INTERVENTION OF A PHYSICAL MOVEMENT PROGRAM "BODY MANAGEMENT IN SAFE RANGES" ENHANCES SELF-MANAGEMENT IN AGING

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Abstract

Active aging is a broad concept in the sociology of aging. It emphasizes the links between health and activity and aging healthily (WHO, 2001a). As a strategy, active aging is to maximize everyone's potential to improve their individual quality of life. Self-management is a concept to which the idea of active aging is applied. This theory is used in many intervention. Self-management in aging relates to people's involvement in initiating progressive actions that will prepare them for aging. The Body Management in Safe Ranges (BMSR) program is a self-management program for aging. BMSR uses functional task (FT) movement as a means for managing aging, strengthens participants' self-efficacy, supports cognitive-motor strategies and movement in safe ranges. We use quasi experiment 2x2x2 design: intervention (experiment – control) X time (before-after) X group (community-retirement residence). For collecting data were used self-management questionnaire (SMAS-30), general self-efficacy questionnaire, BMSR questionnaire (BMSR-21) created for the current study. A significant improvement was found in the intervention group compared to the control group. No difference was found between social networks. Significant improvements were seen in program participants' reports about their physical abilities and condition, as well as their perceptions of the program, self-efficacy and additional factors encouraging them to improve their day-to-day functional abilities. The higher the final BMSR score given, the better their self-management abilities and self-efficacy. It was found that positive change to managing their bodies in safe ranges correlated to positive changes in self-management and self-efficacy ranges. BMSR is an independent factor that does not depend on social networks and environment or on participants' starting condition (age, amount of physical exercise, pain levels), can be carried out in varied framework, physical conditions, and abilities for which further research is needed. Changes seen in self-management and self-efficacy measurements in the intervention groups indicate that the BMSR program can serve as a self-management program in old age using movement as a means.

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Keywords: self-management, self-efficacy, aging-management, successful aging, active aging, body management.

Introduction

The Body Management in Safe Ranges (BMSR) program consists of functional lessons focused on elements from day-to-day life making up fitness components for the third age population subject to World Health Organization recommendations (WHO, 2012; 2020).

The first objective of the presented study was to examine the effect of the BMSR method on a self-management program in an aging population. It examines the extent to which the BMSR intervention program improves self-efficacy, ability to self-manage and functioning of elderly people in two different social networks: subjects living in the community versus those living in a retirement residence framework. Elderly people in the community are characterized by independent lives and informal social networks based on family ties, friends, and heterogeneity. In contrast, retirement residences life is based on social encounters among a population characterized by a similar profile, and a formal network created by institution staff. .Thus, an additional objective of the study was to explore whether any differences would be found between the two social networks regarding the effect of the BMSR program on self-management in old age.

The research hypothesis was that the effect of BMSR on self-management dimensions would be greater among participants from the community than those living in retirement residences (Auge, 1995). This assumption was based on the fact that in a retirement residence social interactions are mostly formed by those who are responsible for the care of residents, and therefore these people are less involved in managing their life circumstances (Litwin, 2003).

Literature review

Life expectancy in recent decades has increased rapidly, and hence a care management strategy for aging populations is necessary. Indeed, the field of interdisciplinary gerontology is constantly developing, allowing new multi-systemic methods and approaches to be implanted into care management of aged populations.

Active aging is a broad concept, consisting of many layers, starting at the personal up to national and worldwide levels of people's lives. The concept emphasizes the involvement of older people in social, economic and cultural activities, as well as physical activity and maintaining daily functioning (Walker,

2006). Self-management is one of the theories of intervention through which the idea of active aging is applied

The basic principle of self-management theory is individuals' aging drives and awakens motivation to best meet their physical and social needs (Pachana & Laidlaw, 2014). Lorig and Holman (2003) developed a theory by which processing factors and criteria of active aging, a range of intervention programs could be established (Pachana & Laidlaw, 2014). They proposed that the term self-management determines that people are responsible for the day-to-day management of their activities and circumstances of their lives (Lorig & Holman, 2003).

Self-management focuses on three series of tasks defined by Corbin and Strauss (1988): medical management, task management and emotional management (Corbin & Strauss, 1988). According to D'Zurilla and Nezu's (1999) model, these tasks consist of a set of five core competencies: setting goals, decision making, exploiting resources, establishing a partnership between subjects and caregivers and taking action (Lorig & Holman, 2003).

Setting goals in self-management means, defining problems, exploring various solutions including consulting with health personnel and friends, learning relevant skills, implementing solutions and assessing possible results (D'Zurilla & Nezu, 1999). Making decisions points tp the ability to solve problems. Exploiting resources means the ability to find and use resources that help to improve the individual self-management. The role of health professionals is to establish partnerships with elderly people and act as their professional supervisors. On the other hand, elderly people must be capable of accurately reporting and discussing their needs with professionals' therapists. The last competence is taking action, which is the result of fulfilling the previous four components

Mastering the above competences is the cornerstone of the self-efficacy model. According to this model, self-efficacy refers to peoples' belief in their ability to manage the challenges they, face as well as organizing and carrying out actions needed to reach a given goal. Thus, it was hypothesized by Bandura that self-efficacy influences individuals' choice of activity, effort and perseverance (Bandura, 1977, 1986).

This hypothesis give rise to another, that those with high self-efficacy perceptions, will work harder and persevere for longer when facing difficulties than those who doubt their abilities (Schunk, 1991). Lorig, Gonzalez and Ritter (1999) showed that improving self-efficacy was one of the mechanisms responsible for improved states of health among people who participated in self-management programs (Lorig, Gonzalez & Ritter, 1999).

Improving self-efficacy must play a key role in any intervention program designed to promote self-management. Therefore, intervention program instructions must include the four components contributing to self- efficacy improvement: controlling performances, modelling, interpreting symptoms and social persuasion. Mastering these competences is actually taking action i.e. people getting actively

involved in behavioral changes. Controlling performance as well as modelling can be achieved through drawings, pictures or videos that have been adjusted to the population concerned. Reinterpreting physiological symptoms, for example, refers to helping individuals find explanations for their symptoms and their causes, motivating them to try new behaviors of self-management to ameliorate symptoms' intensity. Finally, social persuasion is a powerful tool to improve self-efficacy. If people around participate in an activity, it is reasonable to assume others will follow them (Lorig & Holman, 2003). An example of these principles is learning how to start and improve a physical exercise program. Lorig and Holman (2003) pointed out that when an intervention program is personally adapted, participants must learn the principles to make specific behavioral changes as well as acquire decision making and problem-solving competences. All these are part of self-management programs leading to successful self-adjustment (Lorig & Holman, 2003).

Many studies have been published demonstrating the effect of self-management based interventions on well-being. In a randomized controlled trial, consisting of single women, aged 55 years' of age and above, it was found that an intervention based on the self-management significantly improved self-management ability, well-being, social and emotional loneliness in the intervention group immediately after the intervention (Kremers *et al.*, 2006). Goedendorp and Steverink (2017) pooled data from three randomized controlled trials, which included 445 single older females, and found that that older adults who face some or more physical, psychological, and/or social issues can benefit from interventions based on self-management (Goedendorp, & Steverink, 2017).

Healthy aging depends on physical health aspects of aging as well as social and psychological aspects of life. Thus, in the self-management of well-being, individuals who have better overall self-management abilities will also achieve, maintain or restore physical and psychosocial well-being. BMSR is a physical movement program for self-management in aging. The method which has been developed by the primary author over the last decade, is based on cognitive-motor strategies (Schure, Christopher, & Christopher, 2008). The program focuses primarily on elderly adults' physical aspects also affecting their mental and emotional aspects in light of functional decline (Parisi, Roberts, Szanton, Hodgson, & Gitlin, 2019).

The aim of the BMSR method is to improve and strengthen participants' self-efficacy through conscious movement exercise in safe ranges. This method provides a functional toolbox for optimal functioning in day-to-day life. Physical exercises used in the BMSR program are focused on participants' current physical state and aim to consciously improve their physical abilities without pain, while recognizing the body's limitations. BMSR recruits elderly adults to undertake intensive treatment of their condition and provides tools for them to organize their body in space. As a result of their participation in the BMSR program, improved

body control and ability to correct restrictive physical patterns that reduce pain and enable improvements in functioning, mobility, and independence, are achieved. All of these actually produce participants' active involvement in changing their life circumstances. Most self-management programs deal with the treatment of illness and are connected in some way with the process of living in the shadow of illness (Lorig & Holman, 2003). However, BMSR is intended for practice to prevent illness.

Hence, the BMSR program can be a tool to improve self-management ability of the physical aspects of aging. It can be integrate into health promotions arrangements as one of many programs for home treatment. Program rationale: BMSR is a way of getting the elderly population to manage their bodies through conscious movement exercises in safe ranges. This is achieved by teaching participants to become familiar with body systems that serve movement and stabilize the skeleton and joints, as well as becoming aware of their bodies' limitations and abilities that have changed with age. By so doing, the BMSR program leads to improving participants' circumstances, strengthening their self-efficacy, thereby promoting their self-management.

Self-management components are expressed in the BMSR program as follows: (1) *Setting goals - personal meetings* between an instructor and individual participants were conducted at the beginning of the program. Goals and targets were defined based on each participant's physical condition and execution strategies were chosen; (2) *Decision making* - participants were trained to make decisions according to their daily functioning. They learned to recognize their bodies' limitations on training days and act accordingly; (3) *Exploiting resources* - Participants learned to identify their abilities and organize information received from a number of medical personnel until they acquired a new, clear and accurate picture of their physical condition; (4) *Establish relationships* between participants and health professional caregivers. Professionals in the framework of the BMSR program can be teachers as well as professional supervisors. Instructors teaching the BMSR program should be qualified in the field of physical exercise for the third age and trained in the field of typical injuries and illnesses at that age. Hence, they accompany participants in decisions linked to managing their physical condition as well as referring them to medical advice from specialists if a need arises; (5) The BMSR program is conducted in small groups to create connections between the instructor and trainees, as well as among trainees themselves. These new networks are likely to alleviate the sense of loneliness that is often reported in aging (Holmen & Furukawa, 2002); (6) *Taking action* - the desire to change one's physical condition or physical behavior occurs generally when individuals are dissatisfied with their current condition., The more patients are in pain, the greater their desire to change their condition (Lorig & Halsted, 2003). This leads them to participate in the BMSR program to achieve improvement and enhance their self-efficacy.

The BMSR program is focused on the four main components of an intervention program designed to promote self- management: social persuasion, interpreting symptoms, performance control and modelling. Groups play a vital role in social persuasion. Groups provide participants with an encouraging social environment that increases motivation and challenges them to persevere and improve (Halperin *et al.*, 2014). Interpretation of symptoms occurs when participants get to know and identify their own safe movement ranges through exercises. Performance mastery becomes possible by repeated physical exercise. Exercise improves muscle power and support for body joints. Modelling is achieved when instructors carry out exercises together with trainees as well as when veteran participants accompany new participants thereby constituting a model. To the best of our knowledge, no self-management programs in aging have been developed to address health promotion in aging.

Methodology

The research has a 2x2x2 design: intervention (experiment – control) X time (before-after) X group (community-retirement residence).

Research aim

To examine the correlation between the extent of changes in body management in safe ranges and changes occurring in old people's self-management ability and their perception of self-efficacy. Three hypotheses were formulated: 1. There will be an improvement in the extent of body management in safe ranges as a result of the intervention, which will be greater among old people living in the community than those in retirement residences. 2. There will be an improvement in elderly adults' self-management ability and perception of self-efficacy as a result of the intervention, which will be greater in elderly adults living in the community than those in retirement residences. 3. The greater the improvement in body management in safe ranges, the greater the improvement in elderly adults' self-management ability and perceptions of self-efficacy.

Participants

149 elderly participated in this study, 123 women (82.6%) and 26 men (17.4%), between the ages of 65 and 97 ($M = 77.09$, $SD = 7.71$). Eighty-two (55.0%) participants took part in 21 sessions of the BMSR intervention (46 in the community, and 36 in an retirement residence), and 67 (45.0%) participants served as a control group (34 in the community, and 33 in a retirement residence). There were two community centers and one retirement residence, all made up of a similar population, with an average to above-average socio-economic status. All

participants were Hebrew speakers, showing physical phenomena characteristic of their age range, including: arthritis, joint wear, heart disease and diabetes. All were independent and not defined as suffering with dementia.

Participants were 77 years old on average, with no group (intervention-control) difference ($F(1, 145) = 2.78$, $p = .098$, $\eta^2 = .019$) (table 1). Participants in the retirement residence were significantly older than those in the community ($M = 82.75$ $SD = 4.36$ vs. $M = 71.72$ $SD = 5.16$, $F(1, 145) = 187.43$, $p < .001$, $\eta^2 = .569$). Most were women, with no group ($Z = 0.30$, $p = .764$) or social setting ($Z = 0.41$, $p = .678$) difference.

Close to half of the participants were widowed, and about half were married or in a relationship. A few were divorced or separated. Comparing the rate of married participants with widowed/ divorced/ separated, no group differences were found ($Z = 0.90$, $p = .369$), yet a higher percentage of participants in the community were married than in retirement residence ($N = 60$ 75.0% vs. $N = 14$ 20.3%, $Z = 6.66$, $p < .001$).

Over half of the participants reported an above average economic status, with about a quarter reporting average economic status, and about a fifth reporting below average economic status. No group ($\chi^2(2) = 0.48$, $p = .788$) or social setting ($\chi^2(2) = 5.82$, $p = .055$) differences were found.

Table 1. Background characteristics of participants, by group and social setting (N = 149)

Total N (%)			Intervention (n = 82)		Control (n = 67)	
		Community (n = 46) N (%)	Retirement residence (n = 36) N (%)	Community (n = 34) N (%)	Retirement residence (n = 33) N (%)	
Age (*M*, *SD*)	62-97	77.09 (7.71)	71.26 (4.27)	82.03 (4.00)	72.35 (6.17)	83.62 (4.68)
Gender	Female	123 (82.6)	38 (82.6)	29 (80.6)	29 (85.3)	27 (81.8)
	Male	26 (17.4)	8 (17.4)	7 (19.4)	5 (14.7)	6 (18.2)
Marital status	Widow	68 (45.6)	12 (26.1)	28 (77.8)	5 (14.7)	23 (69.7)
	Married	74 (49.7)	33 (71.7)	5 (13.9)	27 (79.4)	9 (27.3)
	Divorced, separated	7 (4.7)	1 (2.2)	3 (8.3)	2 (5.9)	1 (3.0)

Economic status	Below average	27 (18.2)	11 (23.9)	5 (13.9)	7 (20.6)	4 (12.5)
	Average	41 (27.7)	17 (37.0)	4 (11.1)	9 (26.5)	11 (34.4)
	Above average	80 (54.1)	18 (39.1)	27 (75.0)	18 (52.9)	17 (53.1)

Program contents

Over six months, in accordance with previous studies (Resnick, 2007), each intervention group had 21 50-minute weekly sessions of a structured program based on functional exercise and including components of self-management and self-efficacy.

Tools and variables

- Self-management questionnaire (SMAS-30) -a self-reporting questionnaire testing self-management ability, which was originally written by Schuurman *et al.* (Schuurmans *et al.*, 2005). The questionnaire contains 30 items, ordered in six sub-scales, and rated on a 6-point Likert scale. Acceptable to high internal consistencies were found in pre- and post-program tests. These were: Taking Initiatives- $\alpha = .60$ and $\alpha = .88$, Investment Behavior- $\alpha = .75$ and $\alpha = .89$, Variety- $\alpha = .73$ and $\alpha = .87$, Multifunctionality- $\alpha = .82$ and $\alpha = .85$, Self-efficacy- $\alpha = .86$ and $\alpha = .92$, Positive Frame of Mind- $\alpha = .82$ and $\alpha = .76$, and the total score- $\alpha = .93$ and $\alpha = .95$ (pre-test and post-test, respectively). According to these scales, higher scores represent greater self-management ability.
- General self-efficacy questionnaire (Chen & Gully, 1997) translated by Grant-Flumin (1998) is a self-reporting questionnaire containing eight questions with three possible answers: (1) not at all; (2) moderately; (3) greatly. The questionnaire was completed at the start and end of the study. High internal consistencies were found both at pre-test: Cronbach $\alpha = .93$, and post-test: Cronbach $\alpha = .94$. According to these scales, higher scores represent higher self-efficacy.
- Body Management in Safe Ranges (BMSR) questionnaire (BMSR-21) is a self-reporting questionnaire designed to measure the ability of BMSR to improve self-management and functioning conditions. The questionnaire was assembled for the purpose of the current study to test whether any changes had occurred during the intervention and the effect of the program's various aspects on participants' performance The questionnaire has four sections.
1) A question concerning the extent of physical activity per week, from none to at least six hours a week, rated 1 to 5.

2) Fourteen items concerning individuals' physical status and perception of the BMSR program. A principal components factor analysis, with varimax rotation and Eigenvalue greater than 1, over time, yielded three factors: Factor 1: General physical feeling, seven items, Eigenvalue = 5.91, 42.23% of the variance, loadings = 0.49 to 0.81. Cronbach α = .89. Factor 2: Satisfaction with the program, four items, Eigenvalue = 1.63, 11.62% of the variance, loadings = 0.51 to 0.83. Cronbach α = .81. Factor 3: Sense of pain, three items, Eigenvalue = 1.26, 8.99% of the variance, loadings = 0.62 to 0.81. per measurement, that higher scores per measurement represent better general physical feeling, greater satisfaction with the program, and a lower sense of pain. The total score was composed as well, as the total Cronbach α = .88, with higher scores representing a better status.

3) Five items relating to the self-management aspect of the BMSR program. A principal components factor analysis, with varimax rotation and Eigenvalue greater than 1, over time, yielded one factor: Eigenvalue = 2.15, 42.92% of the variance. Cronbach α = .65. The factor was composed from items means, per measurement, with higher scores representing better perceived self-management skills. The total score for these self-management items was found to relate positively to the total score of the Self-Management Ability Scale (SMAS). Although the pre-test score of SMAS was unrelated to BMSR self-management in the 2nd session (r=.10, p=.419), it related positively to it in the 10th session (r=.32, p=.004). The post-test score of SMAS was positively related with BMSR self-management in both the 18th session (r=.49, p<.001), and the final session (r=.49, p<.001). These relationships lend some validity to the BMSR self-management items and score.

4) Eleven items depicting various components that encourage participants to persevere in the program. They were coded 0 (not encouraging participation), and 1 (encouraging participation). A principal components factor analysis, with varimax rotation and Eigenvalue greater than 1, over time, yielded three factors. Item 8 was excluded due to low communality (0.17) and low loadings on all factors <0.34. Factor 1: Improved general feeling, four items, Eigenvalue = 2.79, 27.88% of the variance, loadings = 0.58 to 0.77. Cronbach α = .72. Factor 2: Improved everyday competencies, four items, Eigenvalue = 1.57, 15.71% of the variance, loadings = 0.48 to 0.75. Cronbach α = .59. Factor 3: Social motivation, two items, Eigenvalue = 1.18, 11.76% of the variance, loadings = 0.79 to 0.81. r = .39, p < .001. The three factors were composed of items means, per measurement, so that higher scores represent greater importance attributed to components composing each factor.

Physical tests: Three physical tests were used at pre- and post-intervention stages: UST (Unipedal stance test) (Bohannon *et al.*, 1984). STS (Sit to stand test)

(Janssen, Bussmann & Stam, 2002), and TUG (timed up and go) (Zaion *et al.*, 2004). Inter-rater reliability for the three physical tests was examined with five participants and three judges, using ICC (Intraclass correlation coefficient). High values of inter-rater reliability were found. UST: ICC = 0.995, STS: ICC = 0.977, TUG: ICC = 0.990. Normative functioning was defined for each test according to its norms. UST: over 9.3 seconds. STS: below 19.4 seconds. TUG: normative-score 0-14, needs partial assistance- score 15-20, needs full assistance- score 21 and higher.

Demographic background: data about participants' physical condition and socio-economic status, as well as diagnosed limitations to participants' lower limbs was collected.

Procedure: Authorization was obtained from two community centers and a retirement residence, and explanatory meetings were conducted. Ethical authorization was obtained from the Research Ethics Committee of the Faculty of Philosophy and Social-Political Sciences at the Alexandru Ioan Cuza University of Iasi to conduct the research.

Community participants and retirement residence were offered the BMSR intervention as an additional physical activity class to those held there. Every participant in the intervention and control groups completed an informed consent form. Questionnaires were distributed to all participants before the intervention started and at its end, after 6 months. In addition, the BMSR questionnaire was distributed to the intervention groups at the start of the intervention, at the end of sessions 2, 10 and 18 and at the end of the intervention.
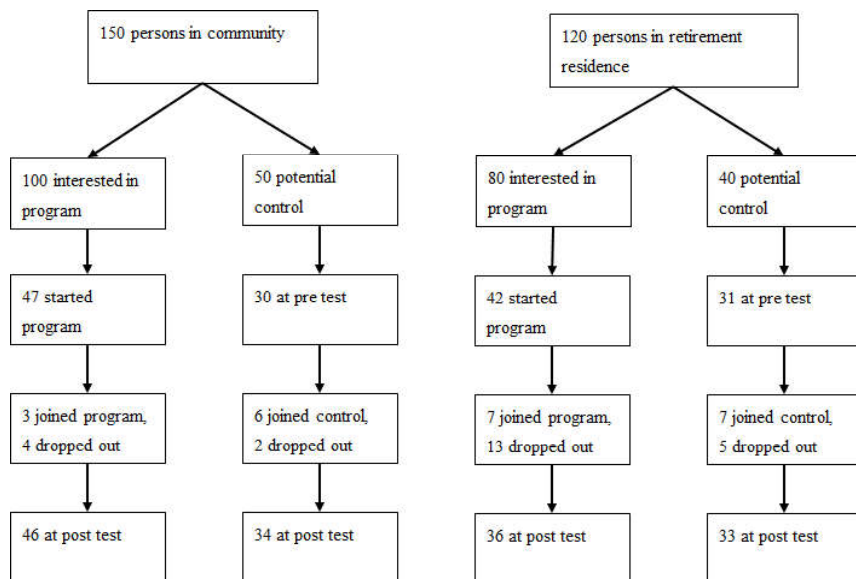

Figure 1. Consort flow chart

Data analysis

Data was analyzed using SPSS ver. 26. The first hypothesis was examined with two ways repeated measures analyses of variance, by time (pre/ post), group (intervention/ control) and social setting (community/ retirement residence) (2x2x2). Analyses included main effects for time, group, and social setting, all second order interactions and the third order interaction of time by group by social setting. Initial group differences, when significant, were controlled for. Significant interactions were interpreted with estimated marginal means. The second hypothesis was examined for the intervention groups, with repeated measures analyses of variance, by time (four measurements), and social setting (community/ retirement residence) (4x2). For the purpose of examining the third hypothesis, change scores in the study variables in the intervention groups, between the second and last session, were calculated with adjusted residual gains, defining each change score while controlling for the initial score. Multiple hierarchical regressions were calculated for change in self-management and self-efficacy, with social setting, number of sessions attended, and change in the BMSR dimensions.

Results

About half ($N = 72$, 48.3%) of the participants reported having a limitation in at least one joint of their limbs, with no significant group difference ($Z = 0.78$, $p = .434$). Most of them (57 of 72, 79.2%) reported that it had been diagnosed and had lasted over a year ($N = 63$, 87.5%). Results of the three physical tests revealed that most participants functioned normatively on the STS (Sit-to-Stand) test ($N = 135$, 90.6%). About a third of the participants functioned normatively on the TUG (Timed-up-and-go) test ($N = 52$, 34.9%), about half needed partial assistance ($N = 74$, 49.7%), and some needed full assistance ($N = 23$, 15.4%), with no group difference ($\chi^2(2) = 4.79$, $p = .091$). Close to half the participants functioned normatively on the UST (Unipedal Stance test) test (N = 65, 43.6%), however a significantly higher percentage of participants in the intervention group performed normatively, more than in the control group ($N = 46$ 56.1% vs. $N = 19$ 28.4%, $Z = 3.40$, $p < .001$).

The first hypothesis was about change in BMSR by social networks. Participants in the community attended an average of 14.59 sessions ($SD = 2.47$) of 21, while participants in the retirement residence attended an average of 16.44 sessions ($SD = 3.18$) ($t(80) = 2.97$, $p=.004$). Significant correlations were found between the number of attended sessions and final scores in the BMSR questionnaire, so that more consistent participation in the program correlated to better BMSR at the end ($r = .48$, $p < .001$ for the total score).

Change in BMSR was analyzed at four measurement points: aftersessions 2, 10, 18 and the final session. There was a total of 82 participants in the intervention

groups, yet some were missing at each measurement point. Sixty participants (73.2%) completed the BMSR questionnaire at all four measurement points, 33 (71.7%) in the community, and 27 (75.0%) in the retirement residence. Thus, the general repeated measures analysis of variance, that included the four time points by social network (design of 4x2) had 60 participants, yet the gradual change between each time point and the next was analyzed separately, per two time points in each analysis, to retain as large sample as possible.

Figure 2 presents the change in the extent of participants' reported physical activity, by time and social network. The total time difference was significant ($F(3,174) = 9.07$, $p < .001$, $\eta^2 = .135$), but the interaction of time by setting was not significant ($F(3,174) = 2.67$, $p = .082$, $\eta^2 = .045$). The final difference by social network, controlling for initial difference and number of sessions attended, was significant ($F(1,75) = 11.94$, $p < .001$, $\eta^2 = .168$). That is, a gradual increase was noted in the extent of physical activity in both social networks, and initial difference was retained.
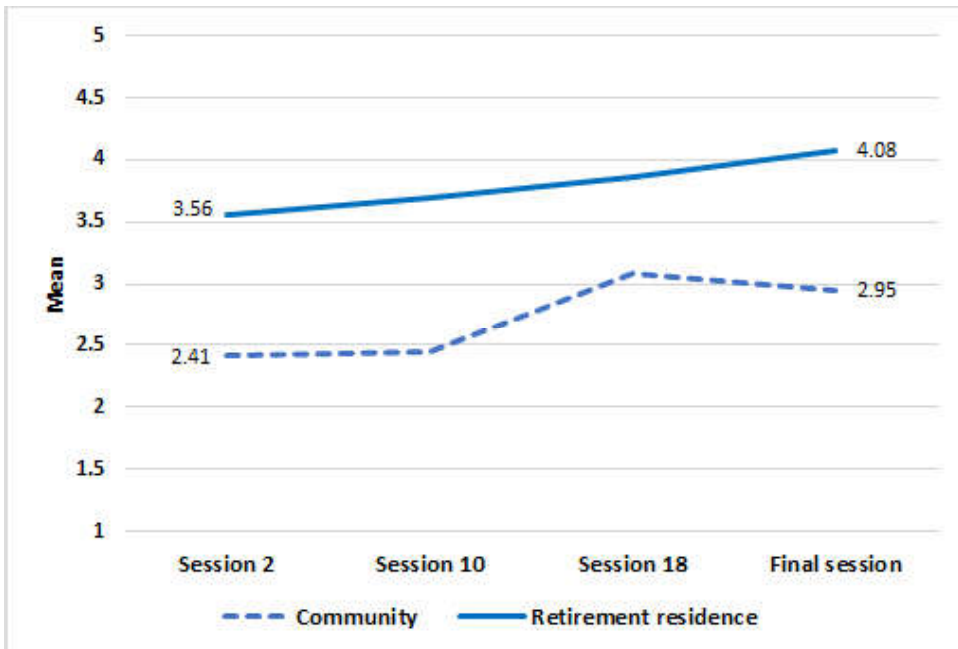

Figure 2. Change in the extent of participants' reported physical activity, by time and social network

Figure 3 presents the change in participants' physical status and exercise perceptions, by time and social network. The total time difference for the total score was significant ($F(3,174) = 23.54$, $p < .001$, $\eta^2 = .289$), and so were the time differences for general physical feeling ($F(3,174) = 25.81$, $p < .001$, $\eta^2 = .308$), and satisfaction with the program ($F(3,174) = 21.44$, $p < .001$, $\eta^2 = .270$). The

time difference for sense of pain was not significant, and so were all interactions with social networks.

That is, the total score, general physical feeling and satisfaction with the program all increased significantly in both social networks. When controlling for the number of sessions attended, the final total score and satisfaction with the program was higher in the community than in the retirement residence (total score: $F(1,75) = 9.16$, $p = .003$, $\eta^2 = .109$; satisfaction with the program: $F(1,75) = 16.44$, $p < .001$, $\eta^2 = .180$). Sense of pain, which was very low from the beginning, did not change significantly in both settings.
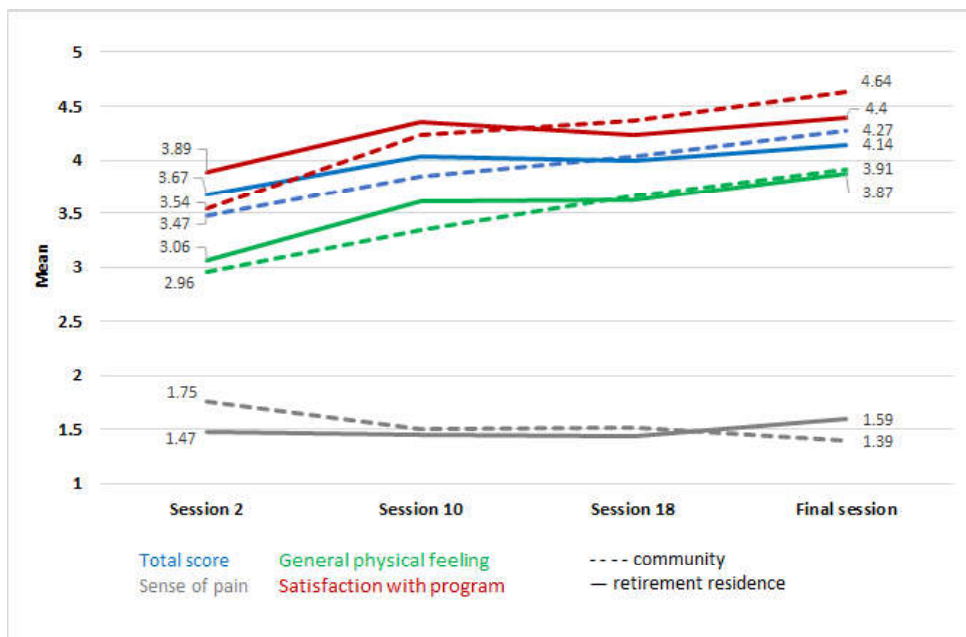

Figure 3. Change in perceptions of physical status and program, by time and social setting

Figure 4 presents the change in the self-management aspect of the program by time and social network. The total time difference was significant ($F(3,174) = 19.05$, $p < .001$, $\eta^2 = .247$), and the interaction of time by setting was not significant ($F(3,174) = 0.70$, $p = .482$, $\eta^2 = .012$). The final difference by social network, controlling for initial difference and number of sessions attended, was not significant ($F(1,75) = 2.38$, $p = .128$, $\eta^2 = .039$). That is, a gradual increase was noted in self-management in both social networks.
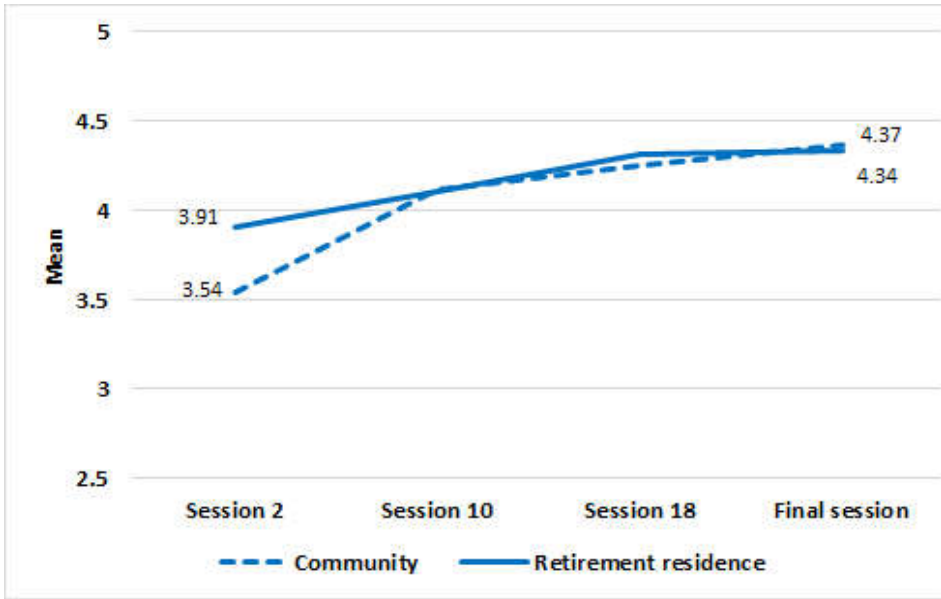
Figure 4. Change in self-management aspect of the program, by time and social network

Figure 5 presents the change in factors encouraging participation by time and social network. Different trends were found for the various types of factors encouraging participation. With regard to *improved everyday competencies* (i.e., balance, self-care, self-management), the total time difference was significant ($F(3,174) = 17.09$, $p < .001$, $\eta^2 = .228$), as was the interaction of time by setting ($F(3,174) = 2.74$, $p = .049$, $\eta^2 = .045$). The final difference by social network, controlling for number of sessions attended, was not significant ($F(1,75) = 3.28$, $p = .074$, $\eta^2 = .042$). That is, an increase was noted in both settings, with a slightly different pattern, yet a positive change was evident in both settings.

With regard to *improved general feeling* (i.e., personal strength, general feeling, motivation to improve), the total time difference was significant ($F(3,174) = 36.95$, $p < .001$, $\eta^2 = .389$), as was the interaction of time by setting ($F(3,174) = 13.84$, $p < .001$, $\eta^2 = .193$). The final difference by social network, controlling for number of sessions attended, was significant ($F(1,75) = 52.78$, $p < .001$, $\eta^2 = .413$). Different patterns characterized the retirement residence and community in this respect. In the retirement residence, no change was noted between sessions 2 and 10 ($p = .125$), while a marked increase characterized the change between sessions 10 and 18 ($p < .001$), and a marked decrease between session 18 and the final session ($p < .001$). In the community a marked increase was noted between sessions 2 and 10 ($p < .001$), stabilization between sessions 10 and 18 (p = .642) and some decrease between session 18 and the final session ($p = .029$). A final significant difference by setting was found, in favor of the community participants. That is,

in the end, improved general feeling was a more important encouraging factor in the community than it was in the retirement residence.

Social motivation (i.e., meeting friends) showed some change. The total time difference was significant ($F(3,174) = 3.52$, $p = .021$, $\eta^2 = .057$), as was the interaction of time by setting ($F(3,174) = 3.02$, $p = .038$, $\eta^2 = .049$). The final difference by social network, controlling for number of sessions attended, was significant ($F(1,75) = 5.64$, $p = .020$, $\eta^2 = .070$). Social motivation was stable in the retirement residence between sessions 2 and 10 ($p = .716$), and decreased significantly from then on to the final session (sessions 10 to 18: $p = .049$, and session 18 to the final session $p = .013$). It was rather stable in the community ($p = .877$, $p = .193$, and $p = .397$, between sessions 2, 10, 18, and the final session, respectively), until in the end it was higher in the community than in the retirement residence.
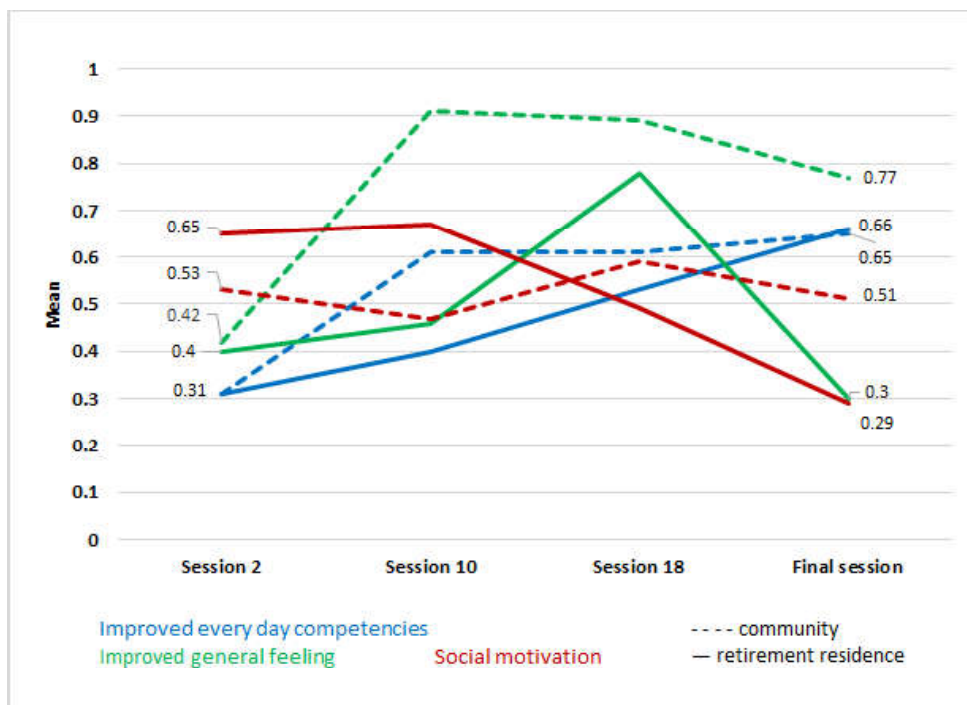

Figure 5. Change in factors encouraging participation, by time and social network

The first hypothesis was thus partially supported. Significant improvements were noted in the extent of the participants' reported physical activity, their perceptions of their physical status, their program perception, the self-management aspect of the program, and the motivating factor of improved everyday competencies. Change, however, was generally similar in both social networks. The other factors encouraging participation showed different trends by social network. Improved general feeling had generally increased in the community and did not change in

the retirement residence, while social motivation did not change in the community and decreased in the retirement residence.

The second hypothesis, regarding change in self-management and self-efficacy, was examined with two ways repeated measures analyses of variance (2x2x2). Table 2 presents means and standard deviations for self-management and self-efficacy, at pre- and post-program tests, by group and setting; and table 3 shows the results of the analyses of variance. All analyses included main effects for time, group, and social setting, all second order interactions, and the third order interaction of time by group by social setting. Significant interactions were interpreted with estimated marginal means.

Initial group differences were found for self-management- total score ($F(1, 145) = 7.29$, $p = .008$, $\eta^2 = .048$), self-management- investment behavior ($F(1, 145) = 9.37$, $p = .003$, $\eta^2 = .061$), and self-management- self efficacy ($F(1, 145) = 7.49$, $p = .007$, $\eta^2 = .049$), and were controlled for. No gender differences were found ($p = .171$ to $p = .753$).

Table 2. Levels of self-management ability and self efficacy, by time, group and social network (N = 149)

	Intervention (n = 82)				Control (n = 67)			
	Community (n = 46)		Retirement residence (n = 36)		Community (n = 34)		Retirement residence (n = 33)	
	Pre M (SD)	Post M (SD)	Pre M (SD)	Post M (SD)	Pre M (SD)	Post M (SD)	Pre M (SD)	Post M (SD)
Self-management:								
Total score (1-6)	4.11 (0.58)	4.58 (0.47)	4.13 (0.49)	4.99 (0.31)	3.73 (0.79)	3.58 (0.51)	3.92 (0.77)	3.21 (0.48)
Taking initiatives	3.79 (0.55)	4.57 (0.63)	4.04 (0.44)	4.96 (0.47)	3.56 (0.76)	3.67 (0.54)	3.91 (0.76)	2.98 (0.58)
Investment behavior	4.15 (0.72)	4.43 (0.64)	4.20 (0.62)	5.22 (0.43)	3.72 (0.84)	3.41 (0.64)	3.84 (0.93)	2.99 (0.62)
Variety	3.40 (0.73)	3.80 (0.64)	3.36 (0.55)	4.33 (0.46)	3.01 (0.78)	2.96 (0.55)	3.30 (0.90)	2.72 (0.55)
Multi-functionality	4.62 (0.89)	4.78 (0.49)	4.78 (0.75)	4.97 (0.44)	4.33 (1.27)	3.96 (0.57)	4.47 (1.11)	3.26 (0.52)
Self-efficacy	4.53 (0.88)	5.48 (0.55)	4.58 (0.58)	5.81 (0.35)	4.02 (0.98)	4.24 (0.91)	4.35 (0.84)	4.07 (0.77)
Positive frame of mind	4.15 (0.84)	4.43 (0.62)	3.78 (0.88)	4.66 (0.30)	3.72 (1.11)	3.27 (0.6)	3.64 (1.14)	3.22 (0.35)

Self-efficacy (1-3)	2.57 (0.41)	2.77 (0.31)	2.55 (0.41)	2.76 (0.32)	2.44 (0.56)	2.28 (0.47)	2.47 (0.57)	1.84 (0.45)

Table 3: F values for change in self-management ability and self efficacy, by time, group and social network (N = 149)

				Third order interaction:			
				Intervention-Community	Intervention-Retirement residence	Control-Community	Control-Retirement residence
	F_{time} (1,145) (p) (η^2)	$F_{time \times group}$ (1,145) (p) (η^2)	$F_{time \times group \times setting}$ (1,145) (p) (η^2)	F_{time} (1,145) (p) (η^2)	F_{time} (1,145) (p) (η^2)	F_{time} (1,145) (p) (η^2)	F_{time} (1,145) (p) (η^2)
Self-management							
Total score	5.35 (p=.022) (η^2=.036)	108.44 (p<.001) (η^2=.428)	20.56 (p<.001) (η^2=.124)	25.57 i (p<.001) (η^2=.150)	66.37 i (p<.001) (η^2=.314)	1.74 (p=.190) (η^2=.012)	40.84 d (p<.001) (η^2=.220)
Taking initiatives	14.37 (p<.001) (η^2=.090)	117.35 (p<.001) (η^2=.447)	25.41 (p<.001) (η^2=.149)	57.36 i (p<.001) (η^2=.283)	60.84 i (p<.001) (η^2=.296)	0.86 (p=.354) (η^2=.006)	57.77 d (p<.001) (η^2=.285)
Investment behavior	0.27 (p=.602) (η^2=.002)	83.99 (p<.001) (η^2=.367)	22.33 (p<.001) (η^2=.133)	5.40 i (p=.022) (η^2=.036)	57.00 i (p<.001) (η^2=.282)	5.20 (p=.024) (η^2=.035)	35.49 d (p<.001) (η^2=.197)
Variety	8.84 (p=.003) (η^2=.057)	62.77 (p<.001) (η^2=.302)	18.80 (p<.001) (η^2=.115)	12.97 i (p<.001) (η^2=.082)	58.02 i (p<.001) (η^2=.286)	0.13 (p=.719) (η^2=.001)	18.87 d (p<.001) (η^2=.115)
Multi-functionality	14.32 (p<.001) (η^2=.090)	33.90 (p<.001) (η^2=.190)	6.80 (p=.010) (η^2=.045)	1.12 (p=.291) (η^2=.008)	1.17 (p=.281) (η^2=.008)	4.78 d (p=.022) (η^2=.032)	48.53 d (p<.001) (η^2=.251)

Self-management self-efficacy	52.47 (p<.001) (η^2=.266)	58.71 (p<.001) (η^2=.288)	7.07 (p=.009) (η^2=.047)	52.98 i (p<.001) (η^2=.268)	69.57 i (p<.001) (η^2=.324)	2.06 (p=.153) (η^2=.014)	3.29 (p=.072) (η^2=.022)
Positive frame of mind	0.79 (p=.375) (η^2=.005)	38.14 (p<.001) (η^2=.208)	2.91 (p=.090) (η^2=.020)	3.63 (p=.059) (η^2=.024)	28.29 i (p<.001) (η^2=.163)	7.11 d (p=.009) (η^2=.047)	5.72 d (p=.018) (η^2=.038)
Self-efficacy	5.33 (p=.022) (η^2=.035)	57.12 (p<.001) (η^2=.283)	9.10 (p=.003) (η^2=.059)	8.05 i (p=.005) (η^2=.053)	7.26 i (p=.008) (η^2=.048)	3.75 (p=.055) (η^2=.025)	55.64 d (p<.001) (η^2=.277)

Note. i = increase, d = decrease
Positive frame of mind- only the group by time interaction is significant: Intervention group $F(1,145) = 27.53$, $p<.001$, η^2=.160 (increased); Control group: $F(1,145) = 12.78$, $p<.001$, η^2=.081 (decreased).

Data for self-management showed that most third order interactions (time by group by social network) were significant, except for 'positive frame of mind', where the second order interaction of time by group was significant. Interpretation of these results generally showed significant increases in both intervention groups, no change in the community control group, and significant decreases in the control group at the retirement residence. Exceptions were 'multi-functionality' for which no change was observed in the intervention groups, and a decrease noted in both control groups; 'self-efficacy in self-management', for which increases were observed in both intervention groups, and no change in both control groups; and 'positive frame of mind', for which an increase was noted in the intervention group as a whole and a decrease in the control group as a whole.

Results for self-efficacy revealed that the third order interaction was found to be significant. Its interpretation showed significant increases in both intervention groups, no change in the community control group, and a significant decrease in the control group at the retirement residence.

Hence, the second hypothesis was partially supported. Significant improvements were noted in both intervention groups, compared to no change or decreases in the control groups, yet change did not differ by social networks.

The third hypothesis focused on relationships between change in BMSR and change in self-management and self-efficacy. To assess this hypothesis, changes in the scores of BMSR, self-management and self-efficacy between the 2nd and last sessions were calculated with adjusted residual gains, defining each change score while controlling for the initial score.

The hypothesis was examined with multiple hierarchical regressions of change in self-management ability (SMAS) and change in self-efficacy, with: social network (1-community, 0-retirement residence), number of sessions attended, and change in BMSR dimensions. Table 4 presents the multiple hierarchical regressions for change in self-management ability (SMAS) and change in self-efficacy.

Table 4. Multiple hierarchical regressions for change in self-efficacy and self-management ability with change in BMSR dimensions (N = 63)

	SMAS total score	Taking initiatives	Investment behavior	Variety	Multi-function-ality	Self-manag-ement self-efficacy	Positive frame of mind	Self-efficacy
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
Social setting	-.62*** (0.29)	-.52*** (0.33)	-.58*** (0.26)	-.39** (0.28)	-.26 (0.39)	-.46*** (0.36)	-.63*** (0.34)	-.11 (0.35)
No. of sessions	.16 (0.04)	.18 (0.05)	.23* (0.04)	.35** (0.04)	-.16 (0.06)	-.04 (0.05)	.02 (0.05)	-.17 (0.05)
BMSR total	.30** (0.12)	.28* (0.14)	.22* (0.11)	.28* (0.12)	.24 (0.16)	.35* (0.15)	.30* (0.14)	.55*** (0.14)
Motivation: improved everyday competencies	.17 (0.12)	.15 (0.14)	.17 (0.11)	.01 (0.12)	.22 (0.16)	.16 (0.15)	.12 (0.14)	-.12 (0.16)
Motivation: improved general feeling	.10 (0.13)	.20 (0.15)	-.02 (0.12)	-.09 (0.13)	-.03 (0.18)	.03 (0.16)	.28 (0.15)	-.04 (0.16)
Social motivation	.13 (0.10)	.22* (0.11)	.07 (0.09)	.01 (0.10)	.07 (0.13)	.01 (0.12)	.31* (0.12)	.08 (0.12)
Adj. R²	.51	.34	.58	.52	.06	.25	.27	.12
F(6, 56)	11.58***	6.40***	15.25***	11.97***	1.71	4.41***	4.80***	2.32*

*p < .05, **p < .01, ***p < .001

Regression results revealed that seven of the eight models were significant, with 12% to 58% of the variance being explained in them. In most cases change in self-management ability was higher in the retirement residence than the community. Change in 'Investment behavior' and in 'Variety' correlated to participation in a greater number of sessions. Beyond social networks and number of sessions attended, increase in total BMSR score predicted increases in self-management ability (except for 'Multi-functionality') and self-efficacy. Of the various motivations to participate in the program, increase in social motivation predicted increase in two dimensions of self-management ability: 'Taking initiatives' and 'Positive frame of mind'. Thus, the third hypothesis was supported. Positive change in BMSR scores correlated to positive changes in self-management ability and self-efficacy.

Analysis the BMSR questionnaire (BMSR-21) revealed it to be self-reporting questionnaire designated to measure the ability of BMSR to improve self-management and functioning conditions in the current study. The total score for these self-management items was found to correlated to the total score of the Self-Management Ability Scale (SMAS). Although the pre-test score of SMAS was unrelated to BMSR self-management in the 2nd session (r=.10, p=.419), it correlated positively to it in the 10th session (r=.32, p=.004). The post-test SMAS score correlated positively related to BMSR self-management in both the 18th session (r=.49, p<.001), and the final session (r=.49, p<.001). These relationships lend some validity to the BMSR self-management items and score.

Discussion

The aim of the current study was to explore the extent of change in self-management ability and self-efficacy of elderly people in relation to a change in physical activity using BMSR as an intervention program. This effect was studied among elderly living in the community and elderly living in a retirement residence.

The rate of physical activity, as well as satisfaction with the BMSR program increased in both intervention groups compared to the control group. However, there was no difference between elderly living in the community and those living in the retirement residence. In addition, with the BMSR program intervention, an improvement in everyday skills was seen in both populations, improvement in general feeling increased in the community with no change observed in the retirement residence and social motivation remained intact in the community while decreasing among the retirement residence population. Thus, the first hypothesis of the study was proved, i.e., there was an improvement in the extent of body management in safe ranges as a result of the BMSR program intervention. However, although it was hypothesized that the change in physical activity would be higher in the community population than in retirement residences, no difference was noted between the two populations.

The essence of the BMSR program focused mostly on the physical activity of elderly participants, which also affected their reduced mental and emotional aspects due to declining functioning of various physiological systems. The BMSR method has embedded in it a functional training program (FT), which is biased on cognitive-motor strategies, and is recommended for senior trainees (Netz & Raviv, 2004). Moreover, the WHO's recommendations for physical activity programs for the elderly, which include the four components of physical fitness, are implanted in the BMSR Program (WHO, 2012; 2020). The BMSR program is held in small groups, during which elderly trainees are encouraged to persevere with physical activity and the importance of attending the sessions in any functional situation is emphasized. At the opening session of the program practical goals to increase participants' motivation for self-care are set. These insights and improvement in the physical ability acquired during sessions may be responsible for the increased rate of physical activity, as well as levels of satisfaction from the program in intervention groups among both populations.

Significant improvement in self-management and self-efficacy among intervention program participants, compared to control groups, was noted in both community and retirement residence participants. In most cases the degree of change in self-management was higher in the retirement residence intervention population than the community, despite the higher age of participants and lockdown during the COVID-19 crises (when post-program tests were conducted) (Berg-Weger, & Morley, 2020). A possible reason for the greater improvement seen in the retirement residence population is that in this population the final test was held immediately at the end of the intervention, while in the community the test was delayed due to difficulty coordinating tests because of lockdown, and the effect of the BMSR intervention might have started to decline. The results show that neither participants' age nor social network in which they live were meaningful, and therefore the effect of the intervention seems to be significant. As might be expected, there was no change in self-management and self-efficacy in the community control group, whereas in the retirement residence control group there was a decline. This can be explained by the timing of data collection, which was during the quarantine imposed on all residents in the retirement residences owing to COVID-19. It could be that without this lockdown retirement residence participants in the control group would not have lost any of their sense of self-management and self-efficacy, as with the control group in the community. Nevertheless, the two intervention groups demonstrated an improvement in all variables of self-management and self-efficacy, regardless of social network in which they live or any lockdown. In other words, improvement in self-management and self-efficacy went beyond age or environmental conditions. Thus, the second hypothesis was partially supported, since indeed there was an improvement in participants' self-management ability and perception of self-efficacy as a result of

the intervention, however, its rate was similar in both community and retirement residence populations.

The rationale and essence of the BMSR program it is to improve and strengthen participants' self-efficacy by practicing conscious movement in safe ranges and providing a functional toolbox for optimal functioning in daily life. The program evaluates participants' current physical situation and then focuses on improving physical abilities, in a conscious manner recognizing body limitations. The program sharpens participants' existing skills consciously and painlessly. It encourages elderly participants to take care of their conditions more intensively and provides tools for organizing the body in space. Interestingly, Loring *et al.* (1999) demonstrated that empowering self-efficacy is one of the mechanisms responsible for improving the health status of people who have participated in self-management programs (Lorig, Gonzalez, & Ritter, 1999).

Improvement in physical control and ability acquired during the execution of the BMSR program result in gaining correct restrictive physical patterns that reduce pain and allow better function, mobility, and independence. These components enable elderly participants to be actively involved in changing their physical condition – i.e. proving that they are able to improve and change behavior, which is necessary for progres in the process of better self-management.

Improvement in BMSR score (i.e., physical state) was found to correlate to improvement in self-management and self-efficacy scores. The data revealed that an increase in the total BMSR score predicted increases in self-management ability (except for 'Multi-functionality') and self-efficacy. It is interesting to note that change in 'Investment behavior' and in 'Variety' was higher in association with participation in a higher number of BMSR sessions. Thus, the third hypothesis that positive change in BMSR scores is related to positive changes in self-management ability and self-efficacy was supported.

The effect of BMSR on self-management scores stands on the program's rationale, which is how to teach an elderly population to manage their bodies and change their behavior consciously, by strengthening self-efficacy. During the BMSR program, participants learned to be familiar with body systems used to move and stabilize the skeleton and joints. Awareness of movement in safe ranges teaches participants the limits and abilities of their bodies that have changed with age.

An intervention based on personalization and adopting principles for changing behavior dictates individuals' ability to improve their self-management (Lorig & Halsted, 2003). Indeed, the BMSR program is based on the principle of learning one's body status to make progress in physical activity and thereby self-management

There are studies demonstrating how self-management can encourage subjects to increase physical activity. For example, long-term effects of a self-management intervention on physical activity and depressive symptoms were examined in 198 men and women after cardiac rehabilitation. Four and twelve months later,

physical exercise levels were higher in the intervention group which had received brief self-regulatory skills training focused on exercise planning strategies (i.e., self-management intervention) (Scholz *et al.*, 2006). In a study of 335 type-2 diabetic patients, who were randomized in either a computer-assisted, tailored self-management intervention or health risk appraisal with feedback control, demonstrated an improvement in physical activity after 2 months in the intervention group (Goedendorp, & Steverink, 2017). The BMSR program, on the contrary, aims to mediate self-management by improving participants' physical activity. The program was actually established to assist elderly people to manage their old age by focusing mainly on the physical aspects of the elderly. The concept of old age management is based on the 5 components of a self-management program reviewed by Lorig and Halsted (2003). The BMSR program also includes these 5 components and teaches participants to choose new appropriate behaviors to improve their condition and empower them.

The BMSR program is intended to be practiced by aging populations and accompany them throughout the remainder of their lives. It is not designed for any specific physiological condition or disease. Therefore, its purpose is address daily life self-management among all older people and not disease management, as other self-management programs.

Conclusion

The BMSR intervention program improves physical activity thereby empowering self-management and self-efficacy in older people. The effect is independence irrespective of age or living environment. The BMSR program, which is based on the 5 components of self-management suggested by Lorig & Holman (2003) contributes a variety of tools designed to mediate self-management and self-efficacy in older people. It can be considered novel in the field of self-management theory because it combines aspects of social and physical life with the field of aging.

Limitation of the study

This study is not free from limitations, some of which were known to the researchers, before the initiation of the study and some popped up during the study and may have skewed or affected the study results. However, steps taken to minimize and reduce these consequences, as well as awareness of the constraints of the current study, will allow furthermore accurate research to be conducted with maximal transparency based on the current study.

Some of the limitations of the present study were: multiplicity of variables and a desire to encompass within a single study a large number of areas. This proved to be a great burden for the research team and participants. The researcher's personal

involvement may have skewed research results, therefore an explanatory research method was chosen combining quantitative and qualitative methods.

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