European Journal of Human Movement

Article

Comparison of Daily Life Physical Activity Between Trained and Non-Trained Individuals with Down Syndrome

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Received: date; Accepted: date; Published: date

Abstract: Physical activity and sports practice plays an important role in maintaining health, well-being, and quality of life. As related concepts, those are not well studied in persons with disabilities, particularly with intellectual disability or Down syndrome. This study aimed to assess the daily life physical activity levels of competitive persons with Down syndrome and to compare those with active and untrained individuals with the same condition. Twenty participants were allocated to international competitive (N=8; 25.8±7.4 years), recreational (N=6; 22.0±4.3 years) and untrained (N=6; 24.0±7.4 years) groups. The daily physical activity was assessed with a CE Mark class I electronic medical device (WalkinSense®), designed to monitor dynamics of human lower limbs'. Time spending in sports practice was not accounted for this analysis. Differences were found between the competitive and the recreational groups in the number of training hours per week and walking distance. Similarly, the competitive group showed differences with the two other groups in weight, body mass index, training hours per week, steps/day and walking distance. Our findings suggest that individuals with Down syndrome engaged in competitive training are more active persons behind their sport comparing to their non-competitive peers, but remain far from the 10 000 steps/day that is the recommended guideline for healthier adults without any disability.

Keywords: intellectual disability; body composition; lower limb activity; sport participation.

1. Introduction

Down syndrome is a classic developmental disorder caused by the presence of the whole (or part) of an extra copy of chromossome 21. (Irving et al., 2008; Bhattacharyya, 2020). Mistakes that are made during development of a particular organ system result in the characteristics of the disorder. In the brain, mistakes during prenatal brain development lead to intellectual disability (Bhattacharyya, 2020).

This condition includes several clinical characteristics, including distinctive physical features, predisposition to a higher incidence of cardiovascular disease, diabetes, osteoporosis and obesity, and higher susceptibility to a premature and significant decline in function as they grow older (González-Agüero et al., 2010; Hill et al., 2003; Rimmer et al., 2004). Despite the fact that the intelectual disability affects everyday funtioning, the children and adolescents with intellectual disabilities but no Down syndrome health profiles remain unremarkable, in contrast with those with Down syndrome (Rimmer et al., 2004). As for the persons with intellectual disability but not Down syndrome, the degree of intellectual disability in individuals with Down syndrome is determined by limitations in cognitive function as well as in adaptive behavior, such as conceptual (language, reading and writing, self directions), social (self esteem, gullibility, naiveté, avoids victimization) and practical adaptive skills (dressing, toileting, preparing meals, using transportation, occupational skills), all important aspects for individuals be functional in their day-to-day lifes (Rimmer et al., 2004). Nevertheless, accompanying the improvement in social and medical support systems, the survival of persons with Down syndrome has been increasing in the past few decades (Pitetti et al., 2013).

The increasing acceptance of people with intellectual disabilities in the general community has also grown, leading to potentially richer lives, although still with less autonomy and social relationships than their peers without disability (Carr, 2008). As for the general population, the physical activity and sport participation in people with Down syndrome arises as important strategy to reach a better quality of life. Health related benefits, such as cardiovascular fitness improvements (Vicente-Rodriguez et al., 2005), healthier lifestyle (Stewart et al., 2003), antioxidant defense system enhancement (Franzoni et al., 2005), as well as benefits in social factors associated with sport participation (Andriolo et al., 2005), have been reported for this kind of population. However, evidence suggests that most persons do not meet the minimum required amount of daily physical activity (Troiano et al., 2008; Temple et al., 2006) and, when concerning persons with intellectual disabilities, studies indicate that this population is even less active (Einarsson et al., 2015; Foley & McCubbin, 2009; Hinckson et al., 2013; Peterson et al., 2008) and their sedentary time is greater than the typically developed individuals (Dixon-Ibarra et al, 2013). Sport participation usually decreases over time, although there are references indicating that this fall-off was no more than the one seen in the general population, without Down syndrome (Carr, 2008).

Furthermore, no specific physical activity guidelines have been developed for adolescents with Down syndrome taking into account the impairment of this population, such as muscle hypotonicity, low cardiovascular fitness and decreased muscle strength (Matute-Llorente et al., 2013) which is a key factor for training prescription. Therefore, quantifying physical activity in daily life is of great value and the time spent actively during daily life, together with intensity and frequency, are key issues in the analysis of a population's usual physical activity levels (ACSM, 1998).

The aim of the current study was to assess the daily life physical activity levels of competitive swimming and athletics with Down syndrome, comparing them to physically active persons and untrained individuals with the same condition. It was hypothesized that trained participants would present a higher number of steps/day, walk longer distances on daily life along with lower body mass index. It was also expected that trained participants with Down syndrome would meet the recommended steps/day criteria determined for the healthier population without any disability.

2. Materials and Methods

Participants —Twenty individuals with Down syndrome participated in this study and were divid-ed in three groups according to sport participation: international level competition group (swimming and athletics) (IG; N=8; 25.8±7.4 years), recreational group (swimming and athletics) (RG; N=6; 22.0±4.3 years) and six subjects from a day care Institution that acted as control (CG; N=6; 24.0±7.4 years). Exclusion criteria were any traumatic-orthopaedic impairment, pain or difficulty with independent gait.

All individuals, or their parents, gave written in-formed consent to participate in the current study, which was approved by the local ethics committee and carried out according to the Declaration of Helsinki.

The IG subjects had been involved in oriented sports training for, at least, four years, with 12.1 ± 2.1 h of training per week over the entire season. Recreational practitioners were active for four years and practiced 4.2 ± 0.8 h per week, without competitive participation. Control subjects did not participate in any kind of regular or organized sport activity, with less than 90 min of nonspecific physical activity a week.

As persons with Down syndrome may experience difficulties in adaptive skills, all participants had one career responsible for giving assistance on putting in and taking off the device.

Anthropometry — Stature and body mass were measured to the nearest 0.1 cm and kg using a portable stadiometer and an electronic weighing scale, respectively. All measurements were taken by the same trained researcher with participants in light clothing and barefoot. Body mass index was also calculated by the ratio between body mass and stature2 and body mass in-dex cut-points were used to classify participants as either underweight (≤ 18.4), normal weight (18.5-24.9), overweight (25.0-29.9), obese (30.0-39.9) or morbid obese (≥ 40) [20].

Physical activity — Daily physical activity was assessed using the WalkinSense®, which is a CE Mark class I electronic medical device designed to dynamically monitor human lower limb ac-tivity. It gathers and processes quantitative information, sending it to a fixed laptop or palmtop computer, via wireless Bluetooth® connection or wired USB cable, to be analyzed with the WalkinSense® software (Tomorrow Options SA, Sheffield, UK). The device (weight 68 g, length 78 mm, width 48 mm and depth 18 mm) contains a micro electro-mechanical system triaxial accelerometer and one gyroscope, and an array of eight force sensing resistors for foot pressure measurements (Querido et al., 2016).

Distance is calculated from the triaxial accelerometer and gyroscope, by a sensor fusion algorithm based on an extended Kalman filter with a velocity zero update at each cycle. The participants and/or their careers were instructed to attach the WalkinSense® over the anterior-inferior surface of the right tibia, from waking in the morning until bed-time for five consecutive days (from Wednesday until Sunday). The five days of the device use were chosen in order to involve three week days and two weekend days. This way, it could be observed the participants activity out of the week routines.

Each participant should wear the device from day one when waking up untill the day five when sleeping time. The device was already switch on at day one and has enough autonomy to stay on during the five consecutive days. Verbal and writing instructions were given to both participants and careers about how to wear the device during all waking hours except while training, bathing, showering and contacting water. The careers were al-so given a sheet so they could take simple notes about the hours and the reasons that the participants had to take off the WalkinSense®. All the data was collected during school/job time in oposition to vacation time, so that the normal routines of the participants were maintained.

The following indices were used to classify the degree of physical activity: (i) sedentary lifestyle index if < 5000 steps/day, (ii) low active if 5000-7499 steps/day, typical of daily activity excluding sports/exercise, (iii) somewhat active if 7500-9999 steps per day, which likely includes some volitional activities (and/or elevated occupational activity demands), (iv) active if 10.000-12500 steps per day and (v) highly active if > 12500 steps per day (Tudor-Locke & Bassett Jr, 2004). These are reference values for healthy adults (Tudor-Locke & Bassett Jr, 2004).

Statistical procedures — Descriptive statistics (means and standard deviations) were calculated for the three groups. Shapiro-Wilk analysis was used to test if the variables were normally distributed. Kruskal-Wallis test was used to identify the differences between groups in anthropometric measures and daily physical activity values. Effect size was calculated using eta-squared ($\eta 2$) and interpreted as small (0.01), medium (0.06) or large (0.14) [23]. The significance level in all analyses was set at 0.05. Statistical analyses were conducted using SPSS version 24.0.3.

3. Results

Differences between the IG and the RG were observed for the number of hours of training/week and the travelled distance. The subjects form the CG were considerably heavier, presented higher BMI values and fewer hours of sport engagement than the other participants. Differences between the IG and the CG were also observed for steps and distance (Table 1).

Table 1. Mean values (SD), χ and p-values for Kruskal-Wallis test of different anthropometry and physical activity measures according to sport participation. Effect size (η^2) was also displayed.

Variables	IG (N=8) Mean ± SD	RG (N=6) Mean ± SD	CG (N=6) Mean ± SD	χ	p-value	η^2	p-values for difference IG vs RG	IG vs CG	RG vs CG
Height (cm)	153.3 ± 6.2	151.8 ± 6.4	155.4 ± 4.0	1.1	0.590	0.064	0.662	0.573	0.394
Weight (kg)	55.0 ± 5.9	56.3 ± 5.0	63.6 ± 5.7	5.2	0.075	0.339	0.573	0.043^{b}	0.093
BMI	23.5 ± 2.0	24.4 ± 0.6	26.3 ± 1.8	7.5	0.024	0.383	0.414	0.020^{b}	0.015^{c}
Training units/week (h)	12.1 ± 2.1	3.2 ± 0.8	1.3 ± 0.4	17.0	<0.001	0.933	0.001^{a}	0.001^{b}	0.002^{c}
Steps (nº)	7104.4 ± 2451.1	5222.8 ± 1746.0	3593.5 ± 1139.1	8.8	0.012	0.402	0.282	0.001^{b}	0.240
Steps/min (nº)	5.0 ± 3.7	2.7 ± 1.0	4.0 ± 4.0	4.6	0.100	0.093	0.081	0.181	0.937
Distance (m)	2193.5 ± 770.1	957.1 ± 443.4	1129.5 ± 396.1	12.2	0.002	0.521	0.001^{a}	0.003^{b}	0.589

BMI = body mass index, IG = international level competition group, RG = recreational training group, CG = control group. a, b and c stands for differences between IG and RG, IG and CG and RG and CG, respectively ($P \le 0.05$).

4. Discussion

We aimed to understand if competitive individuals with Down syndrome lead more active daily lives than their recreational training and untrained peers by studying parameters related with the daily life activity. We found that although the IG was involved in a considerably large amount of training hours (this time was not taken in account for the measurements), their daily life was more active than those of the RG and the CG. It was not our intention to analyze what kind of activities these persons did in their daily live,

but to understand, by a quantitative analysis, their number of steps and distance walked in day-to-day basis.

The current study shows no differences between the IG and the RG regarding the number of steps in their daily routines, although subjects involved in competitive sports are in the superior part of the "low active" range and recreational peers are in the inferior part. The CG presents a considerably lower number of steps/day, being classified in the "sedentary lifestyle index". It is also important to notice that these data do not include sports activities so, for both the IG and the RG, there is a considerably amount of time where they are involved in physical activity practice and, thus, being active. Furthermore, the daily life of IG subjects seems to be more active comparing to the other groups.

There is still a lack of information about the daily life activity and physical activity profiles of persons with intellectual disabilities (with or without Down syndrome). Therefore, it is required much more research, even why it is very difficult to make direct comparisons with other studies due to different methodologies (Pitetti et al., 2013; Einarsson et al., 2015). Although information regarding physical activity in persons with Down syndrome and other intellectual disabilities are still inconclusive and mixed, with various studies indicating that youth with intellectual disability have lower, similar and higher physical activity levels than their peers with no disabilities, mostly due to significant methodological limitations (Frey et al., 2008), Einarsson et al. (2015) observed that children with intellectual disability are considerably less active and took part in few organized sports after school than typically developed children. More specifically, children and adolescents with Down syndrome have been shown to be as less active than those without this condition (Sharav & Bowman, 1992) and, although neither adolescents with and without Down syndrome achieved the recommended 60 min of moderate physical activity daily, the first engaged less time in sedentary, moderate, moderate to vigorous and vigorous physical activity than their age-group peers but more min of light physical activity (Matute-Llorente et al., 2013). Carr (2008) considered aspects of daily life in a population of persons with Down syndrome and a control group of non-disabled individuals and concluded that participants with Down syndrome health was reasonably good although less good than those of the control group. The sport participation decreased over time for individuals with Down syndrome, but no more than the observed decrease for the general population, without disabilities. A study of adults with intellectual disabilities living in community settings, found a mean of 6621 ± 3366 steps/day (Peterson et al., 2008), staying in-between the results from the current study for the IG and the RG (7104 ± 2451.1 and 5222.8 ± 1746.0 steps/day) and is considerably higher than those of the CG (3593.5 ± 1139.1 steps/day). Accordingly to these authors, their results are similar to the values of the adult general population (cf. Chan et al., 2003; Sequeira et al., 1995).

A large porpotion of children and adolescents with Down syndrome do not meet the recommended amount of daily aerobic activity (Pitetti et al., 2013). Therefore, there was a significant drop in moderate and vigorous physical activity as children age and this decline in physical activity patterns with age should be confirmed in adults with Down syndrome. Are the transitions observed in physical activity and lifestyle as adolescents became adults also observed in adolescents and adults with Down syndrome? The current study indicates that international level competitors and recreational training persons with Down syndrome lead healthier day-to-day lives, giving more steps/day and walking longer distances/day than their untrained peers. Although it was not our intention to analize the kind of daily activities the subjects of this study were involved at, we should not forget that the fact that the training sessions were not taken into account for the results may impact on the conclusions. Especially for the international group of athletes, the time spent at sport practice is an important part of their day and a great contribution for these person's health and physical fitness. Sports practice plays an important role in considering a person's being physically active and healthy. It is our opinion that despite the fact that the main purpose of this study was to analize the number of daily steps of the subjects, this fact should be taking in account when looking at the overall results.

Some studies point out the fact that the differences between persons with intellectual disabilities and the non-disabled ones are likely to have cultural and environmental causes rather than biological justifications (Pitetti et al., 2013; Einarsson et al., 2015), since athletes with intellectual disabilities who have the opportunity to be engaged in sports can reach the same fitness levels as non-disabled athletes (Van De Vliet et al., 2006). Children with intellectual disabilities participate in fewer organized sports after school than typically developed individuals the same age and a high percentage of those who practice are engaged in low-intensity sport, like Boccia (Einarsson et al., 2015). Dependence on parents for commuting, lack of understanding on the environment and distance to school may also be considered as barriers for sport participation for individuals with intellectual disability (Einarsson et al., 2015). The fact that most of the studies in this matters, even the intervention ones, are carried out with participants that are not involved in an intensive sports practice for several years, makes more difficult to compare studies and reach to conclusions. Most of the studies are with sedentary, recreative or in the begining of their training process persons and very few studied the training effects on populations with Down syndrome.

5. Practical Applications.

The main limitation of the current study is the limited number of participants in each of the studied groups. However, it is very difficult to get participants willing to be evaluated and wearing a non-usual device for five consecutive days. Nevertheless the time demanding, the cost issues of getting a larger sample (due to the need of higher the number of devices) and eventual difficulties in getting a large number of persons with Down syndrome and intellectual disability on using an external body device for several days, it would be very interesting in conducting a sex analysis by group in the future. Also, it is a limitation that the used device was not validated for this population, despite the fact that exclusion criteria were used. Results concerning this topic seem to be inconclusive and scarce for persons with intellectual disability, with or without Down syndrome. Moreover, the determination of the kind of activities that these groups are involved in their daily lives and checking if there are differences in the groups for week and weekend days (in both a quantitative and qualitative analysis) would come in handy. Also, it became clear that what is somehow well accepted for persons without disabilities concerning the positive training effects on body composition items, is not so consensual when it comes to persons with intellectual disabilities and Down syndrome. Although different methodologies make it difficult to compare the results, there are still inconclusive conclusions that need to be clarified concerning persons with Down syndrome. Also, studies focusing on high level competitors with Down syndrome are needed. The effects of training on performance, body composition and daily life activities on athletes envolved in intensive training processes should be of special concerning for those who study competitive athletes, as these results may help coaches and other professionals who work with athletes with Down syndrome achieving higher performances.

6. Conclusions

Trained individuals with Down syndrome present a higher physical activity level in their daily life than recreational peers and, especially, untrained adults with the same intellectual disability. So it can be concluded that international level sport competitors with Down syndrome are, in general, active persons, since their steps/day are in the "low active" range, but very close to the "somewhat active" group. This idea is reinforced by the fact that the time these high level competitors spent in sports training was not accounted for the steps counting. This study reinforces the importance of a regular sport practice, since it can help persons with Down syndrome to attain healthier and active lives, with positive consequences on their day-to-day activities, besides the well-accepted physiological and body composition outcomes.

Funding: This research was funded by the Portuguese Foundation for Science and Technology (FCT), grant number SFRH/BD/78513/2011.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Faculty of Sport, University of Porto (protocol code CEFADE 19.2020, September 2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest.

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