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Correlation between Anthropometric Measurements and Trunk Muscles Endurance for Normal Young Girls

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ABSTRACT

The purpose of this study was to determine the correlation of the selected anthropometric measurements with the trunk (extensors and flexors) muscle endurance for girls in government primary school children. One hundred fifty eight normal girls with age ranged from 7-12 years participated in this study. They were evaluated using selected anthropometric measurements [body weight (kg), body height (m) and body mass index (kg m^{-2})] and trunk muscle endurance test. The results revealed that body weight and body mass index had negative correlation with trunk (extensors and flexors) muscle endurance (r = -0.16, -0.28, -0.3, -0.36, respectively). Regarding to body height; it had positive correlation with trunk extensors muscle endurance (r = +0.07) and negative correlation with trunk flexors muscle endurance (r = -0.08). It could be concluded that girls had weak relationship of body weight and body height with trunk (extensors and flexors) muscle endurance and moderate relationship of body mass index with trunk (extensors and flexors) muscle endurance. These results may be attributed to morphological variations and ages.

Key words: Anthropometric measures, trunk muscle endurance tests, normal children

INTRODUCTION

Anthropometric is the term describing combination of the old Greek words of "Anthropos" and "Meter" (human and measurement) (Koc *et al*., 2012). Anthropometry is the measurement of human body that provides scientific methods and techniques for taking various measurements and observations on the living human body and the skeleton (Anupama and Dakshayani, 2013).

Isometric muscle endurance of the torso has been reported in children, adolescents and adults. These values are important as they have been identified as potential risk factors for developing low back pain and decreased athletic performance. Given that endurance test postures require the body to be supported horizontally, it makes sense that anthropometrics would influence endurance (Dejanovic *et al*., 2012).

Anthropometric measures are reported to be population dependent and vary from race to race. Therefore, differences in endurance time norms across regions and populations could be due largely to anthropometric and morphological variations that exist across regions, heterogeneity of research samples (healthy and patients populations), methodological variations in testing procedures and definition of endurance time, among other factors so, this is open to speculations and future investigations (Mbada *et al*., 2011).

The trunk extensors and flexors are postural muscles which play an important role in trunk stabilization as they are simultaneously triggered. Decreased endurance of the abdominal and lumbar musculature influences the occurrence of muscular imbalance which over time leads to lumbar syndrome (Mbada *et al*., 2010) and associated also with habitually adopting passive sitting posture, reduced activity levels and Low Back Pain (LBP) (Reddy *et al*., 2012).

The current study was conducted to determine the correlation of the selected anthropometric measurements [body weight (kg), body height (m) and body mass index (kg m^{-2})] with the trunk (extensors and flexors) muscle endurance for girls in government primary school children.

MATERIALS AND METHODS

Agreement of the ethical committee of the Faculty of the Physical Therapy, Cairo University, Egypt was obtained before the beginning of the study. Also, school and teaching area approval were obtained before the beginning of the study.

Subjects: One hundred fifty eight normal girls were selected from one of the Egyptian government primary schools, East Cairo teaching area and participated in this study. This experimental study was conducted during the period from September 2013 to December 2013. Normal girls were selected after the physical examination according to the following criteria:

Inclusion criteria:

- Girl's age was ranged between 7-12 years old
- Girls should be cooperative and understand the procedures
- Girl's psychological state should be stable
- Parent's consent

Exclusion criteria: Girls were excluded if they had any of the following:

- Symptomatic low back pain, thoracic and cervical pain
- Spinal/trunk deformities such as scoliosis and kyphosis
- Upper or lower limb fractures
- Previous history of neurological/orthopedic problems of the hip or pelvis
- Behavioral problems
- Congenital or acquired chest wall deformity (e.g., straight chest and pectus carnatus)
- Cardiopulmonary diseases with decreased exercise tolerance [e.g., Rheumatic and congenital heart disease, bronchial asthma and Chronic Obstructive Pulmonary Disease (COPD)
- Athletic children

Materials and instrumentation:

- Standard weight and height scale (Seca apparatus 'SMIG') was used to measure body height (m) and weight (kg) of all girls
- Testing bench (plinth) with a suitable height and wide was used to apply tests
- A fabricated wooden wedge angled 60° from the floor was used according to Reiman *et al*. (2012) in the application of trunk flexion test

- Straps were used to fix the lower body at the ankles, knees and hips in trunk extension test and to fix the feet in trunk flexion test
- Hand held stopwatch was used to count the time from the beginning of each trunk extension/flexion testing until the girl didn't maintain a horizontal position (visually deviated from the horizontal position or when she reached 300 sec)

Procedures:

- Physical examination of the spine by forward bending test to exclude any musculoskeletal problems such as kyphosis and scoliosis
- All girls were informed about the purpose and nature of the study
- Each girl was instructed to keep an erect posture as much as possible during measurements of anthropometric variables (body weight and body height and to maintain her position as much as possible during lumbar trunk muscle endurance tests (upper body horizontal position in extension test and/erect position in flexion test)
- Body weight (kg) was measured in an upright posture for each girl
- Body height (m) was measured with girl standing bare-feet in an upright position
- Body Mass Index (BMI) was calculated by dividing weight in kilograms by height in meters squared [BMI= weight (kg)/height (m^2)] according to Kouda *et al.* (2012)
- Trunk extension testing procedure (Sorensen test) was used according to Dejanovic *et al.* (2012) and Reiman *et al.* (2012). Each girl was instructed to lie prone with her hips (Anterior Superior Iliac Spine (ASIS) in-line with the edge of a tested plinth. The lower body has been fixed to the table surface via straps at the level of ankles, knees and hips while, the upper body (from just above the level of the anterior superior iliac crest) has been held off the surface of the plinth by pushing with her extended arms on a chair directly below her. At the beginning of the test, each girl was asked to lift her upper limbs off the chair and crossed over the chest with the hands resting on the opposite shoulders then; she was instructed to maintain the horizontal position holding her arms across the chest for as long as possible once testing commenced. During the test, each girl had been allowed to be verbally corrected twice to maintain a horizontal position and the test ended on the third correction. A stopwatch was used to count the time from the instant the upper limbs were lifted off the chair and crossed over the chest until the girl could no longer maintain a horizontal position (visually deviated from the horizontal position) or when she reached 300 sec
- Trunk flexion testing procedure (Weber test) was used according to Dejanovic *et al.* (2012) and Reiman *et al.* (2012). Each girl was adopted a sit-up position with arms placed across the chest, hips and knees flexed to 90° and trunk begin resting against a jig (prefabricated wedge) angled 60° from the floor. Also, the feet were secured under toes with straps or by a researcher. At the beginning of the test, the jig was pulled back 10 cm while the girl held this position for as long as possible. A stopwatch was used to count the time from the onset the prefabricated wedge was moved back. The test stopped when the girl's back touched the jig (visually reestablished contact with the jig) or when she reached a maximum time of 300 sec

Statistical analysis: Statistical analysis of the data was performed using SPSS software program 18.0 for medical statistics. Descriptive statistics (mean and standard deviation) were calculated for each variable. Spearman rank-order correlation was used to determine the correlation of the

selected anthropometric measurements (body weight, body height and body mass index) with the trunk (extensors and flexors) muscle endurance for girls in government primary school children. Level of significant was set at p = 0.05.

RESULTS

Two hundred girls were recruited from one of the Egyptian government primary schools, East Cairo teaching area. Only one hundred fifty eight normal girls were selected and participated in this study after the physical examination and forty two girls were excluded as shown in Fig. 1.

General characteristics of girls: Mean±SD values of age, body weight (BW), body height (BH), body mass index (BMI), trunk extensors muscle endurance and trunk flexors muscle endurance were presented in Table 1.

Correlation between selected anthropometric measurements and trunk (extensors and flexors) muscle endurance for girls: Table 2 demonstrated the correlation between body weight (kg) and trunk (extensors and flexors) muscle endurance (sec.) for girls. Spearman correlation analysis revealed that there was statistical negative correlation between body weight and trunk (extensors and flexors) muscle endurance for girls.

Table 3 demonstrated the correlation between body height (m) and trunk (extensors and flexors) muscle endurance (sec) for girls. Spearman correlation analysis revealed that there was

Table 1: General characteristics of girls

Variables	Mean±SD
Age (years)	9.51±1.45
Weight (kg)	37.58±11.22
Height (m)	1.36±0.09
BMI (kg m^{-2})	19.80±4.08
Trunk extensors muscle endurance (sec)	60.48±31.06
Trunk flexors muscle endurance (sec)	107.53±80.49

*SD: Standard deviation

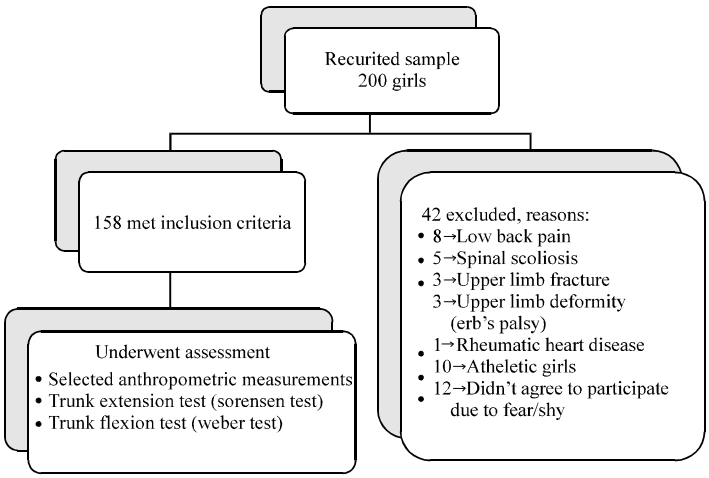

Fig. 1: Flow chart for the girls

Table 2: Correlation between weight and trunk (extensors and flexors) muscle endurance for girls

	Body weight (kg)		
Trunk muscles endurance	r-value	p-value	S
Trunk extensors muscle endurance (sec)	-0.16	0.03	S
Trunk flexors muscle endurance (sec)	-0.28	0.0001	S

*r-value: Correlation coefficient, p-value: Probability, S: Significance

Table 3: Correlation between body height and trunk (extensors and flexors) muscle endurance for girls

	Body height (m)		
Trunk muscles endurance	r-value	p-value	S
Trunk extensors muscle endurance (sec)	+0.07	0.35	NS
Trunk flexors muscle endurance (sec)	-0.08	0.29	NS

*r-value: Correlation coefficient, p-value: Probability, S: Significance, NS: Non-significant

Table 4: Correlation between body mass index and trunk (extensors and flexors) muscle endurance for girls

	Body mass index (kg m^{-2})		
Trunk muscles endurance	r-value	p-value	S
Trunk extensors muscle endurance (sec)	-0.30	0.0001	S
Trunk flexors muscle endurance (sec)	-0.36	0.0001	S

*r-value: Correlation coefficient, p-value: Probability, S: Significance

statistical positive correlation between body height and trunk extensors muscle endurance and statistical negative correlation between body height and trunk flexors muscle endurance for girls.

Table 4 demonstrated the correlation between body mass index (kg m^{-2}) and trunk (extensors and flexors) muscle endurance (sec) for girls. Spearman correlation analysis revealed that there was statistical negative correlation between body mass index and trunk (extensors and flexors) muscle endurance for girls.

DISCUSSION

The purpose of this study was to determine the correlation of the selected anthropometric measurements [body weight (kg), body height (m) and body mass index (kg m^{-2})] with the trunk (extensors and flexors) muscle endurance for girls in government primary school children.

The results of the present study revealed negative correlation between body weight and trunk (extensors and flexors) muscle endurance for girls in government primary school children.

These findings agreed with the work of Dejanovic and Zivkovic (2008) who studied the connection between the anthropometric characteristics of the body and the isometric endurance of the lumbar and abdominal musculature of children aged 7-10 as their results showed negative relation between body volume and the isometric endurance of the lumbar and abdominal musculature for girls.

Dejanovic *et al.* (2012) studied the correlation of anthropometric measures and torso muscle endurance of children aged 7-14 doesn't support the results of the present study as their results revealed positive correlation of body weight and each of back extension test endurance and flexor endurance test for girls.

On the other hand, the current results revealed positive correlation between body height and trunk extensors muscle endurance and negative correlation between body height and trunk flexors muscle endurance for girls in government primary school children.

These findings agreed with the work of Dejanovic *et al.* (2012) who studied the correlation of anthropometric measures and torso muscle endurance of children aged 7-14 as their results found positive correlation of body height and back extension test for girls.

Dejanovic and Zivkovic (2008) studied the connection between the anthropometric characteristics of the body and the isometric endurance of the lumbar and abdominal musculature of children aged 7-10 confirmed the results of the present study and their results showed positive relation between the longitudinal dimension and the isometric endurance of the lumbar musculature for girls.

The results of the present study disagreed with the work of Dejanovic *et al.* (2012) as their results revealed positive correlation of body height and flexor endurance test for girls.

Dejanovic and Zivkovic (2008) doesn't support the results of the present study as their results reflected positive relation between the longitudinal dimension and the isometric endurance of the abdominal musculature for girls.

Also, the current results revealed negative correlation between body mass index and trunk (extensors and flexors) muscle endurance for girls in government primary school children.

It can be assumed some explanations that may be attributed to the pre-mentioned results that exist between the correlation of body mass index and trunk (extensors and flexors) muscle endurance for girls in government primary school children. Differences in morphology of trunk muscles (trunk mass) and general fitness level between obese and non obese children may be related to the efficiency of cardiorespiratory endurance that connected indirectly to musculoskeletal endurance and resulting in rapid muscular fatigue with increasing body mass index.

In fact, the current study is considered as a unique one which has the privilege to report data on the correlation of the body mass index with trunk (extensors and flexors) muscles endurance for girls in primary school children. Besides, there were no related studies to use for explaining the current results which need a further research.

The contradict results existing between the current study and the pre-mentioned studies regarding the correlation of the selected anthropometric measures with trunk (extensors and flexors) muscle endurance may be explained by Samour and Helm (2005) who stated that there are growth differences among black, white and Mexican-American children but with small differences and there are also differences in the growth of Chinese or Japanese-American children or American children of other racial or ethnic groups compared with that of white, black and Mexican-American children represented on the growth charts.

Dejanovic *et al.* (2012) suggested also that hormonal changes associated with puberty that affect one's effort during physical exertions may have an impact on differences existing in torso endurance testing. Therefore, further research is needed as in the current study, hormonal changes may exist around sample ages of girls.

Rodic (2012) stated that positive and negative effects on children movement are results of certain morphological feature combinations and they can vary in structure and level of motor abilities due to the occurrence of differentiated morphological structures of the effector system which, under the influence of biomechanical laws may produce different kinetic and/or kinematics effects.

Also, Bharati *et al.* (2005) suggested that physical growth of children is reflected by different anthropometric measurements especially weight and height. The physical dimensions of the body are much influenced by nutrition in growing period of school age while, Kamal *et al.* (2004) suggested that height is influenced by hereditary and environmental factors and body weight is more sensitive to environmental factors.

It can be attributed that anthropometric measures vary from race to race, therefore, differences in endurance time across regions and populations could be due to anthropometric and morphological variations that exist across regions, sample age and different assessment procedures. The current study was the first and unique one to report data on trunk muscles endurance for girls in Egyptian government primary school.

There are following two limitations of this study:

- Difficulty to obtain approval for entering different schools
- Few previous researches were done in this area

CONCLUSION

From the obtained results of the present study, it can be concluded that girls with age ranged from 7-12 years had weak relationship of body weight and body height with trunk (extensors and flexors) muscle endurance and moderate relationship of body mass index with trunk (extensors and flexors) muscle endurance. These results may be attributed to morphological variations and ages.

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