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PERFORMANCE IN TABLE TENNIS PLAYERS WITH  
INTELLECTUAL DISABILITIES: A COMPARISON  
BETWEEN THE YEARS 2016 AND 2022****TELESNA ZMOGLJIVOST IN GIBLJIVOST  
IGRALCEV NAMIZNEGA TENISA Z MOTNJAMI V  
DUŠEVNEM RAZVOJU: PRIMERJAVA MED  
LETOMA 2016 IN 2022****ABSTRACT**

Training routine is beneficial for people with intellectual disabilities, increasing their physical fitness, improving the balance and consequently reducing the risk of falls. However, during the COVID-19 breakdown, training restrictions could impair these benefits. This is a two-fold study aimed to compare the physical fitness performance and balance in table tennis athletes with intellectual disability (ID) during 2016 and 2022; and to analyse the association between the fitness and balance parameters. Table tennis athletes with ID, from both sexes and members of the Special Olympics Czech Republic, were assessed in 2016 (n=33) or 2022 (n=32). The FUNfitness protocol was used to measure the physical fitness parameters and balance (e.g., functional shoulder rotation, timed sit-to-stand test, partial sit-up test, handgrip test, single leg stance eyes open, single leg stance eyes closed). Comparison and correlation statistical tests were used ( $p<0.05$ ). The physical fitness parameters and balance presented no statistically significant between the years (2016 vs 2022) or better results in 2022 (single leg stance, partial sit-up test). The correlation of physical fitness parameters and balance demonstrated that balance is positively related to flexibility (single leg stance eyes closed:  $r=0.32$  and  $0.58$  for males and females, respectively) and lower limb strength (single leg stance eyes open:  $r=-0.31$  and  $-0.52$  for males and females, respectively). In conclusion, the development of flexibility and low limb strength in ID population can help improve the balance, and consequently minimize the risk of falls.

**Keywords:** balance, strength, flexibility, pandemic, Special Olympics

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**IZVLEČEK**

Redna telesna vadba je koristna za ljudi z motnjami v duševnem razvoju, saj povečuje njihovo telesno zmogljivost, izboljšuje ravnotežje in posledično zmanjšuje tveganje za padce. Med pandemijo COVID-19 bi omejitve vadbenega procesa lahko zmanjšale te koristi. Namen te študije je primerjava parametrov telesne zmogljivosti in ravnotežja ter analiza povezanosti parametrov telesne zmogljivosti in ravnotežja pri športnikih z motnjami v duševnem razvoju, ki so med letoma 2016 in 2022 tekmovali v namiznem tenisu. V študijo so bili vključeni športniki z motnjami v duševnem razvoju obeh spolov, ki so člani Specialne olimpijade republike Češke. Testiranje je bilo izvedeno leta 2016 (n=33) ali 2022 (n=32). Za merjenje parametrov telesne zmogljivosti in ravnotežja (npr. test praskanja hrbta, test vstajanja s stola, delno upogibanje trupa, test stiska pesti, test ravnotežja na eni nogi z odprtimi očmi, test ravnotežja na eni nogi z zaprtimi očmi) je bil uporabljen FUNfitness protokol. Izvedena je bila statistična analiza primerjave in povezanosti parametrov ( $p<0,05$ ). Parametri telesne zmogljivosti in ravnotežja niso pokazali statistično značilnih razlik med letoma 2016 in 2022 ali boljših rezultatov leta 2022 (test ravnotežja na eni nogi, delno upogibanje trupa). Povezanost med parametri telesne zmogljivosti in ravnotežjem je pokazala, da je ravnotežje pozitivno povezano z gibljivostjo (ravnotežje na eni nogi z zaprtimi očmi:  $r=0,32$  pri moških in  $r=0,58$  pri ženskah) in jakostjo spodnjih udov (ravnotežje na eni nogi z odprtimi očmi:  $r=-0,31$  pri moških in  $r=-0,52$  pri ženskah). Zaključimo lahko, da razvoj gibljivosti in jakosti spodnjih udov lahko pomaga izboljšati ravnotežje in posledično zmanjšati tveganje za padce pri športnikih z motnjami v duševnem razvoju.

**Ključne besede:** ravnotežje, jakost, gibljivost, pandemija, specialna olimpiada

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## INTRODUCTION

Over the past few decades, the engagement of people with intellectual disabilities (ID) in sports disciplines has been increasing due to the Special Olympics movement (Harada and Siperstein, 2009), and as a consequence, the literature has demonstrated a positive effect of this practice of social and physical aspects. Athletes with ID present an increase in physical fitness compared with ID non-athletes (Rintala et al., 2016). Increasing physical fitness levels can improve mechanisms involved balance directly related to posture and postural stability (Bibrowicz et al., 2019; DiPasquale and Roberts, 2022), reducing, therefore, the risk of falls.

Compared to the general population, falls have been demonstrated to be a more frequent cause of injury and subsequent hospitalization among people with ID (Sherrard et al., 2001). Several mechanisms contribute to impaired balance in people with ID: ID which affects not only cognitive but also motor functions, premature aging and inactive lifestyle (Enkelaar et al., 2012). Although previously reported by Spreat and Baker-Potts (1983) that people with moderate and profound ID had a higher risk of injury than people with mild ID, study by Chiba et al. (2009) observed that the severity of ID was not a risk factor for falling. On the other hand, poor fitness and physical inactivity were observed to increase the risk of falls during walking (Mertz et al., 2010). Identifying factors improving balance which can have a protective role for the risk of falls in population with ID is therefore necessary.

On account of the beneficial impact of sport on the physical fitness of athletes with ID, periods of training cessation can be prejudicial. In the last years, the world witnessed a pandemic situation, caused by the highly contagious respiratory virus (COVID-19), in which restrictive measures limited access to sports activities (Paludo et al., 2022). Similarly, the restriction also reduced the engagement of people with ID in their usual physical activities (Fari et al., 2023). In this regard, considering that people with disabilities have historically been stigmatized and socially vulnerable (rather than inherently vulnerable), this specific group may be disproportionately impacted by the COVID-19 pandemic (Jesus et al., 2021). In the Czech Republic, distinct protective lifestyle regulations took place between the years 2020 to 2022, including lockdowns formally announced (12th of March to 17th of May 2020; 5th of October 2020 to 11th of April 2021; 26th of November to 25th of December 2021), restricting the sports events and training sessions.

As the pandemic was an unpredictable and long-lasting event the current impact is still currently investigated. In such a manner, the purpose of this study was to describe the physical fitness

level of table tennis athletes with ID in 2016 and 2022. The second aim of this study was to investigate the association between components of physical fitness and balance test. Based on previous research on non-ID population (Ng, 2010) we hypothesize that balance is significantly correlated with lower limb strength.

## **METHODS**

### **Participants**

A total of sixty-five table tennis athletes with ID (50 males, 15 females) took part in the study in the year 2016 (n=33) and 2022 (n=32). The athletes were participating at National Tournament in Table Tennis, Special Olympics Czech Republic during the data collection. The inclusion criteria consisted of participating in the tournament, having no current injury limiting the performance on physical tests, and being older than 18 years. All the procedures were performed in accordance with the ethical standards of the Helsinki Declaration. Participants or their legal guardians provided a written Declaration of Consent with participation at Healthy Athlete screenings within Special Olympics Czech Republic prior to participation in this study.

### **Study design**

The present study is a cross-sectional analysis of physical fitness in table tennis athletes with ID. For this purpose, it was assessed one group of athletes in November 2016 and another group of athletes in November 2022. Data collection took place at National Tournament in Table Tennis, Dvůr Králové nad Labem, Czech Republic, during first two days of the tournament. The measurements were obtained between 9:00 and 16:00. The FUNfitness screening, which is part of the Healthy Athlete screenings available for Special Olympics athletes with the aim to provide additional health care to athletes with ID (Special Olympics, 2023a), was offered for all Tournaments participants. Athletes underwent anthropometric measurements (body height and body mass) using a stadiometer and scale (Tanita, Japan) followed by physical fitness and balance tests.

### **Physical Fitness tests**

FUNfitness screening protocol (Special Olympics, 2023b) was used to assess the balance and fitness of athletes with ID. Following tests were assessed:

Functional shoulder rotation

To assess the functional shoulder rotation, modified Apley's test was used. Athletes when standing were instructed to reach one arm behind the head and down the back while the other arm reaches behind the hip and up the back. The distance in cm between the index fingers was measured (if the fingertips cannot touch, the distance was reported as negative, e.g., -2.5 cm, if the fingertips overlap the distance was reported as positive).

#### Timed Sit-to-Stand Test

To assess the lower limb strength Timed Sit-to-Stand test was used. Athletes were instructed to complete 10 full stands from a seated position, as quickly as possible without the use of arms. Arms remain by their sides flexed at the elbow at 90 degrees.

#### Partial Sit-Up Test

To assess the abdominal muscle strength, partial sit-up test was used. Athletes were instructed to complete 25 partial sit-ups within one minute from a supine position, with flexed lower limbs at hips and knees to 90 degrees and placed on a chair or stool.

#### Handgrip Test

Handgrip dynamometer was used to assess the strength of hand and forearm muscles. Athletes were instructed to sit up straight on a chair with their arm bend to 90 degrees and to squeeze as hard as possible. Three tries were recorded for each hand and the best try was used in further analysis.

#### Single Leg Stance Eyes Open

To assess the balance, single leg stance (SLS) was tested. Athletes were instructed to maintain the balance on one leg as long as possible, hands were placed on hips. The time completed before loss of balance (up to 30 seconds) was recorded for each lower limb (R: right, L: left).

#### Single Leg Stance Eyes Closed

To assess the balance without visual cues, SLS with eyes closed was tested. Athletes were instructed to maintain the balance on one leg as long as possible while having the eyes closed, hands were placed on hips. The time completed before loss of balance (up to 30 seconds) was recorded for each lower limb (R: right, L: left).

The screening was performed by FUNfitness clinical director of Special Olympics CZ and trained volunteers.

## Statistical analysis

As most of the analysed variables were not normally distributed (tested by the Shapiro–Wilks test), we used non-parametrical inferential statistics for statistical analysis. Mann–Whitney U test was used to compare differences between the year 2016 and 2022 for females and males separately. To assess the relationship between analysed fitness tests and balance, Spearman's rho was used. Correlations were referred to as trivial (0–0.1), small (0.1–0.3), moderate (0.3–0.5), large (0.5–0.7), very large (0.7–0.9), nearly perfect (0.9) and perfect (1.0) (Hopkins et al., 2009). The level of statistical significance was set at  $\alpha = 0.05$ . Statistical analysis was performed using IBM SPSS Statistics software (Armonk, New York, USA, version 28).

## RESULTS

Participants' characteristics (age, body height, body mass) are shown in Table 1. No statistically significant difference between participants in the year 2016 and 2022 was observed (Table 1). When comparing female and male participants statistically significant differences were observed, demonstrating a higher body height ( $p < 0.001$ ) and body mass ( $p = 0.003$ ) in males compared to females. The mean BMI suggests overweight in both, females and males in 2016 and 2022.

Table 1. Characteristics of participants and their comparison between the year 2016 and 2022.

	Males					Females				
	2016 (n=24)		2022 (n=26)		<i>p</i>	2016 (n=9)		2022 (n=6)		<i>p</i>
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Age (years)	38.92	11.80	40.15	14.04	0.763	39.22	9.27	36.00	10.75	0.864
Body height (cm)	171.79	8.38	172.58	6.51	0.662	158.44	7.42	157.33	2.34	0.955
Body mass (kg)	78.39	16.72	83.88	14.54	0.203	67.84	12.61	65.40	17.09	0.776
BMI	26.47	4.85	28.27	5.33	0.260	27.33	6.63	26.45	7.04	0.689

In Table 2, differences in analysed fitness tests between the year 2016 and 2022 are shown. In 2022, significantly higher results in partial sit-ups ( $p < 0.001$ ) and single leg stance on right lower limb ( $p < 0.05$ ) were observed in males compared to the year 2016. In 2022, significantly higher results in partial sit-ups ( $p < 0.05$ ) were observed in females compared to the year 2016.

Table 2. Differences between the year 2016 and 2022 in performance and balance parameters.

	Males					Females				
	2016 (n=24)		2022 (n=26)		<i>p</i>	2016 (n=9)		2022 (n=6)		<i>p</i>
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
SLS R eyes open (s)	14.82	12.00	23.38	11.13	0.007*	18.40	11.63	18.17	11.75	0.864
SLS L eyes open (s)	17.84	10.83	20.69	12.22	0.244	14.08	10.10	18.17	10.80	0.456
SLS R eyes closed (s)	6.65	5.76	7.27	8.33	0.613	5.03	3.96	8.67	10.65	0.573
SLS L eyes closed (s)	7.36	8.31	6.65	8.01	0.661	6.25	7.80	8.67	10.76	0.662
Shoulder rotation R (cm)	-12.38	15.84	-15.24	15.83	0.471	-11.78	12.17	-2.33	7.37	0.113
Shoulder rotation L (cm)	-13.88	15.76	-19.80	18.03	0.183	-17.67	16.93	-6.33	9.97	0.066
Handgrip R (N)	312.67	116.33	358.08	107.00	0.327	178.33	62.25	218.33	33.12	0.328
Handgrip L (N)	282.46	115.83	350.80	107.62	0.072	183.67	85.59	206.67	26.58	0.689
Timed Sit-to-Stand (s)	19.25	6.43	19.63	5.91	0.938	19.78	7.29	20.67	4.99	0.999
Partial Sit-Up (n)	16.04	6.36	24.64	1.71	0.000**	12.25	5.99	23.50	3.67	0.008*

\* Statistically significant at 0.05; \*\* Statistically significant at 0.001

In males, a statistically significant correlation between single leg stance test with eyes open and shoulder rotation (moderate correlation), timed sit-to-stand test (small to moderate correlation) and partial sit-ups (moderate to large correlation) was observed. When having the eyes closed, a statistically significant correlation between SLS and shoulder rotation (small to moderate correlation) was observed.

In females, a statistically significant correlation between single leg stance test with eyes open and body mass (large to very large correlation) and timed sit-to-stand test (large correlation) was observed. When having the eyes closed, a statistically significant correlation between SLS, body mass (large to very large correlation) and shoulder rotation (large correlation) was observed (Table 3).

Table 3. Correlation between fitness tests and balance tests in table tennis players with ID.

	SLS R eyes open (s)		SLS L eyes open (s)		SLS R eyes closed (s)		SLS L eyes closed (s)	
	Males (n=50)	Females (n=15)	Males (n=50)	Females (n=15)	Males (n=50)	Females (n=15)	Males (n=50)	Females (n=15)
Body height (cm)	.064	.042	.145	-.053	.124	.126	.108	.066
Body mass (kg)	-.038	-.537**	.102	-.710***	.067	-.803***	-.175	-.618**
Shoulder rotation R (cm)	.358*	-.281	.401*	.261	.239	.527**	.316*	.577**
Shoulder rotation L (cm)	.349*	-.160	.411*	.294	.282	.509**	.358*	.551**
Handgrip R (N)	.134	.138	.072	.257	-.104	-.013	-.035	-.230
Handgrip L (N)	.122	.207	.033	.115	-.168	-.198	-.072	-.293
Timed Sit-to-Stand (s)	-.260	-.632**	-.307*	-.521**	-.107	-.259	-.241	-.139
Partial Sit-Up (n)	.545**	.211	.327*	.427*	.058	.319*	.151	.229

\*Moderate correlation (0.3–0.5); \*\*large correlation (0.5–0.7); \*\*\*very large correlation (0.7–0.9)

## DISCUSSION

The cross-sectional design of this study compared the results of selected physical fitness and balance tests in table tennis athletes with ID between the years 2016 and 2022. Findings of this study show that the physical fitness components (e.g., functional shoulder rotation, timed sit-to-stand test, handgrip test, single leg stance eyes closed) did not differ between the years or better results were observed in 2022 (e.g., single leg stance, partial sit-up test), even with a restriction on training practice during the COVID-19 pandemic. The second aim of this study was to analyse the factors of fitness affecting the balance as they can be associated with the increased risk of falls in ID population. In both, females and males, balance was related with flexibility and lower limb strength. Additionally, in females balance was related to the body mass, and in males, correlation between abdominal muscle strength and balance was observed.

Although fitness and physical activities are crucial for people with disability, previous studies show athletes with ID's fitness level is not enough. For instance, Rintala et al. (2016), Temple et al. (2014), and Marks et al. (2010) reported that Special Olympics athletes who train regularly

have low fitness levels, and a significant number of them are overweight or obese. Similar observation was seen in the results of this study as the mean BMI suggested overweight in both, females and males in the year 2016 and 2022. These findings emphasized the importance of strategies and interventions focused on gain of weight in this specific population.

Around half of the people with intellectual disabilities (ID) was reported to experience chronic loneliness (Gilmore and Cuskelly, 2014), and COVID-19 measurements increased their vulnerability to loneliness and social isolation (Courtenay and Perera, 2020; Scheffers, Moonen and van Vugt, 2021). Physical activity levels and mental health were reported to be negatively impacted by the COVID-19 pandemic in children and young with ID (Theis et al., 2021). Furthermore, the negative impact of the pandemic on the quality of life and functional autonomy was observed in adults with ID (Muñoz-López et al., 2023). Previous study by Teraoka et al. (2022) comparing fitness tests during and before COVID-19 pandemic in community-dwelling older adults showed a significant deterioration in flexibility and muscle strength during the pandemic. Interestingly, on the contrary, the results of this study show no statistically significant deterioration in flexibility, balance and strength when comparing athletes with ID in 2016 and after the pandemic. However, caution regarding this affirmation should be taken, as we do not have information about the parameters from 2016 to 2020 (right before the pandemic started) and due to the cross-sectional design of this study.

Lower limb strength was observed to be a good predictor of risk of falls and balance in previous studies (Menant et al., 2017; Tsuyuguchi et al., 2018; Matsuno et al., 2022). Both, knee extensors strength (Menant et al., 2017) and toe flexor strength (Tsuyuguchi et al., 2018; Matsuno et al., 2022) were observed to be associated with the risk of falls. In this way, the present study demonstrated that lower limb strength plays an important part in the balance of table tennis ID athletes, with correlations ranging from small to large. Similar to the finding of this study, the timed sit-to-stand test was observed to be an indicator of balance in a previous study by Ng (2010) in community dwelling stroke survivors.

The role of flexibility on balance is not clear. Previous study by Schenkman et al. (2000) shows that spinal flexibility contributes to balance. However, studies focused on hamstring flexibility shows no relationship between flexibility and balance tests (Kibar et al., 2016; Kloubec, 2010). In this study, functional shoulder rotation was observed to correlate with SLS in table tennis players with ID. Previous studies focused on specific exercise interventions observed improvements in both, balance, and shoulder flexibility without analysing the relationship



between these variables (e.g., Stozek et al., 2016; Polsgrove et al., 2016). Table tennis players were observed to exhibit shoulder adaptations as this sport requires unilateral and intensive movement of the upper limb (Kamonseki et al., 2018). Future studies focused on the relationship between flexibility, sport modalities and balance would bring a better insight into the role of flexibility on balance in population with ID.

### **Strengths and limitations**

The limitations of this study include the cross-sectional design and the small sample size. As the participants were not the same in years 2016 and 2022, we need caution to interpret the changes in fitness parameters. Also, not measure the participants before the pandemic starts in a year 2020, we cannot attribute any cause-effect of COVID-19 pandemic on fitness parameters in athletes with ID. The low number of female participants consists another limitation of this study, however, the lower engagement of females with ID in sports has been reported before (van de Vliet et al., 2006). Besides the limitations, to our knowledge, this is the first study investigating the fitness level of table tennis players with ID in 2016 and 2022 and associating the fitness parameters involved in their balance. Indeed, taking into account the aim of the study, future investigations should be conducted with athletes with ID participating in different sports modalities, to corroborate or refute the findings of the present study.

### **CONCLUSION**

In conclusion, it is possible to observe that despite the restrictive measures related to COVID-19, no statistically significant deterioration in fitness parameters was observed from 2016 to 2022 in table tennis athletes with ID. However, caution on the interpretation of the results should be taken considering the cross-sectional design of this study. The results also pointed out the overweight among the participants, especially in females, highlighting the need for encouraging strategies to increase their fitness level in order to minimize the overweight and obesity in ID population. Furthermore, the development of flexibility and lower limb strength in ID population can help improve the balance, and consequently minimize the risk of falls. Future studies focused on the relationship between flexibility and balance in different sport modalities would bring a better insight into the role of flexibility on balance in population with ID.

## Ethical Approval

Participants or their legal guardians provided a written Declaration of Consent with participation at Healthy Athlete screenings within Special Olympics Czech Republic prior to participation in this study.

## Funding

Special Olympics Czech Republic: Healthy Community 2015-17, Healthy Athlete/Fun Fitness 2022

## Conflict of interest

No conflicts of interest have been declared.

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