Two different strength training and untrained period effects in children

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Abstract:

The purpose of this study was to investigate effects of different strength training in trained period and untrained period. Thirty children (1st group weight mean: 30.50 ± 7.04 kg; height mean: 128.65 ± 6.74 cm; BMI: 18.06 ± 2.80 kg/m² and 2nd group weight mean: 28.78 ± 4.50 kg; height mean: 131.12 ± 2.80 cm; BMI: 17.11 ± 2.83 kg/m²) participated to this study. Strength training was applied for 6 weeks. The children were divided to two groups as elastic band group and body weight training group. Height and weight measurements, leg strength test, sit-up test and push-up test were used in the study. All the tests were applied five times. Paired t- test, one Way ANOVA and repeated ANOVA statistics tests were used to analyze the data. The study results show that there were significant differences in leg strength and repetition of push-up between trained with elastic bands group and body weight after training group ($p < 0.05$). There was no significant difference between sit-up ($p > 0.05$). The time-dependent significant differences were found in push-ups, leg strength and sit-up ($p < 0.05$).

Key words: Strength training, elastic band, untrained, children.

Introduction

Strength training is a training method in which an external resistor is used to induce a change in the functional capacity of the muscles. In previous years there has been misinformation in publications regarding preadolescent strength training such as its being a harmful and a high risk training type that may cause disability and since it is considered dangerous it could negatively impact the development of children (Kreamer and Fleck 1993; Docherty et al, 1987; Hetherington 1976). Despite this, in the last twenty years it has been sufficiently analyzed and shown that strength training practiced by prepubescent children is useful not only for children's muscle and bone development but also is beneficial for their socialization, mental development and self-knowledge (Faigenbaum and Michelle 1988; Kreamer and Fleck 1993; Faingenbaum et al, 1993; Hetzeler et al, 1997; Guy and Michel 2001; Malina 2006; Kotzamanidis 2006; Szymanski et al, 2007).

The important thing is the intensity of the children training program, its frequency, duration, exercise type and use of appropriate materials for the children's developmental level. Well organized and controlled strength training, if applied by experts gives meaningful results from the scientific point of view. Although exercises for strength training that is frequently recommended in children are done through the use of their own body weights or additional weights, there are arguments saying that the yield obtained by the use of children's own body weight not being enough, showing that preadolescent children cannot have enough strength to do these movements (Faingenbaum and Westcott 2000). Moreover in recent years, the use of elastic band has been expanded as they are easy to use, cheap and very safe. However there has not been research on the use and impact of them in children. The purpose of this study was to investigate effects of different strength training in trained period and untrained period.

Method

Participants

Thirty children (1st group weight mean: 30.50 ± 7.04 kg; height mean: 128.65 ± 6.74 cm; BMI: 18.06 ± 2.80 kg/m² and 2nd group weight mean: 28.78 ± 4.50 kg; height mean: 131.12 ± 2.80 cm; BMI: 17.11 ± 2.83 kg/m²) participated to this study.

In the beginning, thirty six children were allowed by their parents. However the research was completed with 30 children (Fig.1).

Procedure

The children were divided to two groups as elastic band group and body weight training group. Groups were taken to training areas independent of each other and at different times. Studies were performed

in the gym of elementary on the sports field, during school hours, in physical education classes and school hours that include free activities during on two consecutive days. For the group that did the training with elastic band exercises such as; bending legs, stretching legs, lifting arms side wards (for shoulder muscles), push from the chest (for chest muscles), pull down (for back muscles), arm bending, arm stretching, leg pushing were done. Group that did training with their own body weight, push-ups, squat, right and left lunge forward, and bouncing with both legs and bounce over a box exercises were given. Exercises were repeated as a sequence of right / left arm and leg. 7 different training exercises, 2 times per week, each workout with 1-2 sets and 10-12 repetition were applied. Intensity of the training was set according to 10 RM, exercises continued for 30 minutes including their heating and cooling periods. Before starting training, the band colors that children can do a maximum of 10 repetitions were found (Kraemer and Fleck 1993; Zatsiorsky and Kraemer 2006).

During training yellow, green and blue color bands were used. Green, yellow and blue bands were used for determinate maximum of 10 repetitions. Definition of band color on maximal 10 repetitions was repeated 3 times; in the beginning of trainings, on 3rd and 6th week. Finding maximal 10 RM was tried for each exercise, after each trial a period of 5 minutes were given for rest and each exercise was continued 10 repetitions until they made the maximal 10 repetitions.

This training program was prepared accepted standards of the field have been used (American academy of pediatrics, Committee on sports medicine and fitness. Strength training by children and adolescents. Pediatrics 2001; Barkley et al, 2011).

The study was approved by the Canakkale Provincial Directorate of National Education (approval date 18/04/2011). All the procedures in this study have been applied by taking into consideration all the principles of Declaration of Helsinki of World Medical Association.

All the children have adapted to the training methods and no any problem occurred during the study. Some children that were excluded from the research as they did not come to school in the training or test days (Figure 1). In the study, children's height and weight were measured and BMI values were calculated.

Leg Strength Test: Children that placed their feet on dynamometer stand in a knee bent case position, arms stretched, back flat and torso tilted slightly forward, grasped dynamometer bar by their hands and pulled it up vertically using their legs at the maximum rate. This was repeated twice per child and the best value of each child was recorded. Leg strength was measured by the leg / back dynamometer (500 kg MED- DYNA 100).

Fig 1- Period of research

Sit-up Test: Children back, shoulders facing the ground, had soles adhered to cushion, knees bent (90 degrees), hands on neck, trunk in upright seated position, while shoulders contact with the ground so as to lie

back. The number of repetitions was recorded in specified period of time (Morrow et al, 2005; Hoffman, 2006).

Push-Up Test: To the girls in the knee over half push-ups and to the boys standard push-ups were applied. The number of push-ups within the specified time that was correctly applied was recorded (Morrow et al, 2005; Hoffman 2006).

Data analysis: The data obtained in the research was statistically analyzed and significance level was set to $p < 0.05$. To determine the impact factor of both training methods on the groups the paired t test was used, to determine the difference of training methods between groups one way ANOVA was used, to analyze the changes between the groups during untrained period the repeated ANOVA tests were used.

Results

Thirty children (1st group weight mean: 30.50 ± 7.04 kg; height mean: 128.65 ± 6.74 cm; BMI: 18.06 ± 2.80 kg/m² and 2nd group weight mean: 28.78 ± 4.50 kg; height mean: 131.12 ± 2.80 cm; BMI: 17.11 ± 2.83 kg/m²) participated to this study. There were no significant differences in age, height ($p=0.50$), weight ($p=0.65$) and BMI ($p=0.55$) between group 1 and group 2 ($p>0.05$).

Table 1: The difference between groups before and after training

	Before Training	After Training	t	p
Training with Body's Own Weight (Group 1) n=14				
Sit-up (repetition)	22.00 ± 2.71	24.29 ± 6.04	-1.572	0.140
Push-up (repetition)	23.43 ± 5.34	18.50 ± 6.71	2.953	0.011
Leg Strength (kg)	26.10 ± 11.71	30.75 ± 12.30	-1.200	0.251
Training with Elastic Band (Group 2) n=16				
Sit-up (repetition)	20.19 ± 4.41	26.31 ± 5.25	-4.178	0.001
Push-up (repetition)	21.50 ± 5.02	24.81 ± 9.46	-1.620	0.126
Leg Strength (kg)	27.08 ± 8.55	42.68 ± 12.66	-5.369	0.000

There were no significant differences in leg strength ($p=0.79$), sit-up ($p=0.19$) and push-up ($p=0.31$) between group 1 and group 2 in before training ($p>0.05$).

There were no significant difference in leg strength and repetitions of sit-up between before and after training in group 1 ($p>0.05$). However, significant difference was found in repetition of push-up between before and after training ($p<0.05$). There were significant difference in leg strength and repetition of sit-up between before and after training in group 2 ($p<0.05$), but there was no significant difference in push-up ($p>0.05$). Significant difference was found in leg strength ($p=0.014$) and push up ($p=0.047$) in after training period between group 1 and group 2 ($p<0.05$), there was no significant difference in sit-up ($p=0.334$) ($p>0.05$). When groups time-dependent change is generally examined, the push-up ($p=0.000$), leg strength ($p=0.000$), and sit-up ($p=0.000$) time-dependent significant differences were observed ($p<0.05$).

Table 2: Changes in trained and untrained periods

Training with Body's Own Weight (Group 1)					
n=14	Before training (Week 1)	After training (Week 6)	Untrained period (Day 14)	Untrained period (Day 28)	Untrained period (Day 42)
Sit-up(repetition)	22.00 ± 2.71	24.29 ± 6.04	17.86 ± 4.65	19.57 ± 6.73	13.50 ± 4.60
Push-up(repetition)	23.43 ± 5.34	18.50 ± 6.71	9.50 ± 6.09	14.00 ± 8.92	13.71 ± 7.10
Leg strength (kg)	26.10 ± 11.71	30.75 ± 12.30	29.73 ± 16.47	27.12 ± 15.02	22.28 ± 11.45
Training with Elastic Band (Group 2)					
n=16	Before training (Week 1)	After training (Week 6)	Untrained period (Day 14)	Untrained period (Day 28)	Untrained period (Day 42)
Sit-up (repetition)	20.19 ± 4.41	26.31 ± 5.25	25.94 ± 4.75	21.37 ± 6.02	20.88 ± 6.92
Push-up (repetition)	21.50 ± 5.02	24.81 ± 9.46	24.05 ± 8.62	22.88 ± 6.53	21.63 ± 6.74
Leg strength (kg)	27.08 ± 8.55	42.68 ± 12.66	43.12 ± 12.64	37.29 ± 11.77	36.57 ± 11.38

Group 2 showed 0.37 decrease repetitions in sit-up on the day 14 during untrained period, 0.76 decrease repetitions in push-up, 0.44 kg increase in leg strength. Group 1 showed 6.43 decrease repetitions in sit-up, 9 decrease repetitions in push-up, 1.02 kg decrease in leg strength. In group 2 its 28th day showed a 4.57 decrease repetitions sit-up, 1.17 decrease repetitions in push-up, 5.83 kg decrease in leg strength. In group 2 showed 1.71 increase repetitions sit-up, 4.5 increase repetitions in push-up, 2.61 kg decrease in leg strength were determined on day 28. Group 2, on day 42 (week 6) showed 0.49 decrease repetitions in sit-up, 1.25 decrease repetitions in push-up, 0.72 kg decrease in leg strength. Group 1, on day 42 showed 6.07 decrease repetitions in sit-up, 0.29 decrease repetitions in push-up, 4.84 kg decrease in the leg strength.

Discussion

In the literature the importance of type, intensity, frequency and duration of a training program as well as appropriacy of the used materials for the child's development and implementation of the training by the experts have been emphasized. The results obtained with such an approach have also been scientifically identified as to more significantly contribute to children's life (Kreamer and Fleck 1993; Ozmun and ark., 1994; Guy and Micheli 2001; Tsolakis et al, 2004). Research methods used, their duration, frequency, intensity, and exercise types were shown to differ (among them there are also research showing the use of elastic band has been emphasized to be safe for children (Faingenbaum and Westcott 2000; Annesi et al., 2005; Ignjatovic et al., 2009) and there have been contradictory results showing inefficiency of frequently recommended training by use of own body weight. More specifically, strength training among children of 7-9 of ages was shown to give positive results (Faingenbaum and Westcott 2000) and effective results had been obtained from long term training. On the other hand, uniform and monotonous training types were shown to reduce performance and materials used in the training as well as content diversity of training were stated to increase children's motivation and participation to the exercise (Barkley et al., 2011). In this study, the group that trained with their own body weight showed a significant decrease in push-up performance training and no significant increase could be detected in other parameters. Moreover, results obtained from group 2 brings the following question to our mind "children how to act performance materials to make the training?" The strength training in which diversity of material as well as safety was prioritized, the group that used elastic band was observed to be better motivated by the researchers. In group 1 (elastic band) number of sit-ups and leg strength after training showed an increase compared to before training. No significant increase was found in the performance of push-up. Therefore, the reason of the failure of researches in which children move their body weight exercises during push-up is also explained. In spite of increase in strength, push-up test that is widely used also in this age group is envisioned not to fully reflect the results.

The first studies regarding developing resistance and force of children before puberty, it was determined that there is not a significant effect of strength training, due to production of sufficient amount of testosterone secreted in middle and late adolescents strength would not be earned during the strength training (American Academy of Pediatrics). In adults strength training cause muscular hypertrophy, and cause a change in fiber composition, but in children and adolescents it is also highlighted that this is not the case (Ignjatovic et al, 2009). However, it is also underlined that the reason of the increase in strength is not primarily associated to hypertrophy but associated with neural compliance (Falk et al, 2003). Neural performance in adulthood is known to slowly decrease throughout the detraining (Hakkinen and Komi 1983; Naric et al, 1989), when it comes to children changes in force are based on the neural factors. In general there is a positive correlation between the development time of strength and the time of loss of strength. In adulthood, with discontinuation of heavy strength training force has been shown to begin to decrease (Hortobagyi et al, 1993). Although the force of muscular hypertrophy in children is rising very little has been transferred earlier to occur (Ignjatovic et al, 2009). Although force increases in children, muscular hypertrophy in them was shown to be very little. In children stopping trainings that do not cause muscular hypertrophy but increases strength, at which period and to what degree changes occur in, training with elastic band the into the group without training on day 14 there has been 0.37 decrease in sit-up, 0.76 decrease in push-up, 0.44 kg increase in leg strength, in the untrained period of 2 group on day there have been 6.43 decrease in sit-up, 9 decrease in push-up and 1.02 kg decrease in leg strength was found. In this study, in the absence of performance of training in the children that only follow their own course, changes in all parameters have been identified during the usual physical activity or when they participate in game-like activities. In both groups, children were told to continue physical activities and attend their physical activity classes that they used to do before the strength training survey, except strength training no activity that the children are naturally imposed was inhibited. Accordingly, during the untrained period of the group that did training with the elastic band, on day 28 there have been 4.57 decrease in the number of sit-ups, 1.17 reduction in the number push-ups, 5.83 kg decrease in leg strength , in children in group 2 on day 28, 1.71 reduction in the number of sit-ups, 4.5 reduction in the number of push-ups, 2.61 kg reduction in leg strength were determined. During the untrained period of the children that did training with elastic bands, on day 42 0.49 decrease in sit-ups, 1.25 decrease in push-up, 0.72 kg decrease in leg strength, in the other group 6.07 decrease in sit-up, 0.29 decrease in push-up, 4.84 decrease in leg strength were found. In the survey that has been conducted by Faigenbaum et al, (1996) the effect of detraining on children in the age group of 7-12 age group was examined, 4 weeks after detraining a noticeable decrease in the loss of strength has been found. In this study, the most intensive decrease in the elastic band group was observed in the week 4. When analyzed in general, considering the decrease in values before and after training the decrease in average was observed in group 2.

Conclusions

In conclusion the strength training that is done with elastic band made is more effective than the training done by own weight. When untrained period is examined it was determined that there is less decrease in strength acquired in the group that did strength training with elastic band acquired compared to the group

that gained strength by the use of own weight. The use of these applications and materials is suggested to be used in physical education classes as the material is safe and attractive and have positive effects on strength.

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