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A Person-Centered Perspective on Physical Activity-Related Barriers Perceived by Male Fluctuators 50 Plus: A Cross-Sectional Study

Helmut Strobl[1], Anne Herrmann-Johns[2], Julika Loss[3], Robert Hable[4], and Susanne Tittlbach[1]

Abstract

Men aged 50 or older (50 plus) represent a hard-to-reach target group for health-enhancing physical activity (PA) interventions. However, a considerable percentage of men 50 plus do not entirely fail to achieve the PA milestones set by the World Health Organization (WHO) guidelines. They show fluctuating PA behavior, influenced by various barriers hindering or preventing regular PA participation. As "one-size-fits-all" behavioral change interventions are only partially effective in specific subgroups, it is essential to tailor PA promotion measures to the particular needs of male fluctuators 50 plus. The standardized questionnaire included validated instruments measuring participants' current stage of behavioral change, their perceived barriers to PA, questions on selected psychosocial correlates of PA, and sociodemographic variables. Out of 1,013 participants, 133 men (13.1%) classified themselves as fluctuators. Using a person-centered approach, we formed groups with similar intra-individual relevant barrier profiles using hierarchical cluster analysis (Ward method) followed by k-means clustering. We identified four clusters. Cluster 1 (n = 31) involves men predominantly perceiving physical constraints. Cluster 2 (n = 33) represents men lacking self-motivation and struggling with their weaker selves. Men in Cluster 3 (n = 51) primarily indicate professional and private obligations that prevent them from being physically active. Finally, men in Cluster 4 (n = 18) miss appropriate sports courses that meet their individual needs. Our findings support identifying individually tailored strategies designed to promote regular PA in male fluctuators 50 plus. Further research is required to determine the effectiveness of this approach in improving adherence to PA guidelines and corresponding health-enhancing effects for men 50 plus.

Keywords

stages of change, health promotion, cluster analysis, gender, men

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Background

The benefits of regular physical activity (PA) for different population groups are well established. Among middle-aged, older, and elderly adults, being physically active has been proven to enhance overall physical and mental health and prevent chronic diseases; it is also associated with longer life expectancy (Warburton & Bredin, 2017). Despite the well-known benefits, the prevalence of insufficient PA is high, especially in Western high-income countries (Guthold et al., 2018; Tison et al., 2022). Many people fail to reach the widely acknowledged Health-Enhancing Physical Activity (HEPA) guidelines—provided by the World Health Organization—of at least 150 minutes of moderate-intensity PA per week or 75 minutes of vigorous-intensity PA, or an equivalent combination (World Health Organization [WHO], 2010).

[1]Bayreuth Center of Sport Science, University of Bayreuth, Bayreuth, Germany
[2]University Regensburg, Regensburg, Germany
[3]Robert Koch Institute, Berlin, Germany
[4]Deggendorf Institute of Technology, Deggendorf, Germany

Corresponding Author:
Helmut Strobl, Bayreuth Center of Sport Science, University of Bayreuth, Universitätsstraße 30, 95447 Bayreuth, Germany.
Email: helmut.strobl@uni-bayreuth.de

Governmental public health initiatives (e.g., IN FORM—Germany's national initiative to promote healthy diets and physical activity) aim to increase population-wide HEPA through a variety of interventions and programs. However, many of these interventions and programs do not appeal to men at the age of 50 or older (further referred to as "men 50 plus"), as they often neglect sociocultural factors relevant to male health behavior (Courtenay, 2000; Robertson et al., 2013; WHO, 2018). Using those sociocultural factors rather than neglecting them is a promising way to increase participation rates of men 50 plus in health promotion programs, as reported by a variety of international studies (for an overview see Strobl, 2019).

Interventions and programs fostering HEPA should further rely on behavior change theory. (Marcus et al., 2006). There is a large number of theoretical explanations of behavior change. For example, the transtheoretical model (Prochaska & Velicer, 1997) illustrates the process from inactivity to regular PA behavior by passing through qualitatively distinct behavioral stages. According to this model, people are associated with a certain stage, based on their behavior and behavioral intention—usually measured via self-reported responses to a series of survey items. Interventions and programs to initiate and maintain behavior change differ according to the corresponding behavioral stage of the addressed people (Marcus et al., 2006).

Fluctuation represents a specific stage of behavioral change (Duan et al., 2016; Strobl et al., 2016). It depicts an intermediate PA pattern between action (attempting the change) and maintenance (having been able to sustain behavior change for a longer time), characterized by repetitive lapses and relapses into a PA behavior below the HEPA guidelines. The behavioral intention of fluctuators is relatively high, leading to good prerequisites for regular PA behavior. However, fluctuators perceive significantly higher barriers regarding PA compared to action and maintenance stages (Shang et al., 2018; Strobl et al., 2016).

Barriers are defined as individually relevant factors hindering or preventing participation in PA (Bauman et al., 2012; Biddle & Mutrie, 2008; Krämer & Fuchs, 2010). They may refer to the expected negative consequences of PA behavior, such as having less time for other activities or getting injured while being physically active. Barriers may also relate to current situational constraints, such as being too tired after an exhausting workday or being demotivated because it is raining outside. Finally, environmental circumstances may influence the perception of barriers, for example, the lack of appropriate sports facilities nearby (Bauman et al., 2012; Biddle & Mutrie, 2008; Krämer & Fuchs, 2010). Implementing HEPA promotion interventions and programs targeting those barriers is necessary to transform the intention of fluctuators into action (Schwarzer, 2008).

Previous research on behavioral change mainly focuses on perceptions of barriers related to the general male population. At its best, studies are separating between active and inactive men (e.g., Gavarkovs et al., 2017), older and oldest men (e.g., Spiteri et al., 2019), or men on different stages of behavioral change (e.g., Sørensen & Gill, 2008). However, those rather general investigations of existing barriers may disregard that there might be subgroups of male fluctuators with distinct predominant perceived barriers. For example, it can be assumed that for some male fluctuators, the expected negative consequences of PA could be a more relevant barrier than the environmental circumstances—and vice versa for other subgroups. Identifying homogeneous subgroups among male fluctuators with the same predominant perceived barriers is of particular relevance as a single barrier may be enough to disengage someone from physical activity (André & Agbangla, 2020).

From a statistical point of view, this procedure is linked to a person-centered approach, analyzing the intra-individual relevance of the perceived barriers (Meyer & Morin, 2016). Instead of operating with average levels of relevant barriers for the whole sample (i.e., a variable-centered approach; Meyer & Morin, 2016), a person-centered approach facilitates **inter**individual comparisons based on each person's intraindividual weighting of the barriers. The current exploratory study employs this issue by addressing the following research questions:

1) Which homogeneous subgroups of male fluctuators with the same predominant perceived barriers can be identified?
   To answer this question, we integrated relevant barriers concerning PA behavior into the study and calculated the intra-individual relevance of those barriers for a sample of male fluctuators according to an approach introduced by Sudeck et al. (2011; see also Krauss et al., 2017). We explored homogeneous subgroups using k-means clustering.
2) What are the main sociodemographic and psychosocial characteristics of the men belonging to the respective clusters?
   For this purpose, we included different sociodemographic and psychosocial variables in the questionnaire. Associations between cluster membership and those variables were examined to characterize the respective clusters further.
3) Based on the study results, what are the consequences for aligning and promoting HEPA measures according to the individual needs of the target group?

We derived recommendations for HEPA promotion for male fluctuators 50 plus, taking into account the findings of specific characteristics of the identified homogeneous subgroups.

Method

Study Design

The data for the present study originate from a cross-sectional survey conducted within the project ACTION for men (A4M), a subproject of the research consortium Capital4Health. A4M aims to increase capabilities for HEPA among men 50 plus who live in a rural community setting (Loss et al., 2020; Strobl et al., 2020). We implemented A4M in two communities (10,000–20,000 inhabitants each) in a socio-economically relatively disadvantaged county within Bavaria (Germany). Health data show increased mortality of men in this region (Brey, 2016). At the beginning of the project, a standardized paper-and-pencil survey was conducted with men 50 plus residing in the involved communities.

Measures

Barriers were measured using a questionnaire with 10 different single items, validated in various international studies (Duan et al., 2015; Strobl et al., 2016). The item selection was based on previous studies on behavioral change, investigating the most frequent barriers hindering people to engage in PA (Bauman et al., 2012; Biddle & Mutrie, 2008). Those items refer to:

- Professional commitments: Lack of time for PA due to work-related responsibilities.
- Private commitments: Lack of time for PA due to responsibilities related to private life.
- Lack of appropriate sports activities: Lack of specific sports offers that reflect personal needs/interests.
- Lack of self-motivation: Not being able to motivate oneself for engaging in PA, for example, after an exhausting workday.
- Lack of interest in PA: Lack of engagement in PA due to valuing and prioritizing interests other than PA.
- Fear of physical overload: Being worried that engagement in PA will be too strenuous.
- Fear of injury: Being worried that engagement in PA will lead to injuries.
- Lack of individual capacities: Being worried that the physical and conditional abilities for engagement in PA are too low.
- Poor physical condition: Feeling uncomfortable to engage in PA given one's current physical state, for example, being overweight.
- Health-related constraints: Inability to engage in PA due to physical complaints, for example, an aching knee.

To analyze participants' current stage of behavioral change, we integrated a validated self-report algorithm reflecting the different stages of behavior change (Duan et al., 2016; Prochaska & Velicer, 1997). The survey further included questions on selected psychosocial correlates of behavior change, i.e., variables being significantly related to behavioral change processes (Strobl et al., 2016): intention to engage in PA, action self-efficacy, and expected benefits. All questions stem from validated and published surveys. Three experts in physical activity promotion research further checked the validity and consistency of the final questionnaire version. For an overview of the questionnaire components and measurement details, please see Table 1. In addition, sociodemographic variables were collected with the help of the questionnaire, including age, employment status, and educational level.

Sample Recruitment

All male inhabitants 50 plus of the communities involved received a printed questionnaire and informed consent with a free return envelope. The residents' registration office provided men's addresses. After 3 weeks, all men received a reminder letter, regardless of whether they had participated in the survey or not. Participation was voluntary, and returned questionnaires were only used for analysis if they were sent back together with signed informed consent. Recruitment occurred between August and October 2019. In total, 4,002 questionnaires were disseminated, of which 1,068 were returned with signed informed consent (response rate 26.7%).

Ethics Approval and Consent to Participate

This study was reviewed and approved by the research ethics committees at the University of Bayreuth prior to the start of data collection (Approval No.: O 1305/1-GB). Written informed consent was obtained from all participants prior to participating in the study, and participants were reminded that participation was voluntary and that they could withdraw at any time.

Data Preparation

Returned completed questionnaires (n = 1,068) were scanned, and data were electronically processed into a

Table 1. Overview of Questionnaire Components and Measurement Details

Outcome	Instrument	Description
Stages of change		
Stages of change	Six statements assessing the current stage of PA (Duan et al., 2015, 2016; Strobl et al., 2016)	• Participants were asked if they engaged in at least moderate-intensive PA for an accumulated time of at least 150 min per week. • The response format was on six statements ranging from 1 ("No, within the last year I was not and I am not thinking about starting in the future") to 6 ("Yes, I did engage in physical activity as such, for 12 months or more").
Barriers		
Perceived barriers to PA	Ten items assessing perceived reasons hindering engagement in PA (Duan et al., 2015)	• Participants were asked why PA could not be conducted regularly. • The response format was on a 7-point scale ranging from 1 ("I don't agree at all") to 7 ("I totally agree"). • Items represent (in bold letters items finally used in the study, see chapter *data preparation*): professional commitments, private commitments, lack of appropriate sports activities, lack of self-motivation, lack of interest in PA, fear of physical overload, fear of injury, lack of individual capacities, poor physical condition, and health-related constraints.
Psychosocial correlates of behavior change		
Intention to engage in PA	One item assessing intention to engage in PA (Göhner et al., 2009)	• Participants were asked to reflect their strength of intention to engage in PA regularly within the next 4 weeks. • The response format was on a six-point scale ranging from 0 ("I don't have this intention at all") to 5 ("I have a strong intention").
Action self-efficacy	One item assessing confidence in one's capacity to perform PA (Göhner et al., 2009)	• Participants were asked to reflect their confidence in being capable of engaging in PA regularly within the next four weeks. • The response format was on a six-point scale ranging from 0 ("I am not confident at all") to 5 ("I am totally confident").
Expected benefits	Eighteen items assessing the expected benefits of PA in the long- or short-term (Duan et al., 2015)	• Participants were asked which benefits they expected from engaging in PA. • Response format was on a seven-point scale ranging from 1 ("I don't agree at all") to 7 ("I totally agree"). • A summary score was calculated to provide a measure for the factors health and fitness (four items; $\alpha = .85$), stress relief (three items; $\alpha = .87$), body shape (three items; $\alpha = .92$), performance (four items; $\alpha = .70$), sociability (three items; $\alpha = .79$) and nature (1 item). Higher scores indicate higher expected benefits.

Note. PA = physical activity.

text file (QuestorPro 3; Blubbsoft GmbH, Berlin, Germany). Questionnaires were excluded if missing data exceeded over 50% ($n = 24$) and if respondents were unengaged, assuming respondents gave the same answers to each item ($n = 27$). There were no significant differences in sociodemographic data between the excluded and remaining data sets. From the remaining 1,017 questionnaires, only participants who assigned themselves fluctuators via the self-report stage algorithm were selected for further analysis ($n = 137$).

As the next preparatory step, we examined the 10 items describing the perceived barriers to their usability for cluster analysis. Items were considered reasonable if they reflected between-subject heterogeneity via non-extreme mean values as well as a substantial standard deviation. Each item should additionally provide discriminant information, assessed by raw bivariate correlation coefficients (Backhaus et al., 2018). We considered the following four items as inappropriate as mean values were below 2.0 and standard deviation below 1.0: lack of interest in PA, fear of physical overload, fear of injury, and poor physical condition. Accordingly, we excluded them from further analysis. Mean values of all other items ranged between 2.36 and 3.52, and their standard deviation reached at least 1.5. Raw correlation coefficients between those items were all below .5. We considered the remaining six items appropriate for cluster analysis: professional commitments, private commitments, lack of appropriate sports activities, lack of self-motivation, lack of individual capacities, and health-related constraints. As cluster analysis requires complete data sets (Backhaus et al., 2018), we scanned data for missing values in the selected six perceived barriers (n = 6). We replaced missing values for those six respondents with the average mean value across the remaining barriers for the respective person.

An intraindividual standardization with the six barriers was conducted according to an approach introduced by Sudeck et al. (2011; see also Krauss et al., 2017). This approach allows an interindividual comparison of perceived barriers based on their intraindividual weighting by each subject. For that purpose, we arranged data in three steps (each calculation was done for each participant separately): 1) Calculation of the overall mean over the six barriers (mean level of the individual barrier means), 2) Calculation of the overall standard deviation over the six individual means, and 3) z-standardization of each barrier by subtracting from each barrier value the overall mean (resulting from step 1) and dividing the result by the overall standard deviation (resulting from step 2). Consequently, a mean individual weighting of a given barrier had an intra-individual standardized z-value of 0. Positive respective negative z-values expressed higher respective lower weightings.

In the last step, the single-linkage method for hierarchical clustering was conducted to control for extreme individual barrier profiles. Based on that analysis, we excluded four participants from further calculations. We used Ward's method (Squared Euclidean Distance) to cluster barrier profiles. The final number of clusters was derived according to a visual inspection of the dendrogram and by applying the stopping rule developed by Mojena (1977; see also Milligan & Cooper, 1985) with a threshold value of 2.75. After considering those criteria, four clusters were revealed.

Statistical Analysis

The final Ward cluster solution was optimized using a nonhierarchical method (k-means clustering). Therefore, the cluster centers from the preliminary hierarchical analysis were used as initial seed points. To quantify the degree of within-cluster homogeneity of the optimized cluster solution, the within-cluster variance related to the overall variance for a given z-standardized barrier was calculated. A ratio lower than 1 ($F < 1$) indicates a lower within-cluster deviation compared with the variation of the respective z-standardized barrier over all subjects (Backhaus et al., 2018). Ratios were lower than 1 for almost all z-standardized barriers, except for the *lack of individual capacities* in Cluster 1 and the *lack of self-motivation* in Cluster 4. For further interpretation of the final cluster solution, a t-statistic was computed. Therefore, for each z-standardized barrier, the difference between the cluster mean and the overall mean of the respective z-standardized barrier over all subjects was calculated. The received value was subsequently divided by the *SD* of the respective z-standardized barrier over all subjects (Backhaus et al., 2018). The t values represent normed values indicating the item's relevance under investigation in each cluster compared to the total sample (negative values represent less importance and vice versa).

Furthermore, descriptive statistics were computed for the psychosocial correlates of behavior change and capabilities for the final study sample in total and split according to the identified clusters. Between-cluster differences were tested using a one-way analysis of variance (ANOVA) for metric data and chi-square tests for categorical data, with cluster membership as the independent variable and the descriptive variables as dependent variables (α = .05). Statistically significant between-group differences were further analyzed using the Games-Howell post hoc test for metric data and comparison of standardized residuals for categorical Chi^2 tests (α = .05). Statistical analyses were conducted with SPSS Version 26 (IBM SPSS Statistics for Windows, Version 26.0; Armonk, NY, USA: IBM Corp.).

Results

Study Sample

The final sample for the study consists of n = 133 male fluctuators (corresponding to 13.1% of the total available data). Descriptive statistics of the study sample are presented in Table 2 (column *Total*).

The mean age of the sample is 62.61, with a standard deviation of 8.89. One third of participants (33.3%; n = 44) indicated being retired, and the minority (42.9%; n = 57) stated having at least a high school diploma.

Table 2. Characteristics of Sociodemographic and Psychosocial Variables for the Overall Data Set (Total) and Clusters 1 to 4

Sociodemographic and psychosocial variables	Total	Cluster 1 Physical constraints	Cluster 2 One's weaker self	Cluster 3 Busy men	Cluster 4 Unattractive sports offers	Test statistic
Number of subjects (*n*)	133	31	33	51	18	116
Age (years)	62.61 (8.89)	68.85[a] (9.21)	59.24[b] (4.98)	59.04[b] (7.23)	69.46[a] (9.91)	$F_{df=3,129} = 14.74$, $p < .001$, $\eta^2 = .29$
Retirement rate	33.3%	76.7%+	18.2%	15.4%	100%+	$Chi^2_{df=3} = 24.04$, $p < .001$, V = .60
Educational level (high school)	42.9%	30.8%	55.2%	43.2%	38.5%	$Chi^2_{df=3} = 13.38$, $p = .037$, V = .24
Intention	4.15 (1.34)	3.78[a] (1.37)	4.32[a] (1.01)	4.48[a] (1.36)	3.38[a] (1.39)	$F_{df=3,129} = 3.39$, $p = .021$, $\eta^2 = .09$
Self-efficacy	4.22 (1.28)	3.74[a] (1.40)	4.36[a] (1.10)	4.54[a] (1.24)	3.77[a] (1.24)	$F_{df=3,129} = 3.04$, $p = .032$, $\eta^2 = .08$
Health and fitness	5.67 (0.93)	5.28 (0.89)[a]	5.89 (0.70)[b]	5.97 (0.86)[b]	4.96 (1.10)[a]	$F_{df=3,129} = 7.41$, $p < .001$, $\eta^2 = .17$
Stress relief	4.57 (1.54)	3.82 (1.52)[a]	5.07 (1.35)[b]	5.16 (1.34)[b]	3.10 (0.90)[a]	$F_{df=3,129} = 12.62$, $p < .001$, $\eta^2 = .25$
Body shape	4.96 (1.50)	4.85 (1.51)[a]	5.39 (1.27)[a]	5.24 (1.36)[a]	3.39 (1.43)[b]	$F_{df=3,129} = 7.60$, $p < .001$, $\eta^2 = .17$
Performance	2.44 (1.15)	2.24 (0.93)[a]	2.80 (1.41)[a]	2.50 (1.15)[a]	1.89 (0.66)[a]	$F_{df=3,129} = 2.39$, $p = .073$, $\eta^2 = .06$
Sociability	3.93 (1.79)	4.15 (1.45)[a]	3.81 (1.76)[a]	4.02 (1.60)[a]	3.43 (1.79)[a]	$F_{df=3,129} = 0.70$, $p = .555$, $\eta^2 = .02$
Nature	5.23 (1.45)	4.93 (1.47)[a]	5.54 (1.37)[a]	5.33 (1.43)[a]	4.93 (1.64)[a]	$F_{df=3,129} = 1.08$, $p = .362$, $\eta^2 = .03$

Note. Columns total and Clusters 1 to 4: Indication of percentage for categorical data, means, and standard deviation for metric data. Last column: Indication of the test statistic for chi-square tests (categorical data) and one-way analysis of variance (metric data). Clusters being significantly different from other clusters are denoted with different superscripts (e.g., a cluster with superscript a is significantly different from a cluster with superscript b). Clusters with the same superscripts show no significant differences. Categorical data: Superscript $^+$ indicates a significantly higher proportion than expected based on standardized residuals.

Characterization of Clusters

Each of the four clusters represents homogeneous subgroups based on distinct intra-individually relevant barriers (Table 3 and—for a better illustration of the cluster structure—Figure 1). The number of each cluster's participants ranges from 18 to 51, representing a cluster size of at least 13.5% of the overall sample. Further specification of each cluster occurs according to descriptive and inferential statistics in Table 2 (columns *Cluster 1 to Cluster 4*).

Cluster 1 (23.3%; n = 31): Men With Physical Constraints (Physical Constraints). Predominant barriers for this cluster are health-related constraints and a lack of individual capacities. In contrast, lack of time due to private and professional commitments has no impact. Compared to Clusters 2 and 3, participants in this cluster are significantly older, and the proportion of retired men is significantly higher. Health and fitness are significantly lower expected benefits of PA compared to Clusters 2 and 3. Finally, although the post hoc test did not detect significant between-group differences, the intention to engage in PA and the level of self-efficacy in this cluster are lower than in Clusters 2 and 3.

Cluster 2 (24.8%; n = 33): Men Struggling With Their Weaker Self (One's Weaker Self). Participants in this cluster mainly report a lack of self-motivation and—less critical—professional commitments as reasons for fluctuating PA behavior. On the contrary, private obligations and a lack of individual capacities are perceived as less relevant. Compared to Clusters 1 and 4, participants in this cluster are significantly younger, and the proportion of retired men is lower (not significant). Health and fitness and stress relief are significantly higher reported expected benefits of PA than in Clusters 1 and 4. Although the post hoc test did not detect significant between-group differences, the intention to engage in PA and the level of self-efficacy in this cluster are higher than in Clusters 1 and 4.

Cluster 3 (38.4%; n = 51): Busy Men (Busy Men). That cluster comprises men who perceive private and professional commitments as the main reasons for showing

Table 3. Final Cluster Solution After Optimization Process (Quick Cluster)

	Cluster 1 (n = 31) Physical constraints			Cluster 2 (n = 33) One's weaker self			Cluster 3 (n = 51) Busy men			Cluster 4 (n = 18) Unattractive sports offers			Overall (n = 133)
Barriers	$\bar{x}$	F	t	$\bar{x}$	F	t	$\bar{x}$	F	T	$\bar{x}$	F	t	$\bar{x}$
Private commitments	−.50	.87	−.67	−.25	.51	−.40	.81	.70	.72	−.11	.35	−.26	.13
Lack of self-motivation	.42	.74	−.13	1.32	.41	1.09	.03	.31	−.65	.62	1.20	.15	.51
Professional commitments	−.70	.20	−.92	.50	.55	.21	1.08	.52	.76	−.94	.17	−1.15	.28
Health-related constraints	.89	.95	1.24	−.36	.58	−.19	−.62	.32	−.49	−.53	.32	−.39	−.19
Lack of appropriate sports activities	−.45	.49	−.11	−.60	.47	−.30	−.65	.31	−.37	1.18	.58	2.04	−.37
Lack of individual capacities	.34	1.41	1.02	−.61	.32	−.38	−.66	.40	−.44	−.18	.77	.25	−.36

Note. Means, F-values, and t-statistic of intraindividual relevant barriers for each cluster; means of intra-individually relevant barriers of the overall sample.

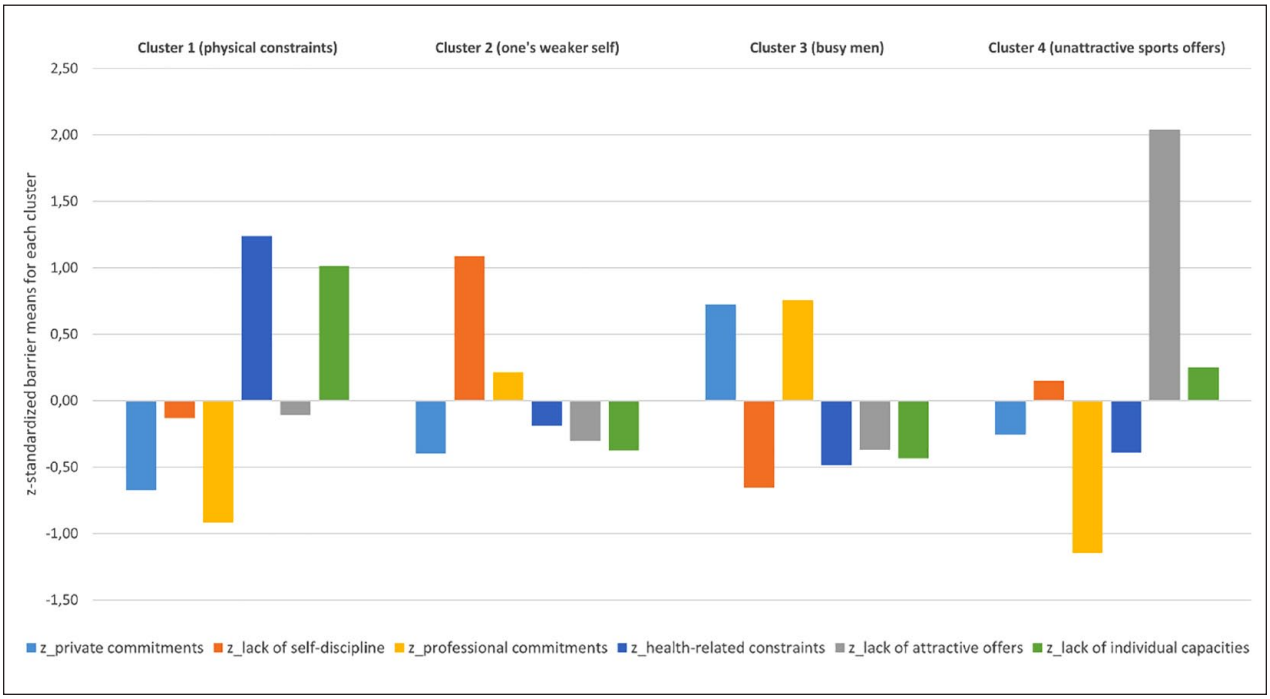

Figure 1. Perceived Barriers Profiles of Clusters 1 to 4
Note. Profiles are based on *t* statistics (high values indicate high relevance for the corresponding cluster in relation to the overall sample and vice versa).

fluctuating PA behavior. All other barriers, especially lack of self-motivation, are not relevant to them. As in Cluster 2, participants in Cluster 3 are significantly younger, the proportion of retired men is lower (not significant), and health and fitness and stress relief are significantly higher reported expected benefits of PA than in Clusters 1 and 4. The intention to engage in PA and the self-efficacy level are higher than the other clusters, although the post hoc test did not detect significant between-group differences.

Cluster 4 (13.5%; n = 18): Men Not Attracted by Existing Sports Offers (Unattractive Sports Offers). The predominant barrier for this cluster is the perceived lack of appropriate sports courses. Lack of individual capacities and self-motivation play a marginal role, whereas lack of time

due to professional commitments is irrelevant for the respective men. Participants of this cluster are significantly older compared to Clusters 2 and 3, and the proportion of retired men equals 100%. They further report the lowest value of health and fitness as expected benefits of PA. Although the post hoc test did not detect significant between-group differences, the intention to engage in PA and the level of self-efficacy in this cluster are lower than in Clusters 2 and 3.

Discussion

The purpose of this study was threefold: (1) to identify homogeneous subgroups of male fluctuators with the same predominant PA barriers, (2) to describe the main characteristics of the men belonging to the respective clusters, and, finally, (3) to derive recommendations on how to align and promote HEPA measures according to the individual needs of the target group. Using a person-centered approach, we clustered a sample of men 50 plus who classified themselves as fluctuators, according to their intra-individual weighted relevant barriers that hinder engagement in PA. The analysis revealed four different clusters:

Cluster 1 (*Men with physical constraints*) is characterized by older men 50 plus (mean age: 68.85), who are mainly retired (76.7%), and consider their physical and conditional abilities for any PA as too low. Despite existing physical complaints, they value health and fitness as less relevant reasons for engagement in PA. Members of Cluster 2 (*Men struggling with their weaker self*) mainly indicate a lack of self-motivation. Even though they have sufficient time resources and intend to engage in PA, they often do not overcome their weaker self and stay inactive. Men in this cluster are younger (mean age: 59.24), and most are still working (81.8%). Also, men in Cluster 3 (*Busy men*) are younger (mean age: 59.05) and often still working (84.6%). They further indicate a high level of intention, feel very self-efficacious, and appreciate the stress-relieving effects of PA. However, in contrast to Cluster 2, they perceive their personal and professional obligations as the main reasons for their irregular PA behavior. Finally, for members of Cluster 4 (*Men not attracted by existing sports offers*), professional commitments have no impact due to a retirement quote of 100%. Given their relatively higher age (mean age: 69.46), they are worried about a potential lack of physical capacities to engage in PA. Nonetheless, the main reason for their fluctuating behavior is the absence of appropriate sports courses that reflect their specific interests and needs.

Overall, identifying different clusters within the behavior stage of fluctuation provides novel insights into this vital area of research. It also aligns with a similar study investigating homogeneous subgroups of people with fluctuating PA behavior: Duan et al. (2020) examined the psychosocial profiles of Chinese office employees and found two distinct clusters (uncommitted versus moderately committed). However, we cannot directly compare the results of both studies, as Duan et al. used different variables for the clustering process and conducted calculations based on a variable-centered approach (in contrast to the person-centered approach used in the current study). Nonetheless, the findings of both studies emphasize the added value of investigating existing subgroups of people at different stages of behavioral change to derive more specific recommendations for HEPA promotion.

Some of our specific findings are comparable with studies investigating barriers to PA in relation to age. Health-related constraints are mainly an issue for older people (Sørensen & Gill, 2008; Spiteri et al., 2019). In addition, retired men often struggle more with the lack of appropriate PA programs than younger men. They may feel that existing sports courses do not meet their needs and preferences due to a lack of gender sensitivity (Strobl, 2019) or their primary focus on younger and fitter people (Evans & Crust, 2015). In contrast, younger age groups usually score higher on priority barriers (being busy and having problems with time management; Moschny et al., 2011; Sørensen & Gill, 2008; Spiteri et al., 2019). More youthful men still occupied with their professional lives are often under time pressure by job and family commitments. Thus, they may benefit from adequate behavior regulation strategies to integrate PA into their daily lives.

There are also surprising findings concerning age. The older men in Clusters 1 (physical constraints) and 4 (unattractive sports offers) significantly score lower on health as an expected benefit of PA than the younger men in Clusters 2 (one's weaker self) and 3 (busy men). This finding contrasts with studies that identified maintaining good health as an important reason for being physically active among older men (Barnett et al., 2012; Sjörs et al., 2014). An explanation may be a lower level of health literacy of older men in comparison to their younger counterparts, which was identified in other studies (Ashida et al., 2011; Sponselee et al., 2021). Some older people may still believe that physical activity is unnecessary or potentially harmful (Franco et al., 2015). Accordingly, men in Clusters 1 and 4 might question the benefit of HEPA. Instead, they may put emphasis on activities they perceive as purposeful or productive, such as carpentry, gardening, or housework (Barnett et al., 2012).

In sum, dissimilarities between Clusters 1 (physical constraints) and 4 (unattractive sports offers) in comparison to Clusters 2 (one's weaker self) and 3 (busy men) often relate to age-specific differences. However, our study results demonstrate a greater level of heterogeneity of the sampled male fluctuators that goes beyond age

differences and that, to our knowledge, has not been detected so far. We can distinguish between older men primarily burdened by physical complaints and those not attracted by existing sports offers. Younger men are distinct in perceiving time pressure or a lack of self-motivation as the main barriers to increased PA. Considering those differences could contribute to tailoring HEPA promotion measures according to the individual needs of the target group. This approach recognizes that "one-size-fits-all" behavior change interventions are at best only partially effective in specific subgroups (Hagger, 2010). In contrast, aligning measures to a predefined target group will likely lead to increased participation and adherence rates and consequently to improved effectiveness of the implemented strategies (Hawkins et al., 2008).

Recommendations for HEPA Promotion for Male Fluctuators 50 Plus

Based on our study results, we derived some suggestions to consider the diverging needs of male fluctuators 50 plus to improve their participation in and adherence to HEPA promotion measures.

Providing ways of being physically active despite existing health constraints may be essential to facilitate regular PA in men of Cluster 1 (physical constraints). Therefore, we recommend better communicating the variety of exercises that take into account existing health problems, such as back or knee pain, and offering a corresponding PA program, potentially using medical assistance, to reduce current health- or capacity-related concerns (Spiteri et al., 2019). Emphasizing the evident benefits of those exercises for staying physically active and independent may help convince potential participants of the likely and valuable outcomes of the program.

For men in Cluster 2 (one's weaker self), the systematic dissemination of behavioral change techniques (BCTs; Michie et al., 2013) is a promising approach to foster regular PA. BCTs represent essential components of interventions that effectively change health-related behaviors. According to Brand and Ekkekakis (2018), they can influence conscious reflection (e.g., deliberately planning when, where, and how to perform the intended behavior) and unconscious affective processes (e.g., redirecting current negative emotions by listening to one's favorite music). Those techniques contribute to overcoming situational constraints that hinder PA engagement, such as bad weather or feeling tired after an exhausting workday (Brand & Antoniewicz, 2016; Göhner et al., 2009; Schwarzer, 2008). Nudges may be a worthwhile additional strategy to support men belonging to Cluster 2 in altering decisions in favor of more healthy behaviors. Nudges are slight changes in people's environment (e.g., signs encouraging pedestrians to use stairs) with the idea of influencing individual decision-making processes at points of choice (such as taking the stairs or the escalator at an underground station). Although there is preliminary evidence on the effectiveness of nudges in increasing PA, more research is needed to determine when and how to use this strategy for PA promotion in men 50 plus (Forberger et al., 2019).

The characteristics underlying Cluster 3 (busy men) could lead to HEPA promotion measures corresponding to a lifestyle determined by private and professional commitments. Consequently, there is a need for less time-consuming interventions, which are feasible in settings where men live and work. For instance, interventions aiming to interrupt sitting time for office workers may be easy to implement and could result in increased PA and stress-relieving effects (Nooijen et al., 2019). Those interventions may also benefit from using BCTs like regular prompts and reminders, supported via technical assistance to maximize effectiveness in PA promotion (Fry & Neff, 2009). Another approach would be implementing a more complex HEPA promotion program, emphasizing the vital role that fathers, respectively, grandfathers, play in children's social, academic, cognitive, and behavioral development (Lundahl et al., 2008). Highlighting the added value of spending quality time with the family and being a healthy role model may help increase the PA of the participants of this cluster (Morgan et al., 2014).

Finally, men of Cluster 4 (unattractive sports offers) may benefit significantly from gender-sensitized PA programs (for an overview, see Strobl, 2019). Enabling groups of like-minded men (e.g., similar age and physical constitution) in settings where they feel a strong sense of affiliation (e.g., football stadium) may raise awareness of and interest in PA in that population group. Such offers should use prescriptive and straightforward messages, avoiding words with direct health or feminine connotations such as "slimming" and "relaxation.." This strategy may help reduce the threats that traditional healthcare approaches pose to men's masculine capital and, subsequently, may facilitate the participation of men 50 plus in corresponding PA programs (Lee et al., 2008; Strobl, 2019).

Limitations

Cluster analysis is an explorative procedure dependent on the investigators' criteria for selecting relevant cluster variables and determining the final cluster number. Accordingly, this approach might generate slightly different results in different data sets (Backhaus et al., 2018). Therefore, in the context of our study, we tried to illustrate the selection process as transparently as possible by providing several formal criteria such as between-subject

heterogeneity and discriminatory informational content for the chosen barrier items. We determined the final cluster number based on the visual inspection of the dendrogram along with a formal stopping rule. As a result, we received an economic number of clusters regarding their content-related interpretability with a very satisfying within-cluster homogeneity. Hence, we could derive HEPA promotion measures that are likely feasible in HEPA providers' daily practice due to the limited number of clusters to be addressed.

Because of self-reported questionnaires, the fluctuation identification was highly subjective and retrospective, potentially resulting in recall bias. The cross-sectional nature of the data can only offer a snapshot of fluctuators' PA behavior and the psychosocial profile behind it. Consequently, we tried to increase the validity of our findings by a clear conceptualization of the fluctuation stage in line with an existing review (Shang et al., 2018) and by using well-validated questionnaires. However, objective fluctuation identification and prospective designs tracking the natural changes in fluctuators' PA behavior and their changes in psychosocial variables should be prioritized in future research (Duan et al., 2020).

Our sample size ($n = 133$) may seem considerably low, consisting of men who assign themselves as fluctuators. Nonetheless, it corresponds to 13.1% of the total sample ($n = 1{,}013$). It is thus in line with the majority of current findings suggesting that 13% to 30% of the adult population show fluctuating PA behavior (Shang et al., 2018). In terms of statistical requirements, the sample exceeds the recommended minimum of 10 times the number of clustering variables (i.e., six variables in the present study; Dolnicar et al., 2016; Mooi et al., 2018). However, based on a convenient sample, the extent to which our results can be generalized may be limited.

Conclusion

Men 50 plus represent a hard-to-reach target group for HEPA. As "one-size-fits-all" behavioral change interventions are at best only partially effective in specific subgroups, it is essential to tailor HEPA promotion measures according to the individual needs of the target group. The results of this study demonstrate four different homogeneous subgroups of male fluctuators 50 plus in terms of their perceived barriers and allow the identification of potential strategies to facilitate regular PA behavior in this population group. Therefore, our findings present significant novel insights into this vital area of study, which help develop person-centered HEPA promotion interventions in men 50 plus. The results of this research could help HEPA providers to pre-define for whom they want to implement corresponding measures and tailor their actions to the needs of the specific target group. Further research is required to determine the effectiveness of this approach in improving adherence to HEPA guidelines and corresponding health-enhancing effects for men 50 plus.

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ORCID iD

Helmut Strobl https://orcid.org/0000-0003-2459-1477

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