain (ES), Italy (IT) and Greece (GR)) and two Eastern European transition countries (the Czech Republic (CZ) and Poland (PL)). In all countries, data collection is based on probability household samples where all people above 50 years plus their (possibly younger) partners were interviewed using Computer Assisted Personal Interviews (CAPI).

For the analyses, we restricted the sample to all people who already left the labour market in wave 2 (at time of health assessment) and reported to be employed at least once during mid-life. This serves our aim to study the influence of mid-life working conditions on health in older ages. Furthermore, there are restrictions necessary to avoid that results are related to sample composition. First, in order to minimize the effect of ill health causing both specific working careers (e.g. periods of unemployment or downward mobility) and the report of poor health during retirement, all men and women with a period of long term sickness absence during working life (lasting at least 6 months) were excluded from the analyses. Second, to avoid an over-selection of respondents with an early exit from the labour market (probably with poorer health conditions) only respondents aged 60 or older when retired were selected. Finally, respondents who had difficulties to respond to the retrospective questionnaire (4%) were not included either to prevent biased information on work histories. These restrictions resulted in a final sample with full available data of 4822 men and 3787 women born between 1908 and 1947.

2.2. Measures

2.2.1. Mid-life working conditions

The third wave of SHARE contains an extensive module on the individual work history. These data are collected retrospectively using a lifegrid method, where respondent's working life is represented graphically by a grid that is filled in the course of the interview. This method was developed first for use in the Boyd Orr Cohort as a self-completion questionnaire (Blane, 1996); with subsequent development of a CAPI version by UK National Centre for Social Research (Scholes et al., 2009) which was adopted for SHARELIFE (Schröder, 2011a). The module collects information on each job a respondent had during his or her working career, together with details on each period when the respondent was not employed (if the respective period lasted 6 months or longer). Information on jobs includes a measure of the occupational position and a description of the psychosocial work environment (for the last main job of the working career). Information on periods when the respondent was not employed includes a description of the situation (e.g. unemployed, sickness absence, domestic work, etc.). Moreover, each time the respondents left a job, the reason was assessed (e.g. being laid off, retired). By combining these data, we can provide specific descriptions of occupational careers and reasons of their discontinuity, thus shedding light on the entire work history in terms of employment situations across each age period. To illustrate the richness of information evolving from this data, Fig. 1 presents the frequencies of different employment situations over the work life for the sample under study, separately for men and women. It clearly shows that working careers vary substantially between men and

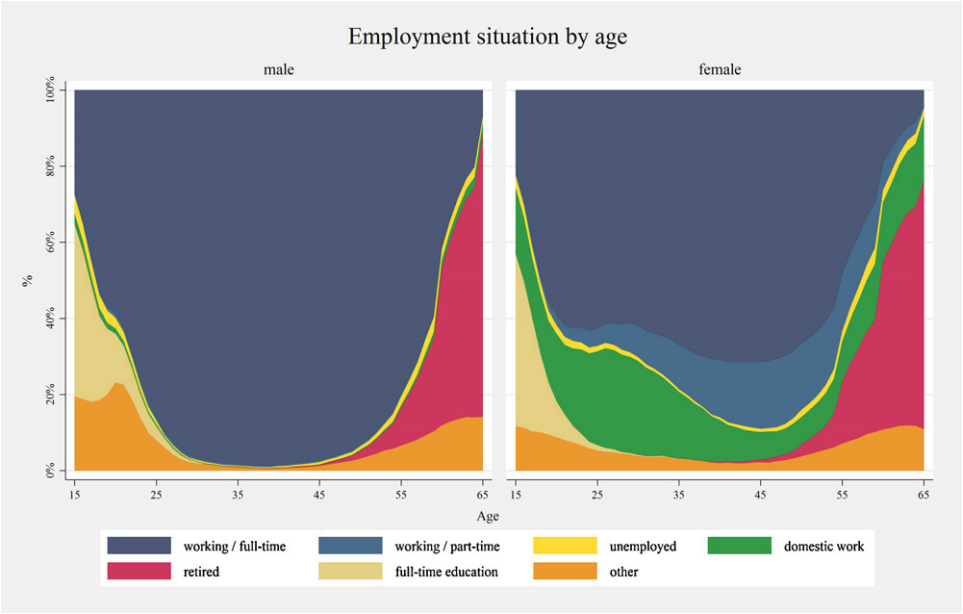


Fig. 1. Employment situation by age for men and women ($N = 8609$).

women, with higher labour market participation (mostly full-time employment) and no domestic work for men compared to women—a result that further supports our approach of conducting analyses separately.

For the following analyses, we concentrate on mid-life and the lifespan between the age of 40 and 55 (Willis & Martin, 2005). In line with our theoretical considerations we distinguish the following four types of mid-life working conditions: (1) a stressful psychosocial work environment (as assessed by the two work stress models) (2) a disadvantaged occupational position throughout the whole period of mid-life, (3) experience of involuntary job loss, and (4) exposure to job instability.

(1) *Psychosocial stress during mid-life*: To measure the exposure to psychosocial stress at work during mid-life, five binary indicators of poor psychosocial working conditions were computed, based on 11 questionnaire items (4-point Likert scaled) taken from established work stress measures. These measures refer to the main job of the working career, with a mean length of 22 years in our sample. Each indicator corresponds to a core dimension of the two work stress models described above and was taken from original questionnaires (Karasek et al., 1998; Siegrist et al., 2004): physical demands (2 items), psychosocial demands (3 items), social support at work (2 items), control at work (2 items), and reward (2 items). All items are displayed in Appendix A. For the analyses, we calculated a simple sum-score for each dimension, with higher scores indicating higher work stress. Each measure was transformed into a binary indicator, where participants scoring in the upper tertile of the respective measure were considered to experience stress at work.

(2) *Disadvantaged occupational position throughout mid-life*: We used two indicators of a disadvantaged occupational position throughout mid-life based on respondents' occupational positions held between the age of 40 and 55, first, the mean occupational position held during mid-life, and second, the extent of intra-generational social mobility during mid-life. In SHARE-LIFE, occupational positions were assessed according to the ten main occupational groups of the International Standard Classification of Occupation (ISCO), developed by the International Labour Office (1990). For the analyses, these groups were further reduced to the four different skill-levels representing the broad hierarchical structure of the ISCO classification, where higher skill levels are related to higher occupational positions. For the first indicator, the mean skill level during mid-life was calculated, by summing up the available skill levels for each year in mid-life divided by number of years in employment. By rounding up or down the resulting mean scores, respondents were regrouped to the four skill levels (very low: 1st skill level; low: 2nd skill level; high: 3rd skill level; very high: 4th skill level). For our second indicator (social mobility), the skill level of respondents' occupation at the age of 40 (or first job after 40 if not employed at age 40) was compared to the last main job of the working career. On this basis, four categories were defined (1) continuous high position (3rd or 4th skill level), (2) continuous low position (1st or 2nd skill level), (3) upward mobility, and (4) downward mobility). To avoid misspecifications, only jobs lasting at least two years were considered for this procedure.

(3) *Involuntary job loss*: We used one binary indicator to measure an involuntary job loss during mid-life, measuring whether the respondent left a job because of being laid off.

(4) *Job instability*: Two relevant indicators are based on individuals' employment situations between 40 and 55,

as displayed in Fig. 1. By further applying descriptive techniques of sequence analysis (Brzinsky-Fay & Kohler, 2010), we derived two binary indicators of job instability, measuring (1) whether the respondent experienced an episode of unemployment during mid-life (lasting at least 6 months), and (2) whether the respondent was exposed to a discontinued, fragmented working career (in terms of frequent (3 or more) job changes or in terms of staying in paid employment for less than 10 years during mid-life).

2.2.2. Health

Our main measure of mental health was a binary indicator of depressive symptoms. This measure was defined on the basis of the EURO-D depression scale (Prince et al., 1999). The EURO-D depression scale includes 12-items asking about the presence of depressive symptoms, with higher values reflecting more symptoms. For our analyses we used the cut-point of three (more than 3 symptoms) indicating a clinically relevant condition of depressive symptoms. While this cut-point does not meet the standards of a physician-based diagnosis of depression, it was nevertheless shown to be a valid and consistent indicator of elevated levels of depressive symptoms in a cross-European study (Prince et al., 1999).

2.2.3. Additional variables

We included a number of additional individual measures, in particular as confounders within the multivariate analyses. In addition to age, we included two variables related to childhood circumstances which were also measured in the retrospective survey and may both influence working careers and health in later life: first, an indicator of socioeconomic circumstances, measured by the number of reported books in the household when the respondent was ten years old, and second a measure of health during childhood (self-reported poor health as a child at the age of ten).

2.2.4. Analyses

All analyses were conducted separately for men and women. First, after a basic description of mid-life working conditions (Table 1), we studied the prevalence of increased depressive symptoms according to working conditions (Table 2). Next, we calculated multilevel logistic regression models (random intercept only) for binary dependent variables to estimate the probability of increased depressive symptoms according to mid-life working conditions, with individuals (level 1) nested within countries (level 2) (Skrondal & Rabe-Hesketh, 2010). By using multilevel modelling, accurate adjustment for country affiliation is possible, and the dependence of residuals within a country is considered, since the constant is allowed to vary across countries. Moreover, likelihood ratio tests were performed comparing the multilevel models to ordinary logistic regression and revealed better model fits in all cases. Regression models are presented for each measure of working conditions (Table 3), one for men

Table 1
Description of measures and frequencies ($N = 8609$).

		Male $N = 4822$		Female $N = 3787$	
		%	*N*	%	*N*
Psychosocial stress during mid-life					
High physical demands	Yes	28.37	1368	22.21	841
	No	71.63	3454	77.79	2946
High psychosocial demands	Yes	26.71	1288	21.76	824
	No	73.29	3534	78.24	2963
Low work control	Yes	15.08	727	23.55	892
	No	84.92	4095	76.45	2895
Low reward	Yes	20.63	995	27.65	1047
	No	79.37	3827	72.35	2740
Low social support	Yes	17.44	841	20.15	763
	No	82.56	3981	79.85	3024
Disadvantaged occupational position throughout mid-life					
Mean occup. position during mid-life	Very low	14.74	711	20.33	770
	Low	54.56	2631	60.81	2303
	High	14.02	676	7.31	277
	Very high	16.67	804	11.54	437
Social mobility during mid-life	Cont. high position	27.06	1305	16.48	624
	Cont. low position	68.00	3279	80.30	3041
	Upward mobility	3.73	180	2.27	86
	Downward mobility	1.20	58	0.95	36
Involuntary job loss					
Laid off	Yes	3.77	182	4.33	164
	No	96.23	4640	95.67	3623
Job instability					
Period of unemployment	Yes	2.24	108	2.22	84
	No	97.76	4714	97.78	3703
Discontinuous and fragmented career	Yes	6.08	293	16.77	635
	No	93.92	4529	83.23	3152

Table 2
Frequencies of high depressive symptoms (EURO-D) according to mid-life working conditions ($N = 8609$).

		Male $N = 4822$	Female $N = 3787$
Psychosocial stress during mid-life			
High physical demands	Yes	20.83	37.69
	No	15.20	27.66
High psychosocial demands	Yes	20.19	31.67
	No	15.56	29.40
Low work control	Yes	25.58	35.87
	No	15.24	28.05
Low reward	Yes	21.41	34.96
	No	15.60	27.96
Low social support	Yes	23.07	42.73
	No	15.47	26.65
Disadvantaged occupational position throughout mid-life			
Mean occup. position during mid-life	Very low	24.19	38.83
	Low	16.99	29.87
	High	14.50	22.74
	Very high	11.57	18.76
Social mobility during mid-life	Cont. high position	12.72	19.39
	Cont. low position	18.60	32.19
	Upward mobility	12.78	24.42
	Downward mobility	18.97	30.56
Involuntary job loss			
Laid off	Yes	21.43	25.61
	No	16.62	30.09
Job instability			
Period of unemployment	Yes	22.22	21.43
	No	16.67	30.08
Discontinuous and fragmented career	Yes	24.91	34.17
	No	16.27	29.03
Total		16.80	29.89

and one for women. Importantly, all models include relevant confounders, such as age, childhood social position and prior health status. In the results, we present odds ratios and levels of significance. All calculations were done using STATA 11.

3. Results

3.1. Descriptive findings

The sample of participants with full data consisted of 4822 men (mean age: 70.6 years) and 3787 women (mean age: 70.2). The mean number of observation across countries was 662, with smallest number in Austria (314) and largest number in Belgium (945).

In Table 1, all measures of mid-life working conditions and their frequencies are reported, separately for men and women. With regard to our five indicators of psychosocial stress at work, we found somewhat higher rates of physical and psychosocial demands amongst men, and somewhat higher rates of low work control and low reward among women. Turning to the mean occupational position, women tended to have achieved lower occupational positions during mid-life than men. Mobility during mid-life was low for men and women. Rates of an involuntary job loss were as low as around 4% for men and women. Most respondents of our sample experienced rather stable working arrangements during mid-life, with low rates of unemployment episodes (longer than 6 months), and low levels of fragmented working careers (specifically for men). These latter findings support our notion that measuring chronic psychosocial stress experienced in one's main occupation during mid-life is particularly useful to test the study hypotheses.

Are mid-life working conditions associated with increased depressive symptoms after labour market exit? Table 2 gives a preliminary answer to these questions, presenting frequencies of increased depressive symptoms according to working conditions. Concerning an adverse psychosocial work environment during mid-life, men and women who experienced stressful work during mid-life were more likely to report increased depressive symptoms in later life. Strongest associations are observed for men with low level of control and for women with low level of social support at work. Furthermore, Table 2 demonstrates a clear-cut social gradient of depressive symptoms, where levels of depressive symptoms were lower amongst those who had worked in higher social positions. Moreover, Table 2 shows that people who were locked in a low position during their whole mid-life career and those who experienced downward mobility were more likely to report high depressive symptoms after exit from labour market. In case of involuntary job loss, results show higher frequencies of depressive symptoms amongst those who had been laid off during mid-life. Finally, the experience of an episode of unemployment (for men only) and of a

Table 3
Association between mid-life working conditions and high depressive symptoms in older ages: results of multilevel logistic regression analyses (odds ratios and significance levels, *N* = 8609).

		Male *N* = 4822	Female *N* = 3787
Psychosocial stress during mid-life			
High physical demands	Yes	1.31**	1.36***
	No	–	–
High psychosocial demands	Yes	1.49***	1.29**
	No	–	–
Low work control	Yes	1.68***	1.27**
	No	–	–
Low reward	Yes	1.58***	1.37***
	No	–	–
Low social support	Yes	1.56***	1.74***
	No	–	–
Disadvantaged occupational position throughout mid-life			
Mean occup. position during mid-life	Very low	1.77***	1.92***
	Low	1.26	1.50**
	High	1.22	1.28
	Very high	–	–
Social mobility during mid-life	Cont. high position	–	–
	Cont. low position	1.25*	1.55***
	Upward mobility	0.93	1.64
	Downward mobility	1.66	2.10
Involuntary job loss			
Laid off	Yes	1.54*	0.84
	No	–	–
Job instability			
Period of unemployment	Yes	1.72*	0.78
	No	–	–
Discontinuous and fragmented career	Yes	1.67***	1.17
	No	–	–

Note: All models are adjusted for age, childhood social position and child health.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

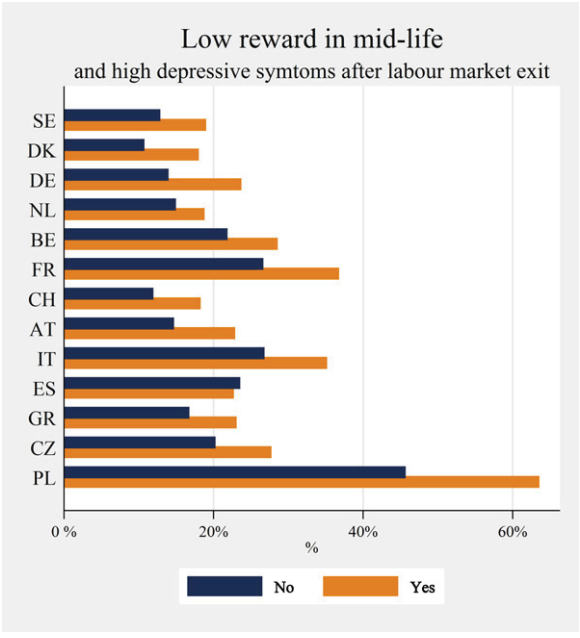


Fig. 2. Frequencies of increased depressive symptoms after labour market exit according to low reward (No/Yes) during mid-life across SHARE countries (N = 8609).

fragmented working career were both associated with high depressive symptoms. As exemplified in Fig. 2, findings were confirmed at the level of countries, using low reward at work as an indicator for men and women.

3.2. Multivariate findings

In a next step, multilevel models were calculated to test the significance of the described associations between working conditions and depressive symptoms, once important confounders were taken into account. Results of these analyses are given in Table 3, where odds ratios and levels of statistical significance are indicated for each measure of mid-life working conditions.

In case of the five indicators of psychosocial stress during mid-life and the two measures of a disadvantage occupational position throughout mid-life, results confirm our descriptive findings both for men and women. Even after taking into account workers' health conditions and social position before mid-life, we observe significantly higher probabilities of reporting increased depressive symptoms amongst people who reported stress at work during mid-life or who worked in low occupational positions during this period of life. In case of involuntary job loss and job instability we found significant results for men only. Again, men who had been laid off, who

experienced a period of unemployment, or who were exposed to fragmented working careers were at higher risk of reporting increased depressive symptoms after labour market exit. This observation supports our hypothesis of associations between working conditions in mid-life and depressive symptoms in later life.

4. Discussion

With this contribution we set out to study the long-term influences of working conditions in mid-life on mental health after labour market exit, using information on respondents' working life that was collected retrospectively in the SHARELIFE interview. Working conditions were defined and measured on the basis of established models of work stress, specifically the demand–control–support model and the effort–reward imbalance model. On the one hand we used items taken from original questionnaires to measures core dimensions of the two stress models, and on the other hand we derived a variety of specific characteristics of the work history by extending core stress-theoretical assumptions to mid-life working careers. Taken together, we distinguished four types of working conditions: (1) a stressful psychosocial work environment (as assessed by the two work stress models), (2) a disadvantaged occupational position throughout the whole period of mid-life, (3) experience of involuntary job loss, and (4) exposure to job instability. Given the expected sex differences of working conditions in mid-life and their influence on later health, all analyses were conducted separately for men and women.

Main results can be summarized as follows: first, we found important variations of working conditions between men and women. While rates of physical and psychosocial demands were higher for men, women were more likely to experience low work control and low reward at work. Moreover, men had generally higher occupational positions in mid-life and tended to have more stable working careers. Second, we found strong evidence that people who experienced poor working conditions during mid-life are more likely to report elevated levels of depressive symptoms during retirement. However, results differed according to type of working conditions under study as well as according to sex. Experiencing psychosocial stress at work and being confined to disadvantaged occupational positions during mid-life were associated with elevated risk of reporting depressive symptoms after labour market exit both among men and women, with strongest associations for men with low level of control and for women with low level of social support at work. In case of the remaining working conditions, significant associations with depressive symptoms were found for men only. Here, involuntary job loss and job instability during mid-life were significantly associated with later increased depressive symptoms. These associations remained significant after controlling for workers' health conditions and social position prior to mid-life.

Taken together, these results are in line with studies documenting an increased risk of stress-related and mental disorders among people who are exposed to adverse working conditions during mid-life, whether in terms of poor psychosocial work environment (Nieuwenhuijsen et al., 2010; Stansfeld & Candy, 2006) or labour market disadvantages (Bambra & Eikemo, 2009; Bartley et al., 2006; Thomas et al., 2005). Moreover, results confirm previous findings of a long-term impact of working conditions on later health (Schröder, 2011b; Siegrist & Wahrendorf, 2010; Wahrendorf et al., 2012; Schröder, in this issue), but add a new element to its explanation by focussing on mid-life working conditions and testing their long-term associations with mental health following working life. Importantly, in contrast to preceding studies, we choose a theory-driven approach, first, by highlighting mid-life as a stage of the life course with critical challenges of fulfilling needs and meeting responsibilities, and second, by identifying particular unhealthy working conditions over a longer time period of the life course, applying stress-theoretical notions of control and reward. Our results support this approach and underline that disadvantaged working conditions, as measured in this study, contribute towards explaining mental health in later life. Moreover, results support the assumption that level of exposure and its effect on mental health vary between men and women, as indicated in previous studies (Eurofound, 2007; Stansfeld et al., 1999).

Alternative explanations and further mechanisms must be considered when discussing the results. First, while our study and the proposed theoretical framework focus on the psychobiological stress responses to a disadvantaged work environment, additional conditions, such as poverty and health-damaging behaviours, may help to explain the observed associations (Bartley et al., 2006). Furthermore, selection into unfavourable jobs during earlier stages of the life course due to reduced health may exert an indirect effect on poor mental health later on. Finally, unfavourable working conditions in mid-life were shown to increase poor physical health in later life (Siegrist & Wahrendorf, 2010; Wahrendorf et al., 2012), which in turn may reduce mental well-being during retirement.

Several limitations must be considered. First, although we conducted gender-specific analyses in view of differential patterns of labour market participation, we did not analyse additional factors which may modify the shape of working trajectories and associated health risks. For instance, a growing body of research explores the impact of distinct national welfare state policies on a country's quality of work and employment (Bambra & Eikemo, 2009; Dragano et al., 2011). Some findings of this research suggest that favourable national labour market policies (e.g. high degree of investments in rehabilitative care or in adult education and training programmes) to some extent can mitigate the adverse effects on health and well-being attributed to stressful working conditions in these countries. Similar, further analyses may invest if the observed differences between men and women exist for all countries.

A second limitation is given by the fact that our analyses are restricted to a sample of retirees born between 1908 and 1947, representing generations with specific working careers and values. Therefore, the results may not be generalized to more recent generations of working men and women. In terms of life course theory it is important to

keep in mind that the experience of working conditions does not only vary according to a specific life stage, but additionally according to the historical period in which these conditions are shaped and experienced (Elder & Johnson, 2002). Therefore, the significance of our results for a workforce which has been – and continues to be – exposed to more recent changes of work and employment in the context of a globalized economy remains to be evaluated in future studies.

A third limitation relates to the measurement of our core variables within the constraints of this study design. Although working conditions and depressive symptoms have been measured at different time points, we are not able to rule out a reporting bias of our data measuring working conditions. Importantly, a depressive mood may influence how working conditions during mid-life are interpreted and experienced in retrospect. Yet, while this may be critical in the case of our assessment of psychosocial stress at work there is less concern about bias in case of descriptive information about one's working career (occupational position, involuntary job loss, job stability). Furthermore, it should be noted that recent analyses using health measures with less susceptibility to generate biased information, such as health functioning, chronic health conditions or reported symptoms, revealed associations of similar strength between psychosocial work stress and health after labour market exit (Siegrist & Wahrendorf, 2010; Wahrendorf et al., 2012), thus strengthening our theoretical approach. We should also keep in mind that we restricted our sample by excluding people who reported a period of major sickness absence during working life and by focussing on people aged 60 or older. Moreover, controlling for negative affectivity would perhaps have improved the validity of our findings. Yet, respective information was not available and previous analyses of its effect on associations of self-report measures of stressful work with health found relatively weak impact (Bosma, Peter, Siegrist, & Marmot, 1998; Stansfeld et al., 1999).

A final limitation concerns the measurement of psychosocial stress at work which was limited to one major – although highly representative – job during mid-life. Furthermore, due to financial and time constraints of cross-national epidemiological studies (such as SHARE) a full test of the original scales of the two work stress models was not feasible. Therefore, abbreviated measure had to be applied. However, previous studies documented that short versions of these work stress models successfully contribute towards explaining associations of work stress with mental health (Dragano et al., 2011; Siegrist, Wahrendorf, von dem Knesebeck, Jürges, & Börsch-Supan, 2006).

These limitations are balanced by several strengths. First, the SHARE study meets high quality standards of data collection, specifically a vigorously controlled study protocol, the application of validated questionnaires, and the observation of standard procedures of translating the measures into different languages and of collecting and controlling the data (Börsch-Supan & Jürges, 2005). Second, we applied a theoretically grounded approach to measure working conditions. Third, by considering the hierarchical structure of our data in the multilevel analysis (individual nested within countries), we allowed for an accurate adjustment of country affiliation.

In conclusion, the results of this study demonstrate robust associations of working conditions in mid-life and depressive symptoms after labour market exit. Our findings support the notion that work-related interventions and related employment policies should target more explicitly mid-life as a critical period, given its significance for health and well-being in later stages of the life course.

Acknowledgements

This paper uses data from SHARELIFE release 1, as of November 24th 2010 or SHARE release 2.5.0, as of May 24th 2011. The SHARE data collection has been primarily funded by the European Commission through the 5th framework programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the 6th framework programme (projects SHARE-I3, RII-CT-2006-062193, COMPARE, CIT5-CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th framework programme (SHARE-PREP, 211909 and SHARE-LEAP, 227822). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGHA 04-064, IAG BSR06-11, R21 AG025169) as well as from various national sources is gratefully acknowledged (see www.share-project.org for a full list of funding institutions).

This research was conducted in the frame of a post-doc fellowship of the German Research Foundation (Deutsche Forschungsgemeinschaft, project number: Wa 3065/1-1).

Appendix A

See Table A.4.

Table A.4
Measures of psychosocial stress during mid-life.

Dimension	Item (strongly agree, agree, disagree, strongly disagree)
Physical demands	1. My job as [main job title] was physically demanding.
	2. My immediate work environment was uncomfortable (e.g. noise, heat, crowding).
Psychosocial demands	3. I was under constant time pressure due to heavy workload.
	4. My work was emotionally demanding.
	5. I was exposed to recurrent conflicts and disturbances.
Social support at work	6. I received adequate support in difficult situations.
	7. There was a good atmosphere between me and my colleagues.
Control	8. I had very little freedom to decide how to do my work.
	9. I had an opportunity to develop new skills.
Reward	10. I received the recognition I deserved for my work.
	11. Considering all my efforts and achievements, my salary was adequate.

References

Antoniou, A. S., & Cooper, C. (2005). *Research companion to organizational health psychology*. Chelterham: Edward Elgar Publishers.

Bambra, C., & Eikemo, T. A. (2009). Welfare state regimes unemployment and health: A comparative study of the relationship between unemployment and self-reported health in 23 European countries. *Journal of Epidemiology and Community Health, 63*, 92–98.

Bartley, M., Ferrie, J., & Montgomery, S. M. (2006). Health and labour market disadvantage: Unemployment, non-employment, and job insecurity. In M. Marmot & R. Wilkinson (Eds.), *Social determinants of health* (pp. 78–96). Oxford: Oxford University Press.

Berkman, L., & Glass, T. (2000). Social integration, social networks, social support, and health. In L. Berkman & I. Kawachi (Eds.), *Social epidemiology* (pp. 137–173). Oxford: Oxford University Press.

Blane, D. (1996). Collecting retrospective data: Development of a reliable method and a pilot study of its use. *Social Science and Medicine, 42*, 751–757.

Blane, D. (2006). The life course, the social gradient, and health. In M. Marmot & R. Wilkinson (Eds.), *Social determinants of health* (pp. 54–77). Oxford: Oxford University Press.

Börsch-Supan, A., Brugiavini, A., Jürges, H., Mackenbach, J., Siegrist, J., & Weber, G. (2005). *Health, ageing and retirement in Europe. First results from the survey of health, ageing and retirement in Europe*. Mannheim: Mannheim Research Institute for the Economics of Ageing.

Börsch-Supan, A., & Jürges, H. (2005). *The survey of health, aging and retirement in Europe—Methodology*. Mannheim: Mannheim Research Institute for the Economics of Ageing.

Bosma, H., Peter, R., Siegrist, J., & Marmot, M. (1998). Two alternative job stress models and the risk of coronary heart disease. *American Journal of Public Health, 88*, 68–74.

Brzinsky-Fay, C., & Kohler, U. (2010). New developments in sequence analysis. *Sociological Methods & Research, 38*, 359–364.

Dragano, N., Siegrist, J., & Wahrendorf, M. (2011). Welfare regimes labour policies and unhealthy psychosocial working conditions: A comparative study with 9917 older employees from 12 European countries. *Journal of Epidemiology and Community Health, 65*, 793–799.

Elder, G. H., & Johnson, M. K. (2002). The life course and aging: Challenges, lessons, and new directions. In R. Settersten (Ed.), *Invitation to the life course: Toward new understandings of later life, Part II* (pp. 49–81). New York: Baywood.

Eurofound. (2007). *Working conditions in the European Union: The gender perspective*. Luxembourg: Office for Official Publications of the European Communities.

Haidt, J., & Rodin, J. (1999). Control and efficacy as interdisciplinary bridges. *Review of General Psychology, 3*, 317–337.

International Labour Office. (1990). *International Standard Classification of Occupations: ISCO-88*. Geneva: International Labour Office.

Johnson, J. V., & Hall, E. M. (1988). Job strain, work place social support, and cardiovascular disease: A cross-sectional study of a random sample of the Swedish working population. *American Journal of Public Health, 78*, 1336–1342.

Karasek, R. A. (1979). Job demands, job decision latitude, and mental strain—Implications for job redesign. *Administrative Science Quarterly, 24*, 285–308.

Karasek, R., Brisson, C., Kawakami, N., Houtman, I., Bongers, P., & Amick, B. (1998). The job content questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. *Journal of Occupational Health Psychology, 3*, 322–355.

Karasek, R., & Theorell, T. (1990). *Healthy work*. New York: Basic Books.

Kivimaki, M., Virtanen, M., Elovainio, M., Kouvonen, A., Vaananen, A., & Vahtera, J. (2006). Work stress in the etiology of coronary heart disease—A meta-analysis. *Scandinavian Journal of Work Environment & Health, 32*, 431–442.

Mc Munn, A., Breeze, E., Goodman, A., & Nazroo, J. (2006). Social determinants of health in older age. In M. Marmot & R. Wilkinson (Eds.), *Social determinants of health* (pp. 267–298). Oxford: Oxford University Press.

Melchior, M., Berkman, L. F., Kawachi, I., Krieger, N., Zins, M., Bonenfant, S., et al. (2006). Lifelong socioeconomic trajectory and premature mortality (35–65 years) in France: Findings from the GAZEL cohort study. *Journal of Epidemiology and Community Health, 60*, 937–944.

Messing, K., Punnett, L., Bond, M., Alexanderson, K., Pyle, J., Zahm, S., et al. (2003). Be the fairest of them all: Challenges and recommendations for the treatment of gender in occupational health research. *American Journal of Industrial Medicine, 43*, 618–629.

Nieuwenhuijsen, K., Bruinvels, D., & Frings-Dresen, M. (2010). Psychosocial work environment and stress-related disorders: A systematic review. *Occupational Medicine, 60*, 277–286.

Power, C., & Kuh, D. (2006). Life course development of unequal health. In J. Siegrist & M. Marmot (Eds.), *Social inequalities in health: New evidence and policy implications* (pp. 27–53). Oxford: Oxford University Press.

Prince, M. J., Reischies, F., Beekman, A. T., Fuhrer, R., Jonker, C., Kivela, S. L., et al. (1999). Development of the EURO-D scale—A European Union initiative to compare symptoms of depression in 14 European centres. *British Journal of Psychiatry, 174*, 330–338.

Schnall, P., Dobson, M., & Rosskam, E. (2009). *Unhealthy work: Causes, consequences, cures*. Amityville: Baywood.

Scholes, S., Medina, J., Cheshire, H., Cox, K., Hacker, E., & Carli Lessof (2009). *Living in the 21st century: Older people in England. The 2006 English Longitudinal Study of Ageing Technical Report*. NatCen, UK: National Center for Social Research. Data Archive Study Number 5050.

Schröder, M. (2011a). *Retrospective data collection in the survey of health, ageing and retirement in Europe. SHARELIFE methodology*. Mannheim: MEA.

Schröder, M. (2011b). Scar or blemish? Investigating the long-term impact of involuntary job loss on health. In A. Börsch-Supan, M. Brandt, K. Hank, & M. Schröder (Eds.), *The individual and the welfare state. Life histories in Europe* (pp. 191–202). Berlin: Springer.

Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *Journal of Occupational Health Psychology, 1*, 27–41.

Siegrist, J. (2005). Social reciprocity and health: New scientific evidence and policy implications. *Psychoneuroendocrinology, 30*, 1033–1038.

Siegrist, J. (2009). Job control and reward. Effects on well-being. In S. Cartwright & C. Cooper (Eds.), *The oxford handbook of organizational well-being* (pp. 109–132). Oxford: Oxford University Press.

Siegrist, J., & Marmot, M. G. (2006). *Social inequalities in health: New evidence and policy implications*. Oxford: Oxford University Press.

Siegrist, J., Starke, D., Chandola, T., Godin, I., Marmot, M., Niedhammer, I., et al. (2004). The measurement of effort–reward imbalance at work: European comparisons. *Social Science & Medicine, 58*, 1483–1499.

Siegrist, J., & Wahrendorf, M. (2010). Quality of work, health and early retirement: European comparisons. In M. Schroeder, K. Hank, & A. Börsch-Supan (Eds.), *The individual and the welfare state—Life histories in Europe*. Berlin: Springer.

Siegrist, J., Wahrendorf, M., von dem Knesebeck, O., Jurges, H., & Borsch-Supan, A. (2006). Quality of work, well-being, and intended early retirement of older employees—Baseline results from the SHARE Study. *The European Journal of Public Health, 17*, 62–68.

Skrondal, A., & Rabe-Hesketh, S. (2010). *Multilevel modelling*. Los Angeles, London: Sage.

Stansfeld, S., & Candy, B. (2006). Psychosocial work environment and mental health—A meta-analytic review. *Scandinavian Journal of Work Environment & Health, 32*, 443–462.

Stansfeld, S. A., Fuhrer, R., Shipley, M. J., & Marmot, M. G. (1999). Work characteristics predict psychiatric disorder: Prospective results from the Whitehall II Study. *Occupational & Environmental Medicine, 56*, 302–307.

Steptoe, A., & Kivimaki, M. (2012). Stress and cardiovascular disease. *Nature Reviews Cardiology, 8*, 360–370.

Thomas, C., Benzeval, M., & Stansfeld, S. A. (2005). Employment transitions and mental health: An analysis from the British household panel survey. *Journal of Epidemiology and Community Health, 59*, 243–249.

Wahrendorf, M., Sembajwe, G., Zins, M., Berkman, L., Goldberg, M., & Siegrist, J. (2012). Long-term effects of psychosocial work stress in midlife on health functioning after labor market exit—Results from the GAZEL study. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 67*, 471–480.

Westerlund, H., Kivimaki, M., Singh-Manoux, A., Melchior, M., Ferrie, J. E., Pentti, J., et al. (2009). Self-rated health before and after retirement in France (GAZEL): A cohort study. *Lancet, 374*, 1889–1896.

Willis, S. L., & Martin, M. (2005). *Middle adulthood: A lifespan perspective*. Thousand Oaks, Calif., London Sage Publications.

Willis, S. L., Martin, M., & Rocke, C. (2010). Longitudinal perspectives on midlife development: Stability and change. *European Journal of Ageing, 7*, 131–134.

8. **Wahrendorf M.**, Sembajwe G., Zins M., Berkman L., Goldberg M., & Siegrist J. (2012). "Long-term effects of psychosocial work stress in midlife on health functioning after labor market exit—results from the GAZEL study." *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 67:471-480.

   Impact-Faktor: 3.01

Wahrendorf, M., Sembajwe, G., Zins, M., Berkman, L., Goldberg, M., & Siegrist, J. (2012). Long-term effects of psychosocial work stress in midlife on health functioning after labor market exit—results from the GAZEL study. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, *67(4)*, 471–480, doi:10.1093/geronb/gbs045. Advance Access published on April 29, 2012

Long-term Effects of Psychosocial Work Stress in Midlife on Health Functioning After Labor Market Exit—Results From the GAZEL Study

Morten Wahrendorf,[1] Grace Sembajwe,[2] Marie Zins,[3,4] Lisa Berkman,[2] Marcel Goldberg,[3,4] and Johannes Siegrist[1]

[1]Department of Medical Sociology, University of Duesseldorf, Germany.
[2]Department of Society, Human Development and Health, Harvard School of Public Health, Boston, Massachusetts.
[3]INSERM U1018, Epidemiology of Occupational and Social Determinants of Health—Centre for Research in Epidemiology and Population Health, Villejuif, France.
[4]Versailles-Saint Quentin University, France.

Objectives. To study long-term effects of psychosocial work stress in mid-life on health functioning after labor market exit using two established work stress models.

Methods. In the frame of the prospective French Gazel cohort study, data on psychosocial work stress were assessed using the full questionnaires measuring the demand-control-support model (in 1997 and 1999) and the effort–reward imbalance model (in 1998). In 2007, health functioning was assessed, using the Short Form 36 mental and physical component scores. Multivariate regressions were calculated to predict health functioning in 2007, controlling for age, gender, social position, and baseline self-perceived health.

Results. Consistent effects of both work stress models and their single components on mental and physical health functioning during retirement were observed. Effects remained significant after adjustment including baseline self-perceived health. Whereas the predictive power of both work stress models was similar in the case of the physical composite score, in the case of the mental health score, values of model fit were slightly higher for the effort–reward imbalance model (R^2: 0.13) compared with the demand-control model (R^2: 0.11).

Conclusions. Findings underline the importance of working conditions in midlife not only for health in midlife but also for health functioning after labor market exit.

Key Words: Gazel—Health functioning—Long-term effects—Work stress.

RAPID increase in life expectancy at middle ages combined with continued low birth rates promotes population aging in industrialized countries and contributes to the emergence of a new stage of the life course, the so-called "third age" (Laslett, 1996). Maintaining core capabilities and appropriate health functioning during this stage of life is an important goal of public health policy as well as of labor market policy because reduced health and functioning were shown to be associated with early retirement (Lund & Villadsen, 2005). Although evidence on a compression of morbidity in aging societies is still scarce (Kalache, Aboderin, & Hoskins, 2002), there is reason to believe that investments into health-promoting conditions during midlife exert favorable effects on functioning and well-being at later stages of the life course (Berney, Blane, Davey Smith, & Holland, 2000; Power & Kuh, 2006). Given their overriding influence, health-related behaviors are a primary target of such investments (Stringhini et al., 2010). Yet additional determinants of health during midlife deserve attention. Among these, health-adverse work and employment conditions in modern economies are of particular relevance (Schnall, Dobson, & Rosskam, 2009). In recent years, many observational and experimental studies have documented an increased risk of physical or mental illness and of reduced health functioning among people who were exposed to an adverse psychosocial work environment (Bonde, 2008; Cartwright & Cooper, 2009; Kivimaki et al., 2006; Marmot & Wilkinson, 2006; Stansfeld & Candy, 2006). Additionally, an adverse psychosocial work environment was associated with increased risks of early retirement due to disability (Dragano & Schneider, 2011). In a majority of studies, an adverse psychosocial work environment was measured by validated questionnaires measuring work stress in terms of two complementary theoretical models that allow for an identification of specific stressful aspects of the workplace, namely the demand-control-support model and the effort–reward imbalance model.

The former model, developed by Karasek (1979) and extended by Karasek and Theorell (1990) and by Johnson and Hall (1988), identifies stressful work in terms of job task profiles defined by three specific dimensions, (a) the amount of psychological (or psychomental) demands, (b) the degree of control or decision latitude at work, and (c) the degree of social support received from supervisors or coworkers. More specifically, the model posits that jobs with high psychological demands and low levels of decision latitude (low control) are stressful and adversely affect

Received February 17, 2011; Accepted March 16, 2012
Decision Editor: Merril Silverstein, PhD

health because they limit the experience of autonomy at work, while exerting continued pressure. This combination is labeled "high job strain." Moreover, the model assumes that lack or low level of social support at work increases the burden of stressful work and its adverse effects on health.

"Effort–reward imbalance" was developed as a complementary model (Siegrist, 1996) with a focus on the work contract and the principle of social reciprocity lying at its core. Social reciprocity defines distinct obligations to be performed in exchange for adequate rewards. These rewards include money, esteem, and career opportunities (job promotion and job security). On this basis, the model claims that lack of reciprocity (high effort in combination with low reward or effort–reward imbalance) generates strong negative emotions and psychobiological stress responses with adverse long-term effects on health. A lack of reciprocity may specifically occur frequently in modern working life, for instance, among employees who have no alternative choice in the labor market or who are exposed to heavy competition. Moreover, this sociological model includes a psychological component termed "overcommitment" that addresses the intrinsic motivational source of high effort, in addition to the above-mentioned extrinsic source. Thus, people who are strongly overcommitted to their work while experiencing effort–reward imbalance are at excess risk of developing a stress-related disorder.

Taken together, both work stress models cover different but equally relevant aspects of the workplace, where lack of autonomy (high demand and low control, "job strain") and frustration of legitimate rewards (imbalance between high efforts and low rewards, effort–reward imbalance) matter most. Although these combinations delineate the essence of stressful experience at work, each single component of the two models may contribute to the overall risk. Therefore, in our analysis, we will analyze effects on health functioning that are due to the combined measures as well as those that are due to their single components (see below).

Several prospective observational investigations analyzed the effects of stressful work in terms of these two models with an emphasis on health functioning as an outcome (Cheng, Kawachi, Coakley, Schwartz, & Colditz, 2000; Kuper, Singh-Manoux, Siegrist, & Marmot, 2002; Stansfeld, Bosma, Heminway, & Marmot, 1998), but their findings were related to populations whose majority was still employed at the time of assessing health functioning. To our knowledge, no study has yet explored long-term effects of an adverse psychosocial work environment with a focus on health functioning after labor market exit as an outcome.

In this study, we set out to fill this gap by linking data on stressful work, in terms these two models, obtained from screenings conducted between 1997 and 1999 in the frame of the French GAZEL cohort, with data on health functioning obtained in 2007, a time when almost all respondents had left the labor market. More specifically, we test the hypothesis that employees who experienced a high level of stressful work in terms of the two models are at elevated risk of experiencing poor mental and physical health functioning after labor market exit compared with their less exposed colleagues. We test this hypothesis with respect to the two combined measures of work stress, their single scales as well as distinct interaction terms between scales. Given the strong and enduring endogenous effects of poor health in midlife on functioning and well-being later, available information on health at the time of work stress assessment needs to be included in respective analyses (Breeze et al., 2001).

In addition to this first aim, a second aim of this contribution concerns the methodology of assessing an adverse psychosocial work environment. As the GAZEL study protocol includes the full original versions of the Job Content Questionnaire (JCQ) measuring the demand-control-support model (applied in 1997 and 1999; Karasek et al., 1998) and of the effort–reward imbalance questionnaire (applied in 1998; Siegrist et al., 2004), we are given the opportunity to analyze (a) the interrelations of all single scales and the effects of single and combined scales of each model on health functioning and of analyzing and (b) the combined effects of the two models, adjusted for each other, and two theoretical assumptions of effect modifications (high job strain and low social support; effort–reward imbalance and high overcommitment). Moreover, using measures of model fit, the statistical power of each work stress model of predicting health functioning later on can be compared. Although several previous studies explored the separate and combined effects of scales measuring, these two work stress models (Calnan, Wadsworth, May, Smith, & Wainwright, 2004; de Jonge, Bosma, Peter, & Siegrist, 2000; Ostry, Kelly, Demers, Mustard, & Hertzman, 2003; Rydstedt, Devereux, Sverke, 2007), to our knowledge, no investigation has yet analyzed all steps mentioned above within the frame of a prospective study design analyzing long-term effects of work stress in mid-life on health functioning after labor market exit.

Methods

Study Population

Data were obtained from the GAZEL cohort study (M. Goldberg et al., 2007) initiated in 1989 among employees of the French National Electricity and Gas Company (EDF-GDF). Since study onset, a self-administered questionnaire has been sent annually to the participants. Information on work stress was obtained among respondents who were still employed between 1997 and 1999 (see measurement for details). Data on our health outcome were measured in 2007, where the majority of the participants were retired (90%). For all years, response rates ranges from 75% to 72%, with a sample largely constituted by the same participants throughout the years (over 90 percent). In our analyses, we were interested in work stress and its long-term effect on health functioning after labor market exit. Therefore, we restricted our sample to all men and women who were employed between 1997 and

1999 and who were retired in 2007. This restriction results in a longitudinal sample with complete information on all variables of 6,053 men and women. Although the GAZEL cohort represents a specific employment sector, the study population was recruited from urban and rural areas throughout France, representing a wide range of occupations and a socioeconomic structure that is well-comparable to the French population, for example, in terms of educational attainment (for a detailed cohort profile see M. Goldberg et al., 2007).

Measures

Psychosocial working conditions.—In the GAZEL study, both work stress models mentioned above were measured using the full original questionnaires, that is, the JCQ measuring the demand-control-support model and the effort–reward imbalance questionnaire (ERI-Q). By collecting full data of these models, we are in a position to analyze all scales of either work stress models including their subscales and to compare separate and combined effects on health functioning. While the effort–reward imbalance questionnaire was assessed only once, in 1998, the JCQ was incorporated twice, in 1997 and 1999. For the analyses, information of the JCQ from 1997 to 1999 was combined to one measure of 1998, where the mean value of both years was calculated. To increase sample size, information for one single year was used if values were available once only. With the proposed strategy of analyses of respective scales, we followed the procedure of a previous paper by Sembajwe and colleagues (2011), where basic test-statistical information is given. Moreover, the psychometric properties of both questionnaires were previously tested for the Gazel study (Niedhammer, 2002; Niedhammer, Siegrist, Landre, Goldberg, & Leclerc, 2000).

The JCQ (measuring the demand-control-support model) consists of 31 items measuring four scales: decision latitude (9 items), psychological demands (9 items), social support (8 items), and physical demands (5 items). Although this latter dimension is not a core part of the theoretical model, we nevertheless included this dimension into the analyses in order to make full use of the JCQ questionnaire. Each item was answered on a 4-point scale (ranging from "totally disagree" to "totally agree"). Sum scores were created for each of the scales according to existing recommendations (Karasek et al., 1998). In the case of decision latitude and social support, the respective subscales were created (decision latitude: skill discretion [6 items] and decision authority [3 items]; social support: supervisor support and coworker support [each 4 items]). Moreover, for each scale and subscale, binary indicators were created using respective tertiles (upper or lower) to identify poor working conditions as well as a binary indicator was created to identify jobs with "high demand" and "low control" (job strain).

The ERI-Q (measuring the effort–reward imbalance model) consists of 23 items and three scales, "effort" (6 items), "reward" (11 items), and "overcommitment" (6 items). All effort and reward items were rated on a 5-point scale, which was answered in two steps. First, respondents were asked whether the items applied, and second—if so—to what extent they felt distressed about it (ranging from "not distressed" to "very distressed"). Statements of overcommitment were rated on a 4-point scale (ranging from "totally disagree" to "totally agree"). Once more, we followed established procedures (Siegrist et al., 2004) and calculated sum scores for each dimension of the model including the three theoretically relevant subscales of reward (esteem [5 items], job promotion [4 items], and job security [2 items]). Next, binary indicators were created for each scale and subscale using upper or lower tertile of the respective scale to measure poor quality of work. Importantly, in order to quantify the degree of mismatch between effort and reward at individual level, the ratio of the scores of the effort and reward scales was calculated (adjusted for number of items) with higher values representing higher levels of stressful work, and the upper tertile was used to identify poor working conditions.

In sum, the measurement approach described above results in seven main scales for both work stress model, seven subscales (see Table 1), and additionally, two summary measures (high job strain; effort–reward imbalance). Thus, a total of 16 binary indicators of poor quality of work are available that were computed in a highly comparable way, based on the original questionnaires.

Health functioning—the Short Form 36 questionnaire.—As main health outcomes, we used two measures of health functioning based on the French standard version of the Short Form 36 Health Survey (SF-36), the mental and physical composite scores (Leplège, Ecosse, Pouchot, Coste, & Pernegger, 2001). The SF-36 questionnaire is an internationally validated measure of health functioning that is based on 36 questions assessing eight specific domains of physical and mental health (Ware & Sherbourne, 1992). The domains related to the physical composite score are physical functioning, role limitations due to physical problems, bodily pain, and general health perception social functioning, and those for the mental composite score are vitality, social functioning, role limitations due to emotional problems, and mental health. The internal consistency of the single domains proved satisfactory in our sample (respective Cronbach's alpha vary between .73 and .94), and two composite scores are derived, a mental composite score (SF-36 MCS) and a physical composite score (SF-36 PCS), both ranging from 0 to 100 with higher scores indicating better health. The psychometric properties of the French SF-36 and the construction of the two scores are fully described elsewhere (Leplège et al., 2001). In order to include maximum information on health functioning in the analyses, continuous data of the two scores were used.

Additional measures.—We included a number of additional sociodemographic measures that mainly served as confounders

Table 1. Description of Measures and Sample (N = 6,053)

Variable (year)	Categories or range	% or mean	N
Gender	Male	83.1	5,030
	Female	16.9	1,023
Age (2007)	54–68 years	62.5	6,053
Educational	University	18.8	1,135
level (1989)	Vocational training	54.0	3,270
	Upper secondary education	7.2	435
	Lower secondary education	20.0	1,213
Occupational	Senior executive	39.8	2,410
category (1998)	Middle executive	51.8	3,133
	Employee	3.5	212
	Worker	4.9	298
Poor self-perceived	No	63.7	3,857
health (1998)	Yes	36.3	2,196
SF-36 MCS (2007)	6.1–71.3	49.1	6,053
SF-36 PCS (2007)	13.6–68.9	50.3	6,053
Job content questionnaire			
Psychological demands (1998)	9–36	22.7	6,053
Decision latitude (1998)	24–96	72.5	6,053
Skill discretion	12–48	35.4	6,053
Decision authority	12–48	37.1	6,053
Social support at work (1998)	8–32	22.0	6,053
Supervisor support	4–16	10.2	6,053
Coworker support	4–16	11.8	6,053
Physical demands (1998)	5–20	7.7	6,053
Effort-reward imbalance questionnaire			
Effort (1998)	6–30	12.9	6,053
Reward (1998)	11–55	46.6	6,053
Esteem	5–25	21.7	6,053
Job promotion	4–20	15.9	6,053
Job security	2–10	8.9	6,053
Overcommitment (1998)	6–24	3.6	6,053

in multivariate models. In addition to age and gender, two indicators of social position (educational level and occupational position) were included to minimize the risk that the observed association between work stress and functional health is mainly due to respondents' social position. Moreover, baseline health based on respondents' self-perceived health was included to adjust for its effect on prospective health functioning. In more detail, the measurements were as follows: Self-rated health was assessed by the following question: "How do you rate your general health status?" Response categories ranged from "very good" (coded 1) to "very poor" (coded 8). This item was previously shown to be strongly associated with physical disease in the GAZEL cohort (P. Goldberg, Gueguen, Schmaus, Nakache, & Goldberg, 2001). For our analyses, participants with answers ranging from 5 to 8 were classified to exhibit poor health. Educational level was assessed by the highest educational degree categorized into four groups (university, vocational training, upper secondary education, upper secondary education). Occupational position refers to respondents' occupation in 1998 and was coded in four categories (senior executive and professional, middle executive, employee, and worker) according to INSEE (French national institute of economic and statistical information; Desrosières & Thévenot, 2002).

Statistical Analysis

First, descriptive analyses were used to explore sample characteristics (Table 1). Second, we studied interrelations between the different scales and subscales of the two work stress models and tested the consistency of the different scales. To do so, correlation coefficients and Cronbach's alpha were computed for each scale and subscale of the demand-control-support model and the effort–reward imbalance model (table 2). Next, to test long-term effects of poor quality of work on health and to test the predictive power of the different scales of work stress, a set of linear regression models (OLS) were calculated using the two SF-36 composite scores as outcomes and the binary indicators of poor quality of work as main covariates (Tables 3 and 4). In the tables, we present regression coefficients (unstandardized coefficient denoted as "ß" and standardized beta coefficient denoted as "Beta") and measures of model fit (coefficient of determination "R^2" as a measure of "explained variance"). While the regression coefficients allow testing for significant effects of the scale, comparisons between their predictive powers should rather be based on the respective model fit. Importantly, to allow these comparisons, all models and their model fit were calculated with the same sample and include the same control variables. In sum, we present estimates of three types of regression models, all adjusted for age, gender, the two indicators of social position (included as categorical variables broken down into dummy variables) and baseline self-perceived health. First, in Model 1, the effect of poor quality of work was calculated for each scale separately (resulting in one regression analysis for each single scale). These models allow for testing the effect of each scale of the demand-control-support model and of the effort–reward imbalance model separately, and to compare their explanatory power based on the model fits. Second, to study the joint effect of the scales of the demand-control-support model and of the effort–reward imbalance model on health functioning, Models 2a and 2b estimate the simultaneous effect of the core dimensions of each respective work stress model. Subscales were excluded in these models due to multicollinearity. By looking at the fit of these models, on the one hand, the predictive power of the two full work stress models was contrasted with the model fit of each single scale (calculated in Model 1), and on the other hand, the predictive power of the demand-control-support model and the effort–reward imbalance model was compared. Finally, in Model 3, the combined effects of all scales of both work stress models were analyzed simultaneously. By doing so, this model allowed to test which of the scales remained important when each single scales of both work stress models were considered and to invest the explanatory

Table 2. Cronbach's α and Intercorrelations of Work Stress Scales and Subscales: All Correlations Except Two are Significant at $p < .001$ ($N = 6,053$)

	Items no.	α	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Psychological demands	9	0.80	1.00													
2. Decision latitude	9	0.81	0.12	1.00												
3. Skill discretion	6	0.72	0.23	0.88	1.00											
4. Decision authority	3	0.70	0.01	0.92	0.62	1.00										
5. Social support at work	8	0.82	–0.16	0.38	0.32	0.35	1.00									
6. Supervisor support	4	0.88	–0.17	0.34	0.28	0.32	0.89	1.00								
7. Coworker support	4	0.79	–0.08	0.26	0.24	0.23	0.71	0.31	1.00							
8. Physical demands	5	0.88	0.06	–0.21	–0.16	–0.22	–0.09	–0.09	–0.03	1.00						
9. Effort	6	0.75	0.52	0.12	0.19	0.05	–0.09	–0.08	–0.07	0.08	1.00					
10. Reward	11	0.86	–0.25	0.25	0.17	0.27	0.45	0.44	0.26	–0.18	–0.29	1.00				
11. Esteem	5	0.81	–0.24	0.22	0.14	0.24	0.48	0.46	0.30	–0.13	–0.26	0.90	1.00			
12. Job promotion	4	0.78	–0.18	0.22	0.16	0.23	0.33	0.33	0.18	–0.18	–0.23	0.87	0.63	1.00		
13. Job security	2	0.32	–0.17	0.16	0.12	0.17	0.21	0.22	0.10	–0.12	–0.23	0.60	0.41	0.39	1.00	
14. Overcommitment	6	0.79	0.44	0.14	0.18	0.08	–0.06	–0.02[a]	–0.09	–0.01[a]	0.52	–0.19	–0.17	–0.13	–0.18	1.00

Note. [a]Not significant.

power when both models are analyzed simultaneously. As a last step of the analysis, in Table 5, the effect modification of job strain by social support and of effort–reward imbalance by overcommitment was analyzed. More specifically, we tested whether interactions between the respective scales were statistically significant. For all regression analyses, traditional model diagnostic was applied based on residual analysis. All calculations were done using STATA 11.

Results

Sample Description

In our sample, 79% of the participants were men (Table 1). In 2007—the year when our health outcomes were measured—the age range was 54–68 years with a mean age of 63. With respect to education and occupation, a majority of men and women had a vocational training diploma (54.5%) and were either senior executives or middle executives. The mean scores of all work stress scales correspond to the values observed in earlier studies (Niedhammer, 2002; Niedhammer et al., 2000; Sembajwe et al., 2011). Most of the respondents (92%) were retired for 4 years or longer (results not shown). Furthermore, with respect to the variations of work stress in our sample, we found higher values of the scale "decision latitude" for men compared with women. Moreover, a clear age gradient in quality of work was observed, with better values among older people (particularly for lower psychological demands, more control at work, and more reward in older ages). In addition, quality of work was found to be socially graded, with better quality of

Table 3. Long-term Effects of Work Stress on Mental Health Functioning: Results of a Set of Linear Regression Models ($N = 6,053$)

	Model 1: Adjusted bivariate			Model 2a: Demand-control-support only			Model 2b: Effort–reward imbalance only			Model 3: Combined model		
	ß	Beta	R^2	ß	Beta	R^2	ß	Beta	R^2	ß	Beta	R^2
High psychological demands	–2.14***	–0.11	0.100	–2.04***	–0.10					–0.78**	–0.04	
Low decision latitude	–1.26***	–0.06	0.092	–1.08***	–0.05					–1.27***	–0.06	
Low skill discretion	–0.91***	–0.05	0.091									
Low decision authority	–0.95***	–0.05	0.091									
Low social support at work	–1.67***	–0.09	0.096	–1.17***	–0.06					–0.62*	–0.03	
Low supervisor support	–1.21***	–0.06	0.093									
Low co-worker support	–2.19***	–0.11	0.102									
High Physical demands	–0.92***	–0.04	0.091	–0.78**	–0.04					–0.76**	–0.04	
High Job strain	–2.69***	–0.08	0.095	–0.08	0.00					0.37	0.01	
High effort	–2.81***	–0.14	0.107				–1.17**	–0.06		–1.16**	–0.06	
Low reward	–2.55***	–0.13	0.105				–1.70***	–0.09		–1.35***	–0.07	
Low esteem	–2.20***	–0.12	0.103									
Low job promotion	–1.93***	–0.10	0.098									
Low job security	–2.19***	–0.11	0.101									
High overcommitment	–3.27***	–0.16	0.114				–2.41***	–0.12		–2.37***	–0.12	
Effort–reward imbalance	–2.92***	–0.15	0.111				–0.53	–0.03		–0.32	–0.02	
						0.109			0.130			0.137

Notes. Model 1: adjusted for age, gender, social position, and baseline self-perceived health; Model 2: M1 + other components of the respective work stress model; Model 3: M2 + all other components of the two work stress model.

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 4. Long-term Effects of Work Stress on Physical Health Functioning: Results of a Set of Linear Regression Models (N = 6,053)

	Model 1: Adjusted bivariate			Model 2a: Demand-control-support only			Model 2b: Effort–reward imbalance only			Model 3: Combined model		
	ß	Beta	R²	ß	Beta	R²	ß	Beta	R²	ß	Beta	R²
High psychological demands	−0.81***	−0.06	0.080	−0.80***	−0.06					−0.55*	−0.04	
Low decision latitude	−0.33	−0.02	0.077	−0.31	−0.02					−0.34	−0.02	
Low skill discretion	−0.24	−0.02	0.077									
Low decision authority	−0.32	−0.02	0.067									
Low social support at work	−0.44*	−0.03	0.078	0.27	−0.02					0.14	−0.01	
Low supervisor support	−0.45*	−0.03	0.078									
Low coworker support	0.39*	−0.03	0.077									
High physical demands	−0.71***	−0.05	0.079	−0.67***	−0.04					−0.65**	−0.04	
High job strain	−0.87**	−0.03	0.078	0.11	0.00					0.19	0.01	
High effort	−0.76***	−0.05	0.079				0.06	0.00		0.01	0.00	
Low reward	−0.61***	−0.04	0.078				−0.21	−0.01		−0.10	−0.01	
Low esteem	−0.65***	−0.05	0.079									
Low job promotion	−0.43***	−0.03	0.078									
Low job security	−1.02***	−0.07	0.081									
High overcommitment	−0.58**	−0.04	0.078				−0.27	−0.02		−0.22	−0.01	
Effort–reward imbalance	−0.96***	−0.07	0.081				−0.73*	−0.05		−0.63*	−0.04	
						0.082			0.081			0.085

Notes. Model 1: adjusted for age, gender, social position, and baseline self-perceived health; Model 2: M1 + other components of the respective work stress model; Model 3: M2 + all other components of the two work stress model.
*p < .05. **p < .01. ***p < .001.

work among people with higher education and among men and women who worked as senior executives or middle executives in 1998 (results not shown).

Correlations Between Work Stress Models and Their Scales

What are the interrelations between the two work stress models and their scales and what are the internal consistencies of the different scales? To answer these questions, Table 2 displays Cronbach's α values for all measures and all Pearson's correlation coefficients between the main scales of both work stress models including their subscales. Cronbach's α values were acceptable for all measures, with except of job security, which includes two items only. Again, findings confirm former analyses (Niedhammer, 2002; Niedhammer et al., 2000; Sembajwe et al., 2011) and show that the JCQ and the ERI-Q are valid and consistent measures of work stress. With regard to the interrelations of the scales, the results are as follows: When comparing the single scales of the demand-control-support model with those of the effort–reward imbalance model, we observed strong associations between psychological demands and efforts. Furthermore, strong associations were found between social support and reward. Regarding correlations within the work stress models, in the case of the demand-control-support model, strongest positive associations were found between decision latitude and social support. In the case of the effort–reward imbalance model, strong associations were found between effort and overcommitment.

Table 5. Interactions and Main Effects of Work Stress Scales on Mental and Physical Health Functioning: Results of a Set of Linear Regression Models (N = 6,053)

	ß	Beta	R^2
SF-36 MCS			
High job strain	−1.62*	−0.05	0.100
Low social support at work	−1.35***	−0.07	
High job strain × Low social support	−0.80	−0.02	
Effort–reward imbalance	−1.92***	−0.10	0.124
High overcommitment	−2.25***	−0.11	
Effort–reward imbalance × High overcommitment	−0.56	−0.02	
SF-36 PCS			
High job strain	−1.24*	−0.05	0.079
Low social support at work	−0.40*	−0.03	
High job strain × Low social support	0.72	0.02	
Effort–reward imbalance	−1.19***	−0.08	0.082
High overcommitment	−0.70*	−0.05	
Effort–reward imbalance × High overcommitment	−0.93*	−0.05	

Notes. All estimates are adjusted for age, gender, social position, and baseline self-perceived health.
*p < .05. **p < .01. ***p < .001.

Long-term Effects of Work Stress on Health Functioning

To test long-term effects of work stress on health functioning, results of regression analyses are presented in Tables 3 and 4. In sum, we present findings of three types of regression models. Whereas Model 1 allows for studying the effect of each scale separately, Models 2a and 2b explore the effects on health functioning attributed to the core scales and the summary measures of the two work stress models, adjusted for each other. Finally, in Model 3, the combined effects on health functioning resulting from a simultaneous analysis of all scales of the two work stress models are estimated.

Here, we briefly describe main findings available from Table 3 (mental composite score) and Table 4 (physical composite score). In Table 3, significant effects of each single work stress scale on mental health functioning are observed, controlling for confounding factors (age, gender, social position, and baseline self-rated health; Model 1). For instance, men and women who experienced high psychological demands in their job (assessed between 1997 and 1999) had a significantly lower mental health score (SF-36 MCS) in 2007, compared with those without high psychological demands. When comparing the different scales of the demand-control-support model, highest coefficients were observed for high psychological demands, low social support (in particular, coworker support) and the summary measure of high job strain.

In the case of the effort-reward-imbalance model, coefficients were relatively highest for the scales "high effort," "high overcommitment" and the summary measure of effort–reward imbalance, and the explanatory power was somewhat higher compared with the demand-control-support model. In addition, a closer look revealed that the three single scales of the effort–reward imbalance model (high effort, high overcommitment, and effort–reward imbalance) contribute most strongly to the explanatory power if compared with a model where control variables only are included (results not shown; $R^2 = .089$).

Turning to statistical Models 2a and 2b in Table 3, we observe that the effect of high job strain (the summary measure) no longer remains significant, indicating that the models' single scales capture most of the significant effect on mental health functioning and that no synergy effect may result from combining the scales (Model 2a). Similarly, in the case of the effort–reward imbalance model (Model 2b), high effort, low reward, and high overcommitment remained significant in Model 2b, but the summary measure effort–reward imbalance lost its statistical significance. Again, no synergy effect is expected to result from a combination of scales. If compared with Model 1, the Models 2a and 2b provide better model fits, and they explain a higher proportion of variance (especially so in the case of the effort–reward imbalance model [13.0%] compared with the demand-control-support model [10.9%]).

Finally, when combining all scales of the two work stress models in a simultaneous analysis (Model 3), the coefficients of the main scales within each model remain statistically significant. This latter finding indicates that the significant scales exert an independent effect on mental health functioning and that they remain important when studying simultaneously the effects of each single scale of both work stress models. However, since there was a modest increase in the variance explained from Models 2a and 2b to Model 3 (from 13.0% to 13.7%), this result should not be overemphasized.

A parallel set of results is displayed in Table 4 with regard to physical health functioning (PCS). Turning to Model 1, we again observe significant effects of all scales of the two models, except in the case of low decision latitude and its subscales. However, the explanatory power (R^2) was generally lower than was the case for mental health (Table 3). In addition, the relative increase in model fit was comparatively low compared with a model with control variables and confounders only (results not shown; $R^2 = .076$). Considering the demand-control-support model, strong effects were found for high psychological demands, physical demands and high job strain, but less so for social support (as was the case for mental health functioning). The conclusion that social support at work may be less important for physical compared with mental health functioning is further supported by findings of Model 2a, where significant associations were found for "psychological" and "physical demands" only.

With respect to the effort–reward imbalance model (Model 2b), the summary measure exerts a synergetic effect, once the effects of the single scales, "effort" and "reward," are controlled. This latter result provides some justification of introducing a summary measures in addition to the models' single scales. When looking at the results of Model 3 (Table 4), the summary measure effort–reward imbalance maintains its statistically significant effect on poor physical health functioning, whereas in the case of the demand-control-support model, significant effects are restricted to the demanding aspects of stressful work.

Again, a small increase in model fit was observed in the final model 3 and scales remained significant, thus supporting further the notions that the significant scales act independently on physical health functioning and that by combining both work stress models the explanation of the physical composite score in our sample is strengthened.

In line with our theoretical argument (see Introduction), we additionally expect two specific interaction terms of single components of the two work stress models to exert significant effects on health functioning later on. First, health risks are increased if high job strain is combined with low social support at work, and second, health risks are increased if effort–reward imbalance is combined with high overcommitment. Respective analyses are presented in Table 5, where interactions between the relevant scales were tested together with the single scales of interest. With regard to the mental composite score, we found no support for a significant interaction term in either case (High job strain × Low social support; Effort–reward imbalance × High overcommitment). Yet, in the case of the physical health functioning score, a significant interaction term was observed for the latter model, with an effect of the combination effort–reward imbalance and high overcommitment above and beyond the effects produced by the single components.

Discussion

This paper used data from the Gazel cohort to study long-term effects of mid-life psychosocial work stress on health functioning after labor market exit. To assess psychosocial

work stress, we used the full original versions of the JCQ measuring the demand-control-support model and of the effort–reward imbalance questionnaire, measured in 1998. Health functioning is assessed 9 years later (in 2007) using the SF-36 mental and physical composite scores. The specific objectives of the paper are to study and compare the relative contribution of two important work stress models (including combined scales, single scales and subscales of the models) on health functioning after labor market exit within the frame of a large prospective study design.

Taken together, main results were as follows: First, findings showed significant effects of both work stress models and their single components on prospective mental and physical health functioning, even if baseline health was taken into account. Though, some differences in effect sizes of the single scales were found according to the health outcomes under study. In the case of the demand-control-support model, the strongest effects were observed for the scale psychological demands for both outcomes, although the scale social support at work was found to be particularly important for the mental composite score and the scale physical demands was important for the physical composite score. Notably, when analyzing the simultaneous effect of the single scales of the demand-control support model, no synergetic effect of high job strain was observed once the two components high psychological demands and low decision latitude were considered—neither for the mental nor for the physical composite score.

In the case of the effort–reward imbalance model, the three single scales effort, overcommitment, and effort–reward imbalance showed strongest effects for the mental composite score, whereas no additional synergetic effect of effort–reward imbalance was found once the single scales were controlled for. Yet in the case of physical health functioning, the mismatch between effort and reward was found to be particularly important and remained significant in Model 2. Thus, although results of Model 1 lend support to the theoretical assumption of the two work stress models that strongest effects on health are observed if the summary measures are analyzed (high job strain, effort–reward imbalance), this support is weakened if models also include the single scales of the summary measures. Still, in the case of effort–reward imbalance, a summary effect remains statistically significant with regard to poor physical health functioning.

A second finding concerning the comparison of the two work stress models is of interest. When comparing the explanatory power of the models, we found that the explained variance was slightly higher for the effort–reward imbalance model (for the mental composite score only). Moreover (for the mental and for the physical composite score), the highest predictive power was found in the final statistical models (Model 3), when the combined effect of the scales was simultaneously analyzed. This suggests that each work stress model makes a distinct contribution toward explaining health functioning after labor market exit.

Third, we found preliminary support for an interaction term of high effort–reward imbalance with overcommitment (in the case of physical health functioning), strengthening the model's theoretical assumption that the intrinsic source of high effort (overcommitment) exerts particularly adverse effects on health if manifested in an extrinsic context of high effort and low reward.

Given the prospective design of our study and the analysis of long-term effects of working conditions on health, our findings add to the existing literature of health determinants at older ages by pointing to the relative importance of midlife psychosocial working conditions not only for health in mid-life but also for health functioning after labor market exit. Hence, the results extend former findings, suggesting that both work stress models contribute independently to the explanation of health variations (Bosma, Peter, Siegrist, & Marmot, 1998, Kivimaki et al., 2002; Stansfeld et al., 1998). This is particularly obvious in the case of mental health functioning, where all single scales remained significant in the final model and where the explained variance was relatively highest. Furthermore—albeit the overall explained variance was relatively small—an important part (4.8% of 13.7%) was shown to be related to the work stress scales rather than to the control variables of our analyses (including social position and baseline self-perceived health). Apparently, midlife must be considered a crucial period of life with long-term effects on health functioning in later life (Breeze et al., 2001). During midlife, core social roles (in particular work) are acquired, which provide opportunities of important experiences of success and failure. Through these roles, essential material and nonmaterial needs are satisfied. Quality of work and employment (in terms of the psychosocial work environment) may play a crucial role in this process, maintaining or even strengthening health functioning and well-being of employed people under favorable conditions, and deteriorating their health and well-being under adverse conditions. These results support efforts to improve the quality of work and the health of working people, as evidenced by the results of respective theory-based interventions (Bourbonnais, Brisson, & Vézina, 2010).

Limitations

The study design including its large study sample and very low attrition rates between the different measurement waves must be considered a particular strength of the study. Moreover, given the application of the full version of validated theory-based measures of work stress and given a systematic analysis of the available scales, the theoretical basis of this study adds to its strength. However, some limitations must be mentioned. First, we were not able to rule out a reporting bias of work stress caused by some unobserved personality characteristics, such as neuroticism, negative affectivity or depression. Yet, previous studies testing adverse health effects of work stress demonstrated that these effects remain statistically significant after adjusting for negative affectivity

(Bosma et al., 1998), a main possible confounder in this respect (Spector, Chen, & O'Conell, 2000). Second, baseline values of SF-36 in 1998 were not collected, and we therefore introduced self-reported health as a proxy measure for respective adjustment in multivariate analysis. It should be noted that correlations between self-perceived health and health functioning in 2007 were found to be relatively strong (PCS: 0.43, MCS: 0.37), suggesting that self-perceived health is an appropriate proxy for health functioning at baseline. It may be, however, that some unmeasured baseline functional states influence both baseline work stress and subsequent outcomes in 2007. Third, by restricting the sample to people that already left the labor market in 2007, some selection bias could affect our findings, given that poor health might be one reason for labor market exit. Yet, same results were found when associations between work stress and subsequent health functioning were analyzed for respondent still employed in 2007. Moreover, the sample was restricted to people that were employed between 1997 and 1999 with available information for all variables. While this serves our aim to compare the different work stress models and its scales, the results might be affected by response bias. However, when comparing the final sample to the group of excluded respondents no differences with regard to our core measures were observed. Fourth, by assessing work stress within a restricted time frame, we may underestimate its long-term effect as previous research documented a dose–response effect between the number of consecutive measurements of work stress over time and the strength of their effects on health (Chandola, Brunner, & Marmot, 2006). A wider time frame would also be informative because we observed an age gradient in our sample. An additional limitation points to the fact that despite a fairly generalizable population (M. Goldberg et al., 2007), conclusion from the Gazel cohort must be drawn carefully because important segments of the population (e.g., nonworking women, self-employed workers) are underrepresented. Moreover, compared with the general population, working and retirement conditions of the Gazel cohort are assumed to be generally better, given low levels of temporary contracts and downward mobility during working life and a relative good financial situation after labor market exit with a secure pension scheme. Yet this might rather underestimate the impact of work stress in our study.

Conclusion

In conclusion, despite the reported limitations, this study supports the notion that poor psychosocial working conditions, measured according to the demand-control-support model, and the effort–reward imbalance model are prospectively linked to reduced health functioning, in particular mental health functioning. These findings may have important implications for interventions and recommendations to improve working conditions that contribute to healthy aging.

Funding

This work was supported by the "Agence nationale de la recherché" and the "Agence française de sécurité sanitaire de l'environnement et du travail" Workage grants and National Institue on Aging (grant numbers 5U01AG027669-06, 3U01AG027669-05S1).

Acknowledgments

The authors express their thanks to EDF-GDF and to the "Caisse centrale d'action sociale du personnel des industries électrique et gazière." We also wish to acknowledge the Cohortes team of the Unit Inserm 1018-Versailles St-Quentin University responsible for the GAZEL data base management. The GAZEL Cohort Study was funded by EDF-GDF and INSERM and received grants from the "Cohortes Santé TGIR Program." M. Wahrendorf performed all statistical analyses and wrote the first draft of the paper. G. Sembajwe and L. Berkman contributed to the revised versions of the manuscript, added references, and approved the final version. M. Zins and M. Goldberg provided access to the Gazel data, discussed the study design, contributed to the revised version of the manuscript, and approved the final version. J. Siegrist contributed to the theoretical background and project development underlying this manuscript. He further was involved continuously in revising and finalizing the manuscript.

Correspondence

Correspondence should be addressed to Morten Wahrendorf, PhD, Department of Medical Sociology, University of Duesseldorf, PB 101007, D-40001 Duesseldorf, Germany. E-mail: wahrendorf@uni-duesseldorf.de.

References

Berney, L., Blane, D., Davey Smith, G., & Holland, P. (2000). Life course influences on health in early old age. In H. Graham (Ed.), *Understanding health inequalities* (pp. 79–85). Buckingham: Open University Press.

Bonde, J. P. E. (2008). Psychosocial factors at work and risk of depression: A systematic review of the epidemiological evidence. *Occupational and Environmental Medicine*, *65*, 438–445. doi:10.1136/oem.2007.038430

Bosma, H., Peter, R., Siegrist, J., & Marmot, M. (1998). Two alternative job stress models and the risk of coronary heart disease. *American Journal of Public Health*, *88*, 68–74. doi:10.2105/AJPH.88.1.68

Bourbonnais, R., Brisson, C., & Vézina, M. (2010). Long-term effects of an intervention on psychosocial work factors among healthcare professionals in a hospital setting. *Occupational and Environmental Medicine*, *68*, 479–486. doi:10.1136/oem.2010.055202

Breeze, E., Fletcher, A. E., Leon, D. A., Marmot, M. G., Clarke, R. J., & Shipley, M. J. (2001). Do socioeconomic disadvantages persist into old age? Self-reported morbidity in a 29-year follow-up of the Whitehall Study. *American Journal of Public Health*, *91*, 277–283. doi:10.2105/AJPH.91.2.277

Calnan, M., Wadsworth, E., May, M., Smith, A., & Wainwright, D. (2004). Job strain, effort–reward imbalance, and stress at work: Competing or complementary models? *Scandinavian Journal of Public Health*, *32*, 84–93. doi:10.1080/14034940310001668

Cartwright, S., & Cooper, C. L. (2009). *The Oxford Handbook of Organizational Wellbeing*. Oxford: Oxford University Press.

Chandola, T., Brunner, E., & Marmot, M. (2006). Chronic stress at work and the metabolic syndrome: Prospective study. *British Medical Journal*, *332*, 521–524. doi:10.1136/bmj.38693.435301.80

Cheng, Y., Kawachi, I., Coakley, E. H., Schwartz, J., & Colditz, G. (2000). Association between psychosocial work characteristics and health functioning in American women: Prospective study. *British Medical Journal*, *320*, 1432–1436. doi:10.1136/bmj.320.7247.1432

de Jonge, J., Bosma, H., Peter, R., & Siegrist, J. (2000). Job strain, effort-reward imbalance and employee well-being: A large-scale cross-sectional study. *Social Science & Medicine*, *50*, 1317–1327. doi:10.1016/S0277-9536(99)00388-3

Desrosières, A., & Thévenot, T. (2002). *Les Catégories Socioprofessionnelles*. Paris, France: La Découverte.

Dragano, N., & Schneider, L. (2011). Work related psychosocial factors and the risk of early disability pensioning: A contribution to assessing the need for rehabilitation. *Rehabilitation*, *50*, 28–36. doi:10.1055/s-0030-1270431

Goldberg, M., Leclerc, A., Bonenfant, S., Chastang, J. F., Schmaus, A., Kaniewski, N., … Zins, M. (2007). Cohort profile: The GAZEL Cohort Study. *International Journal of Epidemiology*, *36*, 32–39. doi:10.1093/ije/dyl247

Goldberg, P., Gueguen, A., Schmaus, A., Nakache, J. P., & Goldberg, M. (2001). Longitudinal study of associations between perceived health status and self reported diseases in the French Gazel cohort. *Journal of Epidemiology and Community Health*, *55*, 233–238. doi:10.1136/jech.55.4.233

Johnson, J. V., & Hall, E. M. (1988). Job strain, work place social support, and cardiovascular disease: A cross-sectional study of random sample of the Swedish working population. *American Journal of Public Health*, *78*, 1336–1342. doi:10.2105/AJPH.78.10.1336

Kalache, A., Aboderin, I., & Hoskins, I. (2002). Compression of morbidity and active ageing: Key priorities for public health policy in the 21st century. *Bulletin of the World Health Organization*, *80*, 243–244.

Karasek, R., & Theorell, T. (1990). *Healthy work*. New York: Basic Books.

Karasek, R., Brisson, C., Kawakami, N., Houtman, I., Bongers, P., & Amick, B. (1998). The Job Content Questionnaire (JCQ): An instrument for internationally comparative assessments of psychosocial job characteristics. *Journal of Occupational Health Psychology*, *3*, 322–355. doi:10.1037//1076-8998.3.4.322

Karasek, R. A. (1979). Job demands, job decision latitude, and mental strain—Implications for job redesign. *Administrative Science Quarterly*, *24*, 285–308. doi:10.2307/2392498

Kivimaki, M., Leino-Arjas, P., Luukkonen, R., Riihimaki, H., Vahtera, J., & Kirjonen, J. (2002). Work stress and risk of cardiovascular mortality: Prospective cohort study of industrial employees. *British Medical Journal*, *325*, 857–862. doi:10.1136/bmj.325.7369.857

Kivimaki, M., Virtanen, M., Elovainio, M., Kouvonen, A., Väänänen, A., & Vahtera, J. (2006). Work stress in the etiology of coronary heart disease—A meta-analysis. *Scandinavian Journal of Work, Environment and Health*, *32*, 431–442. doi:10.5271/sjweh.1049

Kuper, H., Singh-Manoux, A., Siegrist, J., & Marmot, M. (2002). When reciprocity fails: Effort-reward imbalance in relation to coronary heart disease and health functioning within the Whitehall II study. *Occupational & Environmental Medicine*, *59*, 777–784. doi:10.1136/oem.59.11.777

Laslett, P. (1996). *A fresh map of life*. London: Macmillian.

Leplège, A., Ecosse, E., Pouchot, J., Coste, J., & Perneger, T. (2001). *Le questionnaire MOS SF-36—Manuel de l'utilisateur et guide d'interprétation des scores*. Paris: Edition ESTEEM.

Lund, T., & Villadsen, E. (2005). Who retires early and why? Determinants of early retirement pension among Danish employees 57–62 years. *European Journal of Ageing*, *2*, 275–280. doi:10.1007/s10433-005-0013-x

Marmot, M., & Wilkinson, R. (2006). *Social determinants of health*. Oxford: Oxford University Press.

Niedhammer, I. (2002). Psychometric properties of the French version of the Karasek Job Content Questionnaire: A study of the scales of decision latitude, psychological demands, social support, and physical demands in the GAZEL cohort. *International Archives of Occupational and Environmental Health*, *75*, 129–144. doi:10.1007/s004200100270

Niedhammer, I., Siegrist, J., Landre, M. F., Goldberg, M., & Leclerc, A. (2000). Psychometric properties of the French version of the Effort-Reward Imbalance model. *Revue d`Epidemiologie et de Sante Publique*, *48*, 419–437.

Ostry, A. S., Kelly, S., Demers, P. A., Mustard, C., & Hertzman, C. (2003). A comparison between the effort-reward imbalance and demand control models. *BMC.Public Health*, *3*, 10.

Power, C., & Kuh, D. (2006). Life course development of unequal health. In J. Siegrist & M. Marmot (Eds.), *Social inequalities in health: New evidence and policy implications*. Oxford: Oxford University Press.

Rydstedt, L. W., Devereux, J., & Sverke, M. (2007). Comparing and combining the demand-control-support model and the effort reward imbalance model to predict long-term mental strain. *European Journal of Work and Organizational Psychology*, *16*, 261–278. doi:10.1080/13594320601182311

Sembajwe, G., Wahrendorf, M., Siegrist, J., Sitta, R., Zins, M., Goldberg, M., … Berkman, L. (2011). Effects of job strain on fatigue: Cross-sectional and prospective views of the Job Content Questionnaire and Effort Reward Imbalance in the GAZEL cohort. *Occupational and Environmental Medicine*. Advance online publication. doi:10.1136/oem.2010.063503

Schnall, P., Dobson, M., & Rosskam, E. (2009). *Unhealthy work: Causes, consequences, cures*. Amityville, NY: Baywood.

Siegrist, J. (1996). Adverse health effects of high-effort/low-reward conditions. *Journal of Occupational Health Psychology*, *1*, 27–41. doi:10.1037/1076-8998.1.1.27

Siegrist, J., Starke, D., Chandola, T., Godin, I., Marmot, M., Niedhammer, I., … Peter, R. (2004). The measurement of effort-reward imbalance at work: European comparisons. *Social Science & Medicine*, *58*, 1483–1499. doi:10.1016/S0277-9536(03)00351-4

Spector, P. E., Chen, P. Y., & O'Connell, B. J. (2000). A longitudinal study of relations between job stressors and job strains while controlling for prior negative affectivity and strains. *Journal of Applied Psychology*, *85*, 211–218. doi:10.1037//0021-9010.85.2.211

Stansfeld, S., & Candy, B. (2006). Psychosocial work environment and mental health—A meta-analytic review. *Scandinavian Journal of Work Environment and Health*, *32*, 443–462. doi:10.5271/sjweh.1050

Stansfeld, S. A., Bosma, H., Hemingway, H., & Marmot, M. (1998). Psychosocial work characteristics and social support as predictors of SF-36 health functioning: The Whitehall II study. *Psychosomatic Medicine*, *60*, 247–255.

Stringhini, S., Sabia, S., Shipley, M., Brunner, E., Nabi, H., Kivimaki, M., … Singh-Manoux, A. (2010). Association of socioeconomic position with health behaviors and mortality. *Journal of the American Medical Association*, *303*, 1159–1166. doi:10.1001/jama.2010.297

Ware, J., & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Medical Care*, *30*, 473–483.