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THE RELATIONSHIP BETWEEN TRUNK MUSCLES ENDURANCE AND NORMAL BMI AMONG UNIVERSITY STUDENTS WITH SEDENTARY LIFESTYLE

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ABSTRACT

Background: The most important trunk stabilizers are the trunk flexors and extensors. The isometric endurance of the trunk muscles is an essential element for mechanical support of the spine in all positions. The study objectives were to find out the trunk flexors and extensors endurance, its relationship with normal BMI and to find out the ratio of trunk flexors to extensors endurance.

Methods: In this correlation study, 50 subjects were selected by convenience sampling method on the basis of inclusion and exclusion criteria from Asia metropolitan university, Malaysia. The trunk flexors and extensors endurance were assessed by Kraus- Weber and Sorenson test respectively. Paired 't' test and Spearman correlation test were used for data analysis.

Results: There was a significant difference ($p< 0.05$) between trunk flexors (65.4± 26.5) and extensors (107.8±41.7) endurance. Trunk extensors endurance was higher than trunk flexors endurance. A two-tailed test of significance indicated that BMI was unrelated to the subject's TFE, $\underline{r}_s$ (50) = -0.160, $p > 0.01$ and TEE, $\underline{r}_s$ (50) = -0.162, $p >0.01$ but there was a significant strong positive relationship between TFE and TEE, $\underline{r}_s$ (50) = 0.68, $p < 0.01$. The ratio of trunk flexors to extensors was 0.61.

Conclusion: The trunk extensors endurance is higher than trunk flexors endurance and BMI has no relationship with trunk flexors and extensors muscle endurance. The ratio of trunk flexors to extensors endurance value is low.

Keywords: Body Mass Index (BMI), Trunk Flexors Endurance (TFE), Trunk Extensors Endurance (TEE), Kraus- Weber test, Sorenson test.

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INTRODUCTION

Muscle endurance is a muscle's ability to contract repeatedly against a load for a longer duration without fatigue. In fact, most of our daily activities require some muscle endurance [1]. The most important trunk stabilizers are the trunk flexors and extensors [2]. The isometric endurance of the trunk muscles is an essential element for mechanical support of the spine in all positions [3]. Abdominal muscular endurance is considered functionally more vital than abdominal strength [4].Trunk muscles endurance has been investigated among different age groups in many studies. Trunk muscles endurance primarily influence the lumbar pelvic stability. Imbalance in endurance between the trunk flexors and extensors are main reasons for acquiring postural defects, low back pain (LBP), decreased athletic performance and various lumbar spine musculoskeletal injuries. Lacling trunk muscles endurance is associated with LBP occurrences in the future [5-10]. The imbalance between trunk flexors and extensors endurance is more significant than isolated trunk muscle weakness [11]. Prolonged sitting posture is the most important causative factor for the onset of non-specific low back pain in student population [12,13]. Normative values for trunk muscles endurance are available for college-aged students who have no history of LBP [14]. Even though the isokinetic method has been globally recognized as a gold standard for assessing trunk muscles strength, its clinical use has been much limited due to the cost factor [15,16]. The trunk flexors and extensors endurance can be easily evaluated by Kraus-Weber and Sorenson test respectively which are more reliable and valid, easily available, clinically applicable and less expensive tests [17-20]. Very limited studies are available related to analyzing trunk muscles endurance among normal BMI sedentary university students. The current study was conducted to explore the relationship between trunk muscles endurance and normal BMI in sedentary university students. Another objective of this study was to find out the ratio of trunk flexors to extensors endurance. Identifying the trunk flexors to extensors ratio may help to predict the future risk of developing back pain and spine related problems.

METHODOLOGY

In this correlation study, 50 subjects were selected through convenience sampling based on the inclusion and exclusion criteria from Asia metropolitan university, Malaysia. The inclusion criteria comprised of both male and female sedentary subjects aged between 18 to 25 years with normal BMI range. The International Physical Activity Questionnaire (IPAQ) short form was utilized to find out subjects with sedentary lifestyle [21,22]. IPAQ short version has acceptable test-retest reliability and validity for sitting and vigorous activity and also is adapted in 12 countries [23,24]. Participants with symptomatic low back pain, thoracic and cervical pain, spinal deformity, fracture, history of neurological, orthopedic and cardiopulmonary diseases, congenital or acquired chest wall deformity, disinterest in participation were excluded from the study. The university research ethical committee approved this study and informed consent was obtained from all subjects after the study procedures had been clearly explained to them.

PROCEDURES

The trunk flexors and extensors endurance were assessed by Kraus- Weber and Sorenson test respectively.

Trunk Flexor Muscles Endurance Test (Kraus-Weber Test)

Each subject was in a sit-up position with arms crossed over the chest, hips and knees flexed 90º and trunk rested against the back support angled 60º from the couch. The feet were stabilized with straps. At the beginning of the test, the back support was drawn 10 cm behind and the subject was instructed to maintain the position as long as possible. A stopwatch was used to count the holding duration from the time the back support was moved behind. The test ended when the subject's trunk touched the back support of the couch or reaches a maximum holding duration of 300 seconds.

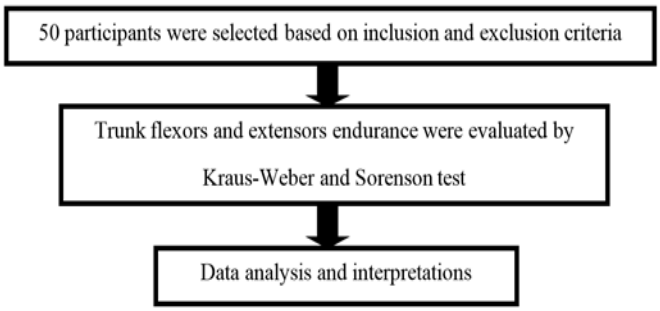
Trunk Extensor Muscles Endurance Test (Sorenson Test)

Each subject was instructed to lie prone with his/her Anterior Superior Iliac Spine (ASIS) in line with the edge of a couch. The lower body was stabilized on the couch using straps at the level of lower thighs and legs; while the upper body was not supported by the surface of the couch by asking the subject to push his/her arms in extension position on a stool directly below him/her. At the beginning of the test, each subject was given instructions to lift the upper limbs from stool support and cross over the chest with hands resting on opposite shoulders and maintain the horizontal position as long as possible. A stopwatch was utilized to record the holding duration from the time the upper hands were crossed over the chest until the subject could no longer maintain the horizontal position or reaches a maximum holding duration of 300 seconds.

Figure (a): Kraus-Weber Test

Figure (b): Sorenson Test

Figure 1: Flow chart indicating the procedure of the study.



DATA ANALYSIS

Demographic characteristics were analyzed by descriptive statistics. Paired 't' test was used to find out the significant difference between trunk flexors and extensors endurance in normal BMI subjects with a sedentary life style. Moreover, the relationship of trunk flexors and extensors endurance with BMI was analyzed using Spearman correlation test. Data were analyzed with SPSS version 20 (Windows 10).

RESULTS

Descriptive statistics were used to evaluate the subject's demographic characteristics which are depicted in Table 1. Paired 't' test was used to analyze the significant difference between trunk flexors and extensors endurance. It was found that there exists a significant difference between trunk flexors and extensors (65.42 ± 26.58; 107.84 ± 41.74, $p<0.05$) endurance. The ratio of trunk flexors to extensors-endurance was 0.61.

Spearman correlation coefficient was done to determine the relationship of trunk flexors endurance (TFE) and trunk extensors endurance (TEE) in normal BMI subjects with a sedentary lifestyle. These are explained in Table 3 and Graphs 2, 3 & 4. A two-tailed test of significance indicated that normal BMI was unrelated to TFE, r_s (50) = -0.160, $p > 0.01$ and TEE, r_s (50) = -0.162, $p > 0.01$ but there was a significant strong positive relationship between the TFE and TEE, r_s (50) = 0.68, $p < 0.01$.

Table 1: DEMOGRAPHIC CHARACTERISTICS OF SUBJECTS

VARIABLES	Mean(SD)
Gender: Male/Female	25/25
Age (Years)	22.9 (1.9)
Body Weight (kg)	61.8 (11.5)
Body Height (cm)	165.8 (10.0)
BMI	22.6 (3.2)

Table 2: COMPARISON OF TRUNK FLEXORS AND EXTENSORS ENDURANCE

Sedentary University students	Paired Differences					't' Value	Sig (2-tailed) (p <0.05)
	Mean	SD	Mean Difference	95% Confidence Interval Of The Difference			
				Lower	Upper		
Trunk flexors	65.42	26.58	-42.42	-51.07	-33.76	-9.85	0.00
Trunk extensors	107.84	41.74					

Graph 1: TRUNK FLEXORS AND EXTENSORS ENDURANCE

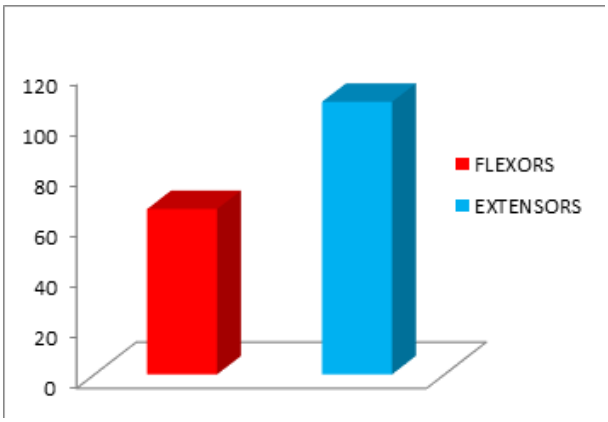
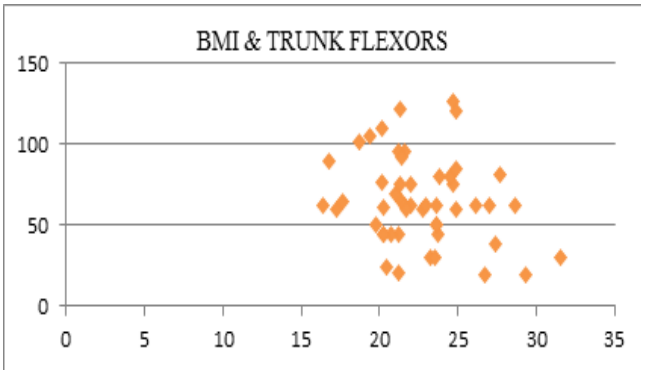


Table 3: RELATIONSHIP OF BMI, TRUNK FLEXORS & EXTENSORS ENDURANCE

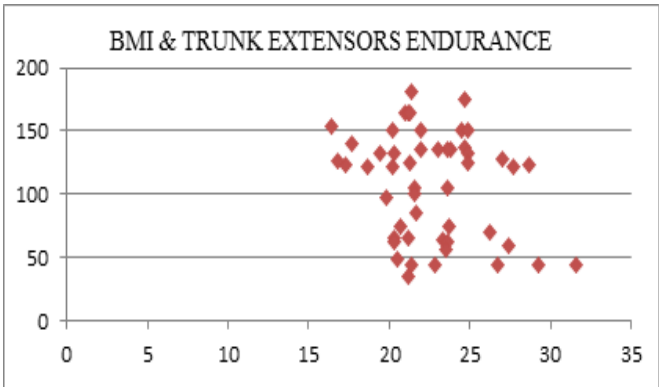
Spearman's rho (r_s)		Normal BMI	TFE	TEE
Normal BMI	r_s	1.000	-.160	-.162
	p	.	.268	.260
	n	50	50	50
TFE	r_s	-.160	1.000	.686**
	p	.268	.	.000
	n	50	50	50
TEE	r_s	-.162	.686**	1.000
	p	.260	.000	.
	n	50	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

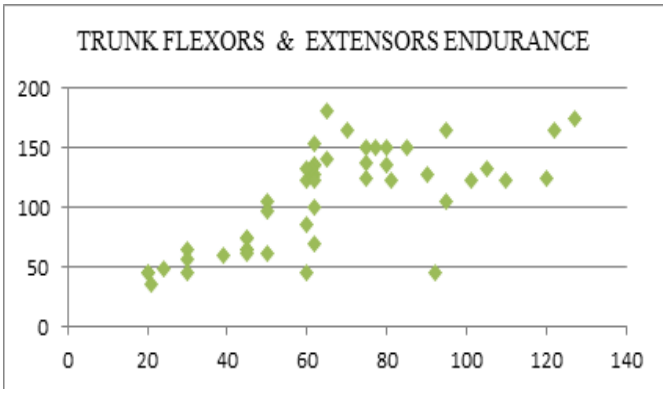
Graph 2: SCATTER PLOT FOR RELATIONSHIP BETWEEN BMI AND TRUNK FLEXORS ENDURANCE



Graph 3: SCATTER PLOT FOR RELATIONSHIP BETWEEN BMI AND TRUNK EXTENSORS ENDURANCE



Graph 4: SCATTER PLOT FOR RELATIONSHIP BETWEEN TRUNK FLEXORS AND EXTENSORS ENDURANCE



DISCUSSION

The primary goal of this study was to investigate the relationship of trunk muscles endurance with normal BMI in sedentary university students. The results of the study showed that trunk flexors and extensors endurance were not related with normal BMI but there was a strong positive relationship between trunk flexors and extensors endurance. When comparing the trunk flexors and extensors endurance, the trunk extensors endurance was higher than the trunk flexors endurance and the ratio of trunk flexors to extensors endurance was 0.61. Trunk flexors and extensors are postural muscles which are rich in type I fibers and have larger diameter muscle fibers. These muscles are suited for low levels of activity for a longer duration. The maximal voluntary capacity (MVC) of the trunk flexors in Kraus-Weber test was found to be low due to reduced moment arm when compared with MVC of trunk extensors during the Sorensen test. The torque generated by trunk extensors during this test has been reported as 40 to 52 percentage of MVC [9].

When we analyze the isometric holding duration for both flexors and extensors muscle groups and its ratio with the previous study findings which had almost the similar participant characteristics (healthy, young and mean age of 23 years) [14], all these values are dramatically reduced in our study. A study conducted by Biering -Sorensen found that a shorter holding duration in the Sorensen test anticipated low back pain in the subsequent year in males [8]. A previous study [25]found that flexors-extensors ratio for both healthy men and women with a mean age of 21 years (men: n=92, women: n=137) was 0.84 and 0.72 respectively and the overall ratio for both genders was 0.77 which was higher than our study result (0.61). Even though all subjects in our study were healthy with normal BMI, trunk muscles endurance and its ratio was less. So it is very clear that a person with normal BMI is not necessary to have an adequate endurance of the trunk muscles. Appropriate objective measurement tool has to be used for measuring trunk muscles endurance instead of predicting only on the basis of BMI.

The study limitations include less sample size and weak sampling technique. Further studies are necessary to find out the relationship and the effect of gender differences, time spent in sitting, biomechanical factors (pelvic alignment), ergonomic factors, psychosocial factors and personal factors (food habits, smoking, and consumption of alcohol) on trunk muscles endurance in subjects with a sedentary lifestyle. Future studies can be conducted on subjects with sedentary lifestyle with and without low back pain in different BMI groups by employing ultrasound imaging techniques and exploring trunk muscle thickness.

Low back pain is a well-recognized major cause of disability in the industrialized world with multi factorial etiology [26]. Spine endurance and stabilization exercises are most commonly prescribed by professionals for the rehabilitation and prevention of low back injuries. Diminished trunk extensor muscle endurance is linked to low back trouble as endurance plays a significant role in back health rather than strength which has a very weak relationship with back health in normal subjects [25]. These mean scores and ratios can be used as a guideline to recognize muscle dysfunction and also to anticipate low back pain occurrence in the future.

CONCLUSION

This study concludes that the trunk flexors and extensors endurance and its ratio are reduced in normal BMI healthy subjects with sedentary lifestyle. Normal BMI has no relationship with the trunk flexors and extensors muscle endurance which clearly shows that trunk muscles endurance is not influenced by normal BMI. But there exists a relationship between the trunk flexors and extensors muscle endurance. Encouraging specific exercises to increase trunk muscles endurance is necessary to avoid the future risk of developing spine related problems instead of relying only on BMI.

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