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Original Article

The Effects of Resistance Training For 12 Weeks on Serum Calcium, Phosphorous and Parathyroid Hormone Levels of Urban and Rural Children

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ABSTRACT

Resistance Training (RT) is considered as an integral component of a comprehensive physical activity program for children and healthy adults and has shown to be an important component for the development of bone strength by improving their muscular power, nerve conduction, and deposition of minerals and maintenance of body balance. **Objective:** To determine the effects of resistance training on the mineral content of bone in children aged 11-14 years boys. **Methods:** Volunteer young boys between the ages of 11 to 14 years, 30 each from rural and urban setting of district Peshawar were recruited. Calcium, phosphorus, parathyroid hormone (PTH) and anthropometric parameters were measured before and after three months of resistance training. *Paired sample t-test* was used for changes over time. **Results:** The study found that there was a significant effect of resistance exercise on participant's serum calcium level (8.44± 0.582 *vs.* 10.24± 0.786, *p value<0.001),* phosphorous (3.82± 0.265 *vs.* 4.59± 0.271, *p value<0.001)* and PTH (20.37± 4.620 *vs.* 29.20± 6.099, *p value<0.001)* in experimental group. **Conclusions:** Resistance training has an effective role in the increase of calcium, phosphorus and PTH and anthropometric measurements.

INTRODUCTION

Resistance Training (RT) can add to musculoskeletal strength, body composition, psychological well-being, and a decrease in cardiovascular risk factors [2]. RT in children allow them to grow strong and healthy [3]. RT has been reported to improve bone strength [4]. In addition, it also helps to increase the parathyroid hormones (PTH) secretion. Low-level activity hampers bone mineralization, such as osteoporosis [5]. Calcium balance, peak bone mass, bone mineral content and bone mineral density are the indications that assist in gagging bone health [6]. The bones of a child have a fast rate of development than adults. The rate of development of the skeletal component and the bones differs with the age of a person. RT helps in the increase of the bone mass and especially in the affected parts that bear weight such as the hip and waist. Calcium is important in ensuring strength of bones [7]. If calcium is taken at an early age, it always helps with bone strength at a later or old age [8]. Largely calcium homeostasis is kept up by the activities of calcium-managing hormones, which most eminently incorporate

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parathyroid hormone, calcitonin, and 1, 25-dihydroxy vitamin D. Phosphorus is a basic component and play important role in different organic procedures [9]. Bone accrual is limited with a lack of enough phosphorus in the body. With less bone accrual, there are chances of a child developing rickets [10]. Phosphate is basically completed with calcium in the skeleton as precious hydroxyapatite stones; the majority of the phosphate occurs as unknown calcium phosphate [11]. Maïmoun et al., showed that RT significantly increased blood phosphorous after the resistance exercise [12]. RT reinforces muscles against gravity and with high weight on bones and joints and help make and secure bone despite bone fortifying [13]. The regulation of bone metabolism is enhanced by PTH. The hormone has both anabolic and catabolic properties. When the osteoclasts are activated, calcium and phosphate are released by PTH [14]. Pakistani population is categorized into old, adults, youth and children, of which children consist of 60%. With the increase in population, the opportunity for children to engage in different sports activities is declining [15]. Osteoporosis is characterized by a decrease in bone density and the breakdown of bone microstructures, which increases the risk of bone fracture [16]. That is the main reason for increasing bone problems and fractures among children. The events of the bone problems and fractures in children are alarming, which is mainly due to the inadequate physical activity or imbalance food intake [17].

METHODS

This study was basically designed to evaluate the effects of RT on the mineral content of bone in 60 volunteer children aged from 11 to 14 years boys from urban and rural areas. There were two groups: control and the experimental group of which the RT was given to the experimental group (n=30 in each group, 15 each from rural and urban areas in each group) for 12 weeks and the control group, no exercise was given to the control group. This study was approved by the Ethical and Review Board of Sarhad University, Peshawar. This study was experimental and quantitative in nature. Before the selection of the samples' written consents were taken from their parents for inclusion. A total of 60 volunteers were selected for the study, 30 each from rural and urban areas.

Pre-test of the Sampled Population: Blood samples of 5ml were taken in the gel tube from all the individuals for serum calcium, phosphorous and PTH hormones tests before the training and were sent to Physiology laboratory of Khyber Medical University Peshawar for investigation.

Control Group: The control group continued their normal daily routine during the experimental period. No training was given to the control group.

Training of Experimental Group: The training schedule was continued for 12 weeks, five days per week. Session of the training lasted for 60 minutes progressively. The first 2 weeks were reserved for physical conditioning and from 3rd to 12 weeks the free weight resistance training performed according to the training protocol. It included Step ups, Pushups, Star jumps, abdominal crunches, Chair dips, 90-degree wall sit, reverse back extensions, and Hover exercises. Every exercise was performed for as many controlled repetitions as possible in the given time duration.

Post-Test of Experimental and Control Group: Blood samples for all the variables of interest (Serum calcium, phosphorous and PTH) of control group and experimental group were conducted in same conditions, same procedure and same laboratory.

Blood Sample Collection Process: Blood was collected in 5cc disposable syringes and transferred to gel tubes for serum calcium, phosphorous and PTH. Within 20 minutes of blood collection blood samples were centrifuged with micro centrifuge machine at 3000RPM at 4c°for 20 minutes and plasma and serum were separated. Serum was saved for 3 months at -80c° temperature for PTH. Both pre and post plasma samples were analysed by Bio-Tek ELx50 machine together with CALBIOTECH PTH ELISA kits in Khyber Medical University Physiology lab with the assistance of expert lab technician. Statistical package for the Social Sciences (SPSS) Version 20 was used for data analyses. Descriptive statistics such as mean, standard deviation and inferential statistics such as paired and independent sample statistics were used. Descriptive statistics for pooled data and divided by control *vs* experimental and urban *vs* rural population were carried out and expressed through different tables in the form of mean and standard deviation. In the second stage of analysis, differences between experimental and control group were determined through *independent sample t-test.* Difference in mean for the same population before and after the intervention was determined through paired sample statistics given in the subsequent sections.

RESULTS

Group	N	Min Age	Max Age	Mean Age	SD
Control Group	30	11 years	14 years	12.53	1.074
Experimental Group	30	11 years	14 years	12.36	1.098

Table 1: Descriptive Statistics of age of Sample Group

Table 2 shows the data on the basis of experimental vs. control group and table 3 shows the data on the basis of urban and rural population for control and experimental group.

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Variables	Control Group			Experimental Group		
	Pre-Test	Post-Test	SD	Pre-Test	Post-Test	SD
Height	1.47	1.48	0.079	1.49	1.51	0.081
Weight	49.57	51.03	7.867	49.53	47.87	8.500
BMI	23.10	23.32	3.946	22.37	20.84	3.166
Calcium	8.60	8.44	0.582	8.51	10.24	0.768
Phosphorous	4.01	4.20	0.507	3.82	4.59	0.271
PTH	15.43	20.37	4.620	16.47	29.20	6.099

Table 2: The Mean and Standard Deviation of all data on the basis of experimental and Control Group Significant value = 0.001

The above table 2 showed the mean and their significance value for the urban and rural population of the control and experimental group. There was no significant difference in the pre and posttest of all parameters in the control group for urban and rural area. There was no significant difference in the pre and posttest of all parameters in the experimental group for urban and rural area except the calcium and PTH. Only significant differences were observed in calcium in rural children and PTH in urban area at pre stage and post stage. That at pre stage rural population showed less PTH level than urban population (14.80mg/dl & 18.13mg/dl, p value <.01) while at post stage urban population showed less calcium than rural population(9.90mg/dl & 10.57mg/dl, *p value <.01).*

Variables		Control Group		Experimental Group			
		Pre-Test	Post-Test	SD	Pre-Test	Post-Test	P-Value
Height	Urban	1.48	1.49	0.519	1.50	1.53	0.256
	Rural	1.46	1.47	1.47	1.47	1.50	0.221
Weight	Urban	48	49.60	0.343	51	48.93	0.351
	Rural	51	52.47	0.327	48	46.80	0.503
BMI	Urban	22.07	22.34	0.186	22.57	20.83	0.743
	Rural	24.14	24.31	0.174	22.17	20.85	0.988
Calcium	Urban	8.63	8.47	0.621	8.75	9.90	0.380
	Rural	8.57	8.41	0.783	8.27	10.57	0.014
Phosphorous	Urban	3.93	4.15	0.779	3.87	4.56	0.379
	Rural	4.09	4.25	0.574	3.78	4.62	0.553
PTH	Urban	14.80	21.73	0.475	18.13	29.73	0.069
	Rural	16.07	19	0.106	14.67	28.67	0.640

Table 3: The Mean and p value of urban and rural for all parameters for control and experimental group Significant value = 0.001

Table 4 showed the independent sample t-test of all parameters for the control and experimental group. There was no significant difference at the pre stage of intervention of the control vs. experimental group. Whereas, significant differences were seen at the post interventional stage of control vs. experimental group for BMI calcium, phosphorus and PTH. At post stage of interventional statistics for BMI (23.325± 3.946 vs. 20.84± 3.166, p value <0.001), calcium (8.44± 0.582 vs. 10.25± 0.786, p value <0.001), phosphorus (4.20± 0.507 vs. 4.59± 0.271, p value < 0.001) and PTH (20.37± 4.620 vs. 29.20± 6.099, p value < 0.001).

Variables	Control Group		
	Pre-Test	Post-Test	P - Value
Height	1.47± 0.078	1.48± 0.079	0.988
Weight	49.57± 8.50	51.03± 7.86	0.383
BMI	23.109± 4.253	23.325± 3.946	0.457
Calcium	8.60± 0.324	8.44± 0.582	0.763
Phosphorous	4.01± 0.277	4.20± 0.507	0.010
PTH	15.43± 4.754	20.37± 4.620	0.417
Variables	**Experimental Group**		
	Pre-Test	**Post-Test**	**P - Value**
Height	1.49± 0.084	1.51± 0.081	0.134
Weight	49.53± 8.83	47.87± 8.50	0.140
BMI	22.37± 3.293	20.84± 3.166	0.009
Calcium	8.51± 1.469	10.24± 0.786	<0.001
Phosphorous	3.82± 0.265	4.59± 0.271	<0.001
PTH	16.47± 5.043	29.20± 6.099	<0.001

Table 4: Independent sample T-test for Control and Experimental group Significant value = 0.001

Table 5 showed paired wise statistics for height, weight, BMI, calcium, phosphorus and PTH of control vs. experimental group. It is clear from statistics that control group showed significant weight gain during interventional period as shown by (49.57kg to 51.03kg, p value<0.001). Similarly, the changes in experimental group were also significant. However, it showed a reduction in weight and BMI as shown (49.53kg to 47.87kg & 22.37kg/m2 to 20.84kg/m2, p value<0.001)respectively.

Variables	Control Group		
	Pre-Test	Post-Test	P - Value
Height	1.47 ± 0.078	1.48 ± 0.079	0.134
Weight	49.57 ± 8.504	51.03 ± 7.867	<0.001
BMI	23.109± 4.253	23.325± 3.946	0.047
Calcium	8.60± 0.324	8.44± 0.582	0.173
Phosphorous	4.01± 0.277	4.20± 0.507	0.240
PTH	15.43± 4.754	20.37± 4.620	<0.001
Variables	**Experimental Group**		
	Pre-Test	**Post-Test**	**P - Value**
Height	1.49 ± 0.084	1.51 ± 0.081	0.2
Weight	49.53 ± 8.831	47.87± 8.500	<0.001
BMI	22.373± 3.293	20.842±3.166	<0.001
Calcium	8.51± 1.469	10.24± 0.768	<0.001
Phosphorous	3.82± 0.265	4.59± 0.271	<0.001
PTH	16.47± 5.043	29.20± 6.099	<0.001

Table 5: Paired sample statistics of Height, Weight, BMI, Calcium, Phosphorous and PTH of Control and Experimental group Significant value = 0.001

It is clear from statistics that control group showed significant difference in PTH level during interventional period as shown by (15.43µg/ml to 20.37 µg/ml, p value<0.001). Similarly, the changes in experimental group were also significant in calcium, phosphorus and PTH as

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shown (8.51mg/dl to 10.24 mg/dl, p value<0.001), (3.82 mg/dl to 4.59 mg/dl, p value<0.001) and (16.47 µg/ml to 29.20 µg/ml, p value<0.001) respectively. RT is beneficial for reducing weight and BMI (weight p value <0.001, and BMI p value <0.001). At pre test stage the levels of calcium, PTH and phosphorus were same in both groups. The data of pretest of control group and experimental group revealed no significance difference in the calcium, phosphorus and PTH level of both groups (p value >0.001). At pre stage of intervention and post stage of intervention calcium and phosphorus levels revealed no significance in the control group (p value >0.001). At post interventional stage experimental group revealed significance difference in the calcium, phosphorus and PTH level vs. control group after 12 weeks of resistant exercises, whereas routine chores of daily life produced no significant effect (p value <0.001). At post stage of intervention only PTH showed significant difference in the control group than the pre interventional stage (p value <0.001).

DISCUSSION

The present study determined the effect of free weight resistance exercises on different physical parameters weight, height, BMI, and chemical parameters for bone health (calcium, phosphorus and parathyroid hormones) were determined. The study was conducted on two groups, control vs. experimental, equally selected from urban and rural population. The study revealed that RT has significant effect on the serum calcium level in both urban and rural children after 12 weeks of training. Many reports have suggested that calcium level is mainly dependent on the level and intensity of exercise. A study looked [18] at the effects of calcium and resistance exercise on bone density in healthy children aged 7 to 16 years, and found that bone density increased. Similar studies of Welch and Weaver (2005) have also reported that moderate exercise appears to have a positive effect on calcium balance and to increase bone metabolism as well [19]. It is also important to report that another study has reported a significant increase in calcium and phosphorus concentration after 8 weeks of continuous training for 3 days a week for 90-120 minutes [20]. The study revealed that RT has significant effect on the parathyroid hormones in both urban and rural children after 12 weeks of training. Physical exercise is important for improving body systems in order to achieve high peak bone mass and avoid bone fractures. When working out, the concentrations of PTH and calcium in the blood were calculated. PTH and serum calcium levels increased in response to physical activity. Long-term activity boosts PTH production, according to the findings [21].

CONCLUSIONS

The current study reveals that resistance training increases the serum calcium level, phosphorous and parathyroid hormones in the blood of children. The researcher further concluded that moderate exercise appears to have a positive effect on calcium balance and as well as increase bone metabolism. Irrespective of the nature of training, exercise in any form is beneficial. Resistance training is important for improving systems in order to achieve high peak bone mass and avoid bone fractures. Resistance training needs special consideration for bone mineralization.

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