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Negative correlation between core muscle function and body composition in young people aged 18-30 years

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Abstract

Young adults (men = 48, women = 50) between the ages of 18 to 30 participated in this cross-sectional study that aimed to investigate the effects of body composition on core muscle function, as well as age and gender differences in core muscle function of young adults. Height, body mass, body mass index (BMI), sum of skin folds and waist circumference were measured. Lengths of time holding the front bridge and side bridge were recorded as the measure of core muscle function. Increased sum of skin folds, body mass and waist circumference were associated with poor core muscle function in men and women ($p < 0.05$). However, high BMI correlated negatively with men's core muscle function only ($p < 0.05$). ANOVA analysis revealed that men had significantly better core muscle function than women ($p < 0.05$).

Keywords: Core muscle function, Body composition, Gender difference, Young adult.

INTRODUCTION

Core muscles refer to the muscles in the lumbopelvic region of the body, which provide balance and stability to the whole body, act as shock absorbers, and protect vital internal organs. Additionally, they facilitate trunk rotation, load transfer and stabilisation of the lumbopelvic region [1,2]. Poor core muscle function in individuals may reduce body stability during activity and lead to excessive stress being placed on the spine, which can result in lower back pain, lower back and lower extremity injuries [3-6].

In the literature, most studies of core muscle function have focused on athletes and older adults. There are few studies on effects of body mass on core muscle function in healthy young adults. A recent study in children aged 6-15 years reported that as body weight increased, the length of time the bridge was decreased [7], while there is no report about such relationship in young adults aged 18-30 years. Some research have been done on core muscle function in young people [8,9] but they did not report on differences between males and females. Although, it is widely accepted that muscle function is influenced by age, the changes that occur in core muscle function between ages of 18 to 30 years has yet to be documented.

The present study aimed to investigate the effects of body composition on core muscle function, as well as age and gender differences in core muscle function of healthy young adults aged 18 to 30 years. We tested the hypotheses: (I) increased body mass, body mass index (BMI), sum of skinfolds, and waist circumference (WC) would negatively affect core muscle function; and (II) there would be age and gender differences in core muscle function between young men and women.

METHODS

Study design and participants

Healthy young men and women aged 18 to 30 years old were recruited. Body composition measurements included body mass, BMI, sum of skinfolds, and WC. Core muscle function was assessed using length of time front bridge and side bridge positions were held. In addition, the participants were further allocated into four age groups and the change trend of core muscle function during 18 to 30 years old was investigated.

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Young healthy adults (men = 48, women = 50) between the ages of 18 to 30 participated in this study. Individuals with conditions such as lower back pain, spinal, abdominal and lower extremity injury or had undergone recent surgical intervention were excluded. The exact details of the study were described to the participants before the tests. Each participant signed a consent form. This project was approved by the Human Ethics Committee at University of Southern Queensland, Australia.

Measurements

Body mass was assessed with a balance scale and body height was measured with a stadiometer (without shoes). BMI was calculated by dividing body mass (kg) by height in meters squared (m^2). Sum of skinfolds in millimetres (mm) from four sites: triceps brachia (vertical fold measured at the midline of the upper arm halfway between the tip of the shoulder and the tip of the elbow), subscapular (oblique fold measured just below the bottom tip of the scapula), abdomen (horizontal fold measured 3 cm to the right of the umbilicus), and thigh (vertical fold measured at the midline of the thigh, two-third the distance from the middle of the patella to the hip) were used to represent body fat mass. WC at the umbilical level was measured in centimetres using a tailor's tape. All measurements were done by the same researcher.

Two exercises, front bridge and side bridge, were used to assess core muscle function. Participants were timed whilst holding front bridge and side bridge positions and these times were used as an indicator of core muscle function.

Data analyses

IBM SPSS statistics software version 19 and Microsoft Excel 2013 was used to collate and analyse the data. All variables were presented as Mean ± SD. Pearson's correlation analysis was done to investigate the relation between core muscle function and body composition. One-way ANOVA was used to analyse any significant differences in the variables between different age groups and gender.

RESULTS

Basic information of the participants and the measured variables were presented in Table 1. All variables except age and BMI are significantly different between male and female ($p < 0.05$). The results of Pearson correlation analyses were shown in Table 2. All variables of body composition in men had significant correlations with core muscle function; while in women, only body mass, sum of skinfolds and WC showed significant correlations with the front bridge time. There were no association between body composition and side bridge time in women.

Changes in core muscle function during 18 to 30 years of age were presented in Figure 1 for men and Figure 2 for women. No significant difference between age groupsin both men and women was observed, though mean front bridge and side bridge times in men plateaued at the 21 to 23 age group and gradually reduced as age progressed. However, these trends did not achieve statistical significance. No significant differences in these variables between the age groups were observed in young men and women.

Table 1: Descriptive statistics of body composition and core muscle function in young adults

	Male (n=48)	**Female (n=50)**
Age (Years)	22 ± 4	22 ± 4
Height (cm)	179 ± 8	166 ± 6*
Body mass (kg)	77.0 ± 11.8	63.9 ± 12.5*
BMI	24.0 ± 3.3	23.1 ± 4.0
Sum of Skinfolds (mm)	58 ± 32	77 ± 34*
Waist Circumference (cm)	84.9 ± 9.6	75.2 ± 9.6*
Front Bridge Time (Sec)	139 ± 61	103 ± 54*
Side Bridge Time (Sec)	86 ± 36	63 ± 31*

*p<0.05

Table 2: Correlation analysis of body composition and core muscle function in young adults

	Men (n=48)		**Women (n=50)**	
Variables	Front Bridge	Side Bridge	Front Bridge	Side Bridge
Weight	-.337**	-.323*	-.298*	-.076
BMI	-.328*	-.396**	-.170	-.063
Sum of Skinfolds	-.568**	-.525**	-.363**	-.170
Waist Circumference	-.418**	-.443**	-.328**	-.119

*p<0.05; **p<0.01

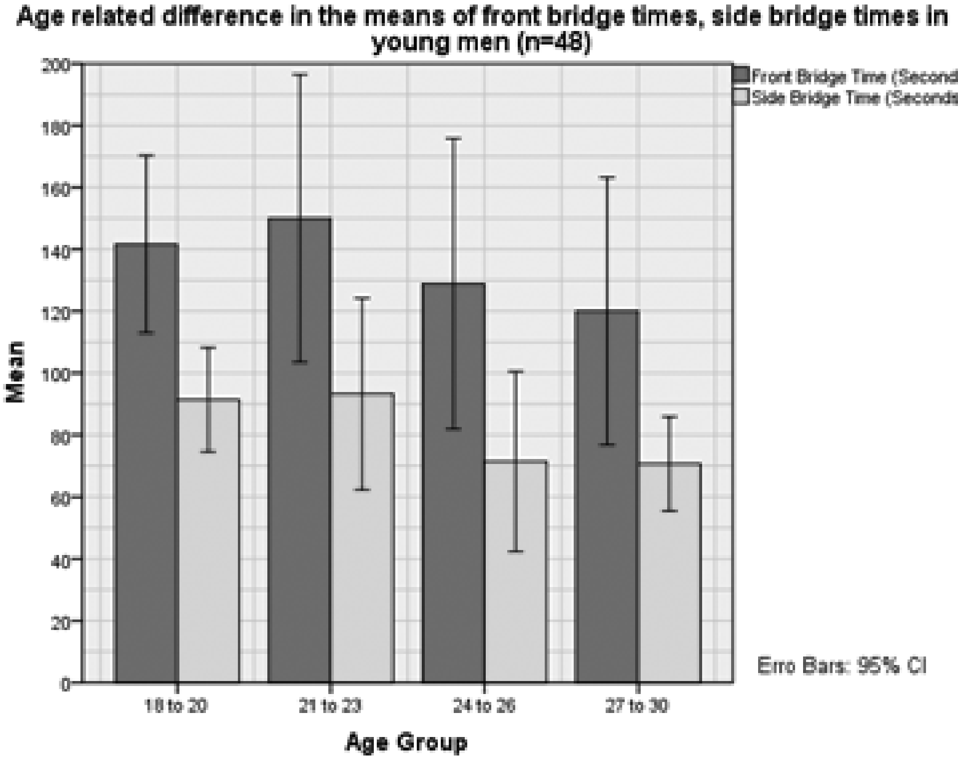

Figure 1: Core muscle function of different age groups in young men

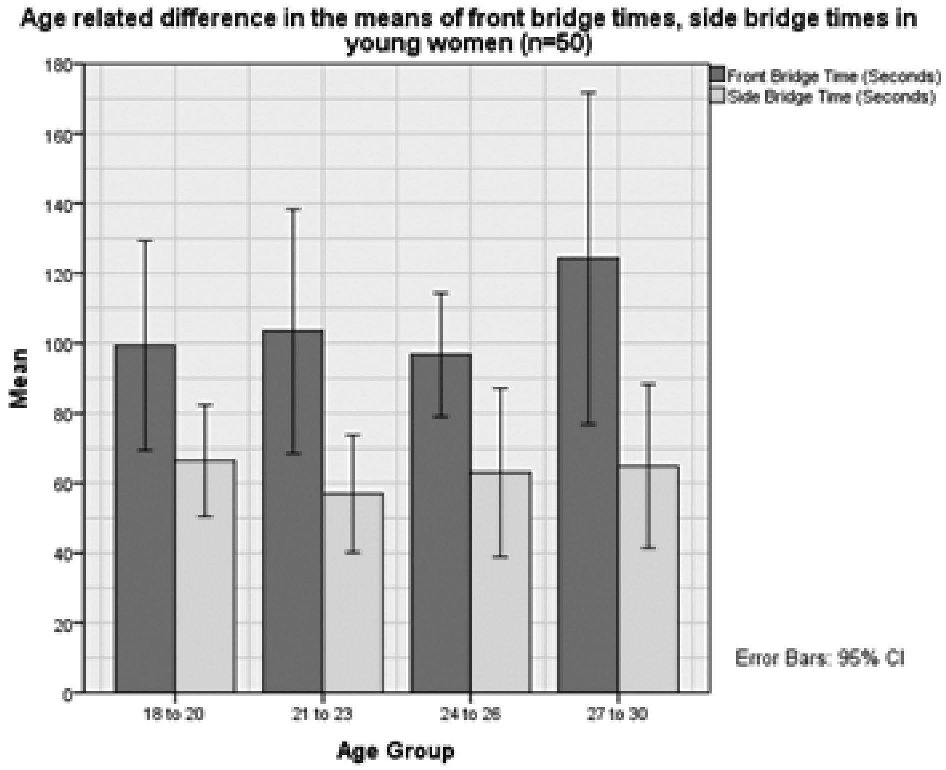

Figure 2: Core muscle function of different age groups in young women

DISCUSSION

The novel finding of the present study was that core muscle function had significant correlations with body composition variables in men, while in women only front bridge performance showed correlations but not side bridge time. In young men, as body mass and BMI increased, their core muscle function decreased. Ervin *et al*. [7] studied the relationship of core, upper and lower body strength with body mass status in children and adolescents. They reported that increasing body mass negatively impacted on front bridge times in children and adolescent boys and girls. Though, their study was performed on a younger cohort (6-15 years old), their results were aligned with our findings. When we focused on the skinfolds, we observed a stronger correlation between the sum of skinfolds and core muscle function, compared with those of body mass and BMI. A previous study indirectly supported our finding in which the authors reported the negative impact of increased fat mass on postural stability [10]. Core muscles play a vital role in postural stability. Results from King *et al*. [10] and our study point towards an interplay between the two factors, meaning that increased fat mass increases the load stress on core muscles affecting their ability to provide postural balance. In addition, these results suggest that body fat mass would play a more important role than body mass in affecting core muscle function. Furthermore, we observed significant correlations between WC and front bridge time and side bridge time in men and with front bridge time in women. Large WC has been associated with poor muscle function and increases the risk of sarcopenia [11], lower back and lower extremity pathologies [12], and low cardiovascular fitness [13,14]. Our current result provided additional evidence of the adverse effect of large WC on low core muscle function in young adults. In summary, the present study suggests that poor body composition may lead to poor core muscle function. This outcome supports the first hypothesis of the present study.

Considering the current situation of worldwide obesity epidemic [15], poor core muscle function would be prevalent in more people which may increase the risk of lower back pain and sport injury in the future. However, as in the cross-sectional design, our results cannot answer the cause-and-effect question. Interventional study is warranted to clarify whether decreased body fat mass would improve core muscle function.

We did not find correlations between body composition and side bridge time in young women of this study. Although side bridge is an excellent exercise for improving core muscle function, our result and that of other studies [4,16] implied that the side bridge test may not be a suitable assessment exercise for untrained women due to the exercise's demanding nature. Tan *et al.* [17] reported that the side bridge exercise showed higher electromyography activity in the core muscles for young men but they did not test this for young women. Our results showed that young women performed poorly in the side bridge exercise. This is similar result to the results of studies done by McGill *et al.* [16] and Leetun *et al.* [4] who reported that females performed very poorly in the side bridge exercise when compared to men. However, the reason for low side bridge performance in women is not known. Though front bridge is a suitable exercise to assess core muscle function in women, more suitable core muscle tests for women are needed to be developed.

Another important finding of this study was a significant difference in core muscle function between men and women. This finding supports the second hypothesis of the present study. Gender difference in core muscle function may have resulted from the difference in trunk and lower limb muscle mass. Marras and colleagues [18] found that men generally had larger trunk and lower limb muscle cross-sectional area than women by using magnetic resonance imaging scan. More body fat mass in women would be another reason for this gender difference. There may be functional differences in core muscle between men and women. Nadler *et al.* [19] studied the association between strength imbalance in hip musculature and lower back pain treatment. They found that muscular strength differences in the left and right hip extensors predicted a need for treatment for lower back pain in young women but not in young men. The results of anatomy and function from the above studies are indicative of existence of differences in the core muscle function of young men and women. To date, the present study is the only study that reports gender related differences in core muscle function of young people.

Age influences many factors of human physiology and core muscle function is no exception to this. There has been many studies [20-23] done on core muscle function and age. However, most of these studies are comparative studies which investigate differences between the young adults and older adults. Age-related difference in core muscle function have been reported to be caused by age-related muscle loss in the truck and lower extremities of the body [20] and different neuromuscular recruitment patterns of core muscles between young and older adults [22,23].

There is a lack of studies that focus on how age influences core muscle function in young adults. This project attempted to fill this knowledge gap and provide evidence of the effects of age on core muscle function in young adults aged 18 to 30. In young men, a non-significant trend was observed showing that mean bridge times plateaued at the 21 to 23 age group and decreased as age progressed. It appeared that core muscle function would peak at around 22 years of age for young men. There were no trends associated with age related difference in core muscle function of young women between 18 to 30 years old in our study. Therefore, for women, the peak may be before 18 years old. However, the small group size of our study did not have strong statistical power and future studies of age-related differences in core muscle function within this age period is needed.

There are limitations in the present study. Being a cross-sectional study, this study can only indicate the relationship between body composition and core muscle function; however, we cannot answer the cause-and-effect questions, such as whether decreased body fat mass would improve core muscle function. Simple body measurements were employed in the present study. Advanced technique, such as dual-energy X-ray absorptiometry to measure body fat would provide more accurate data.

In conclusion, current results suggest that body composition variables negatively affect core muscle function in young adults. In addition, core muscle function differ greatly between young men and women. More studies about suitable tests for women's core muscle function are needed. There is no significant age related differences in core muscle function of young adults aged 18-30 years.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

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HR (Honours student) and JW contributed to study design, experiments, data analyses, manuscript preparation, and final approval of the submitted version. The authors would like to thank all participants who took part in this project.

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