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ORIGINAL ARTICLE

Which social–ecological factors play a role in older adults' participation in a blended physical activity intervention? Results of a multi-layered feedback analysis

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Abstract

Aim This study aimed to evaluate factors affecting older adults' participation in a blended physical activity (PA) intervention, which comprised tailored home-based exercises and supervised on-site group sessions with peers. Specifically, the objective was to explore participants' feedback for identifying specific requirements regarding intervention components and materials.

Subject and methods In a 9-month randomized trial with a cross-over design targeting adults aged 60 and above, web- and print-based materials to promote PA were enhanced based on results of a preceding trial, and tested in $n = 242$ participants. Use of these adapted program components, attendance of group sessions, and acceptance of the intervention were assessed via self-administered paper-based questionnaires 3 and 9 months after baseline, as well as in interviews and group sessions. Participant feedback was analyzed via qualitative content analysis of open-ended questions, group interviews, and protocols. The social–ecological model served as a coding framework.

Results Feedback covering six different levels of requirements according to the social–ecological model was analyzed. The content of the program, including the option to track perceived progress in PA, health, and fitness, as well as the group-based components, providing opportunities for social support, and training with the peer group, were appreciated by participants. Criticism and suggestions for improvement were provided with regard to instructors of the group sessions, the group atmosphere, space requirements, program scheduling, and communication.

Conclusions Based on various sources of participant feedback, several requirements and recommendations regarding future characteristics of PA interventions targeting older adults in community settings can be provided.

Keywords Evaluation · Healthy aging · Social–ecological framework · Physical activity · Blended intervention · Feedback

Manuela Peters and Tiara Ratz share first authorship.

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Abbreviations

ACSM	American College of Sports Medicine
BMBF	German Federal Ministry of Education and Research
BMI	body mass index
CG	control group
IG	intervention group
IG1	intervention group 1
IG2	intervention group 2
ISCED	International Standard Classification of Education
PA	physical activity
PRINT	print-based intervention
RRO	residents registration office
SD	standard deviation
SF	short-form
T0	first time point for the assessment (before start of the intervention)

T1	time point of the first follow-up assessment (after 12 weeks)
T2	time point of the second follow-up assessment (after 9 months)
WEB	Web-based intervention
WEB +	Web-based intervention plus activity tracker
WHO	World Health Organization

Background

In Germany, the number of people aged 67 years and above will increase by 22% between 2020 and 2035 (DESTATIS 2022). Aging is associated with a number of health impairments (Beard et al. 2016) and limitations in activities of daily living (Freedman et al. 2002). Older adults with a sedentary lifestyle are at a higher risk for developing health issues, becoming care-dependent, and experiencing lower levels of quality of life (King et al. 1992). Maintaining or taking up a physically active lifestyle in older age can help mitigate these constraints, improve physical, psychological, and social functioning, and enable older adults to live their lives independently for an extended period of time (De Vries et al. 2012; Taylor et al. 2004; Warburton et al. 2006). To foster physical activity (PA) in older age, many local community authorities and health insurance companies offer exercise classes for senior citizens. Exercising with peers can be motivating and beneficial for perseverance, because it entails experiencing a sense of belonging and feeling connected to others (Jenkin et al. 2017). Moreover, the ability to have person-to-person contact with an exercise instructor or coach, including supervision, is a major advantage of exercise classes as it increases the likelihood of remaining physically active (Moore et al. 2016). This is reflected in a higher adherence to supervised group-based programs compared to programs without supervision (King et al. 1998; Picorelli et al. 2014). In addition, feedback and support are associated with increased efficacy (Geraedts et al. 2013; Simek et al. 2012). Drawbacks of participation in supervised exercise programs include the effort to commute to the venue, which might be challenging for older adults with financial and physical limitations (Dishman 1988). Previous studies identified spatial and structural conditions (e.g., access to the program location, the time of the day) (Boekhout et al. 2017; Rimmer et al. 2004; Zhang et al. 2019), as well as facility issues (Rimmer et al. 2004) as relevant factors for participation in PA programs in the past.

In recent years, technology has been increasingly used to deliver PA and exercise interventions to various populations (Muellmann et al. 2018). Previous research suggests that web-based interventions can be effective for increasing PA levels (Davies et al. 2012; Joseph et al. 2014). Nevertheless, ensuring engagement of participants in these PA programs over time has been reported as a major challenge (Eysenbach 2005), as they are often characterized by high rates of non-use (i.e., not all participants use or keep using the intervention components as intended by the developers) (Kelders et al. 2012). A lack of exposure to intervention content has been linked to reduced intervention effectiveness regarding participants' PA levels (Donkin et al. 2011).

Both adherence and effectiveness may improve, when individual preferences are taken into account (Amireault et al. 2019; Prestwich et al. 2014). An increasing number of studies demonstrate the value of tailoring. Home-based programs which are delivered via tablet or smartphone provide more opportunities for tailoring to individual needs than group-based in-person programs (Krebs et al. 2010; Webb et al. 2010). In addition, digitally delivered home-based interventions may be particularly useful for tracking individual progress (Davies et al. 2012; Krebs et al. 2010). Self-monitoring of PA behavior (e.g., via tracking apps or PA diaries) and individual feedback are key components of successful interventions for PA promotion (Muellmann et al. 2018). However, in-person contact between a specialist or coach and other participants is also required to ensure that exercises are performed correctly (Dishman 1988). To date, the effects of blended interventions combining digital with in-person components remain understudied.

In 2015, Olson and McAuley tested an intervention, including independent exercise sessions supplemented by educational theory-based group workshops on behavior modification, goal-setting, and self-monitoring strategies, and found that PA levels in older adults increased in the short term (Olson and McAuley 2015). Mouton and Cloes (2015) found blended interventions to be efficient for increasing PA, which included personal contact for social support and motivation, and web-based components for increasing awareness regarding PA. Thus, blended interventions, including a combination of guided in-person and digital interventions (Hohberg et al. 2022), can compound the benefits of supervised exercising along with peers with the benefits of flexible, tailored individual home-based programs to achieve the required intensity, frequency and duration of exercises (King et al. 1991, 1998; Krebs et al. 2010; Van Der Bij et al. 2002). However, the implementation of such blended programs remains challenging. There are several factors known to affect program engagement among older adults, including individual-level factors, ecological factors (e.g., aspects of the physical and social environment), and organizational factors related to the program and study design (e.g., program characteristics, time, venue/setting) (Bogart and Uyeda 2009; Hawley-Hague et al. 2014; Killingback et al. 2017; Peters et al. 2022). In the past, social–ecological models (Barton and Grant 2006; Boulton et al. 2018; Sallis et al. 2006; Stokols 1996) and their numerous adaptations have been shown to be helpful for describing the complex

interrelations of these factors. A more current example is an adapted social–ecological model which formed the basis for identifying relevant factors influencing older adult's PA intervention engagement at six levels (intrapersonal, sociocultural, content, spatial, digital, organizational) (Wichmann et al. 2020). Based on this model, the present investigation, which was embedded in a 9-month randomized trial with a crossover design, aimed to explore participants' feedback for identifying specific requirements regarding intervention components and materials.

Methods

For this investigation, data from the PROMOTE II study (Pischke et al. 2020, 2022), a subproject of a larger research network on PA and health equity and primary prevention for healthy ageing (AEQUIPA) (Forberger et al. 2017), were used.

Participants and study design

The aim of the PROMOTE II study was to investigate the implementation and effectiveness of a community-based PA intervention among initially inactive adults aged 60 years and above in a 9-month randomized crossover trial. Eligible participants from 14 districts in Bremen, Germany, were randomly assigned to either a) a print-based (PRINT) or b) a web-based intervention (WEB). A randomly selected 30% of the web-based intervention group received an activity tracker in addition (WEB +). A detailed description of the eligibility criteria and study procedure can be found in the published study protocol (Pischke et al. 2020). All participants were fully informed about the study and provided written informed consent.

Brief description of the intervention

The intervention design was based on theories of health behavior change (Michie et al. 2013) and self-regulation (Pomp et al. 2013). The PRINT intervention group was advised to follow the PA recommendations of the World Health Organization (WHO) and the American College of Sports Medicine (ACSM) (Nelson et al. 2007; World Health Organization 2010) and use a self-monitoring system in the form of a printed PA pyramid diary and a brochure with age-appropriate exercises (including suggestions and instructions to improve balance, flexibility, strength, and endurance). The WEB intervention group was advised to follow the same PA recommendations using a web- or android app-based self-monitoring system. The WEB + intervention group received the WEB intervention with an additional activity tracker (Fitbit Zip, Fitbit, San Francisco, CA, USA) for objective PA self-monitoring via synchronization of the device-tracked daily step count with the website. Weekly feedback on personal progress was provided by the web- or print-based PA diary, displaying the proportion of recommended time or units exercised. After 3 months, participants could choose to keep the intervention material they had been assigned to at baseline or exchange it for the material that the respective other intervention group had received. The purpose of this cross-over design was to enable participants to choose the delivery mode (print or IT-based) that best suited their personal preferences and to test the effects of alternating options. Reasons for changing or not changing groups have been reported elsewhere (Pischke et al. 2022).

For all groups, the individual home-based PA program, which consisted of an exercise catalogue and a PA diary, was supplemented by supervised face-to-face components as shown in Table 1:

a) ten weekly group sessions with up to 25 participants per group during the first 3 months, covering 60 min of exercise with peers and 30 min of health education in study phase 1; and
b) four health education group sessions (including lectures on healthy aging, age-appropriate nutrition, and strategies for habit formation and maintenance) in study phase 2 over the course of 6 months.

All group sessions were led by trained research staff. During the group sessions, participants were encouraged to ask questions regarding the exercises, discuss technical issues, or give any other kind of feedback on the program or certain features.

Feedback assessment

This study entailed three assessment time points: T0 — baseline, T1 — 3-month follow-up, and T2 — 9-month follow-up. Details on outcome measure assessments are reported in the study protocol (Pischke et al. 2020). Figure 1 depicts the timeline regarding intervention activities and data collection.

Participants' open feedback on the PA intervention program and their experiences participating in the study were collected using two data collection methods (see Table 2). as described below:

1) Self-administered questionnaire

Information on attendance and acceptance of the group sessions and use of web- and print-based intervention materials were assessed via self-generated items (e.g., number of attended group sessions, frequency of general intervention

Table 1 Content of the group sessions

Study phase 1: Ten group sessions over the course of the first 3 months		
Session number	Group exercise	Health education topic
1	Getting to know various exercises from the exercise catalogue	Presentation of the intervention material
2	Guided walks in the neighborhood, exercises outdoors	Reflection of the personal activity behavior in the neighborhood environment/ getting to know opportunities for PA
3	Exercise during day-to-day activities (e.g., cleaning, gardening, grocery shopping)	Nutrition for well-being (participants present dishes/recipes to each other that make them feel good)
4	Integrating exercises into everyday life (e.g., balancing exercises while brushing teeth or at the bus stop)	Establishing personal exercise plans, collecting advantages and disadvantages of PA
5	Motor coordination training	Importance of memory training, including examples for practicing
6	Stretching and relaxation exercises	Importance of relaxation
7	Strength and endurance training with everyday life equipment (e.g., a towel, a water bottle)	Importance of sports and training for health
8	Exercises that can help relieve pain	Dealing with functional limitations and pain
9	Team sports (e.g., relay race)	Joint PA and social support
10	Strength and endurance training	Reflection on individual progress and transformation to date, personal goal for the future
Study phase 2: Four group sessions over the course of the following 6 months		
Session number	Health education topic	
1	*Being healthy and active in the long term—motivation techniques for everyday life*: Interactive event with a mixture of input and brainstorming of ideas on topics, such as ways to self-motivate oneself, network with others for joint exercising, self-monitor personal fitness levels, rewards for individual goal achievement	
2	*Healthy and active at 60+—what is particularly important now in terms of nutrition?* Focus on nutrition in older age and why it is important to be aware of food choices and the right composition of the diet	
3	How to overcome temptation to remain physically inactive?	
4	Closing event: reviewing experiences of the last 9 months in a group interview	

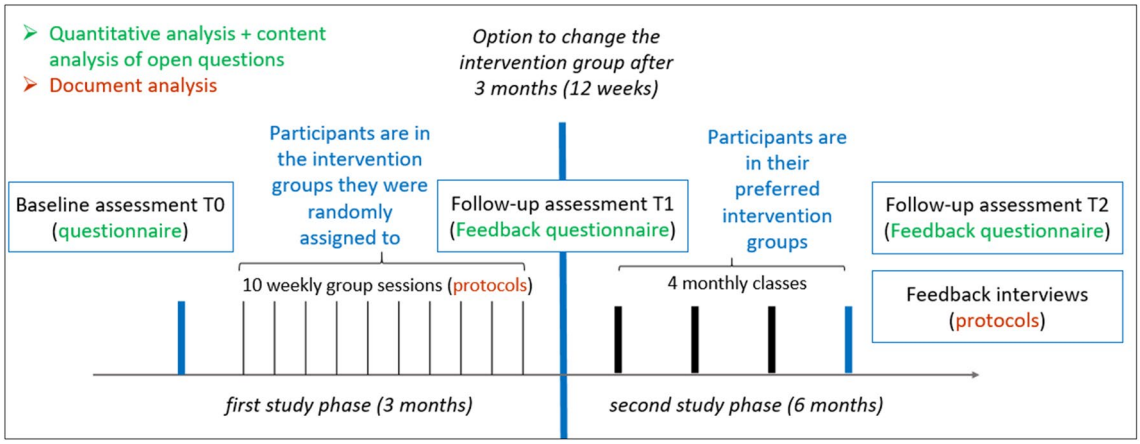

Fig. 1 Timeline of intervention activities and data collection

Table 2 Outcome measures

Follow-up questionnaires		Assessment (time point)
Acceptance and satisfaction	Perceived usefulness	Likert scales (T1, T2)
	Use of the program material	
	Attendance of weekly group meetings	
Use and attendance	Reasons for recommending the program	Open-ended questions (T1, T2)
	Reasons for not recommending the program	
	Aspects the program lacked	
	Suggestions for improvement	
Protocols of final feedback interviews		Assessment (time point)
Acceptance and satisfaction	What do you think about the program as a whole? Was it useful, helpful and easy to use for you?	Group interview following a semi-structured interview guideline (end of the study, fourth monthly group session [T2])
	What do you think about the exercise manuals and other materials? What did you like and what did you find less satisfying?	
	Did you manage to handle the technical equipment (website, Fitbit & app) well? Where did you encounter problems?	
	What is your opinion regarding the content of the weekly and monthly group meetings?	
	How do you feel about the organizational aspects of the program (e.g., regarding the facilities, schedules, or communication with the study team)?	
	What have you personally achieved by participating in the program?	
Usage	In your opinion, which of the program components should continue to be offered or which would you wish to retain?	
Protocols of weekly group meetings		Assessment (time point)
Acceptance and satisfaction	Open narrative feedback, if any	Weekly group session protocols (first 10 weeks)
Use and attendance	Attendance of weekly group meetings	Weekly participant counts (first 10 weeks)

material use, use of different intervention components [on a five-point Likert scale ranging from "never" to "daily"], and perceived helpfulness of the different intervention components [on five-point Likert scales ranging from "not helpful at all" to "very helpful"], see Table 2). Results from closed questions on attendance and acceptance have been reported as part of the primary outcome analysis, i.e., the effectiveness of the interventions in terms of promoting PA (Pischke et al. 2020).

Participants were asked to respond to four open-ended questions at the end of the self-administered questionnaires, both at T1 and T2. Specifically, they were asked why they would (or would not) recommend participating in the intervention. Further, they were asked to state anything they thought was missing in the program and to suggest improvements (see Table 2).

2) Group session protocols

The instructors of the weekly group sessions took notes after each session documenting attendance and open narrative feedback, including any given praise, criticism, and requests that participants voiced (a template of a protocol sheet can be found in the supplementary material). During the last group session (closing event), group interviews were held following a semi-structured approach with pre-defined questions regarding satisfaction, usage, perceived benefits, and plans for maintaining PA. Group interviews were conducted by a researcher from the study staff, who was supported by a student assistant taking notes. The interview guide with open questions was developed by the researchers based on relevant literature and the theoretical key subjects identified during the preceding study phase (see Table 2).

Analyses

The intervention was evaluated using multiple sources of participant feedback, applying qualitative content analysis of the open-ended questions included in the questionnaires at T1 and T2 according to Mayring and Fenzl (2019), as well as a document analysis of the protocols from the feedback interviews and weekly group session recordings. The qualitative data are available on Zenodo (https://zenodo.org/records/10149925).

A directed content analysis method, commonly used in qualitative research (Elo and Kyngäs 2008; Hsieh and Shannon 2005), involved the utilization of an existing theory and code framework right from the start, which is considered to help researchers focus their efforts and build on existing theories (Hsieh and Shannon 2005). The present PROMOTE II feedback data were coded based on a previously developed social–ecological framework (Wichmann et al. 2020) based on preceding theoretical models (Boulton et al. 2018; Sallis et al. 2006). The framework contains the following six requirement levels (Fig. 2):

1. Requirements at the intrapersonal level,
2. Requirements at the interpersonal and sociocultural level,
3. Requirements at the intervention content level,
4. Requirements at the spatial level,
5. Requirements at the digital level,
6. Requirements at the organizational level.

The overarching categories and subcategories that build this framework were derived by two researchers following an iterative process (Wichmann et al. 2020). For the current evaluation based on the PROMOTE II data, two researchers coded participants' remarks gathered in the questionnaires

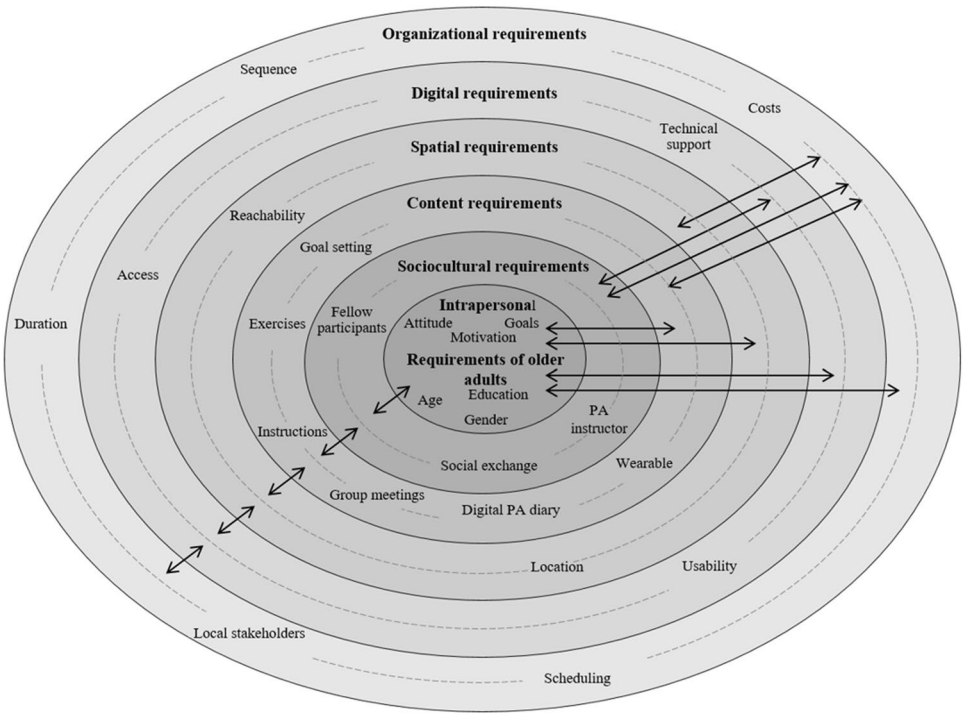

Fig. 2 A social–ecological model for promoting web-based PA interventions among older adults in Germany by Wichmann et al. 2020 (57). Note: *PA*: physical activity; possible interactions of the individual factors are shown by the *arrows*

and documented in the protocols. This was done by charting the data from all subsequent material using the coding matrix from the previously developed social–ecological model-based framework (Wichmann et al. 2020) (deductive coding). Codes which could not be assigned to the existing themes and subcategories were created by studying the segmented information (open coding). If appropriate, the open codes were subcategorized to provide more details for each theme. Consequently, the coding framework was supplemented inductively when new themes arose from the data. Differences in new themes were discussed among the two researchers until consensus was reached. If no consensus was reached, a third researcher was consulted. Results were illustrated with relevant quotes from the open-ended questions. In addition, the codes derived from the qualitative content analysis of answers to open-ended questions in the self-administered questionnaires were counted using the text explorer function of the software JMP (version 15.2, 2019; SAS Institute Inc.) and grouped following the coding matrix that emerged from the deductive qualitative content analysis. To indicate how many individuals were available to provide feedback recorded via the group session protocols, the number of participants in each of the ten weekly group sessions (total number of groups, $n = 16$) was reported. Furthermore, the number of individuals who participated in the final guided group interviews during the last month of the study (number of groups, $n = 14$, as some groups were merged) was counted (see the summary of group session attendance in the appendix).

Results

Descriptive results

Participant flow and available feedback

The baseline sample consisted of $n = 242$ participants (WEB: $n = 91$, WEB +: $n = 38$, PRINT: $n = 113$). Of these, $n = 195$ participants were followed up until T1 (T1 completion by original group allocation: WEB: $n = 74$ [81.3%], WEB +: $n = 30$ [78.9%], PRINT: $n = 91$ [80.5%]). After completion of T1, $n = 179$ (91.8%) older adults chose to keep the intervention material randomly assigned to them at baseline, whereas $n = 16$ (8.2%) decided to cross over to the other group and intervention material. T2 was completed by $n = 160$ participants (study completion by original group allocation: WEB: $n = 59$ [64.8%], WEB +: $n = 22$ [57.9%], PRINT: $n = 79$ [69.9%]). Descriptive characteristics of the baseline sample have been reported previously (Pischke et al. 2022).

Of the 242 participants included at baseline, $n = 183$ answered at least one of the open-ended feedback questions in the questionnaires at T1 or T2. With 16 intervention groups and one protocol per group session over the course of 10 weeks, a total of 160 protocols (10 weeks × 16 groups) were compiled. An average of six participants attended the last group session that the final guided group interviews were held in.

Overall, attendance of the group sessions was relatively high. Nevertheless, in all of the 16 groups, the number of participants attending the group sessions decreased over the course of the first 10 weeks, whereas attendance increased slightly towards weeks 9 and 10 (Fig. 3). Another noticeable aspect is the rapid drop in the number of participants in the WEB + intervention group right after the start of the intervention.

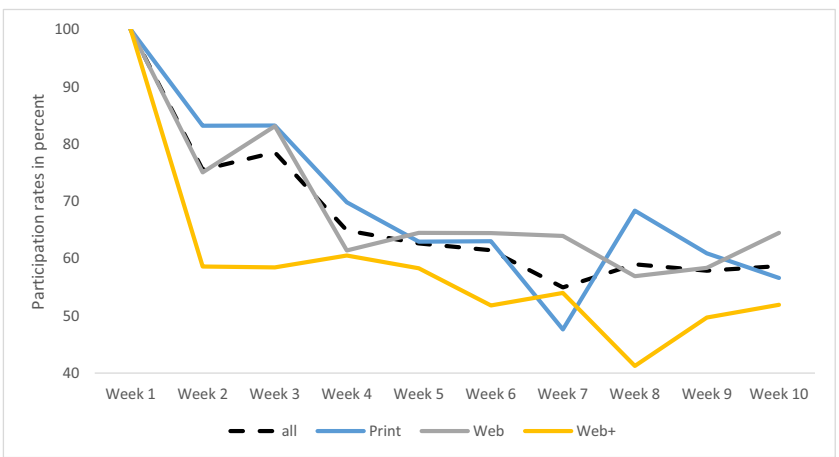

Fig. 3 Participation rates in ten weekly group meetings in percent (total and by intervention group). Note: PRINT intervention = seven groups (*blue line*), WEB intervention = six groups (*green line*), WEB + intervention = three groups (*yellow line*). The number of groups in each intervention pathway is a result of the availability of participants. The WEB + intervention is a minor part of the web intervention (with a sample of 30%) and therefore has fewer participants and number of groups

Results of the content analysis

Requirements at the intrapersonal level

Perceived effects on motivation and fitness Results from the questionnaires This level includes statements that relate to the program content, in general pertaining to individual health benefits, motivation, and enjoyment. Several codes were assigned to the theme "health benefit", including becoming more active because of the program (see [Q1.1] for an exemplary quote in Table 3). Some participants emphasized that by engaging in the intervention, their endurance, strength, balance, and flexibility had improved. Some also mentioned gains in well-being and body awareness.

Among the reasons for recommending the program, numerous motivational requirements were mentioned. These included the program providing motivation for being physically active [Q1.6], giving impulses for implementing daily PA [Q1.7], or improving self-regulation and overcoming one's weaker self [Q1.8]. Finally, enjoyment was mentioned as a reason for recommending the program [Q1.11].

However, by some participants, the program was not deemed helpful [Q1.5] and was thought to be boring [Q1.12]. Some participants mentioned a lack of or decreasing motivation in study phase 2 [Q1.9], therefore some suggested putting greater emphasis on how to increase motivation [Q1.10].

Results from the feedback protocols According to participants, the program helped them become more conscious of daily PA patterns and maintain PA. In addition, participants reported an increased understanding of which exercises affect specific parts of their physical condition, and what kind of endurance and strength activities were already being performed in day-to-day life. They stated that they had become fitter and/or more active, and that they had improved balance and endurance. Criticism included statements that motivation and fitness could not be increased by program participation.

In sum, participants emphasized the health benefits of the program which they felt were motivating, as well as personal enjoyment engaging in the program and the program providing new impulses for regular PA.

Requirements at the interpersonal and sociocultural level

Other participants and social exchange Results from the questionnaires Even though the intervention was a predominantly home-based PA program, some participants specifically mentioned the group sessions as the reasons for participating because of the experienced companionship, receiving encouragement from others, and the possibility of exchange with peers [Q2.1]. There was, however, some dissatisfaction with the group constellations, as several participants mentioned that they had hoped for more networking opportunities [Q2.2] and a more homogenous group in terms of age and fitness level [Q2.3]. These factors were also mentioned as areas for improvement [Q2.4].

Trainers/exercise instructors Results from the questionnaires Trained student assistants led the group sessions, and the feedback regarding the instructors was mixed. While some participants stated that the instructors were one of the reasons for participating in the study [Q2.5], others said that the instructors were a reason for not recommending the program [Q2.6] or criticized the instructors' low levels of qualification [Q2.7], and suggested that the program should be facilitated by a trained professional rather than a student assistant [Q2.8].

Results from the feedback protocols The records of the weekly group sessions and the final guided group interviews support the above-mentioned feedback from the questionnaires, but also indicate that the feeling of being supervised well and supported by the instructor varied greatly, depending on the group and respective staff. In addition, according to the protocols, a closer supervision by a coach, especially after the first 12 weeks of the program, was missed.

Addressing target group requirements Results from the questionnaires The perception of belonging to the target group was present in several of the participants' answers. It was perceived as an adequate entry point for becoming sufficiently physically active. However, while there were only a few mentions of age-appropriateness being a reason for recommending the program [Q2.9], several participants stated that they would not recommend the program to their peers as they assumed that the peers would already be too fit/active for the program [Q2.10]. Some participants suggested improving the eligibility screening process to identify individuals truly belonging to the target group of inactive older adults [Q2.11]. In sum, the social aspect of the group exercises was key for participants. However, there was mixed evidence of views on instructors and fellow participants, with some participants feeling well supervised, others less, and participants differing in their preferences regarding the composition of the peer group (less /more active).

Requirements at the intervention content (including digital) level

Exercises and instructions Results from the questionnaires Exercises and instructions were raised as reasons for recommending the program. In particular, participants appreciated the exercise tips in general, strengthening train-

Table 3 Examples of quotes from open-ended feedback questions

Theme	No	QN	Quote (number of times the associated code was counted)
Requirements at the intrapersonal level			
Health benefit	Q1.1	R	*Because I have noticed that I have become fitter and more active through the program. (36)*
	Q1.2	R	*Positive guidance towards the belief that exercise, physical and mental, can favorably influence the ageing process! (28)*
	Q1.3	R	*Through the course material and the exercise meetings, the importance of movement is realized, and the perception of everyday movement is strengthened. (14)*
	Q1.4	R	*Because I feel so much fitter after just a few weeks. (12)*
	Q1.5	NR	*It didn't do that much for me. Not activating enough for people my age and state of health. (5)*
Motivation	Q1.6	R	*Motivational boost to do something for your health. (59)*
	Q1.7	R	*Because the study prompted me to be more physically active. I've been moving more consciously ever since. (24)*
	Q1.8	R	*Because it helps me overcome my weaker self. (13)*
	Q1.9	L	*Closer supervision, motivation in the 2nd phase. (9)*
	Q1.10	I	*It should be more about motivation. (7)*
Enjoyment	Q1.11	R	*Because it's fun. (12)*
	Q1.12	NR	*I found the exercises boring. (3)*
Requirements at the interpersonal and sociocultural level			
Other participants	Q2.1	R	*Exchange of experience with other participants, social contacts, regular appointments, very good course management. (7)*
	Q2.2	L	*Social contacts. There was no group formation in the sense that the sports activities were continued together after the end of the program. (16)*
	Q2.3	L	*Unfortunately, the group was not set up according to personal fitness level, so that the physical performance limit was not always reached. (5)*
	Q2.4	I	*More should be done to get to know the other participants better and to create movement networks with them. (8)*
Instructor	Q2.5	R	*Very good instructors. (8)*
	Q2.6	NR	*Unprofessional execution. (4)*
	Q2.7	L	*The competence of the (group) instructor to form, moderate and motivate a group according to the age of the participants. (11)*
	Q2.8	I	*Selecting trainers with subject-specific experience. (14)*
Meeting target group requirements	Q2.9	R	*Age-appropriate re-entry into sport and exercise. (4)*
	Q2.10	NR	*Target group 60 + is "ridiculous". (16)*
	Q2.11	I	*It should be checked even better whether the participants really do not do any sports. This was not the case for some in our group. (7)*
Requirements at the intervention content level			
Exercises and instructions	Q3.1	R	*I have learned about many exercises that involve many different muscle groups. (4)*
	Q3.2	R	*New exercises for limitations and weak points, for me balance and flexibility. (3)*
	Q3.3	R	*Good suggestion for specific exercises that can be done in everyday life without special aids or sports equipment. (17)*
	Q3.4	NR	*I was bored, it was not challenging enough for me. (3)*
	Q3.5	NR	*The problem probably lies in the random selection of the subjects and, thus, there is a wide variation in fitness. These differences are not taken into account. An individual classification of the group would be better. (3)*
	Q3.6	I	*Individual appointments, personal approach and assessment. (7)*

Table 3 (continued)

Theme	No	QN	Quote (number of times the associated code was counted)
Health education sessions and lifestyle information	Q3.7	R	*To motivate people to be more active in sports, to use exercise opportunities in everyday life, to take care of themselves and their diet, and to maintain social contacts. (21)*
	Q3.8	R	*Because I learned a lot during the 9 months, I do the exercises I learned every day and I feel very fit! (9)*
	Q3.9	NR	*The group sessions were often not very helpful—except for the exercises. Topics were touched upon very superficially. (2)*
	Q3.10	L	*A balance of exercise and nutrition tips. (22)*
	Q3.11	I	*Inclusion of other health factors besides exercise (e.g. nutrition and addiction prevention). (13)*
	Q3.12	I	*The emphasis on physical activities should be reduced, and mental and psychological components should be included instead. (1)*
Group meetings	Q3.13	R	*We are a great group and it is a lot of fun in the community. (14)*
	Q3.14	R	*Exchange of experience and social contacts. (25)*
	Q3.15	NR	*There was no group experience, which would have been helpful and motivating. (7)*
	Q3.16	NR	*I didn't like the group structure, found that I get more done on my own. (4)*
	Q3.17	L	*Meetings over a longer period of time. Bi-weekly meetings instead of weekly. (19)*
	Q3.18	L	*In the beginning, a get-to-know-you round to overcome the strangeness. Strengthening of the group feeling was missing. (7)*
	Q3.19	I	*Skip the theoretical part at the group meetings. More active time. Health education topics were rather dispensable. (5)*
Specific eHealth intervention components	Q3.20	NR	*Not to be recommended, if readiness for documentation is missing. (2)*
	Q3.21	NR	*The weekly meetings are great. The data entry sucks. I only enjoyed the program in the group. (2)*
	Q3.22	L	*At the beginning, better explanation of the application on the PC. (1)*
	Q3.23	L	*Pedometer is desirable for each group. (1)*
	Q3.24	I	*More practical design of the entries on the website (annoying to click up or down regarding the date). (9)*
	Q3.25	I	*Implement more digital technology & possibilities. (2)*
	Q3.26	I	*More written materials. (1)*
Requirements at the spatial level			
Accessibility	Q4.1	NR	*Too great a distance. (1)*
	Q4.2	L	*Fellow peers in the neighborhood. A walking group has not been found because of different neighborhoods. (1)*
	Q4.3	I	*Events in the community. For me, the distance to the events was too far. (3)*
Room requirements	Q4.4	NR	*The instructions in the completely inappropriate rooms were rather demotivating. (6)*
	Q4.5	NR	*Too little space in the rooms for a sports program. (6)*
	Q4.6	L	*I had imagined that the training exercises would take place in a gymnasium, for example. In my opinion, a classroom does not offer so many possibilities. (11)*
	Q4.7	I	*Rooms that you "look forward to". For me, entering the sometimes "bustling" seminar rooms was often a challenge. (17)*
	Q4.18	I	*More outdoor exercise. (5)*
Requirements at the organizational level			
Sequence and duration	Q5.1	R	*The regular appointments with the training sessions encourage discipline! (20)*
	Q5.2	NR	*Too cumbersome and time consuming! (6)*
	Q5.3	L	*It didn't motivate me to stick with it long term: the group meetings were too noncommittal for me. (7)*

Table 3 (continued)

Theme	No	QN	Quote (number of times the associated code was counted)
Scheduling	Q5.4	R	*Well-structured program. (9)*
	Q5.5	NR	*Constantly changing trainers/ times and places. (4)*
	Q5.6	L	*Originally, I had assumed that the meetings would always be on Thursday. I scheduled my appointments that way. The change to Tuesday was announced too late. (4)*
	Q5.7	I	*Longer weekly attendance requirement 1× per week. (10)*
	Q5.8	I	*Better time management for times in the non-working time and no meetings at noon. (12)*
	Q5.9	I	*Specify all meeting locations in advance. (6)*
Local stakeholders	Q5.10	I	*After the 9 months, there could have been concrete further offers or suggestions (cooperation with local providers, sports clubs). (7)*
Costs, incentives and rewards	Q5.11	R	*Free of charge. (1)*
	Q5.12	R	*Progress bar & weekly pyramid motivate me a lot to do my exercises regularly during the week so that 100% is reached & the pyramid turns all blue. (3)*
	Q5.13	NR	*As long as the participants provide so much (partly also very private) information, but hardly receive anything in return, certainly not. (1)*
	Q5.14	L	*Too little feedback on objectively measurable changes in physical activity. (9)*
	Q5.15	L	*To see how my personal progress has evolved. (7)*
	Q5.16	I	*Better feedback on the results achieved! (7)*
	Q5.17	I	*The respective physical condition would have to be checked regularly. Example: Started at 0%, after 3 weeks at 30% at 7 weeks 65%. Then I know that I am on the right track. (5)*
Aspects related to study participation	Q5.18	NR	*Filling out this questionnaire is complicated and time consuming. The questions do not make sense. (1)*
	Q5.19	NR	*Insufficient communication. (1)*
	Q5.20	L	*A comprehensible concept, clearly identifiable objectives of the study. (6)*
	Q5.21	I	*More transparency and involvement! (1)*
	Q5.22	I	*Bringing the experience gained, including changes, to the outside world in a practicable way (1)*
	Q5.23	I	*More appreciation. No study without participants. (1)*

Note. QN = Question; R = Reasons for recommending the program; NR = Reasons for not recommending the program; L = Aspects the program lacked; I = Suggestions for improvement

ing [Q3.1], balance, and flexibility tips [Q3.2]. They also liked the fact that the program included everyday activities to reach PA recommendations, and that it was feasible [Q3.3].

However, some participants found the home exercises provided in the material too easy [Q3.4], and criticized that they were not sufficiently adaptable to individual requirements [Q3.5]. Some recommended putting more effort into individual support and instruction [Q3.6].

Results from the feedback protocols The program's content was praised during the weekly group meetings, e.g., the well-designed combination and variety of exercises, the exercise catalogue, and the PA recommendations. Participants liked the flexible use of the intervention material and the practical integration into everyday life. The individual monitoring of progress using the exercise diary was well received, and participants reported progress in terms of fitness, attitude, and motivation. However, some participants desired a wider range of exercises to choose from, including more difficulty levels to choose from depending on the individual preconditions, especially regarding the strength exercises. In part, the intervention material was perceived as too rich in text and the descriptions as too complicated and unhelpful. The positive aspects and criticism mentioned were also brought up in the final guided group interviews. With regard to the improvement of the program material, exercises and instructions for persons with health issues or for the relief of pain were suggested.

Health education sessions and lifestyle information Results from the questionnaires Participants appreciated the lifestyle and particularly nutrition information they received during the group sessions [Q3.7, Q3.8]. However, two par-

ticipants criticized the educational components as too superficial [Q3.9]. Several counts were found relating to a lack of sufficient health information [Q3.10] and suggesting to provide more health information, including more information on nutrition, mental health, and health behavior change [e.g., Q3.11 and Q3.12].

Results from the feedback protocols During the group meetings, participants expressed enthusiasm regarding various topics, especially nutrition. They stated that they gained knowledge about weight reduction, self-efficacy, and motivation. Others missed certain topics, in particular content on mental health. In the final guided group interviews, some stated that they would have liked more detailed theoretical input; yet others perceived this part as already too extensive.

Group meetings Results from the questionnaires The group sessions were mentioned as a reason for recommending the program because of experiencing joy [Q3.13] and having the opportunity to make new social contacts [Q3.14]. However, some participants criticized the group spirit [Q3.15] and some described group activities as unnecessary [Q3.16]. Several participants expressed their wish for more group sessions per week, a continuation beyond the 10 weeks [Q3.17], as well as a more motivating group spirit [Q3.18]. These wishes were also reflected in the suggestions for improvement. Participants mentioned that attendance lists, playing music, and wearing nametags would improve attendance and group atmosphere [Q3.19].

Results from the feedback protocols Advantages of the group meetings were also discussed, including the motivational aspect, as well as having fun and exchanging experiences among the group members. The critical aspects which had already been reported in the questionnaires, such as the decreasing group size over time, were also raised during the weekly group meeting and the final guided group interviews.

Specific digital intervention components Results from the questionnaires Only a few participants mentioned that self-monitoring was too time-consuming and that they would therefore not recommend the program to others [Q3.20 and Q3.21]. Data security concerns were only discussed by a small number of participants. Data entry on the website was deemed unpractical [Q3.22]. Some mentioned their preference for printed information, and some stated that they would have preferred receiving or keeping the fitness tracker [Q3.23]. To improve the program, several participants suggested changes in the data entry process [Q3.24], technology, and visualization.

Results from the feedback protocols In contrast to the feedback from the questionnaires, the digital components were more often discussed in the group sessions. In particular, the activity tracker was praised as a good tool for keeping track of personal achievements. Those who used the WEB and WEB + intervention materials complimented the design of the website, and some of those who switched modalities during the intervention period described the digital PA monitoring as more straightforward than using the printed version. However, criticism included difficulties in handling the menus on the web interface or app, and technical problems when synchronizing the fitness tracker with the website.

In sum, materials provided in the intervention were deemed appropriate to develop a personal PA routine. In several cases, more variety in exercises and health topics addressed, such as nutrition, would have been welcomed. Preferences regarding modality of intervention components and materials vary greatly in this population.

Requirements at the spatial level

Accessibility/reachability In the questionnaires, requirements regarding accessibility of the group session site were rarely mentioned. Some participants suggested that the group events should not be too far away from home [Q4.3]. However, this issue was not raised in either the weekly group meetings or the final guided group interviews.

Location Results from the questionnaires The venue of the group sessions was mostly negatively commented on. Participants mentioned the unsuitability [Q4.4] and small size of the rooms [Q4.5] as reasons for not recommending the program. Participants stated that suitable rooms were missing in the PA program [Q4.6], along with the wish for more outdoor group sessions. Accordingly, participants recommended holding the group sessions in properly sized and ventilated rooms or sports centers [Q4.7], as well as outdoors, rather than in seminar or meeting rooms [Q4.18].

Results from the feedback protocols The dissatisfaction with the spatial conditions (too small and stuffy, not suitable for sports) also appeared in the feedback protocols. Participants suggested involving local sports clubs to organize sessions in their facilities.

In sum, suitable locations for exercising with others are key to older adults.

Requirements at the organizational level

Sequence and duration Results from the questionnaires While regular appointments and the continuity the program were reported as reasons for recommending the intervention to others [Q5.1], some participants criticized the program as being too time-consuming [Q5.2] or, in contrast, as having ended too soon. Some feedback related to the lack of support for forming habits [Q5.3].

Results from the feedback protocols Participants also pointed out in the weekly group meetings and the final guided group interview that regular appointments with a group were particularly important for fostering a sense of discipline and establishing structures. Some participants found 10 weeks insufficient to form a habit or to commit to a group. Overall, a longer period of time spent with joint activities was desired, and participants emphasized that regular participation should be initiated more intensely.

Scheduling Results from the questionnaires The program structure was appreciated by some participants [Q5.4], others criticized the inconvenience of the appointments and the change in instructors and locations [Q5.5]. Some participants suggested continuing weekly group sessions after the 3-month follow-up instead of changing towards monthly health education sessions [Q5.7]. Several participants were not able to attend the group sessions and suggested improving the tailoring of the schedule to better fit the needs of older adults in their 60s who are still working [Q5.8], to provide alternative appointments in case of inconveniences, and to better communicate appointments in advance [Q5.9].
Results from the feedback protocols The inconvenient scheduling for employed participants was criticized in the weekly meetings, as well as in the final guided group interviews. To address this issue, offering appointments, including late afternoon or evening time slots, was proposed.

Local stakeholders In the questionnaires, a number of participants recommended including local PA options and suppliers (e.g., community sports clubs) in the PA program to facilitate community-based intervention adoption and maintenance [Q5.10]). The request to involve local sports clubs was also reflected in the protocols.

Costs, incentives, rewards, and feedback Results from the questionnaires Several participants were highly interested in monitoring their progress and in more detailed feedback on their fitness level, as well as in their progress in both fitness and activity levels as a sort of incentive for participating in the program. Under the question of what was missing in the PA program, codes were related to feedback [Q5.14], progress [Q5.15], and fitness test [Q5.16].
Results from the feedback protocols According to the protocols, there was a general wish for more feedback, both on personal progress, as well as on individual fitness level at the end of the program, but also on study results comparing personal PA-levels to those of other participants. In order to acknowledge achievements, prize draws (e.g., of activity trackers) or any kind of award (e.g., a diploma) were recommended, as well as the collection of bonus points for prevention programs of health insurance companies. There were also suggestions to continue offering the program after the end of the study for a small fee.

In sum, the population was very heterogeneous in their requirements regarding intensity and length of intervention activities. Older adults gave valuable advice on how to motivate long-term behavior change and maintenance of behavior and program activities.

Discussion

For this investigation, several sources of participant feedback were analyzed and synthesized, to explore requirements of older participants regarding a blended PA intervention based on an adapted social–ecological model (Wichmann et al. 2020).

Principal findings

Regular appointments, maintaining self-reliance, and keeping in touch with others were the main motivators for participating in the weekly group sessions. Participants recognized the benefits of performing additional home-based exercises, but had concerns regarding motivation. They also experienced a decline in motivation, discipline, and perceived support, once the weekly group meetings were replaced with monthly health education sessions.

Based on the frequency of codes derived from the open-ended questionnaire answers, the majority of participants' feedback was positive and pertained to all requirement levels. Informational content, exercise tips, the exercise catalogue, and the perceived progress in terms of PA, health, fitness and general awareness, and group-based components were appreciated. Negative feedback and suggested improvements regarding the weekly group sessions pertained to instructors and group spirit and to location requirements, scheduling, and communication. The modality of the intervention (print vs web-based), however, did not appear to be one of the key requirements.

Recommendations according to the requirement levels

At the intrapersonal level, the anticipated health benefit of becoming more active and improving endurance, strength, balance, and flexibility, as well as having fun, and increasing overall motivation and awareness of day-to-day activities were identified. The results underline evidence from similar earlier studies (Boulton et al. 2018; Brouwer et al. 2009; Jenkin et al. 2017). However, not all participants could be reached with the program, and a number of participants did neither report having noticed any positive effects in terms

of motivation or fitness, nor having perceived any benefit from the program as a whole. This reflects the heterogeneity of the population, differing in individual prerequisites, expectations, and attitudes. While replicating the common aspects of improved physical well-being, fitness, motivation, and enjoyment, this study more strongly highlights that individual needs and challenges which need to be considered to a greater extent during intervention design, allowing for more tailored content, as well as higher levels of flexibility to address individual needs dynamically (Moore et al. 2016; Wichmann et al. 2020).

Presenting a contrast to an intrapersonal focus, the sociocultural aspect turned out to be one of the most important elements of the program, and the overall satisfaction with the regular group sessions was very high. Although the intervention mainly focused on home-based exercises, the additional group meetings, which provided structure and made it possible to be in touch with peers, exchanging and comparing oneself with other participants, were found to be very helpful and a great motivational source. This confirms the key role of social exchange, which has been previously highlighted (Jenkin et al. 2017; Mouton and Cloes 2015). The importance of the social context is also reflected in the fact that only a few participants chose to switch the program material, which was explained, among other things, by not wanting to leave the actual group. In addition, the perception of belonging to the target group seemed to be a significant factor contributing to program satisfaction and use. Thus, programs containing elements that boost social support by peers may increase engagement in PA and prevent high dropout rates typically reported in intervention research (Jancey et al. 2007; Ratz et al. 2021).

Demonstrating the heterogeneity of preferences across all requirement levels, mixed opinions were voiced with regard to the digital intervention components. While some participants praised the simple handling, others felt strained by the technical requirements or even faced technical problems. This feeling could have arisen because of limited digital literacy and skills, and supports the idea of personalized and selectable forms of intervention delivery in the future. Particularly in this age group (60 +), basic step-by-step instructions and technical support have been previously reported as important (Mehra et al. 2019; Shin et al. 2019) and were also raised by participants in this study as positive aspects of the intervention. Considering that attendance was decreasing rapidly at the beginning of the study, the feedback from participants remaining in the study most probably does not capture all criticism concerning the digital intervention components. Based on the received feedback, however, the exercise diary, in both digital and print form, was mostly rated as very helpful and motivating. Some participants felt they were already very physically active and did not belong to the target group of older, less fit individuals. This sentiment was in line with some of the criticism voiced regarding the intervention content. Previous research found preferences for intervention modality varied, with older or female individuals or those with an adverse weight status appearing to be more likely to favor print-based interventions (Boekhout et al. 2019; Short et al. 2014).

While other studies based on the social–ecological model also emphasize distance aspects and the importance of accessibility for program attendance (Boekhout et al. 2017; Rimmer et al. 2004; Wichmann et al. 2020; Zhang et al. 2019), this was not a concern of participants in this study. Peters et al. (2022) who investigated ecological factors for participation and retention in the preceding study (Peters et al. 2022) did also not find evidence for distance affecting participation. Based on their findings, they concluded that choices regarding the distance are likely to be made prior to deciding to participate, but rarely matter once participants have committed to attending (Peters et al. 2022). With regard to the physical environment, the relevance of certain attributes of sports facilities for intervention engagement has been previously reported (Boekhout et al. 2017; Rimmer et al. 2004; Wichmann et al. 2020; Zhang et al. 2019). To simulate home-based exercise sessions, the majority of the weekly group meetings in our study were held in venues that were not primarily designed for PA (e.g., university seminar rooms). This led to criticism by participants regarding the space sizes and ventilation. Furthermore, it appeared to be worthwhile to plan outdoor activities in a flexible manner (assuming the appropriate season and weather conditions).

At the organizational level, the main feedback pertained to the length of the program and scheduling of weekly group meetings. Many participants expressed interest in continued weekly meetings beyond 10 weeks in order to strengthen commitment and to establish what they had learned and started to incorporate as a habit. There was also a strong demand for more flexible timing adjusted to the needs of certain groups, e.g., those who were still employed. Such age-specific differences have also been observed in past research (Boulton et al. 2018; Wichmann et al. 2020) and point to the restricted appointment possibilities of younger elders still working compared to those already full-time retired. Contrary to statements made in other studies (Boekhout et al. 2017), late afternoon or evening classes were welcomed by participants. While monetary costs were not often mentioned, several individuals desired an incentive for their study participation. Individual feedback on objectively measured PA and fitness progress was perceived as a valuable reward for adhering to the PA recommendations and attending the program.

Strengths and limitations

The social–ecological model served as a solid framework for mapping different facets of program requirements with regard to a blended PA program designed for older adults in Germany. One strength of the study was the synthesis of data from multiple sources, including data gathered via questionnaires and information extracted from protocols of 14 guided, structured group discussions and 160 group sessions. With regard to the analyses, it should be noted that the number of mentions of certain topics extracted from the group session protocols could not be treated separately from the counts of mentions in the questionnaires: The group session protocols merely support the statements made in the questionnaires. This is because the same overall population was involved in both, the questionnaires and protocols, and thus might have voiced their opinions in different ways.

Another limitation was that only older adults who completed T1 were included in the feedback analysis, rendering results prone to both selection and attrition bias, because individuals whose requirements were not adequately addressed most probably discontinued the study before the 3-month follow-up. Hence, both the questionnaire responses and group session feedback protocols lean towards a reflection of older adults' views, who enjoyed the PA intervention in general and the group sessions in particular. With regard to the latter, it should be noted that the participation rate decreased over the course of the 10 weeks. The sharp drop in attendance in the WEB + group right after the start of the study may reflect the difficulties experienced with the required technology (e.g., pedometers and their synchronization). In turn, the slight increase in week 9 was possibly related to the option of changing intervention material, for which the information session was held in week 9 and the choice that had to be made by participants in week 10. Generally, it can be assumed that dissatisfied participants no longer attended the meetings on a continuous basis and were thus unable to provide on-site feedback. On the other hand, weekly feedback was not a mandatory part of the appointments. As a result, there were some records with no feedback noted in them. In addition, the requests for voluntary feedback mostly prompted participants to voice issues and suggest ideas for improvement rather than express what they were satisfied with. Further, an interviewer effect may have occurred (Davis et al. 2010). For example, participants who were not satisfied with the instructor who led the training sessions and was in charge of recording the optional feedback may have been more likely to withhold their on-site feedback, or the way the feedback was recorded may have depended on the instructor(s).

Conclusions

Our results indicate that older adults require regular appointments on a weekly basis to feel motivated engaging in regular PA ,and that they appreciate the social aspect of exercising with peers. Tailored instructions with regard to PA and tracking progress are key for achieving PA goals from older adults' point of view. An intervention not meeting the population's requirements with regard to characteristics of the instructor or the venue, or specific needs regarding scheduling and associated communication, may impact negatively on participation in a blended PA program. Our findings highlight the high level of heterogeneity regarding needs and preferences voiced in the 60 + population. Researchers and practitioners should be aware of differing intervention requirements, which may influence intervention engagement and maintenance of behavior change in the long-term.

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Authors' contributions MP and TR drafted the manuscript. CRP, SL, and CVR conceived and designed the PROMOTE study. SM detailed the conceptual, theoretical framework and original coding matrix of the analysis. TR conducted the enriched coding scheme. MP and TR supervised the collection of data and the implementation of the PROMOTE intervention. TR and MP analyzed the data. All authors read, critically revised, and approved the final manuscript.

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Availability of data and materials The datasets generated and analysed during the current study are publicly available under https://zenodo.org/records/10149925. Any questions regarding the data can be addressed by the corresponding author upon request.

Declarations

Ethics approval and consent to participate Ethical approval was obtained from the Medical Association in Bremen (RA/RE-635, on July 3rd, 2018) and the study was registered with the German Clinical Trials Register on January 10th, 2019 — number DRKS00016073. All study participants were fully informed about the study and provided informed consent.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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