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YOGA EXERCISE INTERVENTION IMPROVES BALANCE CONTROL AND PREVENTS FALLS IN SENIORS AGED 65+

UKREP Z VAJAMI JOGE IZBOLJŠA NADZOR RAVNOTEŽJA IN PREPREČUJE PADCE PRI STAREJŠIH OD 65 LET

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ABSTRACT

Introduction: Body balance control represents a key factor preventing falls and subsequent injuries in seniors aged 65+. Intervention based on yoga exercises seem to be effective in improving balance.

Objective: The objective is to analyse and compare changes in static, dynamic, and total balance scores, changes in body composition and social indices as effects of yoga-based intervention.

Methods: A total of 500 participants (234 men aged 74.5 SD±7.74 and 266 women aged 76.9 SD±7.23) were assessed using the Tinetti Balance Assessment Tool, the InBody 230 bioimpedance body composition analyser, and the SF-36 Health Survey, applied to pre and post-testing. The experimental group (n=262; 122 males; 140 females) underwent a four-week yoga-based intervention, 30 minutes daily, while the control group (n=238; 112 males; 126 females) underwent its usual daily programme at senior homes or centres. The ANOVA model, consisting of the Group, Stage, Subject and Group × Stage interaction factors, was used for data evaluation.

Results: Intervention led to improvements in the static, dynamic and total balance scores in the experimental group compared to the control group. The results of SF-36 showed positive changes in the psychosocial aspects of health, such as promoting of calmness and happiness in male seniors and reducing fatigue, nervousness and depression in female seniors. The post-intervention decrease in body fat percentage and increase in muscle mass in seniors is discussed.

Conclusions: The four-week yoga-based intervention had positive effects on the static, dynamic and total balance scores, body composition and social status.

Keywords:
ageing, balance control, chair yoga, health promotion, social health

IZVLEČEK

Uvod: *Nadzor telesnega ravnotežja je ključni dejavnik za preprečevanje padcev in posledičnih poškodb pri starejših od 65 let. Videti je, da ukrep na osnovi vaj joge učinkovito pripomore k izboljšanju ravnotežja.*

Cilj: *Cilj je analizirati in primerjati spremembe ocene statičnega, dinamičnega in skupnega ravnotežja, spremembe sestave telesa ter spremembe socialnih kazalnikov po izvedbi ukrepa na osnovi vaj joge.*

Metode: *500 udeležencev (234 moških povprečne starosti 74,5 leta, SD ± 7,74 leta, in 266 žensk povprečne starosti 76,9 leta, SD ± 7,23 leta) je bilo v predhodnem in naknadnem testiranju ocenjenih z orodjem Tinetti za oceno ravnotežja (Tinetti Balance Assessment Tool), analizatorjem bioelektrične impedance InBody 230 in vprašalnikom o zdravju SF-36. Pri eksperimentalni skupini (n = 262; 122 moških; 140 žensk) je bil izveden 4-tedenski ukrep na osnovi vaj joge, ki so se izvajale 30 minut na dan, medtem ko je kontrolna skupina (n = 238; 112 moških; 126 žensk) izvajala svoj običajen dnevni program v domovih ali centrih za starejše. Za oceno podatkov je bil uporabljen model ANOVA s faktorji Skupina, Stopnja in Subjekt ter interakcijo Skupina × Stopnja.*

Rezultati: *Ukrep je v eksperimentalni skupini privedel do izboljšanja ocene statičnega, dinamičnega in skupnega ravnotežja v primerjavi s kontrolno skupino. Rezultati vprašalnika SF-36 so pokazali pozitivne spremembe na področju psihosocialnih vidikov zdravja, kot sta povečanje mirnosti in sreče pri starejših moških ter zmanjšanje utrujenosti, živčnosti in depresivnosti pri starejših ženskah. Opisano je zmanjšanje odstotka telesne maščobe in povečanje mišične mase pri starejših po izvedbi ukrepa.*

Zaključki: *4-tedensko izvajanje ukrepa na osnovi vaj joge je pozitivno vplivalo na oceno statičnega, dinamičnega in skupnega ravnotežja, sestavo telesa in socialni status.*

Ključne besede:
staranje, nadzor ravnotežja, joga na stolu, promocija zdravja, socialno zdravje

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1 INTRODUCTION

The European Union defines the term 'senior' as a person aged 65 years and above with rights to a pension, social security and healthcare (1, 2). Seniors aged 65+ are at higher risk of falling, which can be potentially devastating for maintaining independence (3, 4). Fear of falling and the consequent loss of independence are a common challenge among seniors (5). Longer life expectancy will result in a greater proportion of seniors suffering from locomotor impairment. More comprehensive rehabilitation and training practice is therefore necessary (6). From this point of view, chair-based yoga interventions could be an effective rehabilitation strategy among the elderly (7). Balance development exercises have been shown to reduce the risk of falls. Effective and safe exercises may reverse frailty in the elderly, can increase strength and power, improve balance and reduce fall incidence. From this perspective, exercise interventions should become a daily routine among the elderly (8). A lack of movement, i.e. 'hypokinetic syndrome', manifests itself in impulsiveness, irritability, a reduced ability to concentrate, and increased anxiety and depression (8, 9). A common problem among the elderly is fear and anxiety about the deterioration of balance control and the consequent loss of independence (10). Whereas the limbic system is involved in conscious activity, the amygdala is involved in the emotional evaluation of input information and emotion-driven behaviour, including social interaction. The information that passes from the parabrachial pathway to the amygdala brings information about pain, including information from the skin and internal organs, with the accompaniment of emotions associated with pain, anxiety, phobia, etc. (11). The efferent pathways from the amygdala go mainly to the hypothalamus, which is the site of stress transfers to the autonomic, immune, endocrine and humoral management systems. The ageing of the hypacus, eye defects and other sensory disorders lead to somatic imbalances and therefore emotional imbalances, with all the negative effects these have on social interaction. Balance intervention, which involves the leaching of endorphins and enkephalins, has a positive effect on amygdala function and, secondarily, a positive impact not only on somatic balance but also on emotional and social balance (12, 13). A combination of function-oriented challenges with balance control that stimulates the sensory and neuromuscular control mechanism, as well as muscle strength, body flexibility and joint mobility, may be realised among the elderly through the application of a short-term yoga-based intervention (14, 15). The results of a four-week yoga-based intervention indicated that participants' body fat percentage and systolic blood pressure decreased, and that balance and the range of motion of shoulder flexion and abduction improved. It is important to note that other similar exercise intervention studies for the elderly showed that the positive effects on balance development and body composition (16, 17) lasted only four weeks. The objective is to analyse and compare changes in static, dynamic and total balance scores, changes in body composition and social indices as effects of yoga-based intervention. Based on the objective of the study, the hypothesis is that 'applied four-week intensive intervention based on yoga exercises leads to a significant improvement in the total balance score among seniors in the experimental group'.

2 METHODS AND PROCEDURE

2.1 Participants and data collection

A study involved 500 seniors aged 65+ (234 men with an average age of 74.5 SD±7.74; 266 women with an average age of 76.9 SD±7.23), selected by stratified randomised sampling from all the regions of the Czech Republic. The participants were grouped into the experimental group (n=162; 122 males, age average 72.8, SD±7.44, median 71 (67.0, 78.0); 140 females, age average 76.1, SD±8.03, median 76.0 (69.0, 81.0) and the control group (n=112 males, age average 72.2, SD±6.54, median 71.0 (67.0, 74.0); 126 females, age average 72.9, SD±7.32, median 70.5 (67.0, 76.0). During randomising, similar numbers of participants for both samples were retained in the homes or centres at which the participants were based.

All the participants signed up for the research voluntarily, which they confirmed by signing a consent form in the medical record. Before they signed the form, all participants were given information on the method, measurements and exercise itself. However, participants were not informed of the purpose of the research. The research institution's ethics committee expressed its full agreement and indicated that the research conformed with the requirements stipulated in the Declaration of Helsinki. The exclusion criteria for the involvement of participants in the experimental study were determined according to the White Book on Physical and Rehabilitation Medicine in Europe (18) and were as follows: (i) human-to-human infectious diseases and bacillus carriers, (ii) all acute-stage diseases and conditions in which destabilisation of health status can be reasonably expected, (iii) cachexia of various aetiologies, (iv) malignant tumours, (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.

The pre/post examination started with the medical anamnesis provided by a physician, followed by a bioimpedance assessment of body composition provided by an anthropologist. Subsequently, a balance exam using the Tinetti Balance Assessment Tool was provided. Each participant then completed an SF-36 survey with the assistance of a researcher. The survey was used according to its official manual (19).

2.2 Methods

2.2.1 Medical anamnesis

The medical anamnesis protocol was performed by a physician (20) using a standardised protocol specifically focused on the current health status of seniors and on drugs, injuries and surgeries. Finally, the physician made a medical recommendation as to whether to include an individual in the study.

2.2.2 Pre/post examination

2.2.2.1 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. The InBody 230 tetrapolar multi-frequency bioelectrical impedance device (InBody, Seoul, South Korea) was used to assess body weight, BMI, body fat percentage and total muscle mass (21), performed at the same time and under the same conditions, in underwear, barefoot, standing upright.

2.2.2.2 Balance assessment

The Tinetti Balance Assessment Tool was used to measure the static, dynamic and total balance score (18). The static balance test is assessed on the basis of the observation of an individual's somatic behaviour during sitting and standing positions and the changes to that behaviour, 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 maximum 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 reported good to excellent intra- and inter-rater reliability, an intraclass correlation coefficient > .80, and medium sensitivity and specificity to identify fallers (22, 23).

2.2.2.3 RAND 36 Short Form Health Survey (SF-36)

SF-36 represents a valid and reliable indicator of overall health status and is used globally. It comprises 36 items, including social health and general health perceptions. The survey has a reliability of r=.65 to .94 across the scales, with a median of .85, resulting in very good internal consistency and item-discriminant validity (24).

2.2.3 Intervention

The experimental group's four-week intervention was focused on body posture, balance control, flexibility, muscle strength, breathing and relaxation. The exercises were carried out using the Yoga in Daily Life System (25), without contraindications to the elderly (Sarvahita Asanas), while sitting on a chair or standing by a chair. They included: pulling arms up, turning the shoulders, leg stretch, hamstring stretch, shoulder stretch, finger stretch, toe stretch, bottom lift, knee bends, forward bend, balance exercises standing behind a chair with support, standing on one leg, diaphragm breathing, modified 'cat pose' breathing, 'lion grimace' breathing, exercises to relax the muscles of the face and neck, and vibration exercises with vibrational effects in the diaphragm, lung and brain areas. Once per week, a main training lesson lasting 90 minutes was conducted with 10–12 participants under the guidance of a coach and two assistants. After this training, each participant received an educational sheet for the specific week. They featured the following mottos: Week 1 'You are never alone', Week 2 'Change is always possible', Week 3 'Movement is life', Week 4 'Enjoy life and every moment' (26). During the week, participants repeated the learned exercises daily for 30 minutes under the supervision of the assistants. The participants were present and supervised at the care centre on a daily basis. During the intervention, the control group had their usual daily regime at the same care centres.

2.3 Data analysis

ANOVA model consisting of the factor Subject (explaining inter-individual variability), the between-subject factor Group (experimental vs. control groups), and the within-subject factor Stage (before intervention vs. after intervention). Before the ANOVA processing, the original data was transformed by means of a power transformation to attain symmetrical distribution and constant variance (homoscedasticity) in data and residuals (27). Data distribution symmetry and data homogeneity were checked as described elsewhere (28). The statistical software Statgraphics Centurion 18 from Statgraphics Technologies, Inc. (The Plains, Maryland, USA) was used for the calculations.

3 RESULTS

A good randomised experiment is an essential tool for testing the efficacy of any intervention. We therefore tried to generate comparable intervention groups that would be alike in all important aspects (except for the intervention). The basic values of the subjects assigned to the control and experimental groups are presented according to sex, i.e. basic values of monitored men (Table 1) and monitored women (Table 2). The values presented displayed a high level of accordance before the intervention in the monitored groups.

3.1 Balance changes

In both, i.e. among the monitored males and females, the intervention effect on balance was found to be significant for the performance of the static and dynamic balance

test, p<.001. The Group×Measurement interaction (p<.001) showed significant improvements of static and dynamic balance in the experimental group compared to the control group of monitored male and female seniors. A significant positive effect of the intervention was also indicated by the Group×Measurement interaction for the total balance score (p<.001), see Tables 3 and 4.

3.2 Body composition changes

On the basis of statistical analyses of body composition, the data verified that both, i.e. male and female seniors in the experimental group, had more muscle mass after the intervention compared to males and female seniors in the control group. The intervention led to a significant improvement in two body composition measurements. In the experimental group, the body fat percentage decreased among the monitored seniors (males by 1.7%, females by 1.9%) while in the control group, the median of this variable increased (males by 0.3%, females by 0.15%). The analysis showed that the measurement had a significant effect on body fat percentage, p<.001, with a large effect size.

In seniors in the experimental group, total muscle mass increased (males by median 1.3 kg, females by median 1.03 kg) after the intervention, while seniors in the control group remained at the same mean values (Tables 3 and 4).

3.3 Intervention effects on psychosocial health indicators

The post-intervention results of the social indicators among monitored male seniors showed that the intervention had significant positive effects on self-help abilities (Table 3). The yoga-based intervention led to positive changes in performance and in concentration on work and other activities, and in emotional balance, i.e. feelings of calmness and happiness (Table 3). By contrast, there were no psychosocial changes among male seniors in the control group.

From the statistical analyses of the SF-36 survey, the females in the experimental group displayed higher post-intervention emotional and social progress. Compared to females in the control group, they enjoyed a reduction in fatigue, nervousness, sadness, and depression (see Table 4), thereby increasing their potential for social interaction. Progress in physical fitness, such as 'climbing one staircase', also indicates a significant improvement in independence and possible social interactions among female seniors in the experimental group (Table 4).

Table 1. Basal values (shown as median with quartiles) of monitored groups of male seniors (N=234; Experimental group: 122 males; Control group: 112 males).

Variable	Control group	Experimental group	p-value*
Age (years)	71 (67.1, 74.3)	73 (68, 80)	0.186
Height (cm)	174 (170, 178)	174 (170, 180)	0.790
Weight (kg)	82 (73.8, 94.3)	85 (77.8, 90)	0.575
Body fat (%)	26 (22, 35)	26 (22, 33.3)	0.838
Muscle mass (kg)	34 (29, 39)	35 (30, 40)	0.388
Static balance score	14.5 (11, 16)	14 (10.8, 15)	0.394
Dynamic balance (gait score)	10 (9, 12)	10 (8, 12)	0.195
Total balance score	25 (21, 27)	24 (18, 27)	0.280

*Mann-Whitney test

Table 2. Basal values (shown as median with quartiles) of monitored groups of female seniors (N=266; Experimental group: 140 females; Control group: 126 females).

ID	KS	ES	p-valuew
Age (years)	70 (67, 76)	73 (68, 80)	0.034
Height (cm)	164 (160, 168)	163 (158, 166)	0.409
Weight (kg)	73 (64, 81.2)	71.4 (62.5, 83)	0.487
Body fat (%)	33.5 (30, 42)	35 (27, 45.2)	0.959
Muscle mass (kg)	30 (25.3, 32.1)	30 (24, 32)	0.528
Static balance score	14 (11, 16)	15 (10, 16)	0.872
Dynamic balance (gait score)	10.5 (9, 12)	11 (8, 12)	0.800
Total balance score	24 (21, 27.8)	25 (18, 28)	0.823

Table 3. Significant differences in pre-post changes (significant Group × Stage interaction) in the Tinetti balance test scores, body composition and social indicators after the balance-exercise intervention when a comparison is made between the experimental and control groups of monitored male seniors (N=234; experimental group: 122 males; control group: 112 males).

Variable	Experiment	ANOVA, factors and interaction													
		Stage		Group			Pre-Post			Group × Stage			Subj(Group)		
		Pre	Post	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
Static balance score	-	13.8 (13.7, 13.9)	13.9 (13.8, 14)	30.2	<0.001	0.17	29.7	<0.001	0.167	11.1	0.001	0.07	46.1	<0.001	0.979
	+	13.2 (13.2, 13.3)	13.8 (13.7, 13.8)												
Dynamic balance (gait score)	-	10.4 (10.3, 10.5)	10.3 (10.3, 10.4)	32	<0.001	0.173	6.9	0.01	0.043	13.3	<0.001	0.08	34.2	<0.001	0.972
	+	9.9 (9.83, 9.96)	10.2 (10.2, 10.3)												
Total balance score	-	24.1 (24, 24.3)	24.2 (24.1, 24.3)	61	<0.001	0.29	24.5	<0.001	0.141	18.1	<0.001	0.108	66.2	<0.001	0.985
	+	23.1 (23, 23.2)	23.9 (23.8, 24)												
Body fat (%)	-	26.6 (26.3, 26.9)	26.9 (26.6, 27.2)	14.3	<0.001	0.113	14.9	<0.001	0.117	30.5	<0.001	0.214	60.3	<0.001	0.984
	+	26.9 (26.7, 27.2)	25.2 (25, 25.5)												
Muscle mass (kg)	-	33.9 (33.8, 34.1)	33.9 (33.7, 34)	243.8	<0.001	0.683	40.9	<0.001	0.266	48.7	<0.001	0.301	155.6	<0.001	0.994
	+	34.8 (34.7, 34.9)	36.1 (36, 36.2)												
Q12 Self-help ability	-	2.96 (2.95, 2.98)	2.93 (2.92, 2.94)	61.8	<0.001	0.288	3.6	0.061	0.023	7.3	0.008	0.046	19	<0.001	0.95
	+	2.88 (2.87, 2.89)	2.89 (2.88, 2.9)												
Q18 Accomplished less than would like	-	1.85 (1.83, 1.87)	1.82 (1.8, 1.85)	20	<0.001	0.115	0.2	0.624	<0.01	4.8	0.03	0.03	14.5	<0.001	0.936
	+	1.75 (1.73, 1.77)	1.79 (1.77, 1.81)												
Q19 Less careful in work or other activities	-	1.85 (1.83, 1.87)	1.85 (1.83, 1.87)	54.5	<0.001	0.263	4.7	0.032	0.03	4.7	0.032	0.03	19.7	<0.001	0.952
	+	1.72 (1.7, 1.73)	1.78 (1.76, 1.8)												
Q26 Feelings of calmness	-	2.94 (2.85, 3.04)	2.64 (2.55, 2.73)	27.5	<0.001	0.153	7.3	0.008	0.046	5.8	0.018	0.036	11.9	<0.001	0.923
	+	2.49 (2.42, 2.56)	2.47 (2.4, 2.54)												
Q30 To be happy	-	3.08 (2.98, 3.18)	2.83 (2.73, 2.92)	38	<0.001	0.199	2.1	0.151	0.013	6.6	0.012	0.041	11.7	<0.001	0.922
	+	2.53 (2.45, 2.6)	2.6 (2.52, 2.67)												

F, p, and η_p^2 represent F-statistics, p-values, and effect sizes, respectively. For the effect size: 0.01 ~ small effect, 0.06 ~ medium effect, >0.14 ~ large effect.

*Retransformed mean with 95% confidence intervals

Table 4. Significant differences in pre-post changes (significant Group × Pre-Post interaction) in the Tinetti balance test scores, body composition and social indicators after the balance-exercise intervention when a comparison is made between the experimental and control groups of monitored female seniors (N=266; experimental group: 140 females; control group: 126 females).

Variable	Experiment	ANOVA, factors and interaction													
		Stage		Group			Pre-Post			Group × Stage			Subj(Group)		
		Pre	Post	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
Static balance score	-	13.5 (13.4, 13.5)	13.6 (13.5, 13.6)	16.9	<0.001	0.063	23.3	<0.001	0.084	0.7	0.404	<0.01	161.5	<0.001	0.994
	+	13.6 (13.5, 13.6)	13.7 (13.7, 13.8)												
Dynamic balance (gait score)	-	10.4 (10.3, 10.4)	10.4 (10.4, 10.5)	<0.1	0.906	<0.01	11.5	<0.001	0.041	4.9	0.027	0.018	38.4	<0.001	0.975
	+	10.3 (10.2, 10.3)	10.5 (10.5, 10.5)												
Total balance score	-	23.8 (23.7, 23.9)	24 (23.9, 24.1)	4.6	0.032	0.017	35.5	<0.001	0.116	9.7	0.002	0.035	84	<0.001	0.988
	+	23.8 (23.7, 23.8)	24.3 (24.3, 24.4)												
Body fat (%)	-	35 (34.8, 35.3)	34.9 (34.6, 35.1)	29.5	<0.001	0.121	47.2	<0.001	0.18	34.3	<0.001	0.138	95.8	<0.001	0.99
	+	35.1 (34.9, 35.3)	33.2 (33.1, 33.4)												
Muscle mass (kg)	-	29.2 (29.1, 29.3)	29.5 (29.4, 29.6)	2.2	0.142	0.01	102.6	<0.001	0.328	32.4	<0.001	0.134	106	<0.001	0.991
	+	29 (28.9, 29)	30 (29.9, 30.1)												

Variable	Experiment	Stage		ANOVA, factors and interaction											
				Group			Pre-Post			Group × Stage			Subj(Group)		
		Pre	Post	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
Q3 Vigorous activities	-	1.76 (1.74, 1.78)	1.73 (1.71, 1.75)	2.9	0.089	0.011	<0.1	0.94	<0.01	5.2	0.023	0.019	15.2	<0.001	0.938
	+	1.71 (1.69, 1.73)	1.74 (1.73, 1.76)												
Q7 Climbing one flight of stairs	-	2.57 (2.54, 2.59)	2.55 (2.52, 2.57)	57.3	<0.001	0.175	1.9	0.173	<0.01	6.7	0.01	0.024	30.3	<0.001	0.968
	+	2.4 (2.38, 2.42)	2.47 (2.45, 2.49)												
Q24 To be nervous	-	4.44 (4.37, 4.52)	4.33 (4.25, 4.4)	0.5	0.489	<0.01	<0.1	0.907	<0.01	5.7	0.018	0.021	9.8	<0.001	0.907
	+	4.36 (4.31, 4.42)	4.47 (4.42, 4.52)												
Q25 Depressive feelings	-	5.32 (5.26, 5.38)	5.25 (5.19, 5.31)	6.2	0.013	0.022	0.1	0.819	<0.01	4.5	0.034	0.017	11.9	<0.001	0.923
	+	5.15 (5.1, 5.19)	5.24 (5.19, 5.28)												
Q31 To feel tired	-	3.66 (3.6, 3.72)	3.55 (3.49, 3.62)	22.9	<0.001	0.078	0.3	0.596	<0.01	4.3	0.039	0.016	13.5	<0.001	0.931
	+	3.76 (3.72, 3.81)	3.82 (3.78, 3.87)												

F, p, and η_p^2 represent F-statistics, p-values, and effect sizes, respectively. For the effect size: 0.01 ~ small effect, 0.06 ~ medium effect, >0.14 ~ large effect.
*Retransformed mean with 95% confidence intervals

4 DISCUSSION

Postural control is essential for active daily activities and is an integral part of elderly independence and mobility. The personal, social and economic burden of health complications caused by falls and balance problems among seniors is still an issue globally, as highlighted by authors (29, 30) in the USA, EU and Canada within the context of chronic diseases and disabilities. As our findings show, the Tinetti Balance Assessment Tool may be used to evaluate the risk of falls as well as the measures and interventions taken to prevent falls and to develop gait in the elderly. This is consistent with the statement that gait ability prior to fracture had a significant impact on an elderly person's ability to survive after suffering a hip fracture (31).

It is therefore possible to recommend regular yoga-based exercises for seniors aged 65+, as it helps to reduce the number of fall-related cases. The results of the present study demonstrate that yoga-based interventions can have significant positive effects, and can therefore be recommended to seniors aged 65+ to help them develop postural control in a relatively short time. In this study, a short-term yoga-based intervention also led to an improvement in the dynamic balance of monitored seniors aged 65+, and can therefore help optimise walking. These results are consistent with the results of other studies that have highlighted the positive effects of yoga-based intervention and that make similar recommendations for improving balance confidence and stability among older people after a six-week multimodal balance-enhancing exercise programme (32, 33).

It seems plausible that regular yoga training can support anabolic processes in the elderly. This statement is consistent with the results of the studies (34, 35). Accordingly, it can be argued that men aged 65+ can respond positively to exercise intervention, including reductions in body fat and increases in muscle mass, because of testosterone. However, we should also address the increase in muscle mass and fat loss in women aged 65+. The authors (36, 37) state that routine yoga exercises affect the use of protein throughout the body in healthy older women. After yoga-based intervention, the participants had lower body fat and higher muscle mass than those who did not practise yoga; moreover, they also tended to have better balance. Practising yoga can improve protein utilisation and lead to the maintenance of muscle mass in females later in life, when muscle loss is common.

The study looks at the social effects within the context of positive changes in balance control and body composition. The results are consistent with the results of studies (38, 39) that highlight the psychosocial health benefits of yoga-based interventions. The present study is unique in that it examines the effects after a four-week intervention.

There were also positive increases in subjective feelings of happiness, vitality, energy and social balance. The results may inspire future research applications in the field of kinanthropology, healthcare and social care. Applied yoga techniques, which promote total balance performance in seniors aged 65+ in a simple and effective way, may be the subject of further research, with a particular focus on intersexual interactions with balance improvement.

4.1 Limitations of the study

The findings should be interpreted with caution. Further validation of the research is required. Although the results are promising and the number of subjects was relatively high, they may not be representative of the general senior public at the age under observation. Another limitation of the present study was the potential influence of the actual state of anxiety on the performance of static and dynamic balance. However, it should be emphasised that measurements using the Tinetti tool are adequate for the seniors monitored.

5 CONCLUSIONS

The significant positive improvements in static and dynamic balance, with significant body integration, including decreases in fat and increases in muscle mass, point to the importance of simple yoga exercises, which could constitute a safe physical activity for the over 65s. Chair-yoga based intervention represents a financially and spatially undemanding, physically well manageable, feasible, well-tolerated, and safe intervention, and one that may help seniors to develop the balance condition necessary for mobility and social interactions. Using yoga-based intervention to increase social balance is a highly relevant topic for the over 65s.

The findings of the study are new, and provide a basis for future research interventions to promote active ageing.

CONFLICT OF INTEREST

The authors declare that no conflicts of interest exist.

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ETHICAL APPROVAL

The study was approved by the Ethics Committee of the College of Physical Education and Sport PALESTRA, Prague, Czech Republic.

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