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Isokinetic Shoulder Torque Development in Children Six through Twelve Years Old

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ABSTRACT

Muscle strength is necessary for optimal posture and efficient movement to occur. It enables individuals to perform everyday activities without undue fatigue. The purpose of this study was to establish a reference data of isokinetic strength measurements of shoulder flexors and extensors muscles by gender and age. One hundred healthy non-athletic children (50 boys and 50 girls) aged 8 to12 years participated in this study. They were assessed using Biodex isokinetic dynamometer at two angular velocities (60 and 180 degrees per second.). The results revealed significant increase in isokinetic strength with gender differences at both testing speeds from 8 to 12 years of age.

Key words: *Normative values- Isokinetic dynamometer- Shoulder joint-Children-Muscle strength*

INTRODUCTION

Paediatric patients are often referred to physical therapy as a result of deficits in muscle strength that interfere with their ability to achieve motor milestones or perform daily activities. Muscular strength is an essential component of motor performance in that a certain level of muscular strength is necessary to carry out different tasks [1].

Muscle strength has been evaluated with different methods, such as manual tests, hand-held dynamometer, and isokinetic dynamometer. The isokinetic dynamometer is one of the most objective methods that allow a quantitative evaluation of muscle function, throughout variables such as torque, power, and endurance [2]. Measurement of these variables is provide feedback on the maturation and aging of the neuromuscular system as well as evaluating the impact of exercise training and rehabilitation programs in a range of health conditions [3].

Comparing children with deficits and injuries with normal strength values is required in order to find out differences in strength patterns, plan effective treatment strategies and improve function [4]. A considerable effort has been applied to the development of age-related normative isokinetic strength data for 7–13 year olds[1,3]. The majority of previous pediatric studies have examined concentric isokinetic knee extension and flexion torque, while a few studies assessed elbow extension and flexion and single study investigated hip torque, plantar flexor torque and shoulder torque [5].

This study aimed to establish a reference isokinetic normative data of shoulder flexors and extensors muscles strength for healthy school children. Such normal data is essential to the diagnostic and evaluational purposes, quantify the severity of impairments, examine the effectiveness of intervention programs and development of treatment strategies.

MATERIALS AND METHODS

Subjects:

One hundred healthy non-athletic children from both sexes (50 boys and 50 girls) aged 8 to12 years were participated in this study. They were recruited from the elementary school stage, Central area of Cairo. They did not have any surgical intervention in the upper extremities, history of musculoskeletal deformities or neuromuscular disorders and visual or auditory defects. The study Protocol was approved by the ethical committees of the Faculty of Physical therapy Cairo University. Egypt. Following an explanation of the experimental protocols, written consent was taken from the Parents of the children to perform the therapeutic tests.

Instrumentation:

Biodex system 3 pro Isokinetic dynamometer (Biodex Medical INC., Shirley, New York, USA), was used to evaluate the concentric strength of shoulder flexion and extension peak torque in Newton-meters (Nm).

Procedures:

- Before testing the dynamometer was calibrated according to the manufacturer specifications and was checked prior to testing each subject, the therapist explained to the child what he is supposed to do. Simple instructions were provided to help the children understand the task and alleviate fears.
- Children were positioned on the chair with the back supported at a 90 degree sitting

angle. Large strap was applied diagonally across the trunk to minimize body movement during testing. Small children were appropriately positioned on the seat with additional firm back support, small pad or pillow, as necessary to adjust the sitting position to the size of the child.

- The lever arm attachment length and chair back was adjusted so that the rotational axis of the dynamometer was positioned to be co-axial with the shoulder axis during the testing procedures. The torque measured was corrected for the effect of gravity on the lever arm and the handle of the dynamometer, and for each individual limb weight.
- The test was done in the concentric mode, with gravity compensation, at angular velocity of 60 degree/ second then 180 degree/ second. The shoulder attachment of the dynamometer was set to 90 degree of range of motion.
- The children were given three submaximal trials prior to each testing velocity as warm-up and to assist with familiarization to the testing.
- The test protocol consisted of five repetitions at angular velocity of 60 degree/ second (muscular strength) followed by 2 min rest period and ten repetitions at 180 degree/ second (muscular endurance).
- Demonstration of the movement and a few practical repetitions familiarized the child with the dynamometer thus increasing the validity and reliability of the testing procedures.
- Encouragement was provided to ensure that each repetition was performed with maximal effort. Throughout the testing procedures, the child was given verbal encouragement to facilitate maximum performance at each velocity and repetition.

Statistical analysis

Isokinetic normative data of shoulder flexors and extensors muscles strength for boys and girls at different ages was calculated by using descriptive statistics. A two way ANOVA was employed to investigate the effect of age and gender on shoulder flexion and extension peak torque at 60 and 180 degrees /second. Statistical analyses were conducted using computer software package SPSS 12. The level of significance was set at $p<0.05$.

RESULTS

One hundred healthy children aged from 8 to 12 years who fulfilled the inclusion criteria participated in the study. Demographic characteristics are clarified in Table (1).

Table 1. Demographic Data of 100 healthy children

Item	Age/year	Weight (kg)		Height (cm)		Total
		Male	Female	Male	Female	
Mean ± SD	8	32.2±1.8	31.6±3.5	129.8±3.1	130.2±5.1	20
	9	35.4±1.8	35.0±3.2	137.0±5.1	134.7±6.1	20
	10	37.2±3.6	39.7±4.1	137.4±5.3	140.2±6.1	20
	11	41.8±3.8	40.1±4.2	144.0±9.1	141.5±5.4	20
	12	44.2±4.4	43.6±10.5	146.7±7.3	148.6±5.4	20

The values of peak torque for the shoulder flexion and extension at 60 and 180/second respectively were described in table (2). The concentric peak torque values for the shoulder flexion and extension were significantly higher for the male group than those observed in the female group at all ages.

Table 2. Mean values and standard deviations for shoulder flexion and extension peak torque at 60 and 180 /second for male and female at different ages.

Age	Gender	FPT at 60/sec	FPT at 180/sec	EPT at 60/sec	EPT at 180/sec
8	Male	25.8±4.2	20.1±1.2	28.1±2.1	17.3±1.3
	Female	22.9±4.6	17.9±.23	26.2±2.1	12.8±1.4
9	Male	30.1±3.1	22.2±.12	30.8±3.1	20.6±3.7
	Female	23.7±2.9	21.3±1.2	27.1±3.9	15.9±3.4
10	Male	36.1±5.1	25.2±1.4	31.9±4.7	21.6±5.2
	Female	28.6±3.1	22.3±.26	28.9±3.7	16.8±4.5
11	Male	39.3±1.8	30.7±4.4	32.7±5.4	22.1±2.8
	Female	36.8±4.4	26.02±3.6	30.7±8.2	19.8±2.5
12	Male	44.5±4.1	33.6±.75	39.5±3.5	33.1±4.5
	Female	42.4±4.6	31.7±1.7	33.4±7.2	24.5±7.1

FPT: flexion peak torque, EPT: extension peak torque.

To reveal the effect of age and the gender on shoulder flexion and extension peak torque at 60 and 180 degrees /second, two way ANOVA was conducted as shown in table (3) There was a significant increase in strength with age ,significant effect of sex and no significant interaction between age and sex

Table 3. Two ways ANOVA of shoulder flexion and extension peak torque at 60 and 180 degrees /second

Source	FPT at 60/sec		FPT at 180/sec		EPT at 60/sec		EPT at 180/sec	
	F	P	F	P	F	P	F	P
Age	79.35	0.0001*	139.68	0.0001*	10.56	0.0001*	31.97	0.0001*
Gender	29.4	0.0001*	37.89	0.0001*	11.85	0.001*	36.98	0.0001*
Age * gender interaction	1.92	0.11	2.41	0.055	0.62	0.643	1.58	0.184

FPT: flexion peak torque, **EPT:** extension peak torque, * statistically significant difference.

DISCUSSION

There is lack of a normative isokinetic data of muscle strength for children [1]. This study established a normative isokinetic peak torque data for shoulder flexion and extension in children with age ranged from 8 to 12 years old. It also investigated whether developmental differences in strength existed that could be associated with sex or age.

The present results revealed a significant increase in isokinetic strength with gender differences at both testing speeds from 8 to 12 years of age. This finding comes in agreement with Eek et al., (2006) who assessed the isometric torque upper and lower limb muscle groups in healthy children with age ranged from 5 to 15 years. There data established a strong correlation between torque and both age and weight up to the age of 12, and a few differences between girls and boys until that same age [6].

The present results also confirm the findings of De Ste Croix (2007) who reported isometric strength collected from both sexes increase in a fairly linear fashion from early childhood up until the onset of puberty in boys (around 13 y) and until about the end of the pubertal period in girls (around 15 y).

They also represented that changes in dynamic strength have a significant increase with age [7].

Dominance in this study was 100% right side for all participants. Although not shown in studies but the results of this study might not be applicable for left handed population unless proved otherwise.

The result of the present study confirm the findings of Holm et al., (2008) who tested a large group of healthy school children aged 7 to 12 years. Their findings indicated a linear increase in isokinetic knee-extensor and flexor muscle strength with increasing age for both girls and boys [3].

The greater force output demonstrated by males has been attributed to several factors including differences in the musculoskeletal system, morphology and fiber distribution, electromechanical responses and neural activation, hormone concentrations, and physical activity patterns factors [3,8,9,10,11,12,13].

The results of the present study is in contrast to that reported by De Ste Croix et al.,(2002) who found that there was no sex differences in dynamic strength up to the age of 14 years old [14].

CONCLUSION

To assess the amount of deviation from normal and to be able to draw conclusions of change over time, it is an important to do studies healthy growing children. The reference values for torque based on the child's age, and sex make it probable to evaluate eventually and between subjects and give an implement for assessment of physical status and efficiency of therapy. Future research should focus on large population sample of children.

REFERENCES

1. Wiggin M, Wilkinson K ,Habetz S ,Chorley J AND Watson M :Percentile values of isokinetic peak torque in children six through thirteen years old. Pediatr Phys Ther 2006 ;18 , 3–18.
2. Santos A ,Pavao S, Avila M, Salvini T and Rocha N:Reliability of isokinetic evaluation in passive mode for knee flexors and extensors in healthy children. Braz|PhysTher.2013Mar-Apr:17(2):112-120.
3. Holm I, Fredriksen PM, Fosdahl MA, Olstad M and Vollestad N :A normative sample of isotonic and isokinetic muscle strength measurements in children 7 to 12 years of age. Acta Pædiatrica 2008; 97, pp. 602–607.
4. Wilkinson K and Habetz S:Normative isokinetic muscle strength in quadriceps and hamstring in children 6 through 13 years.Phys.Ther 2006;55(6):111-116.
5. De Ste Croix MBA, Deighan MA and Armstrong N: Assessment and Interpretation of Isokinetic Muscle Strength During Growth and Maturation. Sports Med 2003; 33 (10): 727-743.
6. Eek M.N., Kroksmark A.k and Beckung E: Isometric Muscle Torque in Children 5 to 15 Years of Age: Normative Data, Arch Phys Med Rehabil, 2006;87:1091-9.
7. Mark De Ste Croix: Advances in paediatric strength assessment: changing our perspective on strength development. Journal of Sports Science and Medicine 2007; 6, 292-304.
8. Deighan, M.A., Armstrong, N. and De Ste Croix, M.B.A: Peak torque per arm muscle cross-sectional area during growth. In: 7th Annual Congress of the European College of Sport Science (2002) Eds: Koskolou, M., Geladas, N. and Klissouras, V. Pashalidis Medical Publisher, Athens. 47.
9. De Ste Croix, M.B., Armstrong, N., Chia, M.Y., Welsman, J.R., Parsons, G. and Sharpe, P: Changes in short-term power output in 10- to 12-year-olds. Journal of Sports Science2001; 19, 141-148.
10. Wood, L.E., Dixon, S., Grant, C. and Armstrong, N: Elbow flexion and extension strength relative to body size or muscle size in children. Medicine and Science in Sport and Exercise2004; 36, 1977-1984.

11. Gilliam, T.B., Villanacci, J.F., Freedson, P.S. and Sady, S.P: Isokinetic torque in boys and girls ages 7 to 13: Effect of age, height and weight. Research Quarterly 1979;50, 599-609.
12. Schneider, P., Benetti, G. and Meyer, F: Muscular strength of 9- 18-year old volleyball athletes through computational dynamometry. Revista Brasileira de Medicina do Esporte 2004; 10, 92-97.
13. Kanehisa H,Okuyama H,Ikegawa S and Fukunaga T: Sex differences in force generation capacity during repeated maximal knee extensions.Eur.J.Appl.Physiol 1996;73:557-6.
14. De Ste Croix, MBA, Armstrong, N, Welsman, JR, Sharpe,P: Longitudinal changes in isokinetic leg strength in 10-14-year olds. Ann Hum Biol 2002; 29: 50-62.