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BRIEF REPORT

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Differences in physical activity volume and intensity between Unified and non-Unified Special Olympics football training: An observational pilot study

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Abstract

Background: The participation of people with intellectual disabilities in Special Olympics sports and training opportunities offers numerous benefits for health and inclusion. However, little is known about the impact of such training on physical activity behaviour. Here, we evaluate the differences in physical activity volume and intensity of Special Olympics athletes between Unified and non-Unified football training.

Method: Accelerometer data of 12 male athletes from eight standardised training sessions (four Unified, four non-Unified) were analysed.

Results: While there was no statistically significant difference for the main part of the training, athletes showed higher levels of physical activity intensity (MVPA: $M_{diff} = 11.74\%$; 95% CI = 5.50–17.97) and volume (average acceleration ENMO: $M_{diff} = 112.82$ mg; 95% CI = 24.73–200.90) in a Unified compared to non-Unified endurance-related exercise task.

Conclusion: Understanding physical activity participation in different training types can help to design and implement future training programmes.

KEYWORDS
accelerometer, exercise, fitness, intellectual disability, mixed-ability, soccer

1 | INTRODUCTION

Regular physical activity (PA), sport and exercise have various positive effects on health and well-being for people with intellectual disabilities (Hassan et al., 2019; St. John et al., 2020). Nevertheless, compared to people without intellectual disabilities, people with intellectual disabilities are typically less physically active (Havercamp & Scott, 2015), and only a small percentage meet current public health recommendations for PA (Dairo et al., 2016). One way to be physically active for people with intellectual disabilities is to participate in training and activities provided by Special Olympics. Next to higher levels of PA (Hsieh et al., 2017), participation in Special Olympics can have various benefits for the athletes in physical, psychological, emotional and social variables (Tint et al., 2017), for example, higher self-confidence (Weiss et al., 2003) or in terms of social inclusion (Asunta et al., 2022).

In recent years, mixed-ability programmes such as "Unified sports" are becoming more common. In these approaches, people with and without disabilities practice together in various sports. There are positive effects through Unified sports in terms of personal development of athletes and partners, creating inclusion and equal relationships, fostering positive perceptions of athletes, and building a connection to a local community (McConkey et al., 2013). Regarding performance-based

outcomes, investigations revealed that a Unified training programme was successful in increasing the fitness levels and football skills of youths with and without intellectual disabilities (Baran et al., 2013). Aside from these effects, there is no information on the differences in athletes PA volume and intensity, between Unified and non-Unified training.

PA intensity is usually divided into light, moderate and vigorous. For example, the sum of the latter two (MVPA: moderate-to-vigorous PA) is used as a key indicator in current PA guidelines for both people with and without intellectual disabilities (Bull et al., 2020). The overall volume of PA represents the sum of the intensity, duration and frequency of activities over a certain time period. PA volume and intensity can be measured via self-reporting and device-based instruments. For example, measurements of heart rate (Little & Williams, 2007) and the use of an accelerometer in football training are widely used (Sousa et al., 2022), but no empirical data for people with intellectual disabilities exist. This knowledge for Unified training is, however, important to understand the impact of such training on the behaviour of athletes and the underlying mechanisms (e.g., motivation) and to design optimal training sessions (e.g., selection of activities, intensity, minimum and maximum duration for specific exercises).

In this pilot study, we investigated PA participation (intensity and volume) in Special Olympics Unified football training. We want to examine if the presence of Unified partners would be associated with the PA participation of people with intellectual disabilities.

2 | METHODS

2.1 | Sample

This non-randomised observational study was conducted with a convenient sample of male Special Olympics athletes and Unified partners in Graz, Austria, between April and May 2022 (ethical approval from the University of Graz, 39/80/63 ex 2019/20). No further inclusion or exclusion criteria were applied. As can be seen in Table 1, a total of 14 male Special Olympics athletes with mild-to-moderate forms of intellectual disability (age: $M = 35.21$ years; $SD = 11.07$; experience in football: $M = 11.14$ years; $SD = 7.95$) took part. Participants were informed about the study aims and consented to participate.

2.2 | Measures

In total, there were eight training sessions, half with and half without Unified partners (Table 2). The training sessions lasted around 60 min ($M = 61.75$; $SD = 4.17$).

The eight training sessions were standardised and divided into a warm-up part (running ABC, mobilisation; 11 min excluding breaks) and a main part (passing exercises, circle exercise, shooting exercises; 43 min excluding breaks), which are depicted in Figure 1. The aim of the circle exercise was to complete rounds in the given time of 10 min, which also tested the athletes' endurance (see Figure 2). While we also present the results for the main part, we consider the circle exercise (which was also part of the main part) to be more appropriate for our research question, since the athletes' behaviour (e.g., performance, endurance) should be less affected by their football skills (e.g., passing and shooting accuracy, experience) and this exercise has the highest degree of standardisation.

In each training session, wrist-worn GENEActiv accelerometers (dimensions: $4.3 \times 4.0 \times 1.3$ cm, weight: 16 g) from Activinsights Ltd. (Kimbolton, UK) were used to record the motion data as the device-based measurement of PA (Migueles et al., 2017). The

TABLE 1 Overview of the athletes with intellectual disability and their participation in the specific training sessions.

	Age	Football experience (in years)	Club experience (in years)	Total trainings (max = 8)	Unified trainings (max = 4)	Non-Unified trainings (max = 4)
Athlete 1	58	25	4	7	4	3
Athlete 2	22	5	4	5	3	2
Athlete 3	29	7	4	7	4	3
Athlete 4	55	10	4	5	2	3
Athlete 5	34	15	4	6	4	2
Athlete 6	28	8	4	8	4	4
Athlete 7	48	4	3	8	4	4
Athlete 8	19	4	0.5	6	4	2
Athlete 9	29	19	4	6	3	3
Athlete 10	28	9	4	4	1	3
Athlete 11	38	11	0.5	5	1	4
Athlete 12	32	4	4	2	0	2
Athlete 13	37	5	4	4	2	2
Athlete 14	36	30	3	1	1	0
Mean	35.21	11.14	3.36	5.29	2.64	2.64
SD	11.07	7.95	1.22	1.98	1.39	1.04

TABLE 2 Overview of the training sessions and athletes.

Training session	Athletes		Type of training	Duration
	With intellectual disability	Without intellectual disability		
1	9	3	Unified	57 min
2	8	0	Non-Unified	65 min
3	8	3	Unified	61 min
4	9	6 (4 F)	Unified	63 min
5	11	0	Non-Unified	63 min
6	11	2	Unified	55 min
7	11	0	Non-Unified	62 min
8	7	0	Non-Unified	68 min

Abbreviations: F, female; min, minutes.

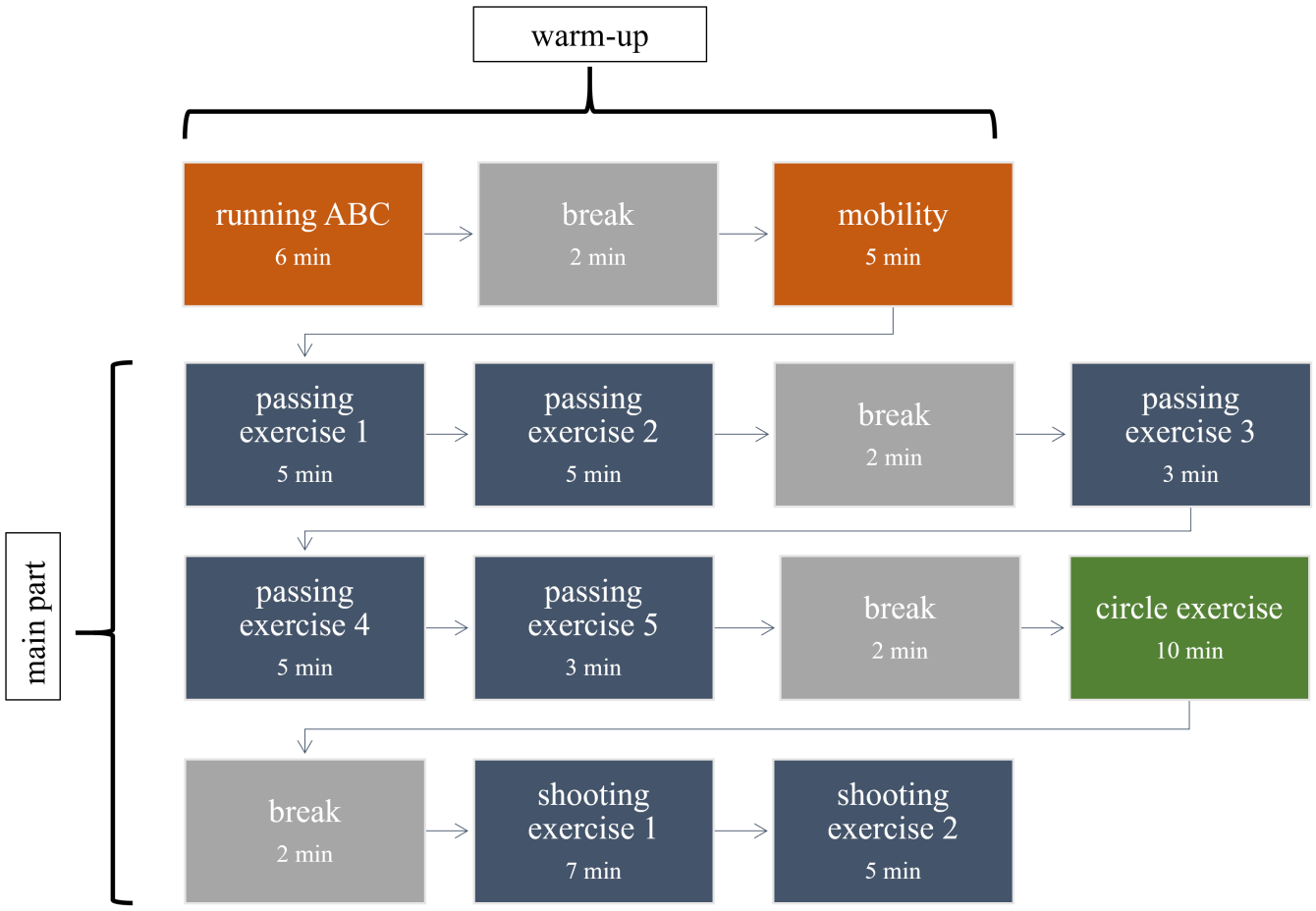

FIGURE 1 Schematic overview of the standardised training. min = minutes. Running ABC is a warm-up exercise containing of several self-determined exercises in terms of running and coordination, for example, to lift up the legs as high as possible during running ("high-knees").

GENEActiv accelerometers used in the present study perform a three-axis measurement (*x*, *y*, *z* axes) using a dynamic range of ±8 *g*. Athletes were encouraged to wear the waterproof device on their non-dominant hand during training (Hildebrand et al., 2014). Acceleration data were recorded at a pre-set maximum duration of 2 h at 100 Hz. The device had to be started manually, and automatically stopped recording after the pre-set time. The times of the individual exercises (e.g., circle exercise) of each session were recorded in a logbook, to distinguish the different exercises and breaks.

2.3 | Analysis

All analyses were performed in SPSS Statistics version 28 (IBM Corp, Armonk, NY, USA), except for accelerometery, which was

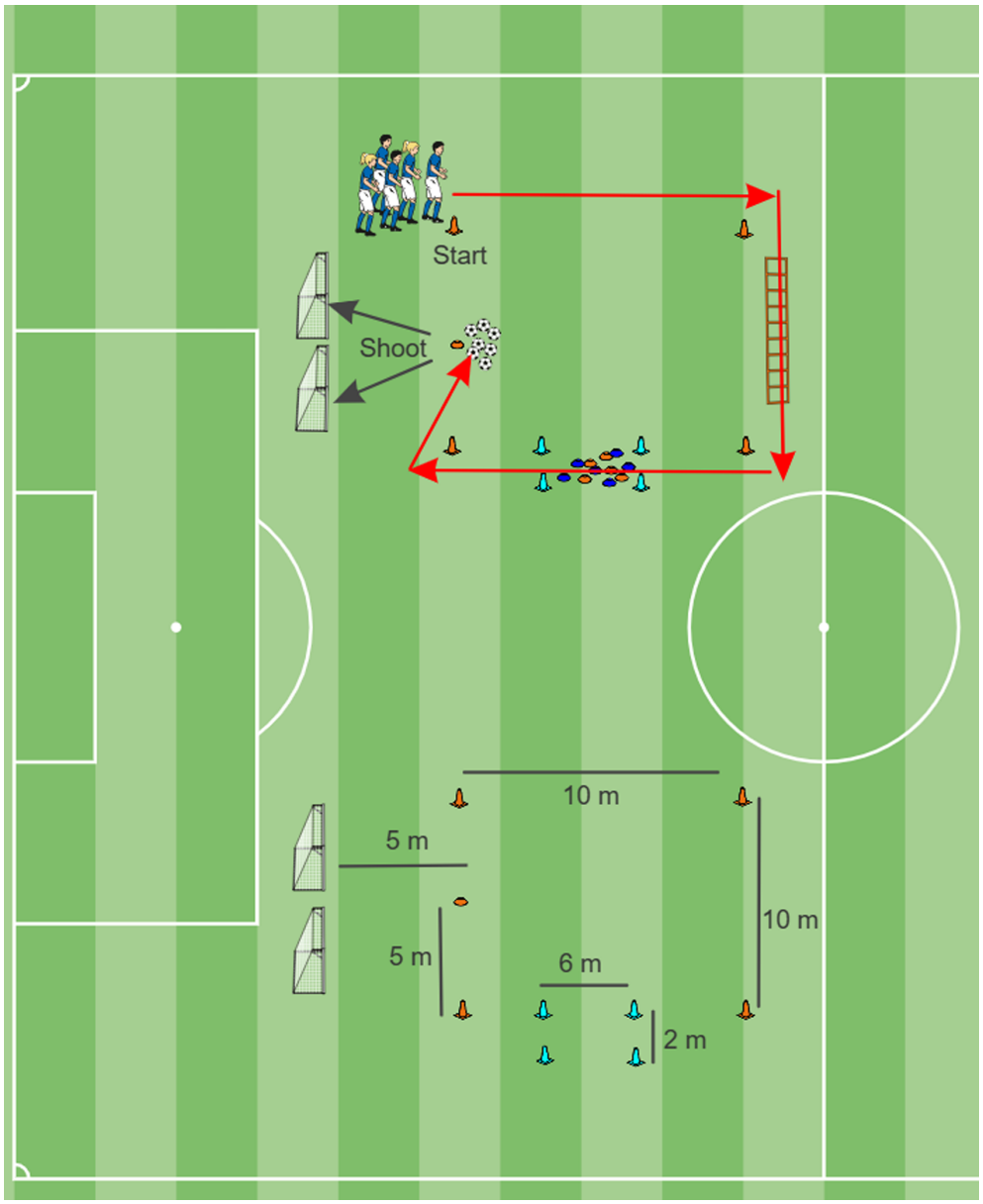

FIGURE 2 Schematic depiction of the 10 min circle exercise. In the upper part of the figure, a schematic overview of the exercise is given. The lower part shows the dimensions of the exercise (in meters). Athletes have to start running, go through a ladder, and then some hurdles, and then shoot a ball into one of the two goals before starting again with the exercise.

performed in R using the GGIR package (version 2.7-1). The vector magnitude (expressed in mg) using the Euclidean norm minus 1 g (ENMO: $\sqrt{a_x^2+a_y^2+a_z^2}-1\,g$) was calculated based on 5 s epochs (van Hees et al., 2013). Any negative values were rounded up to zero. This summary measure was used as an indicator of total volume of PA (i.e., average acceleration during the training session). Moderate-to-vigorous PA (MVPA) was calculated by applying a threshold of 100 mg to each epoch (Hildebrand et al., 2014).[1] MVPA, as an indicator of (higher) PA intensity, was expressed in total minutes of the net training (excluding breaks) and, in addition, relative to each training duration ("MVPA percentage"). The latter variable was selected for further analysis due to the minor variation in training durations. Furthermore, we considered the band-pass frequency filtered BFEN metric (band-pass filtered Euclidian norm, expressed in mg) as an alternative to ENMO because of the short measurement duration and associated problems during auto-calibration. This metric uses a fourth order Butterworth filter with $\omega_0 = 0.2$–15 Hz to further reduce noise in the accelerometer signal before calculating the Euclidian norm (van Hees et al., 2013).

Therefore, the key outcome variables were MVPA percentage, ENMO and BFEN (see Table 2). Those athletes who participated in at least one Unified and one non-Unified training were included in the analysis by using the averages of multiple repeated measurements (to reduce random errors). Finally, paired t-tests to contrast Unified versus non-Unified training were calculated for the main part, as well as the circle exercise. In both sets, p-values were corrected using the Bonferroni-Holm method. Values of <.05 were deemed significant.

[1]This cut point was selected as a proxy for MVPA since no device-specific cut points are available for adults with intellectual disabilities. We considered this (unbouted) metric as an indicator of higher intensity based on an absolute – rather than relative – intensity perspective (Strath et al., 2012).

TABLE 3 Mean and SD of the physical activity volume and intensity in the main part and circle exercise.

	Main part		Circle exercise	
PA domain	**Non-Unified**	**Unified**	**Non-Unified**	**Unified**
BFEN (mg)	516.1 (119.32)	551.9 (117.62)	833.5 (262.00)	1023.5 (291.95)
ENMO (mg)	256.2 (71.95)	282.1 (78.25)	438.1 (160.80)	550.9 (194.34)
MVPA (min)	22.52 (3.61)	20.31 (2.53)	8.11 (1.44)	9.28 (0.88)
MVPA (percentage)	51.24 (8.04)	48.92 (6.10)	80.97 (14.24)	92.70 (8.86)

Note: The main part was approximately 43 min, and the circle exercise was limited to 10 min.
Abbreviations: BFEN, band-pass filtered Euclidian norm; ENMO, Euclidian norm minus one; MVPA, moderate-to-vigorous intensity physical activity; PA, physical activity; mg, milli *g*; min, minutes; SD, standard deviation.

3 | RESULTS

On average, the time in MVPA for the whole training (including warm-up) of the 14 athletes with intellectual disability was between 20.33 and 38.83 min, with an average of 31.64 min (SD = 4.87). For the further analysis, two participants were excluded because they did not participate in both training formats (see Table 1).

The paired *t*-tests for the main part revealed no statistically significant differences for all key indicators (MVPA percentage: $t = 1.72$; $p = .261$; $M_{diff} = 11.74$; 95% CI = 5.50–17.97; ENMO: $t = 1.80$; $p = .261$; $M_{diff} = 25.85$; 95% CI = 5.80–57.50; BFEN: $t = 1.88$; $p = .261$; $M_{diff} = 35.80$; 95% CI = 6.10–77.69). For the paired t-test in the circle exercise, all the key indicators were significant (MVPA percentage: $t = 4.14$; $p = .008$; ENMO: $t = 2.82$; $p = .017$; BFEN: $t = 3.22$; $p = .016$). As can be seen in Table 3, athletes with intellectual disabilities scored significantly higher values in Unified than in non-Unified training sessions (MVPA percentage: $M_{diff} = 11.74$; 95% CI = 5.50–17.97; ENMO: $M_{diff} = 112.82$; 95% CI = 24.73–200.90; BFEN: $M_{diff} = 190.03$; 95% CI = 60.25–319.82).

4 | DISCUSSION

To the best of our knowledge, this is the first empirical investigation that has focused on PA participation in terms of volume and intensity during Unified football training and the potential influence of Unified partners.

Overall, the data suggest that at least half of the training time corresponded to the intensity of MVPA, which is a reasonable and expectable amount (Leung et al., 2017). An even greater amount was observed for the circle exercise. Although there was no statistically significant difference in PA volume and intensity in the overall training, which might be due to manifold reasons (the mix of different tasks, shooting, passing), a difference in the circle exercise was observed. In this exercise, athletes showed more PA volume and higher intensity in Unified compared to non-Unified training. While it is difficult to evaluate the size of the effect and practical relevance, due to the standardised setting, small sample size and the lack of physiological measurements (i.e., relative training intensity), we expect that a difference of 11.74% in MVPA (given the maximum of 10 min) and 112.82 mg in vector magnitude are practically relevant and of a small-to-medium effect size (Rowlands et al., 2021). Nevertheless, somewhat smaller (and larger) effect sizes are also compatible with the data, as indicated by wide confidence intervals and their boundaries.

Overall, the presence of Unified partners can contribute to higher PA levels in athletes with intellectual disabilities in specific exercises. Similar improvements in individual performances when others are present, which can be described as *social facilitation* (Zajonc, 1965), have been observed in comparable endurance and sprint exercises (Edwards et al., 2018). This could be a possible explanation to favour Unified over traditional training, besides the other effects such as greater social inclusion (Baran et al., 2013; McConkey et al., 2013). Besides these explanations, also the bi-directional support in the training group can have effects on PA participation (Pochstein et al., 2023). However, motivational aspects related to the training type (Unified or non-Unified) warrant further examinations (Hutzler & Korsensky, 2010).

4.1 | Limitations

It must be noted that the number of Unified and non-Unified training sessions conducted in this study was relatively small, at four sessions each, and these were not fully balanced across the whole period (i.e., non-randomised observational design). Moreover, we analysed wrist-worn accelerometer data, which represent an absolute measure of PA intensity, compared to relative intensity based on heart rate, oxygen measurements or ratings of perceived exertion. The measurement of PA volume and intensity in the training sessions is also strongly related to the skill level of the athlete, for example, during passing or shooting (e.g., poorer passing accuracy causes greater distances to be covered). Nevertheless, this should be less relevant for the circle exercise, where ball contact is made only once at the end of each round. Furthermore, all participants had experience in football training and it should be noted that the results cannot be generalised.

4.2 | Implications and Outlook

Obtaining a better insight into the underlying processes of PA volume and intensity can help us achieve a better understanding of the

mechanisms in Unified training, as well as providing some implications for the design of training sessions and recommendations. Future (randomised) studies should overcome the limitations of the present pilot study and expand the scope to include both psychological (e.g., motivation, attitude towards Unified training) and physiological measurements (e.g., heart rate, lactate). It might also be reasonable to consider ratings of perceived exertion, for example, through an adaptation of the BORG scale (Stanish & Aucoin, 2007). Such self-reporting tools have been shown to be valid in football training for people with intellectual disabilities (Schmitz et al., 2020). In summary, more empirical findings are needed in this direction through the use of self-reported measurements into how people with intellectual disabilities feel during different training types (Chen et al., 2013).

5 | CONCLUSIONS

This preliminary investigation revealed that athletes with intellectual disabilities show a small-to-medium increase in PA volume and intensity in Unified training, compared to non-Unified (traditional) training. Understanding PA participation in different (Special Olympics) training types will help with the design and implementation of such training programmes. However, several methodological limitations must be considered, and therefore future studies are warranted.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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