Introduction

Physical activity programmes (PA) are adapted as necessary for children with intellectual disabilities to improve their cardiorespiratory ability, endurance, strength and balance (Boswell, 1993; Fotiadou, Neofotistou, Sidiropoulou, Tsimaras, Mandroukas, & Angelopoulou, 2009; Giagazoglou, Arabatzi, Dipla, League, & Kellis, 2012; Giagazoglou et al., 2013; Jankowicz, Mikolajczyk, & Wojtanowski, 2012; Tsimaras, Giamouridou, Kokaridas, Sidiropoulou, & Patsiaouras, 2012). Cardiorespiratory ability (VO2 max) is the basic component of a person’s fitness complex, because it involves the function of the heart, lungs, and the ability of blood vessels and capillaries to send oxygen to all parts of
the body to create energy. The balance of fitness components is essential to maintain the head and body against gravity and the force from outside and maintain the body’s centre of mass to the plane of the pivot. Physical activity programmes adapted to develop cardiorespiratory fitness and balance for children with intellectual disabilities are essential for the wellbeing of children.

Based on the results of a study, the general condition of cardiorespiratory fitness and muscular strength of children with intellectual disabilities (ID) is very low compared with those without intellectual disabilities (Temple, Frey, & Stanish, 2006; Pitetti, Yarmer, & Fernhall, 2001; Pitetti & Yarmer, 2002; Gillespie, 2003; Lotan, Isakov, Kessel, & Merrick, 2004; Dixon, Lee, & Dugala, 2013). The lower levels of cardiorespiratory fitness and muscular strength of children with intellectual disabilities than those without intellectual disabilities are a result of the fact that they do less physical activity and have less motivation to do physical activity (Pitetti, Beets, & Combs, 2009). Children with intellectual disabilities have inactive lifestyles or fewer opportunities for physical exercise, and they have high health risks (Ayvazoglu, Ratilffe, & Kozub, 2004).

In addition, children with mild intellectual disabilities (MID) often have limited motor skills (Westendorp, Houwen, Hartman, & Visscher, 2011). Delays and limitations of the development of motor skills are due to the condition of the brain, which affects its cognitive and motor function (Giagazoglou et al., 2012). The research of Guidetti, Franciosi, Gallotta, Emerenziani, and Baldari (2010) showed that children with intellectual disabilities faced difficulty in coordinating movement from childhood to adulthood. Such difficulties resulted in the lower performance on tests of balance (Hale, Bray, & Littmann, 2007; Minshew, Sung, Jones, & Furman, 2004).

The results of the above studies demonstrated that children with intellectual disabilities had limitations and difficulties of coordination and balance, and the level of physical fitness included cardiorespiratory ability, muscle strength, and muscle endurance were low compared to children without intellectual disabilities. How can exercise intervention be guided in order to improve the balance and physical fitness of children with intellectual disabilities? Few studies have been conducted on this topic. Specifically, most of the studies related to the use of design implementation effectiveness of a cross-sectional survey with a questionnaire to assess physical activity behaviour. This has limitations regarding exercise participation; in particular, changes cannot be observed, and only a simple relationship can be inferred. The lack of adaptive activity programmes that can be applied in school and on the training field is a limiting factor to develop the physical fitness of children with special needs.

Based on the statement above, the purpose of this study was to test the intervention programme of an adaptive circuit workout that can improve cardiorespiratory fitness, leg muscle strength and static balance among children with intellectual disabilities.

**Methods**

**Participants**

The participants of this study were 15 male students with mild intellectual disabilities aged 15 to 17 years who participated in extracurricular sports.

**Research procedure**

The research was carried out in two stages. The first stage was a literature review of previous research to develop an intervention programme of an adaptive circuit training for children with intellectual disabilities. The content validity was reviewed and tested by three physical education specialists. The second stage of the experiment had a one-group pretest-posttest design. Participants were given training (treatment) exercise three times per week for six weeks. Before and after treatment, participants’ cardiorespiratory endurance, coordination, and static balance were tested.

**Intervention**

The adaptive circuit programme was developed and designed based on the literature and the results of previous research. Once developed, it was validated by three experts to assess the Delphi technique. The results of the assessment data validation of three experts were calculated using the formula content validity ratio (CVR) to obtain an agreement. The more the data approach CVR=1 the better the data are. The circuit training programme composed by six stations with 5 meter spacing was used to evaluate the cardiorespiratory, strength and balance of children with intellectual disabilities. The programme was composed by the following stations: Station 1: shuttle run 6 beams move a distance of 5 meters, Station 2 sit-ups 10 times, Station 3 corks jump 10 centimeters 8 times, Station 4 BAKS up 10 times, Station 5 push-ups 10 times, Station 6 runs above the beam (width of 12 centimeters and a length of 4 meters). Circuit training is carried out for six weeks with a frequency of three times per week. From first and second week the circuit training program has been done twice for each week. The resting time was 3 minutes between the repetitions, and on the third and fourth weeks there was an increasing of volume and intensity; the circuit training program has been done 3 times per week with the same time of resting 3 minutes after one circuit. On the two last weeks (the fifth and sixth), the circuit training program still occurred 3 times per week but only there was a restriction of resting time (now 2 minutes).

**Measurements**

The data were obtained first by pre-test of the following variables: (1) cardiorespiratory fitness (VO2max), (2) leg muscle strength, and (3) static balance. The pre-test was done to establish the strengths and weaknesses of the athlete or someone else. After the training during 6 weeks, the post-test of the previous variables has been conducted because the fitness testing is a great way to monitor and assess athlete’s ability as it relates to aerobic fitness, strength, and static balance. It can also help the athlete or someone else to understand how healthy they are and learn to set goals to improve their health-related fitness.

**Cardiorespiratory fitness (VO2 max)**

Cardiorespiratory fitness can be determined by the value of the volume of maximum oxygen uptake (VO2max) (Foster, 1983). Cardiorespiratory Fitness value (VO2 max) max The VO2 max has been tested by using the Queen’s College Step Test is modified. The necessary tools are blocks (28 cm high), a stopwatch, and a metronome. Study participants do step movement up and down the block as high as 28 cm by 22 times up and down the stairs per minute (88 steps per minute) for 3 minutes without break. After 3 minutes, participants were asked to sit down, and their pulse rate was calculated using the radial artery for 1 minute. Counts were recorded as a heart rate of their recovery.

**Leg muscle strength**

Leg muscle strength in this study was measured using the
leg dynamometer (CYBEX division of Lumex). Implementation: the subject wears a waist fastener, then stood with his knees bent up to an angle of ± 45º, then the tool is attached to a waist fastener. After that, the subjects do their utmost with both legs. After the test, it has been seen that the legs were strengthened to the maximum, and then the needle of the device showed the number. The figure states the level of leg muscle strength. Rating: the best score of the three trials is recorded as the score in units kg, with a level of accuracy of 0.5 kg (Barry & Jack, 1979).

**Static balance**

Static balance is the ability to control the balance in the treatment of standing, sitting, and relative stillness. Static balance is measured using the Stork Stand Test. Participants using the pedestal stand with one leg that is considered stronger. One foot is positioned and bent beside the foot of the pedestal. Hand holding the waist, with eyes closed and the researchers commanded the movement by to counting: 1, 2, and 3 (one, two, and three). Participants must maintain the position. Scores are expressed in seconds.

**Results**

**Test of normality of each variable**

According to Table 1, the test normality using Kolmogorov-Smirnov obtained the significance value of each variable: the variable pretest had a significance value of 0.951; cardiorespiratory fitness and cardiorespiratory fitness posttest had a significance value of 0.961; strength pretest variables muscles had a significance value of 0.740, and posttest leg muscle strength has a significant value of 0.309; balance variable significant value 0.799 for the pretest, and posttest balance the significant value was 0.797. All of these variables were significantly greater than 0.05; therefore, it can be concluded that all the variables were normally distributed.

**Table 1. Kolmogorov-Smirnov Test Results (N=15)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strength</td>
<td>Cardio</td>
<td>Power</td>
<td>Muscles</td>
<td>balance</td>
<td>balance</td>
</tr>
<tr>
<td>Normal Parameters a, b</td>
<td>35.036</td>
<td>37.9</td>
<td>81.333</td>
<td>94.6</td>
<td>6.00</td>
<td>7.7333</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.951</td>
<td>.961</td>
<td>.740</td>
<td>.309</td>
<td>.799</td>
<td>.797</td>
</tr>
</tbody>
</table>

**Different Test Results pretest and posttest Cardiorespiratory fitness.**

**Table 2. Paired Samples Test (N=15)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Pre-test Cardio</th>
<th>Post-test Cardio</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>35.0360</td>
<td>37.9253</td>
<td>-</td>
</tr>
<tr>
<td>Pretest-Posttest Power</td>
<td>35 ml/kg/min</td>
<td>45 ml/kg/min</td>
<td>.000</td>
</tr>
</tbody>
</table>

**Different Test Results pretest and posttest Leg Muscle Strength**

**Table 3. Paired Samples Statistics of Strength (N=15)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Pre-test Strength</th>
<th>Post-test Strength</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>81.333</td>
<td>94.6667</td>
<td>.000</td>
</tr>
</tbody>
</table>

Based on Table 3, the results showed the value of significance (2-tailed) was 0.00 (p<0.05). Nevertheless, with a statistical analysis of paired samples, the descriptive value of final test leg muscle strength average 94.6667 is higher than the average value of the initial test of 81.3333. Therefore, we concluded that the circuit exercise training programme increased leg muscle strength in children with intellectual disabilities.

**Different Test Results pretest and posttest Balance**

The Table 4 below showed different test Paired Samples, pre-test and post-test balance of the subject tested.:

**Table 4. Paired Samples Statistics of Balance (N=15)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>6.0000</td>
<td>7.7333</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 4 showed the value of significance (2-tailed) was 0.00 (p<0.05). Therefore, the results of initial test and final test had significant changes. In the same table, we saw that the statistical analysis of paired samples descriptive value of the final test of static balance was on average 7.733 higher than the average value of initial tests 6.000. Therefore, we concluded that the circuit exercise training programme improved the static balance child with intellectual disabilities.

**Discussion**

The results showed that participants with mild intellectual disabilities after training have significantly increased cardiorespiratory fitness (VO2 max; p<0.05). Furthermore, it was shown that the final descriptive test value of VO2 max 37.925 millilitres/kilogram body weight/minute (ml/kg/minute) higher than the initial VO2 max test average of 35.036 ml/kg/minute. The findings of this study are reinforced by several
research results (Alcaraz & Blazevich, 2008; Giannaki, Apha-
mis, Tsoleupas, Ioannou, & Hadjicharalambous, 2016; S. Ro-
mere, Martinez, & Alcaraz, 2013; Mayorga-Vega, Vici-
a, & Cocca, 2013) that stated that circuit programs with resistance and carried out repeatedly within six weeks to eight weeks could increase cardiorespiratory ability. In addition, the results of the studies of Mayorga el al. (2013), and Schmidt, Anderson, Graff, and Strat (2016) state that physical activity programmes using circuit training can increase endurance cardiorespiratory ability.

This study also found that there was a significant increasing of leg muscle strength (p<0.05) for children with intellectual disabilities after conducting the circuit training programme. It was also shown that there was an increasing of average yield of leg muscle strength pretest (mean 81.33) to the leg muscle strength in posttest with (mean 94.66). The findings of this study were similar to the results of several studies that stated that circuit training programs can increase muscle strength (Wirat, Pratoom, & Sootmongkol, 2017; Mayorga et al., 2013; Schmidt et al., 2016; Giannaki et al., 2016).

It was also shown that there was an increasing in the results of static balance pretest (mean 6.00) and posttest of static balance test (mean 7.70). The findings of this study were similar to those of Jankowicz et al. (2012) and Giagazoglou et al. (2013), which stated that circuit training improved static and dynamic balance.

Circuit training programmes can improve cardiorespiratory fitness, leg muscle strength, and the balance of children with intellectual disabilities, when the children were enthusiastic and motivated in carrying out the exercises. This was similar to the results of research by Jan Wilke (2018) stating that circuit training with low intensity can increase the motivation of practicing children.

Based on the research results and the above discussion, it can be concluded that the circuit adaptive activity programme can improve cardiorespiratory fitness, leg muscle strength, and static balance for the child mild intellectual disabilities. The programme can be used by physical education teachers in schools to improve cardiorespiratory fitness, leg muscle strength, and balance for children with intellectual disabilities.

Acknowledgements
We are thankful to the participants in our research who have given a written consent, but also our deeply feelings gratitude were addressed to the children with intellectual disabilities who allowed us to conduct this research with them.

Conflict of Interest
The authors declare that there are no conflicts of interest.

Received: 29 July 2019 | Accepted: 24 September 2019 | Published: 01 October 2019

References
Foster, C. (1983). VO2 max and training indices as determinants of com-
doi:10.1080/02640418308729657
Fotiadou, E.G., Neofotiostor, K.H., Sidiroopoulou, M.P., Tsimaros, V.K., Mandrou-
kas, A.K., & Angelopoulos, N.A. (2009). The effect of a rhythmic gymnastics pro-
trogram on the dynamic balance of individuals with intellectual abil-
ities, 38, 296-301.
1075. https://doi.org/10.1016/j.ridd.2010.04.018
ities, 33, 2265-2270.
org/10.1111/j.1365-2788.2006.00873.x
Lotan, M., Isakov, E., Kessel, S., & Merrick, J. (2004). Physical fitness and func-
tional ability of children with intellectual disabilities: effects of a short-
Pitetti, K.H., & Yarmer, D.A. (2002). Lower body strength of children and ado-
lescents with and without mental retardation: A comparison. Adapted Physical Activity Quarterly, 19, 68-81.
Tsimaros, V.K., Giamouridou, G.A., Kokaridas, D.G., Sidiroopoulou, M.P., & Pati-
Wirat, S., Pratoom, M., & Sootmongkol, A. (2017). The Effects of a Circuit Train-
ing Program on Muscle Strength, Agility, Performance and Cardiovas-