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The impact of multicomponent programmes on balance and fall reduction in adults with intellectual disabilities: a randomised trial

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Abstract

Background One challenge a modern society faces is this: providing those vulnerable and ageing groups of adults who have intellectual disabilities with appropriate support for improving static and dynamic balance. Balance is a crucial component of physical fitness and, consequently, of fall reduction and prevention. The aim of the present randomised controlled trial was to evaluate the efficacy, after 16 weeks, that three different Special Olympics physical activity programmes had on balance and on fall reduction in adults with intellectual disabilities.
Method A convenience sample of 150 persons with mild and moderate intellectual disabilities was recruited from the accessible Special Olympics Slovenia population of physically inactive adults with intellectual disabilities. The sample was randomised to the experimental group 1 (multicomponent balance-specific exercise programme group with additional workshops on such social gerontology topics as active and healthy ageing; $N = 50$), the experimental group 2 (multicomponent wellness programme group; $N = 50$) and a control group (regular Special Olympics athletic training; $N = 50$).
Results Significant differences were found between groups in the balance scores throughout the study period and in the ability to decrease fall frequency.
Conclusions Balance assessment is a high predictor of frequency of falls, and among adults with intellectual disabilities, it significantly correlates with exercise. The results indicate that a multicomponent balance-specific exercise programme with a significant sociogerontological component on active ageing could be a useful intervention for intellectually disabled adults who have poor balance and who experience frequent falls.

Keywords adults with intellectual disabilities, balance, falls, motor activity programmes, Special Olympics

Introduction

Special Olympics (SO) is primarily concerned with a variety of sports programmes; it has, secondarily, developed a number of non-sports programmes that have been designed to benefit athletes with

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intellectual disabilities (IDs) in order to improve their sport performance and overall health (Temple *et al.* 2014). One of the SO Healthy Athletes Programmes is the physiotherapy programme FUNfitness (HAP FF), which was developed in collaboration with the American Association of Physical Therapists in order to provide an assessment of athletes' physical fitness, to provide consultation in order to safely improve their sport performance and to determine whether any follow-up care is needed after HAP FF screening (Bainbridge *et al.* 2013). HAP FF screening of SO athletes globally reveals high levels of unmet balance and physical fitness needs (Bainbridge *et al.*, 2015a). SO's current goal of reaching 11 million people with ID and providing improved access to health services and ensuring 100 healthy communities by 2020 is a milestone on a journey towards ensuring health care and services for all people with ID worldwide (Lorenzo *et al.* 2016).

Despite progress within SO health programmes and global/regional systems, and despite the adoption of the United Nations Convention on the Rights of Persons with Disability, and the '2030 Agenda for Sustainable Development' (Sustainable Development Goals), people with ID continue to face significant barriers identified in national health systems (policies, planning, laws, information, human resources and/or services) (Hahn 2012; Hahn *et al.* 2012; Patel & Greydanus 2010). When comparing people with ID and other developmental disorders to their peers in the mainstream population, we see that the former are more prone to experience poor access to quality health services (Carey *et al.* 2016) and health inequalities (Dieckmann *et al.* 2015). Consequently, there has also been an increased interest in finding solutions for the multidimensional problems stemming from poor physical fitness of people with ID and other developmental disorders, for the active ageing policies of such individuals, and for the promotion of a healthy lifestyle for the ageing population with ID (Patel & Greydanus 2010). Both static balance and dynamic balance are important factors for good posture and the ability to sit, stand, walk and run as well as to perform other functional activities without falling; furthermore, they are significant determinants of a healthy lifestyle and well-being. Good physical fitness and balance are also significant factors in fall prevention. Falls considerably contribute to increased mortality and morbidity, which leads to changes in functioning, disabilities, the limiting of activities and participation in activities, restrictions, increased hospitalisations, admissions to institutions such as nursing homes and increased costs of social and health care (Hahn 2012; Finlayson *et al.* 2010; Morisse *et al.* 2013). Previous studies report that older adults with ID experience poor balance (Hale *et al.* 2007; Cleaver *et al.* 2009) and a higher frequency of falls (multiple falls) and fall-related injuries when compared with the majority of the mainstream population of the same age (Smulders *et al.* 2012; Finlayson *et al.* 2010; Hale *et al.* 2007; Hsieh *et al.* 2012). Previous studies have also examined the factors that influence balance as well as the training methods that improve balance (Lee *et al.* 2016; Kachouri *et al.* 2016; Jankowicz-Szymanska *et al.* 2012; Oviedo *et al.* 2014; Fallah *et al.* 2014). Although the relation between balance and falls has been researched (Enkelaar *et al.* 2012; Dijkhuizen *et al.* 2017), the authors have found no evidence of studies that simultaneously investigate the influences of physical activity (PA) on balance and falls in adults with ID.

Currently, there is no central register detailing the actual number of adults with ID in Slovenia. This fact makes it difficult to target services at this group and to monitor the state of their health in terms of health inequalities and to map appropriate levels of support. The preliminary results of HAP FF Slovenia showed that 95% of 1674 adult SO athletes with ID are not physically active, do not train athletics on regular basis and experience balance problems (Kapel & Kovačič 2018). There was an urgent need for follow-up care for the 180 SO athletes who participated in HAP FF and who had poor balance scores and a history of frequent falls during actual SO sport events, training or everyday life (these particular athletes participate only in track events – i.e. 50, 100 and 200 m races). Other SO athletes train and compete in multiple sports and have better balance scores according to HAP FF analysis (Doberšek *et al.* 2017).

Fitness is becoming the bridge between Health and Sport, offering improved athletic performance and increased opportunities for inclusion. Within SO Healthy Athletes Programmes, nutrition and hydration are taught in the health promotion programme. PA, including balance, coordination, strength and flexibility/stretching, is discussed in HAP FF. Both disciplines can have recourse to a fitness programme. SO offers practice, training and skills focused on sport activities. Fitness should address both health and sport areas (Lorenzo *et al.* 2016).

In 2017, SO Slovenia achieved the status of a healthy community (HC). The goal of HC is to increase access to health, fitness and wellness programmes for people with ID and to improve the health status of people with ID (after HAP FF screening) who have poor balance and a history of falls. The HC award recognises SO programmes that have expanded HAP and developed partnerships and programming that provide ongoing follow-up physiotherapy/health care, health education, wellness and fitness opportunities and community support. Health Community Initiatives is the most ambitious global project to date aimed at improving the health and wellbeing of persons with IDs (Lorenzo *et al.* 2016). In line with this, follow-up care after HAP FF screening is essential and has to be strengthened. We have carried this out on the basis of the results of a previous study (Rugelj 2016), and in agreement with HAP FF, with the American College of Sports Medicines recommendations (Lorenzo *et al.* 2016), and with World Health Organization PA recommendations (World Health Organization, 2010). The wellness programme was developed by SO Slovenia in order to expand fitness offerings to SO athletes interested in pursuing year-round, lifelong physical fitness and a healthy lifestyle. The purpose of the present randomised controlled study was to investigate the effects of two different multicomponent SO 16-week programmes (the multicomponent balance-specific exercise programme – MBSEP and wellness programmes) on static and dynamic balance and fall reduction among physically inactive SO athletes; the broader aim is to use these findings as an integral part of future comprehensive intervention for adults with ID who live a sedentary lifestyle and who have a poor balance and fall history.

Methods

Randomised controlled trial (RCT) protocol has been independently reviewed and approved by the research committee of Alma Mater Europaea (European Center Maribor [ECM]) and the board of ethics committee of the Republic of Slovenia (Nu: 0120-598/2017/7). The study has been approved by the board committee of SO Slovenia. The RCT was conducted in full accordance with ethical principles, including those of the World Medical Association Declaration of Helsinki. The RCT was undertaken with the understanding and written consent of each adult participant with ID (or his or her legal guardian) and in accordance with the above-mentioned principles. The consent has been prepared to facilitate the participant's or legal guardian's understanding of the study and for what they are providing informed consent to.

Study design and participants

The SO Slovenia programme provided a list of all adult athletes in their programme who, despite the designation, are physically inactive (<600 min/week); SO Games Management System software and HAP FF data were used for this purpose. The list of 180 SO athletes with ID who are categorised as being inactive and having a fall history (one fall or more in the past 4 months) was derived from the HAP FF data (in October 2017 for inactive adults with ID) compiled of all 1674 (both physically inactive and active) Slovenian SO athletes older than 18. PA level was determined according to the International Physical Activity Questionnaire (long form).

The stratified random sampling was used for recruitment using the Slovenian SO database (SO Games Management System software) and HAP FF data. A randomisation list was prepared by the independent statistician using random permuted blocks. This technique ensured that equal numbers of inactive adults with ID within each stratum were randomised to each intervention (restricted stratified randomisation). All 150 participants were randomly selected from predetermined strata that correlated with variables in the study (from 79 national SO member programmes within Slovenia, representing both urban and rural areas across all geographic regions in Slovenia). An important feature of stratified randomisation was the use of random permuted blocks, which ensured that equal numbers of adults with Down syndrome, cerebral palsy, autism spectrum disorder, Prader–Willi syndrome, attention deficit hyperactivity disorder and others with mild and moderate ID within each stratum were randomised to each intervention group. Stratification of variables known to influence outcome was carried out in our

RCT design. Stratified randomisation procedures have taken athletes' characteristics into account in order to equalise the groups according to the previously mentioned variables. Our purpose was to reduce sampling error and to increase the external validity of the study.

We used double-blind RCT to make sure the selected people with ID did not know in which of the three programmes they were involved. Even those who tested the participants were unaware of which group they were in. In order to eliminate bias from results, none of the directly involved parties knew which group the adults with ID were allocated to (study or control). Because of the increased control of confounding variables, participants were not included in other therapeutic or recreational activities or in any other PA (during the study period) that might influence the results.

In Tables 1 and 2, the information on the age and weekly PA of participants are presented.

There are 75 men and 75 women in total, with 39 right-handed and 11 left-handed participants in each group of the three groups of 50.

In each group, only one recruit was using assistive devices.

The inclusion criteria are as follows:

- adults (≥18 years) with mild and moderate ID (i.e. ID is diagnosed using medical data),
- physically inactive people who do not reach the World Health Organization recommendations on weekly PA level,
- people who experienced one or more falls during a SO sport events, training or everyday life in the 4 months previous to the study, with no restraints in terms of World Health Organization recommendations on PA (mandatory general practitioner clearance to participate in a PA programme),
- ambulatory (i.e. able to walk independently),
- ability to consent (the ID individuals or their legal guardians had given informed consent in writing. If a guardian signed to provide informed consent but the individual with ID did not want to participate, the individual was not enrolled),
- communication – potential participants should be able to communicate preferences (e.g. whether they liked or disliked exercise), wants (e.g. whether they wanted to exercise more, to do PA for balance) and needs (e.g. assistance with physical activities regimes and transportation issues) through spoken language, and
- residential status: living with parents or in supported living (institutions and small group homes).

The exclusion criteria are as follows:

- adults (≥18 years) with severe and profound ID who could not understand the instructions and were not able to understand the meaning and purpose of the study,
- atlantoaxial instability,
- other limitations (guidelines from their primary care physician),
- no fall history,
- physically active (at least 600 min/week),
- health concerns:
- individuals with restraints according to World Health Organization recommendations on PA (mandatory general practitioner clearance to participate in a PA programme),
- individuals with uncontrolled hypertension, severe heart disease, cancer, diabetes, vestibular disorders and

Table 1 Information on the age of participants

Age (years)	Control group (SO training)		Experimental group 1 (MBSEP)		Experimental group 2 (Wellness)	
	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)
18–29	32	64.0	32	64.0	29	58.0
30–39	14	28.0	14	28.0	18	36.0
40–49	4	8.0	3	6.0	2	4.0
>50	0	0.0	1	2.0	1	2.0
All	50	100.0	50	100.0	50	100.0

SO, Special Olympics.

Table 2 Information on the weekly physical activity of participants

Physical activity per week (days)	Control group (SO training)		Experimental group 1 (MBSEP)		Experimental group 2 (Wellness)	
	Number	Ratio (%)	Number	Ratio (%)	Number	Ratio (%)
Three or more days most weeks	0	0.0	0	0.0	0.0	0
Less than 3 days most weeks (all connected to SO training)	41	82.0	42	84.0	40	80.0
No regular physical activity programme	9	18.0	8	16.0	10	20.0
All	50	100.0	50	100.0	50	100.0

SO, Special Olympics.

- individuals with double diagnosis (ID and psychiatric disorder) who are currently being treated for depression or schizophrenia.

Procedures

Participants with mild and moderate ID were assessed at two stages: before starting interventions (before stratified randomisation) and after 4 months of involvement in three specific SO programmes.

Assessment included measuring of static/dynamic balance and reporting frequency of falls at baseline (i.e. prior to randomisation) and after 16 weeks of randomisation. Balance was tested using the Fun Fitness battery test (a functional reach test and a single leg stance test with eyes opened/closed) (Bainbridge *et al.* 2013). The functional reach test was performed1 h after the PA programme in order to avoid the influence of tiredness. All the assessments were carried out individually in well-lit, quiet, air-conditioned rooms.

Interventions

Once a week (for 60 min), the MBSEP group (experimental group 1) received a multicomponent balance-specific exercise programme described in detail elsewhere (Rugelj 2016) under the guidance of a physiotherapist (with specialisation in neurodevelopmental physiotherapy); twice a week (each time for 60 min), they participated in an individual programme under the supervision of a PT student and in line with World Health Organization guidelines (Evenhuis *et al.* 2000; World Health Organization 2000). MBSEP was designed as group-based physiotherapy programme with lectures and counselling on healthy, active ageing provided by the social gerontologist (based on the World Health Organization guidelines for 2015–2030), and incorporating behavioural-change principles as critical elements for initiating and maintaining structured and multifaceted PA in adults with ID. The MBSEP programme included 36 sessions. These were delivered in a community setting (in a gymnasium situated in a local community sports centre) and in collaboration/partnership between SO Slovenia and Alma Mater Europaea ECM (under the patronage of the European Academy of Science and Arts).

All three groups, MBSEP (experimental group 1), wellness (experimental group 2) and control group, received regular SO athletic training according to the Coach's Guide for Athletics (Special Olympics, n.d.) once a week under the guidance of a certified SO coach (60 min) and twice a week individually (60 min) according to the same instructions given by the coach.

The healthy lifestyle component of the wellness programme provided tips and information for athletes and coaches for leading a healthy and active lifestyle through regular PA (fitness sessions), healthy nutrition and proper hydration. Wellness was conducted in a community setting under the guidance of a fitness instructor once a week (60 min) (all together 12 sessions, which were delivered in a community setting in a local fitness centre), a nutritionist (four lectures on the topics of healthy eating and hydration), and four yoga sessions (4 × 60 min balance exercises) in a community spa centre. The fitness session involves treadmill walking or running (15 min) and dynamic exercises (35 min – leg press, bench press, vertical traction, shoulder press, lower back, leg extension,

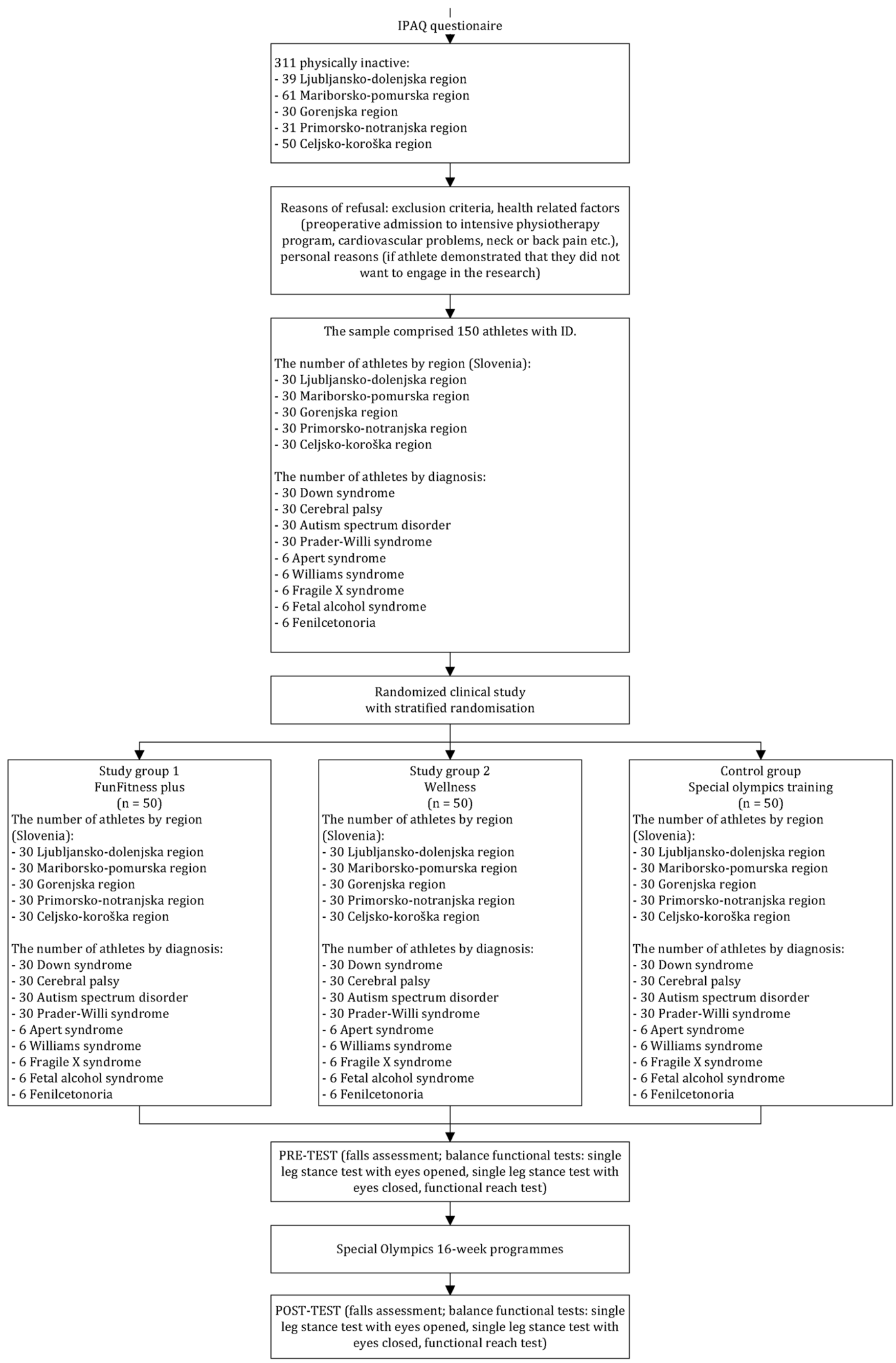

Figure 1. Flow diagram of participants through the study.

biceps curl, triceps pushdown and abdominal curls) and stretching and cooling-down exercises according to (Mendonca *et al.* 2011).

The coaches in the wellness and MBSEP groups were recruited with each athlete with ID. Each coach agreed to participate in each of regular meetings (only for experimental groups) with the participant and to support the participant in a multicomponent programme in community settings.

Figure 1 shows the flow diagram of participants through the study.

Data analysis

Statistical analysis was conducted using IBM SPSS Software, version 22.0. Descriptive statistics were calculated for all outcome measures. For the comparison of mean values for the Fun Fitness battery test and frequency of falls during a 4-month period between groups, two-way analysis of variance (ANOVA) and Tukey's honestly significant difference (HSD) tests were used. Differences were considered significant at $P < 0.05$.

To determine the correlation between static/dynamic balance and frequency of falls during a 4-month period, Pearson correlation coefficient (r) was calculated and interpreted as described by Cohen (1988):

- $<|r| < 0.3$ – small correlation
- $<|r| < 0.5$ – medium/moderate correlation and
- $|r| > 0.5$ – large/strong correlation.

Results

Static balance

The results of 'Single leg stance with eyes open – left leg' (Fig. 1) for the two-way ANOVA indicated a significant main effect for the pre-test/post-test phase, $F_{2,294} = 38.892$, $P < 0.001$, and a significant main effect for the SO programmes, $F_{2,294} = 32.786$, $P < 0.001$. Additionally, the results show a significant interaction between the pre-test/post-test phase and SO intervention programmes, $F_{2,294} = 26.481$, $P < 0.001$.

Tukey's HSD test showed statistically significant differences between the post-test results of 'Single leg stance with eyes open – left leg' for all SO programmes.

The results of 'Single leg stance with eyes open – right leg' (Fig. 2) for the two-way ANOVA indicated a significant main effect for the pre-test/post-test phase, $F_{2,294} = 34.150$, $P < 0.001$, and a significant main effect for the SO programmes, $F_{2,294} = 30.401$, $P < 0.001$. Additionally, the results show a significant interaction between the pre-test/post-test phase and SO programmes, $F_{2,294} = 24.770$, $P < 0.001$.

Tukey's HSD test showed statistically significant differences between post-test results of 'Single leg stance with eyes open – right leg' for all SO programmes.

The results of 'Single leg stance with eyes open – left leg' (Fig. 3) for the two-way ANOVA indicated a significant main effect for the pre-test/post-test phase, $F_{2,294} = 28.607$, $P < 0.001$, and a significant main effect for the SO programmes, $F_{2,294} = 17.540$, $P < 0.001$. Additionally, the results show a significant interaction between the pre-test/post-test phase and SO programmes, $F_{2,294} = 16.183$, $P < 0.001$.

Tukey's HSD test showed statistically significant differences between post-test results of 'Single leg stance with eyes closed' for all SO programmes.

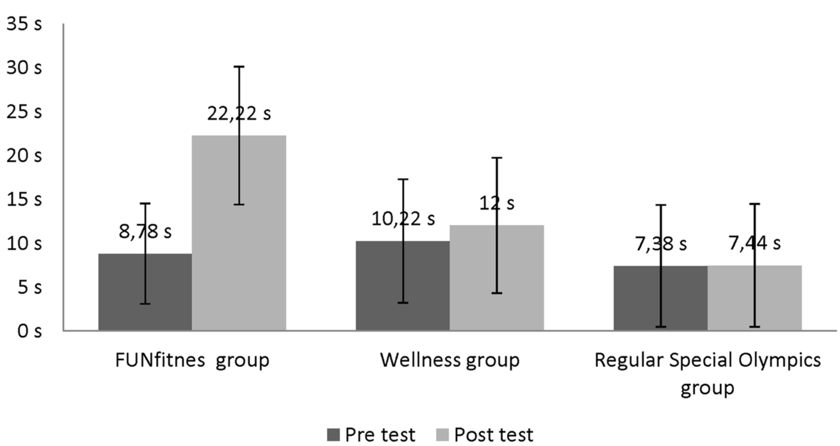

Figure 2. Results of pre/post 'Single leg stance with eyes open – left leg' for all groups.

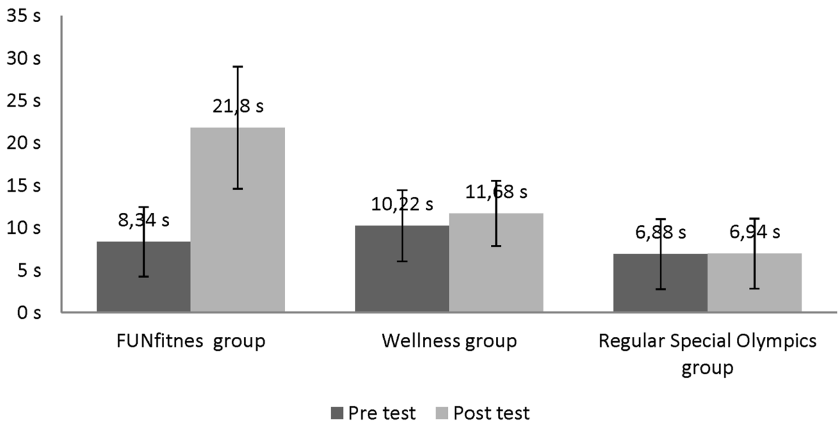

Figure 3. Results of pre/post 'Single leg stance with eyes open – right leg' for all groups.

The results of 'Single leg stance with eyes closed – right leg' (Fig. 4) for the two-way ANOVA indicated a significant main effect for the pre-test/post-test phase, $F_{2,294} = 34.150$, $P < 0.001$, and a significant main effect for the SO programmes, $F_{2,294} = 30.401$, $P < 0.001$. Additionally, the results show a significant interaction between the pre-test/post-test phase and SO programmes, $F_{2,294} = 24.770$, $P < 0.001$.

Tukey's HSD test showed statistically significant differences between post-test results of 'Single leg stance with eyes closed – right leg' for all SO programmes.

Dynamic balance

The results of 'The functional reach test – left arm' (Fig. 5) for the two-way ANOVA indicated a significant main effect for the pre-test/post-test phase, $F_{2,294} = 17.486$, $P < 0.001$, and a significant main effect for the SO programmes, $F_{2,294} = 14.643$, $P < 0.001$. Additionally, the results show a significant interaction between the pre-test/post-test phase and SO programmes, $F_{2,294} = 13.778$, $P < 0.001$.

Tukey's HSD test showed statistically significant differences between post-test results of 'The functional reach test – left arm' for

- the MBSEP (35.92 ± 6.682 cm) and the regular SO (25.32 ± 7.729 cm) group and
- the wellness (30.06 ± 7.391 cm) and the SO (25.32 ± 7.729 cm) group.

The results of 'The functional reach test – right arm' (Fig. 6) for the two-way ANOVA indicated a significant main effect for the pre-test/post-test phase, $F_{2,294} = 15.050$, $P < 0.001$, and a significant main effect for the SO programmes, $F_{2,294} = 12.939$,

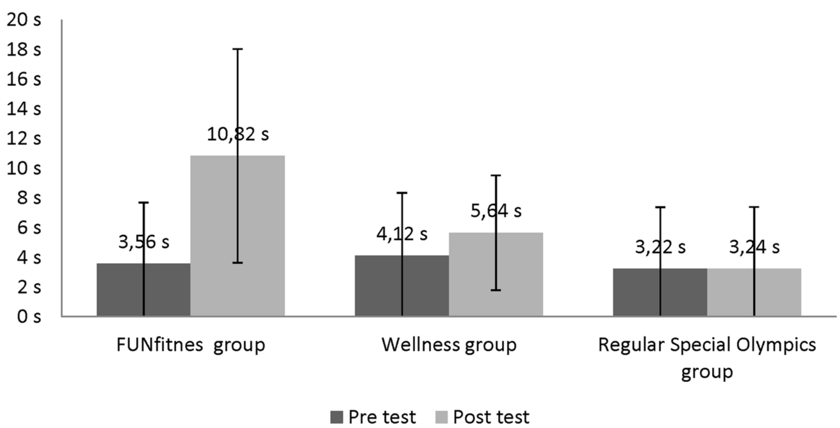

Figure 4. Results of pre/post 'Single leg stance with eyes closed – left leg' for all groups.

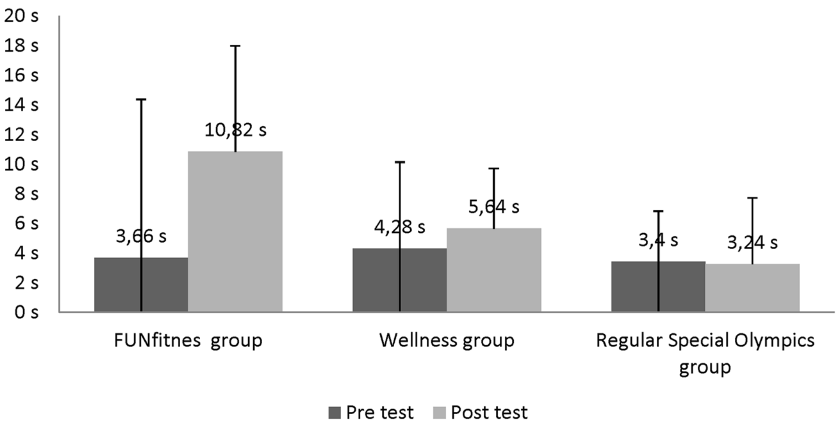

Figure 5. Results of pre/post 'Single leg stance with eyes closed – right leg' for all groups.

$P < 0.001$. Additionally, the results show a significant interaction between the pre-test/post-test phase and SO programmes, $F_{2,294} = 11.486$, $P < 0.001$.

Tukey's HSD test showed statistically significant differences between post-test results of 'The functional reach test – right arm' for

- the MBSEP (34.70 ± 7.215 cm) and regular SO (24.94 ± 7.514 cm) group and
- the wellness (29.02 ± 6.876 cm) and SO (24.94 ± 7.514 cm) group.

Frequency of falls in the 4 months previous to the pre-test/post-test

The results (Fig. 7) for the two-way ANOVA indicated a significant main effect for the pre-test/post-test phase, $F_{2,294} = 25.466$, $P < 0.001$, and a significant main effect for the SO programmes, $F_{2,294} = 15.532$, $P < 0.001$. Additionally, the results show a significant interaction between the pre-test/post-test phase and SO programmes, $F_{2,294} = 13.255$, $P < 0.001$.

Tukey's HSD test showed statistically significant differences between Frequency of falls in the 4 months previous to the pre-test/post-test for

- the MBSEP (0.1 ± 0.303) and regular SO (1.48 ± 1.054) group and
- the MBSEP (0.1 ± 0.303) and wellness (1.38 ± 0.878) group.

In terms of correlations between static/dynamic balance and frequency of falls during a period of 4 months, when combining all groups, the calculation of Pearson correlation coefficient suggests the following:

- strong correlation for 'Single leg stance with eyes closed – left leg' ($r = -0.503$, $P < 0.001$) and

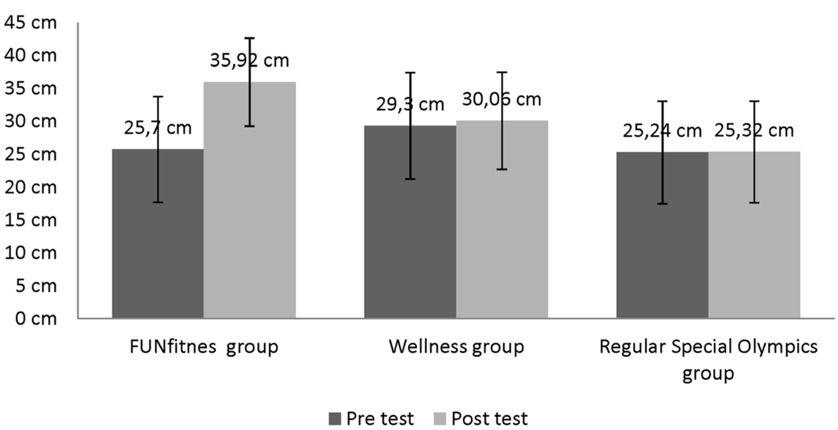

Figure 6. Results of pre/post 'The functional reach test – left arm' for all groups.

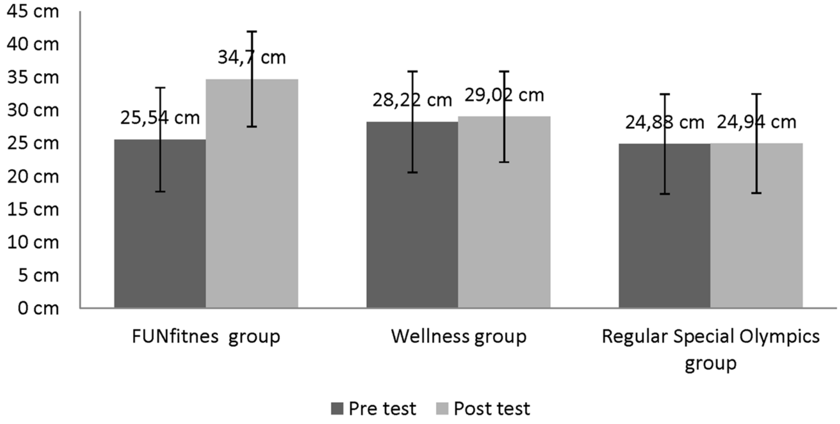

Figure 7. Results of pre/post 'The functional reach test – right arm' for all groups.

- medium strength correlation for all other tests:
- 'Single leg stance with eyes open – left leg' ($r = -0.389$, $P < 0.001$),
- 'Single leg stance with eyes open – right leg' ($r = -0.454$, $P < 0.001$),
- 'Single leg stance with eyes closed – right leg' ($r = -0.491$, $P < 0.001$),
- 'The functional reach test – left arm' ($r = -0.464$, $P < 0.001$) and
- 'The functional reach test – right arm' ($r = -0.404$, $P < 0.001$).

The calculation of Pearson correlation coefficient between static/dynamic balance and frequency of falls during a period of 4 months for the MBSEP group suggests strong correlation for all tests:

- 'Single leg stance with eyes open – left leg' ($r = -0.600$, $P < 0.001$),
- 'Single leg stance with eyes open – right leg' ($r = -0.549$, $P < 0.001$),
- 'Single leg stance with eyes closed – left leg' ($r = -0.536$, $P < 0.001$),
- 'Single leg stance with eyes closed – right leg' ($r = -0.542$, $P < 0.001$),
- 'The functional reach test – left arm' ($r = -0.616$, $P < 0.001$) and
- 'The functional reach test – right arm' ($r = -0.543$, $P < 0.001$).

The calculation of Pearson correlation coefficient between static/dynamic balance and frequency of falls during a period of 4 months for the wellness group suggests the following:

- medium strength correlation for 'Single leg stance with eyes closed – left leg' ($r = -0.318$, $P = 0.001$) and
- small correlation for 'Single leg stance with eyes closed – right leg' ($r = -0.267$, $P = 0.007$).

The calculation of Pearson correlation coefficient between static/dynamic balance and frequency of falls

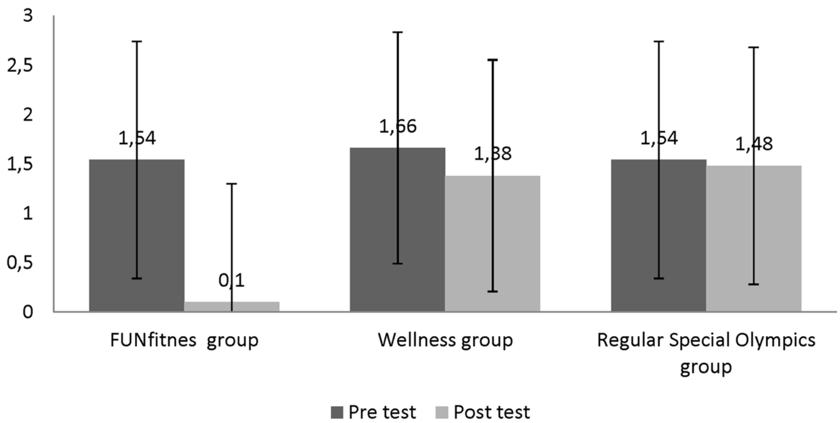

Figure 8. Reported falls in the 4 months previous to the pre-test/post-test for all groups.

during a period of 4 months for regular SO group suggests the following:

- strong correlation for
- 'Single leg stance with eyes closed – left leg' ($r = -0.531$, $P < 0.001$),
- 'Single leg stance with eyes closed – right leg' ($r = -0.524$, $P < 0.001$),
- 'The functional reach test – left arm' ($r = -0.505$, $P < 0.001$),
- medium strength correlation for
- 'Single leg stance with eyes open – left leg' ($r = -0.377$, $P < 0.001$),
- 'The functional reach test – left arm' ($r = -0.415$, $P < 0.001$) and
- small correlation for 'Single leg stance with eyes open – right leg' ($r = -0.260$, $P = 0.009$).

Discussion

The aim of this study was to investigate the impact of the two tested exercise programmes, provided by SO, on balance improvement and falls prevention in adults with ID. The results of this RCT prioritise 'Improving Athlete balance', which requires collaborative approaches from the realms of fitness, health and sport. Since an athlete performs at his or her best when he or she is fit and healthy, weaving together the expertise and strategic priorities of fitness, health and sport is key. Previous studies addressing the motor abilities or limitations of the population of adults with ID are very rare and are usually based on non-experimental methodology, such as participant surveys, and a literature review or analysis of medical reports and records (Cleaver *et al.* 2009; Chiba *et al.* 2009; Cox *et al.* 2010). To our knowledge, this is the first study to analyse the effects of the two multicomponent programmes – specifically, the wellness and the MBSEP groups – on the static and dynamic balance of a vulnerable group of 150 SO adults with ID. The main findings of the current RCT showed that, compared with the intervention baseline, after 4 months of intervention programmes, balance skills were significantly improved among participants in all three tested groups. However, the most significant improvement in balance scores was achieved in the MBSEP intervention group. These results could be observed in such post-intervention tests as Single leg stance with eyes open/closed (right and left), and tests of dynamic balance (functional reach test, right and left arm). The improvements in the wellness and control group were less visible in comparison with the improvements of participants' balance in the MBSEP group. The differences between the participants of SO programmes in improvement of the balance ability were statistically significant. The MBSEP group achieved the highest – and statistically significant – improvement in all measured tests of balance in comparison with the other two specific programmes.

Similar findings have been confirmed in Lee *et al.*'s (2016) comparable study on a sample of adolescents (aged 14–19 years) with ID. In this trial study, it was found that balance training twice a week over a period of 2 months can already have a significant effect on improving postural balance and functional strength. In a manner similar to our study design, the RCT of Oviedo *et al.* (2014) tested the effect of a combined PA programme (focussing on aerobic aspects, strength and balance) on adults with ID over a period of the 3 months and a half. The results showed significant improvement in balance after a training period that included guided exercise 3 days a week. However, implemented in the present RCT was a higher frequency of a specific activity programme – namely, three times per week in the control group and even six times per week in the intervention groups. The regular SO training of the control group was included in both experimental groups, which received three additional training sessions – one guided and two independent. In terms of the frequency, amount and intensity of the implemented PA, which participants received in the three different tested programmes, the obtained findings of our study were in line with expectations. The differences in the tested programmes between the experimental groups lay in the frequency and providers of multicomponent programmes. Therefore, the findings of our study confirmed that crucial factors for balance improvement among the studied population of adults with ID are frequency of multicomponent programme and intervention provider.

Our results revealed a significant decline in the frequency of falls after implementation of the tested SO programmes. The frequency of falls in the

4 months previous to the intervention was comparable between all three groups. Slightly higher frequency of falls, albeit not statistically significant ones, were obtained for frequency of falls in the wellness group. After the end of the intervention, a statistically significant decline in falls was obtained. The participants in the MBSEP group reported the lowest frequency of falls – they had almost no falls after the end of the intervention. The findings showed significant differences between the MBSEP and the other tested SO programmes in decreasing falls after the end of the intervention. Additionally, the frequency of falls was in correlation with all measured static and dynamic balance tests. These findings are in line with expectations and previous studies that have shown that balance tests are significantly associated with frequency of falls and fall history among different populations, that they contribute to the identification of individuals at risk of falls by accurately predicting falls over 6 months (Haveman *et al.* 2010) and that falls can be reliably estimated from ambulatory measurements (Rispens *et al.* 2015).

Therefore, our study findings lead us to recommend future implementation of the MBSEP programme to improve the balance of adults with ID and thus to reduce their risks of falls. However, some studies have reported that the population with ID has limited access to guided PA programmes delivered on a regular basis (Bainbridge *et al.*, 2015b). For this vulnerable part of the population, it is therefore of the highest priority that they be ensured access to quality multicomponent PA programmes provided by an interdisciplinary health care professional team consisting of a physiotherapist, nutritionist, fitness instructor, social gerontologist (active and healthy ageing), coach, occupational therapist, public health nurse and kinesiologist.

Study limitations and needs for future research

Despite the controlled data-collection process, it is not possible to exclude the human impact that may have affected the findings during the trial implementation and the performance of balance tests.

There is a need for future studies to test the effect of the MBSEP intervention programme with a higher frequency on other components of physical fitness, such as flexibility, aerobic fitness and muscle strength.

It must be emphasised that our study is a case study that was implemented on the sample of one country's SO adult athletes. In future studies, the broader international framework must be considered in order to verify the obtained findings in the broader and global context of the population with ID. We did not include a lifestyle survey about nutrition, PA and hydration habits after completion of the RCT; neither did we include self-efficacy for making healthy choices. For many athletes and partners participating in multicomponent PA interventions, these data should be analysed in future. We should also identify the key individual and systems-level health indicators that we need to collect in future in order to demonstrate the impact of those interventions on health and health care outcomes.

An additional complexity, not taken into account in the existing study, is the fact that the economic impacts of inclusion programmes such as MBSEP are likely to be interdependent. However, we have not conducted a cost-effectiveness analysis. Therefore, future studies of randomised controlled experimental design and long-term follow-up duration (over 12 months) are needed to clearly examine the cost-effectiveness of MBSEP intervention in a wide variety of commercial and non-commercial public health settings. Regarding point-of-decision-prompts, the present results of MBSEP as a means of improving balance and reducing frequency of falls might indicate a high potential for cost-effectiveness. MBSEP intervention was designed as an inclusive physical fitness programme in a community setting (group of 10 adult participants: 5 with ID and 5 without ID), which may involve extra initial costs in future implementation, savings through more efficient public health sector or commercial sector spending, and the reduced burden of increased risk of falling in ID population may more than offset the investment in the long-term. Narrowing health gaps through inclusive multicomponent MBSEP intervention can thus have far-reaching benefits beyond simple monetary gains or falls reduction, but further RCTs are needed.

Study strengths

Despite the awareness of certain study limitations, the findings presented allow for significant insight into the improvement of static and dynamic balance in athletes with ID. Nevertheless, it is necessary to emphasise that the stratified sampling which was implemented for recruitment of study participants from the Slovenian SO database resulted in three balanced stratified groups of RCT who were homogenous at the baseline in respect of geographical regions, age, diagnosis and balance abilities of participants. High quality sampling ensured valid and reliable study conclusions from the obtained data.

Conclusions

The obtained findings of the present RCT are in line with comparable previous studies that have shown that significant improvement in balance among adults with ID may already be seen after exercise training three times a week. Further, our study results showed that the provider of PA has a significant impact on balance improvement among adults with ID. Highly educated, experienced professionals are one of the main factors of the exercise effects on the population with ID. Nevertheless, our study confirmed previous findings that frequency of falls significantly correlates with exercise, and falls may be greatly reduced by means of a balance-oriented and well-implemented PA programme.

Evidence from our RCT would indicate that continued action is needed on several fronts. These are just some of the steps required to close the health inequality gap between adults with ID and others: identifying SO athletes and other adults with ID who are not known to services, collecting appropriate ID population data, ensuring physiotherapists and general practitioners are involved in the balance and health check scheme and improving health promotion/balance screening.

Within SO, connecting athletes with care through follow-up and referrals remains present as a future challenge for all SO programmes.

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Conflict of interest

The authors declare no conflict of interests.

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