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A short-term yoga-based intervention improves balance control, body composition, and some aspects of mental health in the elderly men

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Background: Body balance control represents a key function for the physical activities of elderly people aged sixty-five and over. Due to the biological and psychosocial changes in this age group, yoga-based intervention appears to be beneficial to maintaining their ability to balance along with related mental aspects of health. **Objective:** The aim of the presented study was to examine the effects of the 4-week yoga-based intervention on balance, body composition and the mental health aspects of elderly men. **Methods:** 67–80-year-old elderly men (N = 234, mean age 72.5 ± 7.7 years) were assessed with The Tinetti Balance Assessment Tool, bioimpedance body composition analyser InBody 230 and the Health Survey SF-36, applied for the pre- and post-testing. The experimental group (n = 122) underwent the 4-week intervention based on yoga exercises, while the control group (n = 112) had a usual daily program at their senior homes or centers. **Results:** The yoga intervention led to significant improvement of both the static balance and gait scores compared to the control group, with medium effect size, η_p^2 = .070 and .080. The intervention also had an effect on the decrease of body fat percentage (by 1.7%) and an increase in muscle mass (by 1.3 kg), with a large effect size, η_p^2 = .214 and .301. Results of the Health Survey showed that overall mental health did not change significantly although positive improvement in two items connected with emotional problems. **Conclusions:** A short-term yoga-based intervention may have a significant positive influence on physical abilities such as balance control and body composition rather than on mental health aspects in elderly men aged sixty-five and over.

Keywords: exercise, functional mobility, psychic state, seniors

Introduction

With increasing age, postural control and balance skills begin to worsen (Buso et al., 2019; Shumway-Cook & Woollacott, 2016). Impaired balance may result in a decrease in physical activity during daily life and concurrently represents a major risk factor for older people when it comes to falling (Bukova et al., 2019). Fear of falling and the consequent loss of independence are also common problems among the elderly (Dellinger, 2017). Reduction in the deterioration of posture control is therefore considered a key factor in the prevention of falls and subsequent injuries. Incidental falls of the elderly rank high in the category of geriatric health problems that have negative consequences on the physical, mental and social quality of life of elderly people over 65 years (Ni Chronin, Ni Chronin, & Beveridge, 2015). Additionally, these problems also have a high cost of treatment. Since 2000 in the Czech Republic, similarly as in other European countries, the number of persons aged 65 and over has been continuously increasing and as a consequence, treatment costs have become higher.

Motor performance and learning issues are specific in the elderly due to the potential dysfunction of the central and peripheral nervous system as well as the neuromuscular system. These specifics manifest themselves as coordination difficulties, lack of fitness, slower and less precise movements, balance and gait difficulties (Gilleard & Higgs, 2005). These limits may have a negative effect on the ability of the elderly to carry out routine daily activities, including self-care activities. Balance problems during walking with the consequence of a fall are the main source of injury and morbidity in the elderly: 20–30% of the elderly who

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suffer from a fall suffer moderate to severe injuries that limit mobility and reduce the quality of life (Hafström, Malmström, Terdèn, Fransson, & Magnusson, 2016). Slower information processing can also affect motor performance in the elderly (Gillespie et al., 2012). The findings of Bendíková (2017) show that amongst the elderly, movement activities alone play an important role in maintaining social contacts, health and independence, the values of which are particularly specific for the life of the elderly from different points of view.

Recent reviews of literature show that the practicing of yoga exercises may bring advantages to various groups of the elderly, including mental health, psychosocial functioning (e.g., Butterfield, Schultz, Rasmussen, & Proeve, 2017; Pascoe & Bauer, 2015), physical functioning and motor functions (Wang, 2009; Youkhana, Dean, Wolff, Sherrington, & Tiedemann, 2016). These authors pointed out the positive effects of yoga interventions in decreasing depression, mood, stress, fear, anxiety, sleep disorders, and on the enhancement of concentration, emotional stability, self-confidence, social skills and social engagement. The positive benefits of yoga programs were proved in healthy elders as well as in older individuals with cancer, multiple sclerosis, diabetes, chronic pancreatitis, asthma and fibromyalgia (Oken et al., 2006; Tew, Howsam, Hardy, & Bissell, 2017). For the maintenance of posture function and balance abilities in the elderly, yoga exercises may provide a wide range of different movement situations that combine the physical and psychosocial attributes of balance, such as synchronization of movement with breathing, slowed movement sequences, and releasing the mind from fear and worry (Krejci & Kornatovska, 2017; Maheshwarananda, 2000).

However, the previous yoga-based intervention studies with the elderly included women only or gender-mixed samples in which the number of women was very often considerably higher than men. Importantly, the possible effects of yoga were not analyzed separately for elder men and women in those studies. That is in contradiction to possible sex differences and the effects of yoga exercises on these differences, due to the biological and psychosocial specifics of older men and women. The studies with gender-mix samples of the elderly showed that yoga programs can enhance balance and other motor functions that are associated with balance such as muscle strength, flexibility and mobility (e.g., Oken et al., 2006; Tiedemann, O'Rourke, Sesto, & Sherrington, 2013). As a consequence of these effects, fear of falling may decrease (Schmid, Van Puymbroeck, & Koceja, 2010).

Effects of yoga programs on mental health were also demonstrated on common samples of elderly men and women, such as a decrease in depression, social dysfunction (Ebrahimi, Esmaeilzadeh, & Mohamad, 2019), stress levels (Lindahl, Tilton, Eickholt, & Ferguson-Stegall, 2016), an additional stimulation of a sense of well-being and energy (Oken et al., 2006), an increase in self-esteem and a positive attitude towards the surrounding world (Krejci, 2011).

However, to the authors' knowledge, no intervention study has been published that would examine the effects of yoga on the balance and mental functionality specifically in elderly men. A focus of this research on the effects of yoga on balance shows it to be relevant when poorer balance was revealed as one of the significant risk factors of incident falls in elderly men but not in women (Gale, Cooper, & Aihie Sayer, 2016; Gale, Westbury, Cooper, & Dennison, 2018). In addition, it is also important to note that the possible effects of yoga on the mental and physical health of elders were examined mostly in those practicing this activity for longer periods of time, eight weeks or more. Therefore, the aim of the presented study was to examine the effects of short-term yoga intervention on balance, body composition, and the mental health aspects in elderly men. On the basis of the knowledge introduced above on the possible effects of yoga exercises, we hypothesized that short-term intensive yoga intervention in elderly men may lead to the optimization of balance abilities and aspects of physical, mental, emotional and social functioning.

Methods

Participants

The elderly men (N = 234), mean age 72.5 ± 7.7 years (range 67–80 years) were recruited from senior homes and centers on the base of voluntary participation. The participants were randomly assigned to the experimental (yoga) group (Exp; n = 122), mean age 72.8 ± 7.4 years, body height 173.4 ± 7.9 cm; or the control group (Con; n = 112), mean age 72.2 ± 6.5 years, body height 174.0 ± 6.6 cm. Results of the independent t-test (α = .05) showed that the groups did not differ significantly in age (p = .215), body height (p = .684), body weight (p = .689) and body mass index (BMI; p = .445) at the beginning of the experiment. While randomizing, equal or very similar number of participants for both groups were kept in the particular homes/centers. The exclusion criteria for the involvement of participants in the experimental study has been determined according to the White Book on Physical and Rehabilitation Medicine in Europe (Gutenbrunner, Ward, & Chamberlein, 2007) and are as follow: (i) human to human infectious diseases and bacillus carrier, (ii) all acute-stage diseases and conditions in which destabilization of health state can be reasonably expected, (iii) cachexia of various etiologies, (iv) malignant tumors, (v) active attacks or phases of psychoses and mental disorders with asocial manifestations or with reduced communication, (vi) 2nd and 3rd degree of urinary incontinence and stool incontinence.

Written informed consent to participation in the study was obtained from the participants. Participants of the control group were informed about the physical, motor and health status assessment, while participants of the experimental group were provided with the information on both the diagnostic and intervention parts of the program. However, participants of both groups were not informed about the research purpose of the study. The Ethical committee of the research institution expressed full agreement with the research aims and procedures. Research conformed to the requirements stipulated in the Declaration of Helsinki.

Instruments of assessment

Medical anamnesis

The standardized medical anamnesis protocol was applied to assess the health state, drug consumption, disabilities, operations, etc. of each participant, and finally, the physician carried out the medical recommendation/decision to include an individual in the study.

Assessment of body composition

Body height was measured using the Tanita Leicester Height Measure device (Invicta Plastics, Leicester, United Kingdom) with an accuracy of 0.1 cm. A tetrapolar multi-frequency bioelectrical impedance device InBody 230 (InBody, Seoul, South Korea) was used to assess body weight, BMI, body fat percentage and total muscle mass.

Balance assessment

The Tinetti Balance Assessment Tool is a clinical performance-oriented exam used to measure the static and dynamic balance in older adults (Tinetti, Williams, & Mayewski, 1986). The static balance test is assessed on the basis of observation of an individual's bodily behavior during sitting and standing positions and their changes which are defined by nine items. Dynamic balance is judged by eight items that involve characteristics of gait manifested in an individual during a walk across a 4.5-m walkway, first at their usual pace, then at a rapid pace. The particular items of both static and dynamic balance are rated on the 2-point scale or the 3-point scale. The maximal total scores are 16 and 12 points for static balance and dynamic balance (gait), respectively. The higher the score, the better the performance.

The Tinetti Balance Assessment Tool, also named the Tinetti Mobility Test reported good to excellent intra- and inter-rater reliability, intraclass correlation coefficient > .80, and medium sensitivity and specificity to identify fallers (Kegelmeyer, Kloos, Thomas, & Kostyk, 2007).

RAND 36 Short Form Health Survey (SF-36)

This survey (SF-36) is a valid and reliable indicator of overall health status (Ware, Snow, Kosinski, & Gandek, 1993), and it is widely used all over the world today. It is comprised of 36 items that assess eight categories: physical functioning (10 items), physical role of functioning (4 items), emotional role functioning (3 items), social role functioning (2 items), mental health (5 items), vitality (4 items), body pain (2 items), and general health perceptions (5 items). Responses across the items are scored on the two- to six-point scales. One item (question 2) covers a change in health status over the past year. Therefore, participants in the presented study were not assessed on this item. The method was reported to have a reliability of r = .65 to .94 across the scales, with a median of .85. This resulted in very good internal consistency and item-discriminant validity (McHorney, Ware, Lu, & Sherbourne, 1994).

Procedures

The investigations started with the medical anamnesis provided by a physician, followed by a bioimpedance assessment of body composition provided by an anthropologist with two assistants. After the two medical assessments, a physiotherapist conducted an individual balance exam using the Tinetti Balance Assessment Tool, according to the protocol by the Washington Health Care Association (2013).

Then, each participant completed the SF-36 survey with the assistance of a research team member. Each participant was instructed on how to respond to the items on the survey and was told to relax and answer truthfully. No time limit was stated for them to fulfill the survey. The survey was used according to its official manual and interpretation guide (Ware et al., 1993). Each item of the SF-36 was analyzed as to their possible intervention effect. Each participant underwent all of the procedures in a single go. Obtained data was stored and protected according to the Regulation of the European Parliament and the Council of the EU 2016/679. After the pre-measurements, participants of the experimental group underwent the 4-week yoga-based intervention, while the control group ran the standard daily routine program in their senior homes or centers. One to six days after the 4-week intervention, the post-measurements were performed in the same conditions.

Yoga-based intervention

The 4-week intervention of the experimental group was focused on body posture and balance control, flexibility, muscle strength, breathing, the stimulation of psychic harmony and the optimization of social interaction. These yoga exercises were carried out in accordance with the system of Yoga in Daily Life (Maheshwarananda, 2000), and without contraindications to the elderly (Sarvahita Asanas), and the movements whilst sitting on a chair or standing. Once per week, the main training lesson lasting 90 minutes was conducted with groups of 10–12 participants under the guidance of the coach, and with two or three coach assistants who helped seniors to complete exercises easily and correctly during each lesson. After each main training, each participant received an educational sheet, which contained a simple guide and a symbolic attribute for the concrete intervention week. During the week, participants repeated practiced exercises and yoga elements each day in 5–10-minute intervals. The assistants also motivated participants during these weeks to repeat learned exercises. The week program also included the motto: Week 1 "You are never alone", Week 2 "Change is always possible", Week 3 "Movement is life", Week 4 "Enjoy life and every moment" (Krejčí, 2019). During the intervention, the control group had their usual daily regiment at their senior homes or centers.

Statistical analysis

Respecting the skewed distribution and non-constant variance in most dependent variables, these were transformed by Box-Cox transformations to achieve data symmetry and homoscedasticity prior to further processing. The homogeneity and distribution of the transformed data and residuals were checked by residual analysis as described elsewhere (Meloun et al., 2004).

The analysis of variance (ANOVA) model was used for the evaluation of the relationships between dependent variables on one side and the experimental group, measurement and individual subjects on the other side. Therefore, the model consisted of Subject factor explaining inter-individual variability between subject factor Group (control × experimental group) and within subject factors Measurement (before intervention × after intervention), and significant Group × Measurement interaction indicating whether the Group factor significantly influences the change after intervention). Less significant multiple comparisons followed the ANOVA testing. The results obtained from the transformed data (subgroup means and their 95% confidence intervals) were re-transformed to the original scale for the presentation. The effect size of the factors and the Group × Measurement interaction was calculated using partial eta squared (η_p^2) with an interpretation of η_p^2 = .01, .06, and .14 as small, medium, and large effects, respectively. A significance level of α = .05 was set for all tests. Statistical software Statgraphics Centurion (Version 18; Statgraphic Technologies, The Plains, VA, USA) was used for the statistical analysis.

Results

Intervention effects on body composition

The intervention led to the significant improvement of two measurements of body composition. Firstly, the Exp group decreased in body fat percentage by 1.7% of fat while the Con group increased the median of this variable by 0.3% of body fat (Table 1). The analysis showed the effect of the Measurement on body fat percentage and Group × Measurement interaction was statistically significant, $p < .001$, with a large effect size, η_p^2 = .214 (Table 1). Second measurements revealed that total muscle mass increased by 1.3 kg (median) in the Exp group after the yoga intervention, while there was no change in the median of muscle mass in the Con group. The analysis showed the effect of both the Measurement and Group × Measurement (both $p < .001$), with a large effect size of the interaction η_p^2 = .301 (Table 1).

The effect of Measurement was also significant for BMI ($p = .02$) with a decrease in both groups, however, the Group × Measurement interaction was not significant ($p = .38$; Table 1). Concurrently, the effects of Measurement and Group × Measurement interaction were not significant for body weight.

Intervention effects on balance

The effect of Measurement was significant for performance in both Tinetti static and dynamic balance test, $p < .001$ and $p = .010$, respectively. The significant Group × Measurement interaction ($p < .001$) showed that the improvement was significantly higher for static and dynamic balance in the Exp group, from 13.2 to 13.8 and 9.9 to 10.2, respectively, as compared to the Con group, from 13.8 to 13.9 and 10.4 to 10.3, respectively, both with medium effect, η_p^2 = .070 and .080, respectively (Table 2). The positive effect of the yoga-based intervention was also indicated by the significance of Measurement and Group × Measurement interaction for the total score of the Tinetti balance test (both $p < .001$) and medium effect size of the interaction, η_p^2 = .108 (Table 2).

Intervention effects on the health and quality of life measures of the SF-36 Survey

The effect of the intervention was found to improve the self-care abilities item (PF10) of the Physical

Table 1
Body composition measures in the pre- and post-intervention

Measure	Measurement		*p*			η_p^2 Group × Pre-Post
	Pre	Post	Group	Pre-Post	Group × Pre-Post	
Body weight (kg)						
Con	83.6 [83.5, 83.8]	83.4 [83.3, 83.5]				
Exp	84.3 [84.2, 84.4]	84.3 [84.2, 84.4]	< .001	.216	.232	.009
Body mass index (kg/m²)						
Con	27.5 [27.4, 27.5]	27.4 [27.3, 27.4]				
Exp	27.7 [27.7, 27.8]	27.7 [27.6, 27.7]	< .001	.017	.384	.005
Body fat (%)						
Con	26.6 [26.3, 26.9]	26.9 [26.6, 27.2]				
Exp	26.9 [26.7, 27.2]	25.2 [25.0, 25.5]	< .001	< .001	< .001	.214
Muscle mass (kg)						
Con	33.9 [33.8, 34.1]	33.9 [33.7, 34.0]				
Exp	34.8 [34.7, 34.9]	36.1 [36.0, 36.2]	< .001	< .001	< .001	.301

Note. Con = control group; Exp = experimental group. Scores are presented as median [95% confidence interval of median].

Table 2
The Tinetti balance test scores in the pre- and post-intervention

Measure	Measurement		*p*			η_p^2 Group × Pre-Post
	Pre	Post	Group	Pre-Post	Group × Pre-Post	
Static balance						
Con	13.8 [13.7, 13.9]	13.9 [13.8, 14.0]				
Exp	13.2 [13.2, 13.3]	13.8 [13.7, 13.8]	< .001	< .001	< .001	.070
Dynamic balance (gait score)						
Con	10.4 [10.3, 10.5]	10.3 [10.3, 10.4]				
Exp	9.9 [9.8, 10.0]	10.2 [10.2, 10.3]	< .001	.010	< .001	.080
Total score of balance						
Con	24.1 [24.0, 24.3]	24.2 [24.1, 24.3]				
Exp	23.1 [23.0, 23.2]	23.9 [23.8, 24.0]	< .001	< .001	< .001	.108

Note. Con = control group; Exp = experimental group. Scores are presented as median [95% confidence interval of median].

functioning (PF) category. The effect of the Measurement was marginal, $p = .06$, however Group × Measurement interaction was significant for the PF10 item, $p = .01$ (Table 3).

The effects of Measurement and Group × Measurement interaction were not significant for the RP1, RP2 and RP3 items of the Role Limitations due to physical health problems (RP) category (Table 3). Although both groups improved the score in the RP4 item, reflected in a significant effect of Measurement $p = .02$, Group × Measurement interaction was not significant, $p = .18$ (Table 3).

The Con group improved the score of the state of calmness and peacefulness indicated by the MH3 item of the Mental health (MH) category in a larger extent, with the significant interaction $p = .02$ (Table 4). Furthermore, the Con group improved significantly its state of happiness, the MH5 item, while worsening the score in the Exp group, the interaction Group × Measurement $p = .01$ (Table 4).

The yoga-based intervention led to significant positive changes in two of three items related to the Role limitations due to emotional problems (RE) category, with significant Group × Measurement interaction, $p = .03$. Secondly, the Exp group improved the score of the RE3 item while there were no changes in the median score of the Con group. The effects of both Measurement and Group × Measurement interaction on the RE3 item score were significant, both $p = .03$ (Table 4).

Table 3

Physical functioning, Role limitations due to physical health problems and Bodily pain measures of the RAND 36 Short Form Health Survey in the pre- and post-intervention

Scale (score); Item	Measurement Pre	Measurement Post	*p* Group	*p* Pre-Post	*p* Group × Pre-Post	η_p^2 Group × Pre-Post
Physical functioning (PF)						
PF1 (1–3+); Health limit: vigorous activities						
Con	1.77 [1.74, 1.80]	1.72 [1.69, 1.75]				
Exp	1.47 [1.44, 1.49]	1.49 [1.46, 1.51]	< .001	.442	.076	.020
PF2 (1–3+); Health limit: moderate activities						
Con	2.62 [2.59, 2.65]	2.62 [2.59, 2.65]				
Exp	2.29 [2.26, 2.31]	2.34 [2.31, 2.36]	< .001	.275	.275	.008
PF3 (1–3+); Health limit: lifting/carrying groceries						
Con	2.80 [2.78, 2.83]	2.78 [2.75, 2.80]				
Exp	2.65 [2.63, 2.67]	2.68 [2.66, 2.70]	< .001	.960	.065	.022
PF4 (1–3+); Health limit: climbing of several flights/stairs						
Con	2.44 [2.41, 2.46]	2.42 [2.39, 2.44]				
Exp	2.09 [2.06, 2.11]	2.13 [2.11, 2.15]	< .001	.519	.077	.020
PF5 (1–3+); Health limit: climbing of one flight/stairs						
Con	2.76 [2.72, 2.79]	2.72 [2.69, 2.75]				
Exp	2.50 [2.47, 2.53]	2.51 [2.48, 2.54]	< .001	.574	.298	.007
PF6 (1–3+); Health limit: bending, kneeling, stopping						
Con	2.49 [2.45, 2.53]	2.50 [2.46, 2.54]				
Exp	2.24 [2.20, 2.27]	2.26 [2.23, 2.30]	< .001	.442	.786	< .001
PF7 (1–3+); Health limit: walking > 1 mile						
Con	2.64 [2.60, 2.68]	2.57 [2.53, 2.61]				
Exp	2.31 [2.27, 2.34]	2.32 [2.29, 2.36]	< .001	.300	.089	.018
PF8 (1–3+); Health limit: walking several blocks						
Con	2.80 [2.79, 2.81]	2.80 [2.79, 2.81]				
Exp	2.65 [2.64, 2.66]	2.66 [2.65, 2.66]	< .001	.662	.663	.001
PF9 (1–3+); Health limit: walking one block						
Con	2.91 [2.89, 2.92]	2.89 [2.87, 2.90]				
Exp	2.86 [2.84, 2.88]	2.84 [2.83, 2.86]	< .001	.140	.832	< .001
PF10 (1–3+); Health limit: bathing, dressing						
Con	2.96 [2.95, 2.98]	2.93 [2.92, 2.94]				
Exp	2.88 [2.87, 2.89]	2.89 [2.88, 2.90]	< .001	.061	.008	.046
Role limitations due to physical health problems (RP)						
RP1 (1–2+); Past 4 weeks work or other activities decreasing						
Con	1.78 [1.73, 1.82]	1.81 [1.77, 1.86]				
Exp	1.56 [1.52, 1.60]	1.55 [1.51, 1.59]	< .001	.633	.442	.004
RP2 (1–2+); Past 4 weeks accomplished less than would like						
Con	1.68 [1.65, 1.71]	1.70 [1.67, 1.73]				
Exp	1.44 [1.41, 1.46]	1.49 [1.47, 1.52]	< .001	.098	.388	.005
RP3 (1–2+); Past 4 weeks limited in work						
Con	1.73 [1.71, 1.75]	1.71 [1.69, 1.73]				
Exp	1.53 [1.51, 1.54]	1.56 [1.54, 1.58]	< .001	.571	.068	.022

(Table 3 continues)

Table 3 *(continued)*

Scale (score); Item	Measurement Pre	Measurement Post	*p* Group	*p* Pre-Post	*p* Group × Pre-Post	η_p^2 Group × Pre-Post
RP4 (1–2+); Past 4 weeks difficulties in performance						
Con	1.72 [1.69, 1.74]	1.73 [1.71, 1.76]				
Exp	1.53 [1.51, 1.55]	1.59 [1.57, 1.61]	< .001	.021	.177	.012
Bodily pain (BP)						
BP1 (+1–6); Past 4 weeks health problems interfered with normal social activities						
Con	2.27 [2.22, 2.31]	2.24 [2.19, 2.29]				
Exp	2.16 [2.12, 2.19]	2.11 [2.07, 2.14]	< .001	.183	.687	.001
BP2 (+1–5); Past 4 weeks bodily pain						
Con	1.74 [1.68, 1.80]	1.70 [1.64, 1.76]				
Exp	1.94 [1.89, 1.99]	1.84 [1.79, 1.89]	< .001	.106	.476	.003

Note. Con = control group; Exp = experimental group. Scores are presented as median [95% confidence interval of median].

Table 4

Social functioning, General mental health, Role limitations due to emotional problems, Vitality, energy/fatigue, and General health perceptions measures of the RAND 36 Short Form Health Survey in the pre- and post-intervention

Scale (score); Item	Measurement Pre	Measurement Post	*p* Group	*p* Measurement	*p* Group × Measurement	η_p^2 Group × Measurement
Social functioning (SF)						
SF1 (+1–5); Past 4 weeks health problems interfered with normal social contacts						
Con	1.57 [1.54, 1.60]	1.51 [1.48, 1.55]				
Exp	1.77 [1.74, 1.80]	1.77 [1.74, 1.80]	< .001	.261	.177	.012
SF2 (1–5+); Past 4 weeks physical or emotional problems influenced negatively social activities						
Con	4.08 [4.02, 4.14]	3.97 [3.91, 4.02]				
Exp	4.07 [4.03, 4.12]	4.07 [4.02, 4.11]	.197	.105	.141	.014
General mental health (MH)						
MH1 (1–6+); Past 4 weeks nervous						
Con	4.62 [4.53, 4.70]	4.75 [4.67, 4.83]				
Exp	4.58 [4.52, 4.65]	4.60 [4.53, 4.66]	.080	.168	.248	.009
MH2 (1–6+); Past 4 weeks sadness						
Con	5.40 [5.36, 5.44]	5.44 [5.40, 5.48]				
Exp	5.42 [5.39, 5.45]	5.46 [5.42, 5.49]	.515	.167	.968	< .001
MH3 (+1–6); Past 4 weeks calm, peaceful						
Con	2.94 [2.85, 3.04]	2.64 [2.55, 2.73]				
Exp	2.49 [2.42, 2.56]	2.47 [2.40, 2.54]	< .001	.008	.018	.036
MH4 (1–6+); Past 4 weeks depression						
Con	4.83 [4.74, 4.91]	4.93 [4.84, 5.02]				
Exp	4.99 [4.92, 5.06]	5.06 [5.00, 5.13]	.008	.113	.775	.001
MH5 (+1–6); Past 4 weeks happy						
Con	3.08 [2.98, 3.18]	2.83 [2.73, 2.92]				
Exp	2.53 [2.45, 2.60]	2.60 [2.52, 2.67]	< .001	.151	.012	.041

(Table 4 continues)

Table 4 *(continued)*

Scale (score); Item	Measurement Pre	Measurement Post	*p* Group	*p* Measurement	*p* Group × Measurement	η_p^2 Group × Measurement
		Role limitations due to emotional problems (RE)				
RE1 (1–2+); Past 4 weeks due to emotional problems cut down work or other activities						
Con	1.83 [1.8, 1.85]	1.86 [1.84, 1.89]				
Exp	1.77 [1.75, 1.78]	1.77 [1.76, 1.79]	< .001	.107	.292	.007
RE2 (1–2+); Past 4 weeks due to emotional problems accomplished less than would like						
Con	1.85 [1.83, 1.87]	1.82 [1.80, 1.85]				
Exp	1.75 [1.73, 1.77]	1.79 [1.77, 1.81]	< .001	.624	.030	.030
RE3 (1–2+); Past 4 weeks due to emotional problems concentration decreasing						
Con	1.85 [1.83, 1.87]	1.85 [1.83, 1.87]				
Exp	1.72 [1.7, 1.73]	1.78 [1.76, 1.80]	< .001	.032	.032	.030
		Vitality, energy/fatigue (VT)				
VT1 (+1–6); Past 4 weeks full vitality						
Con	2.89 [2.83, 2.96]	2.84 [2.78, 2.91]				
Exp	3.03 [2.98, 3.09]	2.93 [2.87, 2.98]	.012	.079	.510	.003
VT2 (+1–6); Past 4 weeks lot of energy						
Con	3.28 [3.21, 3.35]	3.25 [3.18, 3.32]				
Exp	3.10 [3.05, 3.16]	2.94 [2.88, 2.99]	< .001	.026	.134	.015
VT3 (1–6+); Past 4 weeks exhausted						
Con	4.39 [4.33, 4.45]	4.43 [4.37, 4.49]				
Exp	4.27 [4.22, 4.32]	4.28 [4.23, 4.33]	< .001	.493	.696	.001
VT4 (1–6+); Past 4 weeks tired						
Con	3.84 [3.75, 3.94]	3.97 [3.88, 4.06]				
Exp	3.82 [3.75, 3.90]	3.89 [3.82, 3.97]	.431	.107	.654	.001
		General health perceptions (GH)				
GH1 (+1–5); Subjective state of health						
Con	3.02 [2.99, 3.06]	3.06 [3.02, 3.10]				
Exp	3.17 [3.14, 3.20]	3.15 [3.12, 3.18]	< .001	.800	.218	.010
GH2 (1–5+); Sick easier than others						
Con	3.90 [3.86, 3.94]	3.92 [3.88, 3.96]				
Exp	4.02 [3.99, 4.05]	4.04 [4.01, 4.08]	< .001	.393	.943	< .001
GH3 (+1–5); Healthy as anybody else						
Con	2.28 [2.22, 2.35]	2.25 [2.18, 2.32]				
Exp	2.26 [2.21, 2.31]	2.23 [2.17, 2.28]	.624	.448	.945	< .001
GH4 (1–5+); Health is getting worse						
Con	3.18 [3.13, 3.24]	3.30 [3.25, 3.35]				
Exp	2.75 [2.71, 2.79]	2.81 [2.77, 2.86]	< .001	.012	.448	.004
GH5 (+1–5); Health is excellent						
Con	2.68 [2.64, 2.71]	2.64 [2.61, 2.68]				
Exp	2.79 [2.77, 2.82]	2.77 [2.74, 2.80]	< .001	.209	.773	.001

Note. Con = control group; Exp = experimental group. Scores are presented as median [95% confidence interval of median].

Effects of Measurement and Group × Measurement interaction were significant for no item of the RP, BP (Table 3), SF, VT and GH categories of the SF-36 Survey (Table 4).

Discussion

The current study showed changes in body composition indicated by a decrease in body fat percentage and increase in total muscle mass that followed the yoga-based intervention in elderly men. Body fat percentage usually rises in older adults from their 7th to 8th decennium followed by its decreasing (Honců et al., 2019; Lacroix, Hortobágyi, Beurskens, & Granacher, 2017). At the same time, the tendency of muscle mass loss may also be a serious problem in elderly men. According to recent studies (Chatterjee & Mondal, 2014; Krejci, 2011), our results have suggested that a male organism aged over 65 years, thanks to the testosterone and other anabolic hormones, may respond positively to physical exercises with body fat reduction and increase in muscle mass. The ratio of muscle mass to body fat is significantly influenced by lifestyle, especially food intake, energy expenditure and strength training (Bukova et al., 2019; Ohlsson et al., 2018). The current study suggested that the elderly men probably got into energy balance when their neuromuscular and respiratory systems were stimulated with regular and frequent practicing of yoga exercises. It is also possible that the regular yoga training could support anabolic processes thanks to the presence of testosterone, and as a consequence muscular mass enhanced.

The findings of improvement in static and dynamic balance in elderly men skew in favor of short-term yoga intervention. The English Longitudinal Study of Ageing (Gale et al., 2016) examined many potential factors for incident falls in 1515 men and 1783 women aged 60+. Besides the age and pain, impairment in static balance indicated by the full-tandem stand was revealed as the most significant mutually adjusted relative risk for men while not for women. Therefore, it seems that the regular practicing of yoga-based exercises can be beneficial to elderly men as it assists in decreasing fall-related incidents. According to the results of the current study, one can recommend male seniors aged 65+ to develop posture control via yoga exercises, with possible positive effects even after a short time period.

In the current study, the short-term yoga-based intervention resulted in improvement of dynamic balance, too. Dynamic balance, defined as the ability to maintain postural stability and orientation with center of mass over the base of support while the body parts are in motion, (O'Sullivan, Schmitz, & Fulk, 2014) plays an important role in mobility in the elderly. Dynamic balance was assessed with the use of the Tinetti Balance Assessment Tool that consisted in the observational judgment of features of gait such as hesitation of gait, step length and height, foot clearance, step symmetry and continuity and trunk sway. So, the results of our study suggest that regular practicing of yoga exercises can contribute to optimization of the fundamental locomotion skill such as walking.

However, we consider a bio-psycho-social context to judge changes in posture control and mobility in the elderly. The studies by Dellinger (2017) and Honců et al. (2019) proposed that the maintenance or development of balance ability in the elderly may depend on an interplay of bio-psycho-social factors and determinants. This assumption has been supported by several studies that found positive effects of yoga on stress management, mood harmonization, depression, and anxiety reduction (Pascoe & Bauer, 2015; Randall, Thomas, Whiting, & McGrath, 2017; Yoshihara, Hiramoto, Oka, Kubo, & Sudo, 2014). This is consistent with the findings of a decrease in emotional problems of elderly men in the current study. Specifically, elderly men who regularly practice the yoga–based program perceived reduction of both activity restrictions and concentration problem due to emotional problems (the items RE2 and RE3, Table 4). This finding concurrently with evidence of optimization of postural control suggests that yoga is the appropriate form of regular physical activity for elderly men which can bring significant benefits to their life. This suggestion is consistent with results of the meta-analysis by Youkhana et al. (2016) who reported that yoga may be an optimal form of exercise for older men to improve both physical functioning and mental health, as yoga relieves lower back pain, reduces hypertension, risk of obesity, treats chronic insomnia, and improves mood. Also, Schmid et al. (2010) have indicated that yoga may be a promising intervention to manage the fear of falling and improve balance, thereby reducing fall risk for older adults. One might consider that therapists may explore yoga as a model for balance and falls programming. However, future research is needed to confirm the use of yoga intervention in such programming.

The current study has suggested improvements in the self-care abilities of elderly men following the yoga intervention when they reported decreasing in health limit for activities such as bathing and dressing (the item PF10, Table 3). This finding may be related not only to concurrent optimizing of the balance but also to improved decision-making or mental control. The study by Gothe, Kramer, and McAuley (2014) showed the effect of an 8-week yoga intervention on the improvement in executive functions associated with work activity in older adults.

The novelty of the current study consists in the examination of a short-term yoga intervention specifically in elderly men. The yoga program designed for this study included the activities of standing, sitting, and lying on the floor. These activities practiced with a yoga program can stimulate postural control, mobility, and gait speed (Zettergren, Lubeski, & Viverito, 2011). But it should be noted that the yoga interventions by Zettergren et al. (2011) comprised of the exercises applied only twice or three times per week, whereas participants of the current study performed yoga exercises every day. Each week, they participated in one guided 90-minute training session for one day followed by 10–15 minutes of assisted practice each of the following six days. This type of intervention presents the idea for older people to implement yoga in their daily life.

We believe that short-term yoga interventions are very useful for people aged 65+. It is necessary to focus on the effects of those interventions in future research in accordance with Sivaramakrishnan et al. (2019). According to Tew et al. (2017), yoga represents a holistic activity with expanding popularity which has the potential to produce a range of physical, mental and social benefits. They declared feasibility and effects of an adapted yoga intervention on physical function and health-related quality of life in physically inactive older adults. With yoga, their chances of doing regularly adequate physical activities without any restrictions and in the required quality of the provided activities would be enhanced. This is in line with the results of the publication outputs of European Commission (2016) and the study by Lacroix et al. (2017).

An important aspect of using short-term yoga interventions is to develop balance and mental health in a spa environment as well, where the usual recommended treatment duration is just 4 weeks (Jandová, Formanová, & Morávek, 2018; Náprstek, Krejčí, Kajzar, & Hill, 2019). This represents an entirely new research topic.

Conclusions

Previous research on the effects of yoga has not involved an examination of effectiveness on a very short yoga-based intervention, specifically on posture control, body composition and mental health in elderly men. Results of this study intimated tendencies for positive change in posture control, functional mobility and body composition after the intensive short-term yoga program in elderly men. To optimize the mental aspects of functioning and health, yoga exercises need to be performed for a longer time period. Further research would be needed to understand what neuromotor and psychic mechanisms may underlie the simultaneous effects of both balance and the mental state during yoga in elderly men.

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Conflict of interest

There were no conflicts of interest.

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