The Effect of Balance Training on Reaction Time in Children with Mental Retardation

Mahrokh Dehghani*; Mehmet Günay**

*Gazi University,
Ankara, Turkey.
**Gazi University,
Ankara, Turkey.

Abstract

The purpose of this study was to find out the effect of balance training on reaction times in children with mental retardation. To achieve this purpose, the sample consisted of 22 healthy school aged children 8-13 years old (mean age = 10.23±1.43 years) with mild mental retardation recruited randomly from a special primary school in Turkey. Participants were randomly assigned either to an experimental group (n =11) or a control group (n =11). The experiment group attended a 10 weeks balance training intervention program consisting of 45-min sessions, while the control group followed the regular school schedule. Reaction time was assessed using RT apparatus manufactured by Anand Agencies, Pune. Wilcoxon Signed Rank Test was performed to compare the pre and post training measures of both groups separately. The Mann Whitney U Test was used to identify possible differences between the exercise and control groups. The results of the present study revealed significant difference between the pre-intervention mean values with that of the post-intervention of visual reaction time for study group (P=0.004).

Keywords: Mental retardation, Exercise, Reaction time, Balance training, Children.

1. Introduction

Physical exercise and various sports-related activities are necessary to promote health, fitness, and psychological development among children of school age. In general, the ability to play sports and exercise is lower for children with intellectual disabilities than in children without such disabilities (Kihara & Hashimoto, 2000). Children with intellectual disabilities (ID) often have psychological problems associated with carrying out exercise. Moreover, their experience of exercise is limited (Hayakawa & Kobayashi, 2011).
Intellectual disability affects all spheres of people’s lives who suffer from it. It lowers the level of intellectual functioning, often stigmatizes, characteristically changing features, and decreases motor performance. Unfortunately, modern medicine cannot cure intellectual disability; however, there is a chance to improve the quality of life of people with mental retardation by means of physical exercises and by enhancing coordination, the quality of gait and efficiency in performing everyday activities (Jankowicz-Szymanska et al, 2012).

Mental retardation (MR) is characterized by a significant deficit of intellectual functioning and adaptive behavior. The ability to learn and adapt to the changing environment is limited, resulting in difficulty in activities of daily living and functioning in society. Using the Intelligence Quotient (IQ), classification systems have identified four levels of MR: mild (IQ=50-70), moderate (IQ=35-49), severe (IQ=20-34) and profound (IQ≤20) (Beckung et al,1996 ; LaJoie & Miles, 2002). Research has shown that individuals with MR have longer and more variable reaction times than those without MR(Volman et al, 2007). Differences in reaction times have often been associated with central and peripheral processing components, as well as structural alterations within the CNS (Kubilay et al, 2011).

One of the simple and effective methods of studying the central neuronal processing is the RT that is the interval between the onset of a signal (stimulus) and the initiation of a movement response. It is an indirect index of central neuronal processing and is a simple means of determining sensory-motor association, performance and cortical arousal. Decrease in RT indicates an improved sensory-motor performance and an enhanced processing ability of the central nervous system. It is a sensitive and reproducible test that can be measured with a simple apparatus and setup (Bhavanani et al, 2012). The level of intelligence has been correlated with RT and it has been found that serious MR produces slower and more variable RT (Deary et al, 2001).

Studies of reaction time in which retarded subjects are compared with normal subjects have continually demonstrated that retarded individuals have slower reaction times than do non retarded individuals (Baumeister, Hawkins, & Kellas, 1965; Baumeister & Kellas, 1968; Berkson, 1960; Berkson & Baumeister, 1967; Brewer & Nettelbeck, 1979; Nettelbeck & Brewer, 1981). Differences in reaction times have often been associated with central and peripheral processing components, as well as structural alterations within the CNS.

Wade, Flewell, and Wallace (1978) concluded that reaction time performance differences between retarded and non retarded subjects could be, at least partially, attributed to response patterns or organization. They used both simple and choice reaction time paradigms to examine reaction time and movement time of retarded and non retarded subjects. They found that the reaction time of the retarded individuals was both longer and more variable than that of the non retarded and that movement difficulty in the choice reaction time tasks served to increase the reaction times of both retarded and non retarded subjects. However, the movement time of the retarded population was significantly slower than that of the non retarded group.

Two additional studies (Caffrey, Jones, & Hinkle, 1971; Dugas & Baumeister, 1968) also found that mentally retarded subjects were generally slower in reaction time than their non retarded controls, and that retarded subjects demonstrated a higher degree of between-subject and within-subject variability than did non retarded subjects. Weaver and Raveris (1970) compared reaction
times of mild, moderate, and severely retarded subjects. They found less variability in the mildly retarded group while the severely retarded group exhibited the greatest amount of variability. This finding is consistent with others, which compared the reaction time of non-retarded and retarded subjects.

The purpose of this study was to examine the effect of balance training on reaction time in children with mental retardation. The research hypothesis was that balance training could decrease reaction time in children with MR.

2. Methods

2.1. Participants

The sample consisted of 22 healthy school-aged children 8-13 years old (mean age = 10.45 ± 1.34 years) with mild mental retardation recruited randomly from a special primary school in Turkey. Participants were randomly assigned either to an experimental group (n = 11) or a control group (n = 11), keeping an appropriate ratio between the number of females and males. The experimental group attended a 10 weeks balance training intervention program consisting of 45-min sessions, twice a week, while the control group followed the regular school schedule. All parents or legal guardians provided written informed consent prior to participation, which was approved by an Institutional Review Board for use of human subjects, allowing the children’s involvement in the program and access to relevant information. The IQ of participants with intellectual disability was determined using the Weschler Intelligence Scale test. All participants had IQ=50-70.

2.2. Testing Procedures

The assessment of the level of basic somatic build characteristics, i.e., body weight and height, was conducted. Body weight was assessed on the Tanita scales to an accuracy of 0.1 kg, body height was measured within 1 mm by means of a calibrated anthropometer, and reaction time was assessed using RT apparatus manufactured by Anand Agencies, Pune. In the present study simple auditory reaction time (ART) was recorded for auditory beep sound stimulus and simple visual reaction time (VRT) for red light stimulus. Simple auditory-visual reaction time (AVRT) was recorded for auditory beep sound stimulus and red light stimulus simultaneously. Random reaction time (RRT) was recorded for red light stimulus that turn randomly (right or left). The subjects were instructed to release the response key as soon as they perceived the stimulus. The signals were given from the front of the subjects to avoid the effect of laterised stimulus and they used their dominant hand while responding to the signal (Madanmohan et al, 2005). All subjects were given adequate exposure to the equipment on 2 different occasions to familiarize them with the procedure of RT measurement. RT measurements were done before and after 10 weeks balance training program.

2.3. Exercise Protocol

The exercise program consisted of three components. 1. Warming up phase: In this phase, ten minutes’ walk and stretching exercises were applied. 2. Exercises phase: In this phase balance exercises were repeatedly performed. 3. Cooling Phase: In this phase, the same stretching exercises in the warming up period, were applied. Balance training consisted in toe-to-heel walk, walking on
a line, side walking, reverse walking, zig–zag walking, longer strides, tandem standing, double-leg stance with feet apart and together and one-leg stance. These exercises were performed on the floor and on balance pads, with eyes opened and closed and at different elevations.

2.4. Statistical Analysis

All data were analyzed using the SPSS 16.0 statistical package. Wilcoxon Signed Rank Test was performed to compare the pre and post training measures of both groups separately. The Mann Whitney U Test was used to identify possible differences between the experiment and control groups. Differences a significance level (p) less than 0.05 were considered significant.

3. Results

Table1 shows the mean and SD of the age, height and weight for each group.

<table>
<thead>
<tr>
<th>Physical Characteristics</th>
<th>All Participants (N=20)</th>
<th>Exercise Group (N=10)</th>
<th>Control Group (N=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>10.23±1.43</td>
<td>10.30±1.76</td>
<td>10.14±0.89</td>
</tr>
<tr>
<td>Height</td>
<td>134.88±8.47</td>
<td>135.80±9.47</td>
<td>133.57±7.32</td>
</tr>
<tr>
<td>Weight</td>
<td>33.03±6.61</td>
<td>33.43±6.99</td>
<td>32.47±6.52</td>
</tr>
</tbody>
</table>

Table2 Shows ART, VRT, AVRT and RRT Means ± SD Values in PRE and POST Measurement for Experimental and Control Group

<table>
<thead>
<tr>
<th></th>
<th>Experimental group (n=11)</th>
<th>Control group (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRE (ms)</td>
<td>POST (ms)</td>
</tr>
<tr>
<td>ART</td>
<td>383.95±64.17</td>
<td>372.62±59.78</td>
</tr>
<tr>
<td>VRT</td>
<td>504.10±87.28</td>
<td>417.15±87.89*</td>
</tr>
<tr>
<td>AVRT</td>
<td>358.48±72.39</td>
<td>350.93±73.94</td>
</tr>
<tr>
<td>RRT</td>
<td>591.00±165.09</td>
<td>350.93±141.55</td>
</tr>
</tbody>
</table>

* P<.05 PRE to POST test
Visual reaction time (VRT)  Random reaction time (RRT)
Auditory reaction time (ART)
Auditory -Visual reaction time (AVRT)

When comparing the pre-intervention mean values of reaction time for the study group with that for the control group by using Mann Whitney U test, the results revealed non-significant difference (p=0.536 and 0.669 respectively). On the other hand, when comparing the pre-intervention mean values of visual reaction time for the study group with post-intervention by using Wilcoxon test, the results revealed significant difference between pretest and posttest measurement (p=0.004).
4. Discussion

Individuals with MR often experience reaction time problems and these problems are reflected in their reduced motor capacity. Therefore, it is essential to establish whether reaction time in persons with MR can be reduced by proper training. One of the major finding of this study was that visual reaction time (VRT) improved with exercise. Decrease in RT signifies improved central neuronal processing ability. This may be due to greater arousal and faster rate of information processing, improved concentration and/or ability to ignore or inhibit extraneous stimuli.

In previously studies, the effect of exercise on reaction time has been studied (Laroche et al., 2007; Trombly, 2004). Trombly (2004) showed that reaction time can be improved by training. In a study, Kashihara and Nakahara (2005) found that vigorous exercise did improve choice reaction time and Collardeau et al. (2001) found that exercise improved reaction time during the exercise.

We couldn’t find any study in literature about the effects of balance training on reaction time, separately. Bhavanan et al (2003) showed Yoga may effects reaction time positively. Previous studies on yoga have shown that regular practice of yoga can significantly decrease Visual RT and Auditory RT (Madanmohan, 1992). Bhavanani et al (2012) studied immediate effect of mukha bhastrika on reaction time in mentally challenged adolescents. Results showed an overall reduction of 33 ms and 30.5 ms (10.99% and 12.31% reduction) in mean scores of VRT and ART respectively after mukha bhastrika.

Although in literature, there was lack of evidence about positive effects of balance training on reaction time, in this present study, we observed that this exercise is very effective way to develop VRT in children with mild mental retardation. The vestibular, somatosensory (including proprioceptive and cutaneous inputs) and visual systems are the afferents involved in the complex process of maintaining upright balance in humans (Cheldavi et al, 2014). Any deficit in these systems or in the integration of information from these systems could affect balance. Sensory impairments are common in children with developmental disabilities (Gal, Dyck, & Passmore, 2010), and they are at an increased risk for visual impairments (Creavin & Brown, 2009). Therefore, it seems that balance training could effect visual reaction time.

In conclusions on the basis of the present study, balance training may be used as an effective means of training to improve neuromuscular abilities in special children.

References


