

# EFFECT OF THERAPEUTIC EXERCISE ON THE GENDER DIFFERENCES IN TYPICAL PHYSICAL FITNESS TESTS OF YOUNG INDIVIDUALS WITH INTELLECTUAL IMPAIRMENT

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**Abstract:** *The aim of the study was to examine the effect of therapeutic exercise intervention (TEI) on the gender differences in typical physical fitness tests of young individuals with intellectual impairment (II). Thirty-nine young individuals with II (22 boys, 17 girls; 18.9 ± 3.2 yrs) were examined before and after the implementation of a 3-month TEI. The examined fitness tests were the sit and reach test (SRT), the standing long jump (SLJ) and the Romberg balance test with open (RBTO) and closed (RBTC) eyes. Results revealed significant ( $p < .05$ ) main effect of gender and intervention and their interaction for SLJ, but not ( $p > .05$ ) for the other tests. In conclusion, longer TEI are required to provoke fitness adaptations in young persons with II.*

**Key words:** *disability, daily activities, exercise, Down Syndrome, Autism.*

## 1. Introduction

Individuals with intellectual impairment (II) present numerous disabilities in functional daily activities [26]. Along with impairments in cognitive, social and adaptive behavior, the fitness levels are decreased during the life span compared to typically developed peers [22], [27]. Lower performance in standard fitness tests that assess strength, endurance, flexibility, motor coordination, and cardiovascular endurance is evident in

young individuals with II [10], [14], [16]. The lower scores in physical fitness tests are associated with limited cognitive ability and short attention span [28], limitations in motor development, sedentary lifestyle and lack of motivation to maximize performance during testing [15]. Therefore, individuals with II are at risk of additional impairments associated with physical inactivity [19], [21].

There is evidence that physical activity is beneficial for the improvement of balance, strength, endurance and self-perceived

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health status in aged individuals with Down Syndrome [5]. Furthermore, physical exercise programs were found to significantly reduce their body mass index (BMI) scores, besides significant improvements in the “Sit and Reach” (SRT) and “Sit Up” tests [29]. In general, adults with II seem to improve their physical fitness scores after the implementation of a structured physical exercise intervention program [1]. The developmental trajectories of the results of physical fitness tests were similar for girls and boys with II aged 8-12 years old [16], [18]. Nevertheless, adult females were found to perform lower in physical fitness tests evaluating multiple aspects of physical conditioning compared to males [17].

## 2. Objectives

The main goals set in a therapeutic exercise intervention (TEI) program are the improvement of cardiorespiratory function, the enhancement of physical activity levels, the prevention of musculoskeletal deformities, the improvement of balance and proprioception, the improvement of

visual-motor coordination and general muscle strengthening.

The aim of the study was to evaluate the effect of a 3-month TEI in the context of physical activity in young individuals with II under the perspective of sex differences. It was hypothesized that the TEI will result in advanced physical fitness scores and that no differences will occur between the male and female participants.

## 3. Material and Methods

### 3.1. Participants

Thirty-nine ( $n = 39$ ) young individuals with developmental disorders were recruited to participate in the study (Table 1). Participants with developmental disorders such as intellectual disability, chromosomal anomalies (Down Syndrome) and functional autism spectrum disorders were accepted to the experimental procedure. Among the participants were 6 (4 males, 2 females) persons diagnosed with II and autism, a male and a female with Down Syndrome and a female with mental disorder.

*Anthropometric parameters of the participants (n = 39)*

Table 1

Parameter	Males (n = 22)	Females (n = 17)	t	p	d
Age (years)	19.6 ± 3.2	18.2 ± 3.2	1.344	.188	0.44
Body height (m)	1.68 ± 0.08	1.55 ± 0.10*	3.763	<.001	1.44
Body mass (kg)	80.8 ± 21.3	63.2 ± 16.9*	2.442	.021	0.92
BMI (kg/m <sup>2</sup> )	28.3 ± 6.2	25.7 ± 5.7	1.172	.252	0.44

\*: significant difference ( $p < .05$ ) between males and females

The inclusion criteria were that all the participants had to be certified as mild or moderate II by the National Center for Disability Classification and had records of systematic attendance in Creative Employment Centers for People with Disabilities. The presence of any

contraindication to exercise and any medication jeopardizing the ability to perform activities of daily living served as exclusion criteria. Participants who had experienced at least once seizure and were diagnosed with thrombosis were excluded. In addition, individuals who were on the

severe spectrum of autism and could not follow instructions, with musculoskeletal and cardiorespiratory diseases, or with more than one disability, such as spinal cord injury, cerebral palsy, were also excluded.

A signed informed consent for each participant was collected, fulfilling the requirements of the Declaration of Helsinki. The study was approved by the Institutional Research Ethics Committee (approval number: 2196/22-12-2021).

### 3.2. Procedure

The fitness tests were performed in an indoor sports hall (temperature: 24°C) before and after the implementation of the 3-month TEI. All tests were conducted in a random order.

The testing procedure was designed to examine the lower limb muscle strength with the standing long jump test (SLJ) [6], the hamstring and low back flexibility with the standardized SRT [2], and the proprioceptive ability in the postural control with the Romberg balance test with open (RBTO) and closed (RBTC) eyes [8]. In the balance tests, the feet were parallel at shoulder width and the arms were kept akimbo.

Each test was conducted 3 times and the mean value was selected for further analysis. The intra-test and inter-test rest were 1 min and 3 min, respectively.

In all tests, a short description and a demonstration was given by the researchers. In addition, verbal feedback about the performance was provided during the tests. The examiners gave the necessary instructions in a calm tone of speech, encouraging and motivating the participants to execute the tests optimally. Adequate familiarization was

provided to establish that the participants had comprehended the technique required to execute the tests [24].

The TEI consisted of a weekly routine comprised of once-a-week hippotherapy, swimming therapy, psychomotor education, traditional dance, and Paralympic sports training sessions. Each session lasted 60 min.

### 3.3. Statistical analysis

The statistical analyses were conducted with the IBM SPSS Statistics v.27.0.1.0 software (International Business Machines Corp., Armonk, NY, USA) at an  $\alpha = .05$  level of significance. The data were normally distributed as revealed by the results of the Kolmogorov-Smirnov's test ( $p > .05$ ).

The intra-test reliability was checked using the intra-class correlation coefficient (ICC). The single measure ICC values of  $< 0.40$ ,  $0.40 - 0.75$ , and  $> 0.75$ , with confidence intervals (CI) set at 95% were interpreted as poor, fair to good, and excellent reliability, respectively [11].

The sex differences in the anthropometric parameters were examined with an Independent Samples *T*-test. Cohen's *d* was used to estimate the effect size, with  $d < 0.5$ ,  $0.5 \leq d < 0.8$ , and  $d \geq 0.8$  being interpreted as small, medium and large, respectively.

Finally, a 2 (time)  $\times$  2 (sex) repeated measures ANOVA on the first factor with Bonferroni adjustment was used to check their main effects and the interaction. Significant differences were followed up with pairwise comparisons. The effect size was evaluated using the partial eta-squared statistic ( $\eta_p^2$ ), with  $\eta_p^2 > 0.01$ ,  $\eta_p^2 > 0.06$ , and  $\eta_p^2 > 0.14$  being a small, medium, and large effect size, respectively [25].

## 4. Results and Discussions

### 4.1. Reliability of the fitness tests

The results for the intra-test reliability are presented in Table 2. It is evident that the ICC scores ranged from .364 for the RBTC to .971 for the SRT. The present findings are in reasonable agreement

with older observations stating that there is excellent reliability for fitness tests performed by individuals with II [20], but this was partially confirmed for the balance tests as reported in the past [3]. This can be due to the fact that the past study examined adolescents in a variety of balance tests and not at the balance tests performed in the present study.

*Intra-test reliability scores*

Table 2

Test	ICC coefficient	95% CI	p	reliability
SRT	0.971	0.942 – 0.987	< 0.001	excellent
SLJ	0.940	0.838 – 0.917	< 0.001	excellent
RBTO	0.896	0.696 – 0.972	< 0.001	excellent
RBTC	0.364	0.156 – 0.575	0.176	poor

### 4.2. Flexibility test

No significant ( $p > .05$ ) main effects of sex ( $F = 2,406$ ,  $p = .130$ ,  $\eta_p^2 = .066$ ) and time ( $F = 0,034$ ,  $p = .854$ ,  $\eta_p^2 = .001$ ), nor an interaction of the sex  $\times$  time ( $F = 0,017$ ,  $p = .898$ ,  $\eta_p^2 = .000$ ) was found for the SRT (Figure 1). This finding does not confirm that the application of TEI programs improve SRT scores in adults with II [1], [12], [29]. However, the result about the absence of a difference between males and females is in agreement with past research [7].

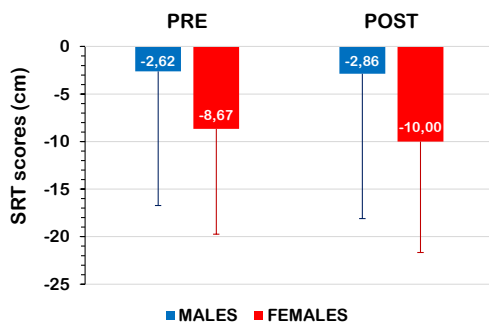


Fig. 1. Results for the SRT.

### 4.3. Lower limb muscle strength

A significant ( $p < .05$ ) main effect of sex ( $F = 4,680$ ,  $p = .044$ ,  $\eta_p^2 = .206$ , large effect size), time ( $F = 5,415$ ,  $p = .032$ ,  $\eta_p^2 = .231$ , large effect size), and interaction of the sex  $\times$  time ( $F = 8,089$ ,  $p = .011$ ,  $\eta_p^2 = .310$ , large effect size) was revealed for the SLJ (Figure 2).

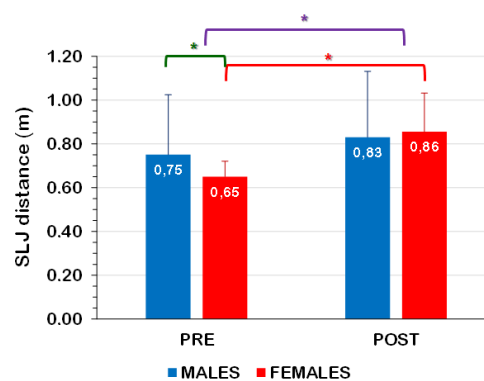


Fig. 2. Results for the SLJ (\*:  $p < .05$ ).

The results confirm previous findings about the positive effect of TEIs regarding the increase of SLJ

performance [1], [13]. However, past research in adults with Down Syndrome did not reveal significant sex differences in the SLJ [9]. Nevertheless, a sex difference in SLJ performance is evident that adolescents with II [23]. It seems that the female participants were benefited from the TEI to improve their lower limb strength capability and this is an encouraging finding as women with II were found to have lower fitness scores [17] and lower rates of moderate to intense physical activity compared to males [4].

#### 4.4. Proprioceptive ability

For the RBTO, no significant ( $p > .05$ ) main effects of sex ( $F = 3,854$ ,  $p = .097$ ,  $\eta_p^2 = .391$ ) and time ( $F = 1,285$ ,  $p = .362$ ,  $\eta_p^2 = .039$ ), nor an interaction of the sex  $\times$  time ( $F = 0,027$ ,  $p = .818$ ,  $\eta_p^2 = .001$ ) was revealed (Figure 3).

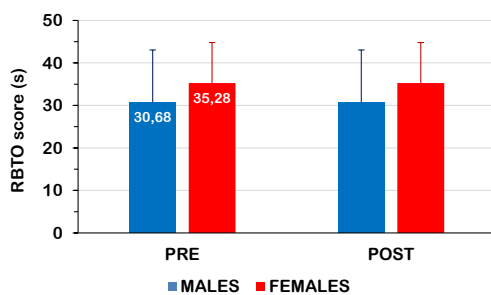


Fig. 3. Results for the RBTO.

No significant ( $p > .05$ ) main effects of sex ( $F = 2,654$ ,  $p = .122$ ,  $\eta_p^2 = .142$ ) and time ( $F = 1,421$ ,  $p = .426$ ,  $\eta_p^2 = .066$ ), nor an interaction of the sex  $\times$  time ( $F = 0,007$ ,  $p = .928$ ,  $\eta_p^2 = .000$ ) was also observed for the RBTC (Figure 4).

The results of the balance tests do not support past research providing evidence of enhanced postural control after the

implementation of TEIs [5]. In addition, individuals of the same age with intellectual and developmental disability were found to exhibit improved postural control to limit the body sway [30]. However, an improvement in the RBTC was not observed in this study.

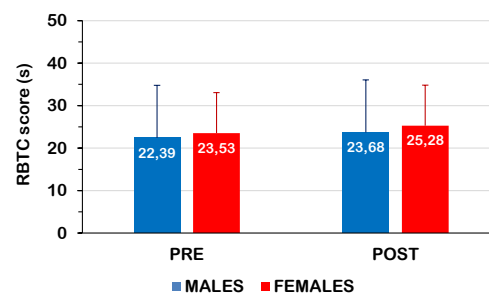


Fig. 4. Results for the RBTC.

No improvements were observed in the SRT and the balance tests. This could be the result of the duration of the TEI. The effectiveness of TEIs on physical fitness of individuals with II is evident when their duration ranges from 4 to 6 months [1], [5], [29]. Another topic is the elements of the applied TEI and their weekly frequency. The implemented TEI comprised of different activities at which the participants were involved only once per week. This might not lead to adequate adaptations, in contrast to structured physical exercise intervention programs that seem to be more effective [1].

## 5. Conclusions

This research highlights the importance of duration and contents of TEI aiming to significantly change the physical fitness levels of individuals with II in the examined tests. A more focused, structured and longer in duration TEI could be more optimal for the

improvement of physical fitness in young individuals with II.

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