Jumping Rope Intervention on Health-Related Physical Fitness in Students with Intellectual Impairment

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ABSTRACT

The main purpose of this study was to examine the effect of jumping rope training on the health-related physical fitness in students with intellectual impairment. Nine students aged between 13-15 and who at Chung-Shan Junior High School in Taichung City were selected as the study sample. Using the random sampling method, students were divided into the experimental group (N=6) and the control group (N=3). Tests of health-related physical fitness were conducted before and after the training. The paired t-test and analysis of covariance (ANCOVA) were used in the statistical analyses for the test results.

Keywords: jumping rope, Intellectual impairment, health-related physical fitness.

INTRODUCTION

According to an annual report published by the Department of Statistics, Ministry of the Interior (2010), the population of Taiwan was 23,162,123 at the end of 2010, and 96,565 people had intellectual impairment; accounting for 1/250th of the entire population. In other words, of every 250 people, one person had intellectual impairment. Studies have pointed out that since the People with Disabilities Rights Protection Act was passed in 1997, the government of Taiwan began to consider the equity for the disabled to participate in social, political, economic, and cultural activities, and facilitate the independent development of the disabled population. People with intellectual impairment are a minority group in Taiwan. These people generally need health care and social welfare services, education and vocational training, and protection acts. Appropriate healthcare service is an essential key to guaranteeing and maintaining the quality of life in people with intellectual impairment (Lin, Yen, Li, Wu & Cheng, 2003). Cognitive and comprehension impairment toward health and exercise in people with intellectual impairment could indirectly cause ineffective movements and burdens on physical ability. In addition, most people with intellectual impairment do not actively participate in sporting activities, limiting their development of health-related physical fitness.

Chen (2010) pointed out that students with intellectual impairment might not be able to understand the instructions in physical education courses at schools. Furthermore, some students were unwilling to participate in physical activities even if they could understand the instruction. The long-term consequences included overweight and poor physical fitness. Regarding physiological and motor development in people with intellectual impairment, more severe impairment causes greater variance in physiological and motor development, which is also associated with health problems (Ho, 2001; Huang, 1989; Draheim, McCubbin, & Williams, 2002). Therefore, understanding the physical ability of individuals with intellectual impairment merits great concern in the public health field. Studies have
discovered that appropriate exercise prevented obesity, diabetes, and cardiovascular diseases; sport activities accompanied by endurance and strength training improved metabolism (Bell, Watts, Siafarikas, Thompson, Ratnam, Bulsara, Finn, O'Driscoll, Green, Jones, & Davis, 2007; Benson, Torode, & Fiararone Singh, 2008; De Stefano, Caprio, Fahey, Tamborlane, & Goldberg, 2000; Poirier & Després, 2001). The results showed that 10weeks of rope jumping exercise training could have a significant effect on improving the flexibility and aerobic capacity of visually impaired students. The rope jumping exercise can help overcome movement restrictions and learning limitations of visually impaired students (Chen & Lin 2011).

Health-related physical fitness implies the physical ability which promotes health, prevents disease, and improves efficiency in daily activities. Exercising is regarded as an approach to improve health status, increase physical activity, and enrich one’s quality of life. On the contrary, a lack of exercise leads to a deterioration of bodily functions and the large and small muscle groups, which could further bring on chronic diseases (Tsai, 2009). Therefore, health-related physical fitness - physical ability which promotes health, prevents disease, and improves efficiency in daily activities - should not be limited to the general population. Given the insufficient awareness toward the body in junior high school students with intellectual impairments who are in the growth stage, health-related physical fitness is a basic skill the students need to improve. The statements above comprised the second motivation of this study.

As a result, it is important to select a physical activity that is suitable for students with intellectual impairment. The activity must not be constrained by the weather or the setting, is interesting and, inexpensive, and can be easily conducted (Chen, 2010). A foreign researcher indicated that jumping rope involved the muscles of the arms and the legs, and improved cardiovascular functions and metabolism. In addition, it helped develop coordination, balance, agility, rhythm, and speed in the lower limbs, and built static and dynamic muscular endurance; which were especially important for performing stable gestures and repetitive movements (Brancazio, 1984). Several researchers studied the effects of jumping rope on health-related physical fitness in students with mild intellectual impairment or visual impairment, and found that jumping rope significantly improved balance, cardiovascular endurance, muscular strength, body composition, and flexibility (Yeh, 2007; Tsai, 2009; Chen, 2010). Studies also suggested that with effective exercise prescriptions involving jumping rope, individuals demonstrated an improvement in cardiovascular function, body composition, flexibility, and muscular strength and endurance, which further contributed to advancements in health-related physical fitness (Shen & Huang, 2000; So & Lin, 2001; Wu, 2002; Feng, 2007; Tsai, 2009; Lee, 2010; Syu, 2010; Masterson, 1993). The above statements reveal that jumping rope is a simple exercise which only requires a rope, and could be performed anytime or anywhere. Moreover, jumping rope will not be constrained by weather, place, or age, and is recognized as to its effectiveness in improving health status. Not only the general population, but also physically and mentally disabled individuals could jump rope, and this exercise brings significant improvements in the physical ability in physically and mentally disabled students.

Therefore, adopting an experimental design, 12-week jump rope training was administered in students with intellectual impairment. Study interventions did not include dietary control, and the jump rope training was delivered 3 times a week, for 45 minutes each time. Exercise intensity was measured using the Rating of Perceived Exertion (RPE), and the goal was to reach between the levels of “fairly light (11)” and “hard (15).” Students in the control group performed general activities. The study examined the effects of the 12-week jump rope training on items of health-related physical fitness in students with intellectual impairment.
METHOD

Study sample

Study participants were recruited from the special education class of Chung-Shan Junior High School in Taichung City. With help from a professional nurse in the school health center, the students’ conditions were evaluated. The purposeful sampling method was used to select nine students aged between 13-15 years who had mild or moderate levels of intellectual impairment. Then, the random sampling method was adopted to divide students into the experimental (N=6) and control (N=3) groups.

Study methods and procedures

The study was conducted between February 28th and May 20th, 2011. Every Monday and Tuesday, the jumping rope training was administered from 15:00 to 15:45; and on Friday, the session was from 14:00 to 14:45. The random sampling method helped to divide students into the experimental (N=6) and control (N=3) groups, and all students went through a pre-test of health-related physical fitness. Students in the experimental group were then provided with 12 weeks of jumping rope training, and those in the control group were asked to keep regular hours. A post-test of health-related physical fitness was performed after the 12-week training intervention.

Training prescriptions in the experimental group

Exercise pattern

Jumping rope was the primary activity in this experimental study. Students had the rope go around once per jump and did 8 cycles in every training session. A cycle was composed of 2 minutes of jumping rope and 2 minutes of rest, which took approximately 35 minutes to complete 8 cycles. In addition, the students performed warm-up and relaxation stretching exercises, which included stretches of the neck, arms, waist, leg muscles, ankles, and wrists. Both warm-up and relaxation stretches took 5 minutes, leading to a total of 45 minutes per training session.

Exercise intensity

The goal for exercise intensity was to reach between level 11 (Fairly light) and level 15 (Hard), based on Borg’s Rating of Perceived Exertion (Borg, 1962); where the scales went from 6 to 20, and the total score could be categorized into 15 levels. Students had the rope go around once per jump and did 8 cycles in every training session. A cycle was composed of 2 minutes of jumping rope and 2 minutes of rest. A special education teacher consulted on students’ perception toward exercise.

Exercise duration and frequency

Students in the experimental group were provided with a 12-week jumping rope training program, delivered 3 times a week, for 45 minutes each time. Students performed 8 cycles of training in each session, where a cycle was composed of 2 minutes of jumping rope and 2 minutes of rest.

Data management and analysis

Test results were analyzed using SPSS 17.0 for Windows. Statistical methods included:
1. Using paired t-test to compare the health-related physical fitness between pre-test and post-test of the experimental group.
2. Using ANCOVA to examine differences in items of health-related physical fitness between the experimental and control groups.
3. The significance level of statistical analyses was set at $\alpha = .05$.

RESULTS

Demographics of the study participants

Nine students from Chung-Shan Junior High School in Taichung City were the study participants. Students’ age, height, weight, and body mass index (BMI) information are displayed in Table 1:

Table 1: Demographics of the study participants.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Age M (SD)</th>
<th>Height M (SD)</th>
<th>Weight M (SD)</th>
<th>BMI M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>6</td>
<td>14(0.63)</td>
<td>148(8.99)</td>
<td>43.4(7.87)</td>
<td>20.1(4.3)</td>
</tr>
<tr>
<td>Control</td>
<td>3</td>
<td>14(0.9)</td>
<td>166.3(5.76)</td>
<td>63.6(15.99)</td>
<td>22.8(5.2)</td>
</tr>
</tbody>
</table>

Within-group comparison of items of health-related physical fitness

In this section, the results of paired $t$-tests of items of health-related physical fitness between pre-test and post-test of the experimental group are displayed. These results were used to testify the effect of jumping rope training on the health-related physical fitness in students with intellectual impairment. $p < .05$ was regarded as significant.

Paired $t$-tests in the experimental group

Table 2 is a summary of the results of paired $t$-tests between pre-test and post-test of the experimental group. As shown in table, in the pre-test, the average BMI was 20.82, and the figure was 20.05 in the post-test; this difference was not significant ($p > .05$). Regarding the sit and reach test, the mean score in the pre-test was 24.33, and it increased significantly to 30.0 in the post-test ($p < .05$). With respect to sit-ups, the average number in the pre-test was 13.83, and the number increased significantly to 21.50 in the post-test ($p < .05$). In terms of the 800 meters walk-run test, the mean scores were 366.67 in the pre-test and 276.50 in the post-test, which were significantly different ($p < .05$).

Table 2: Summary of the results of paired $t$-tests between pre-test and post-test in the experimental group.

<table>
<thead>
<tr>
<th>Test item</th>
<th>Before Test N=6</th>
<th>After Test N=6</th>
<th>t</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index (BMI)</td>
<td>M SD</td>
<td>M SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.82 4.51</td>
<td>20.05 4.35</td>
<td>1.66</td>
<td>.159</td>
<td></td>
</tr>
<tr>
<td>Sit-and-reach</td>
<td>24.33 3.83</td>
<td>30.0 4.47</td>
<td>6.42a</td>
<td>.001</td>
</tr>
<tr>
<td>13.83 8.23</td>
<td>21.50 7.26</td>
<td>3.53a</td>
<td>.017</td>
<td></td>
</tr>
<tr>
<td>800m walk-run</td>
<td>366.67 113.99</td>
<td>276.50 53.96</td>
<td>3.49a</td>
<td>.018</td>
</tr>
</tbody>
</table>

Between-group comparison of items of health-related physical fitness

In order to examine the effect of jumping rope training on the health-related physical fitness in students with intellectual impairment, enrolled study participants were divided into experimental and control groups. Before the jumping rope intervention, students in both groups completed a pre-test of health-related physical fitness; and after 12 weeks, post-tests were conducted. Results from these two tests were analyzed using ANCOVA. A test of homogeneity among covariates is required before
performing ANCOVA. The test of homogeneity examines if the slopes of the covariates obtained from regression models and that of the dependent variable are equal. If the results of interaction tests reach the significance level, there could be interactive correlations between independent variables and covariates, which violates the assumption of homogeneity of regression coefficients. On the contrary, if the results of interaction tests between independent variables and covariates do not reach the significance level, there is no violation of the assumption of homogeneity of regression coefficients (Wu, 2007).

Table 3 displays a summary of homogeneity of covariates of health-related physical fitness in the experimental and control groups. As shown in Table 3, the F-value of each covariate did not reach the significance level (p>.05), and therefore the assumption of homogeneity of regression coefficients was met.

**Table 3: Summary of homogeneity of covariates of health-related physical fitness in both groups.**

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index (BMI)</td>
<td>.062</td>
<td>.062</td>
<td>.053</td>
<td>.83</td>
</tr>
<tr>
<td>Sit-and-reach</td>
<td>.293</td>
<td>.293</td>
<td>.044</td>
<td>.842</td>
</tr>
<tr>
<td>Sit-up</td>
<td>3.936</td>
<td>3.936</td>
<td>.184</td>
<td>.686</td>
</tr>
<tr>
<td>800m walk-run</td>
<td>688.943</td>
<td>688.943</td>
<td>2.21</td>
<td>.197</td>
</tr>
</tbody>
</table>

*p < .05.

As shown in the Table 4 summary of the covariates of health-related physical fitness in the experimental and control groups, jumping rope training did not have a significant effect on BMI, while it significantly affected the results of the sit and reach, sit-up, and 800 meters walk-run tests.

**Table 4: Summary of covariates of health-related physical fitness in both groups.**

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index (BMI)</td>
<td>.067</td>
<td>.067</td>
<td>.067</td>
<td>.81</td>
</tr>
<tr>
<td>Sit-and-reach</td>
<td>50.168</td>
<td>50.168</td>
<td>8.928</td>
<td>.024</td>
</tr>
<tr>
<td>Sit-up</td>
<td>165.841</td>
<td>165.841</td>
<td>8.928</td>
<td>.024</td>
</tr>
<tr>
<td>800m walk-run</td>
<td>14198.351</td>
<td>14198.351</td>
<td>37.907</td>
<td>.001</td>
</tr>
</tbody>
</table>

*p < .05

**DISCUSSION**

The 12-week jumping rope training showed no significant influence on the BMI of students with intellectual impairment. A possible reason was that a BMI shift required not only aerobic exercise, but control of food intake. However, this study did not pose any intervention on diet. This finding was consistent with the results from several domestic studies (Shen & Huang, 2000; So & Lin, 2001; Wu, 2002; Feng, 2007; Tsai, 2009; Lee, 2010; Syu, 2010; Masterson, 1993). The jumping rope training demonstrated significant effects on cardiovascular endurance, flexibility, and muscular strength and endurance. Given the congenital defects in individuals with intellectual impairment, if there is no supportive environment - such as a lack of barrier-free space, guiding tiles, and elevators, toilets, or transportation tools for the disabled - those disabled who have fewer opportunities to participate in physical activities will be affected in terms of muscular and joint stretching, and cardiovascular functions. Many researchers American College of Sports Medicine (2000); Yukselen, Dogan, Turan, Cetin, and Uğan (2008) had pointed out that regular and continuous exercise with appropriate intensity, such as
walking, dancing, jumping rope, biking, swimming, skating, stair climbing, trampoline exercise, rope
spinning, leaping over obstacles, and stair stepping effectively improved cardiovascular endurance.

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REFERENCES

Lippincott Williams, Wilkins.
Bell, L. M., Watts, K., Siafarikas, A., Thompson, A., Ratnam, N., Bulsara, M., Finn, J., O’Driscoll, G., Green, D. J., Jones, T. W.,
adolescents: a systematic review. Obesity Reviews, pp. 9, 43 – 66.
Chen, H. M. (2010). The Effects of rope skipping on health-related physical fitness in student with mild intellectual disability: A
with down syndrome and mental retardation. American Journal of Mental Retardation, pp. 107, 201–211.
Feng, T. C. (2007). The influence of rope skipping on health related physical fitness of junior high school students-A case study of
conditioning research, pp. 7(2), 108-114.
http://sowf.moi.gov.tw/stat/month/list.htm
Physical Education Journal, pp. 31, 81-90.


