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Normative Values of Trunk Flexors and Extensors Muscles Endurance of Healthy College Students

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Abstract

Objective: Objective of this study was to establish normative reference values of trunk flexors and extensors muscle endurance of healthy college students. **Method**: A cross sectional study was carried out with 500 subjects aged between 18 to 25 years. Evaluation of muscle strength and endurance was done with the use of Canadian Standardized Test of Fitness which includes four static and two dynamic muscles performance. **Result**: In this study we establish normative data for male and female both. The mean value for different tests are 60 sec (for male) and 25 sec (for female) for IUA, 21 sec (for male) and 9 sec (for female) for ILA, 36 rep (for male) and 14 rep (for female) for DUA, 29 sec (for male) and 17 sec (for female) for IUBE, 50 sec (for male) and 34 sec (for female) for ILBE, 16 rep (for male) and 9 rep (for female) for DUBE. **Conclusion**: The gender reference norms for static and dynamic endurance of trunk flexors and extensors group of muscles established in this study which could be used as outcome measure for improvement.

Introduction

Strength, muscular endurance, and flexibility are important components of healthy back function *(Hannibal et al, 2006).* Trunk flexors and extensors are the postural muscles for trunk stability and they are designed to fulfill their role of continuous activity throughout the day, but pain and inactivity alter muscles so that they fatigue in normal situations *(Moffroid, 1997).* A number of muscles cross the spine and contribute to lumbar mobility and stability. The muscular system is a complicated system composed of the deep

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muscles and the superficial muscles. The deep muscles are responsible for the control of stiffness and inter-vertebral relationships, and have their origin or insertion on the lumbar vertebrae. The superficial muscle system consists of the large global muscles that produce torque for spinal movement and handle external loads applied to the spine *(McGill et al., 1999). Egwu et al (2012)* reported normative values of spine range of motion (ROM) for proper diagnosis of spinal impairments and in the monitoring of effect of treatment and patient's recovery.

Static endurance of the trunk muscle is important for mechanical support. These must have the ability to sustained isometric contraction to support the trunk in any position. The back extensors are postural muscles; they help to stabilize the whole vertebral column. As they have anti-gravitational function, they are involved in majority of human posture and movement *(Mclntosh et al, 1998).*

Trunk extensor-to-flexor muscles imbalances are major contributors to the etiology of back pain *(Moffroid, 1997).* Lack of endurance of the trunk muscles is an important factor in low back pain (LBP). Decrease in the endurance of postural muscles has been associated with postural defects and deformities *(Mbada et al, 2010).* Low abdominal muscular endurance levels have been linked to the incidence of recurring low back pain *(Rosner, 1995).* Abdominal muscular endurance is thought to be functionally more important than abdominal strength *(Mbada et al, 2010).*

Evaluations of muscle performance encompass both strength and endurance. Muscle strength is the amount of tension or force that muscle or muscle group can voluntarily exert in one maximal effort under prescribed conditions. Muscle endurance is ability of muscle to perform repeated contractions at a certain output (dynamic endurance) or to sustain a contraction over time at a certain level (static endurance) *(Mclntosh et al, 1998).*

A cross sectional study was carried out with 500 students aged between 18 to 25 years. A par-q questionnaire was used as primary screening tool. Evaluation of muscle strength and endurance was done with the use of Canadian Standardized Test of Fitness which includes four static and two dynamic muscle performance.

Normative databases of abdominal muscles endurance are important in identifying alterations of the trunk musculature from the normal which will help clinician to formulate an active conservative strategy to restore function and hopefully reduce or eliminate symptoms. So objective of this study was to establish normative data on static and dynamic trunk flexor and extensor muscles endurance among apparently healthy college students.

Materials &Methods

1. *Design:* A Cross sectional study
2. *Setting:* CHARUSAT University
3. *Sampling method:* Simple purposive sampling
4. *Sample size:* 500 college students
5. *Inclusion criteria*

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- 18-25 years
- Written informed consent was taken

6. *Exclusion criteria*

- Spinal deformity or neurological or cardiovascular diseases.
- History of symptomatic low back pain within 6months of time.
- Subjects who reported regular exercise at high intensity 3-4 times per week for duration of 30 minutes or more were excluded.
- Abdominal, visceral since 1 year.
- Pregnancy

Subjects: Subjects were taken from the CHARUSAT University. It consist of 250 female and 250 male with mean age 19 years (range=18 to 25 year).

Instrumentation

- ⇨ The PAR-Q for pre assessment screening.
- ⇨ Measurement tap
- ⇨ Documentation data sheet
- ⇨ Stabilizing belt
- ⇨ Timer
- ⇨ Plinth

Figure 1: Instruments

Procedure

This study was approved by the Institutional ethical committee. Subjects were recruited from the CHARUSAT University. After taking official permission from the principal of respective college students were taken as subjects of study. Prior to testing the purpose and procedure of the study were explained to the subjects. After analyzing the inclusion and exclusion criteria, each subject was asked to sign an informed consent form. After taking informed consent PAR-Q questionnaire was administered. Individuals who answered affirmatively to three or more questions were excluded. After that Canadian Standardized Test of Fitness (6 test) were performed, prior to that demonstration of six tests of fitness was given.

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Figure 2: Isometric upper abdominals

Figure 3: Isometric lower abdominals

Figure 4: Isometric lower back extensors

Figure 5. Isometric upper back extensors

Data collection tool:

1) The PAR-Q for pre assessment screening.

2) Canadian Standardized Test of Fitness.

Data analysis

Descriptive statistics were used to summarize the data of all participants. Endurance levels were defined using percentiles as low (between 25 and 50th), medium (between 50 and 75th), high (between 75 and 100th) respectively.

Results

The general characteristics of all participants are given in table 1. The mean values and percentile data for the trunk flexors and extensors muscles endurance test of all the participants by gender is presented in Table 2 and table 3 respectively.

Table 1: The general characteristics of all participants

Variable	Mean	SD
Age(year)	19	1.26
Height(cm)	163	9.11
Weight(kg)	56	11.15
BMI(kg/m^2)	21	3.93
Torso length(cm)	51	8.62

Table.2: The mean data for six tests of all participants

Sr. No.	Test	Male	Female
1	(IUA) Isometric upper abdominal(sec)	60	25
2	(ILA) Isometric lower abdominal(sec)	21	9
3	(DAB) Dynamic upper abdominal(rep)	36	14
4	(IUBE) Isometric upper back extensors(sec)	29	17
5	(ILBE) Isometric lower back extensors(sec)	50	34
6	(DUBE) Dynamic upper back extensors(sec)	16	9

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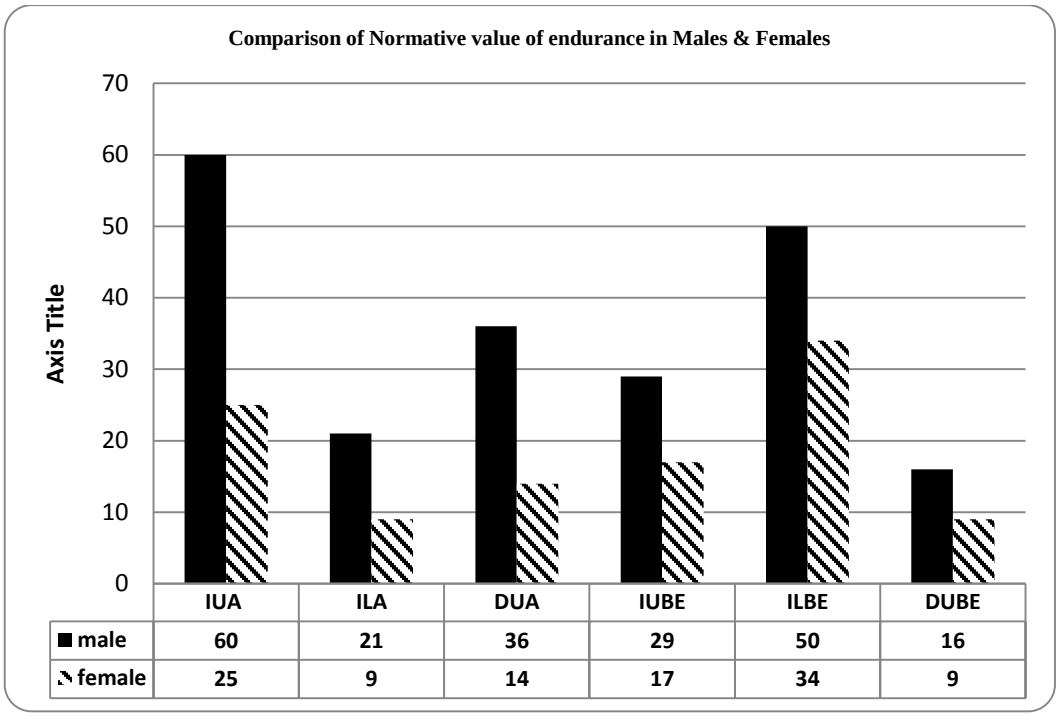

Fig 1: Normative value of trunk flexor and extensor muscle endurance

Table 3: Normative percentile data for the six test of fitness

No.	Test	25-50 %		50-75 %		75-100%	
		M	F	M	F	M	F
1	Isometric upper abdominal	20.4	14	20.4	12.8	35.2	54.4
2	Isometric lower abdominal	33.6	9.2	17.6	8.8	39.6	48.8
3	Dynamic upper abdominal	10.4	5.2	19.6	4.8	58.8	29.6
4	Isometric upper back extensors	12.4	28	16.8	15.2	61.2	43.2
5	Isometric lower back extensors	17.6	22	17.2	19.6	54.4	49.2
6	Dynamic upper back extensors	20	17.6	14.8	14.8	63.2	59.2

There are very few studies done to find normative database on trunk flexor and extensor muscle endurance in specific population like healthy individuals *(Baldauf et al., 1984, McGill et al., 1999)*, athletes *(Quinney et al., 1984, Lanning et al., 2006)* and other group *(Sjolie & Mønness 2007)*. A study by *Mbada et al (2010)* on normative values of static and dynamic abdominal muscles endurance in healthy Nigerians shows mean value 34.9 sec for static endurance and 15.6 rep for

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dynamic endurance. Another study by *McIntosh et al (1998)* on trunk and lower extremity muscle endurance: normative data for adults found that in age group 19-29 years, who had endurance more than 75th percentile were 25% of male and female for dynamic chest raise, 18% male and 14% female for bilateral straight leg raise, 68% male and 62% female for static chest raise, 47% male and 46% female for prone bilateral straight leg raise.

Identification of high, medium and low muscle endurance can alert patients and clinicians for possible modification of the usual treatment regime. Clinician uses many of tests of Canadian Standardized Test of Fitness, but consideration has been given to the issue of reliability. In other studies *Mclntosh et al, (1998)* determined reliability for different tests and reported. fair to good test retest reliability for isometric upper abdominal (r=0.63), isometric lower abdominals (r=0.67), and excellent reliability for dynamic upper abdominals (r=0.87), isometric lower back extensors (r=0.81); and good reliability for isometric upper back extensors is shown by *Rosner (1995)*. Endurance testing may be affected by fatigue of participants; hence subjects were priorly informed about fatigue onset and its influence on test results. Psychological influence on human strength and endurance is also reported by *Malchaire & Masset (1995*). *Petrofsky et al (2005)* reported a mean value of 65.8 ±12.5 Kg specifically for the rectus abdominis using electromyogram analysis.

In the present study the normative data for male and female both has been reported. The mean value for different tests are 60 sec (for male) and 25 sec (for female) for IUA, 21 sec (for male) and 9 sec (for female) for ILA, 36 rep (for male) and 14 rep (for female) for DUA, 29 sec (for male) and 17 sec (for female) for IUBE, 50 sec (for male) and 34 sec (for female) for ILBE, 16 rep (for male) and 9 rep (for female) for DUBE. Significant difference between male and female test results is observed in the study which is similar to test results of other reference populations. Hormones, training, genetics, playing sports and other variables may influence muscular endurance between genders. It is speculated that ethnic and racial differences may significantly influence the pattern of endurance of back muscles.

The percentile values shown in table 3 suggest that there is more number of participants who have high trunk muscles endurance (between 75 to 100%). and fewer participants have medium trunk muscles endurance (between 50 to 75%). It is interesting to observe that those who had endurance more than 75th percentile were 35% of male and 54% female for IUA, 39% male and 48% female for ILA, 58% male and 29% female for DUA, 61% male and 43% female for IUBE, 54% male and 49% female for ILBE, 63% male and 59% female for DUBE (Table 3).

This is the first study to provide a reference value database for trunk flexor and extensor muscles endurance in healthy Indians of 18-25 years age.

Conclusion: This study was done to find out the normative data for static and

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dynamic endurance of trunk flexors and extensors group of muscle in individuals of 18-25 years age group. The reference values found in this study can be helpful for the rehabilitation of patient with low back pain and also as an outcome measure for quantitative improvement and future research purpose.

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