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Comparison of Core Endurance and Physical Activity Levels in Physically Active and Inactive Young Females

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ABSTRACT

OBJECTIVE: To compare core endurance between physically active and physically inactive young females.

METHODOLOGY: Comparative observational study was conducted among 64 apparently healthy females aged 18–40 years. Participants were classified as physically active (n=34) or physically inactive (n=30) using Rapid Assessment of Physical Activity (RAPA) questionnaire. Core endurance was evaluated using McGill Core Endurance Test, comprising trunk flexor, trunk extensor, and bilateral side plank endurance tests. Data was analysed using SPSS v20. Mann–Whitney U test was used to compare the core endurance between groups. Level of significance kept at 0.05.

RESULTS: The mean age of physically active and physically inactivity group were 26.00 ± 5.44 years and 26.83 ± 7.33 years, respectively. The physically active group demonstrated significantly greater trunk flexor endurance ($U = 84.5$, $p < 0.001$), trunk extensor endurance ($U = 182$, $p < 0.001$), right side plank endurance ($U = 182$, $p < 0.001$), and left side plank endurance ($U = 211.5$ $p < 0.001$) compared with the physically inactive group.

CONCLUSION: Physically active young females have significantly greater core endurance than physically inactive young females, highlighting the beneficial influence of regular physical activity on core muscle endurance.

Keywords: Core endurance, physical activity, young females, fitness

INTRODUCTION

Core strength is defined as the ability of the trunk musculature to generate, control, and sustain force during the functional activities. It can be evaluated through different components such as maximal force production, muscular power, and the ability to maintain force over an extended duration of time, commonly referred to as muscular endurance or strength-endurance [(1)]. Over past few decades, core muscle endurance and stability have been in the limelight in accordance with sports injuries prevention, training and fitness. A well-conditioned core facilitates efficient transfer of ground reaction forces from lower limbs through trunk to the upper limb muscles during athletic activities. In contrast, poor core stability may decrease the performance of an active individual and makes then susceptible to injuries. Thus, improved core strength and endurance are believed to

positively influence the performance of an individual engaging in athletic activities [(2)] [(3)].

Physical activity plays an important role in maintaining people's good health and has been proven to be a supporter of healthy life. Regular exercise is also associated with many health benefits and delayed mortality Not only that but it plays an integral role on positively influencing mental well-being of an individual. Correspondingly, there is a growing necessity to enhance people's knowledge, awareness and perception of physical activity and how it affects individual's health which will ultimately result in developing a healthy society [(4)]. Physical activity refers to any bodily movement that increases energy expenditure and contributes to the maintenance of physical and mental well-being. Regular physical activity helps improve overall health, enhances fitness, and supports a better quality of life throughout daily activities [(5)].

WHO defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity refers to all movement including during leisure time, for transport to get to and from places, or as part of a person's work or domestic activities. Both moderate- and vigorous-intensity physical activity improve health [(6)].

In order to promote and maintain health and well-being, all healthy adults aged 18 to 65 years need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on five days every week or vigorous-intensity aerobic physical activity for a minimum of 20 min on three days every week. For example, an individual can meet the requirement by walking leisurely, stretching or doing light house work or gardening. Moderate intensity physical activity which is generally equivalent to brisk walking, strength training and swimming gently; wherein the heart beats faster than normal is recommended for minimum of 30 minutes where each session lasts for about 10 or more minutes each. Vigorous physical activity is embodied by activities like jogging, using stair machine and playing outdoor games wherein there is a substantial increase in heart rate and the respiratory rate and the individual cannot talk or their talk is broken up by large breathes [(7)(8)].

With respect to health of an individual, physical activity is the most important aspect. Adequate participation in physical activity acts as a shielding factor against various diseases, especially life related diseases and disorders. It also plays an important role in maintaining healthy and active lifestyle by promoting a balance between mental and physical health. Optimum physical activity is represented as a crucial asset which limits the onset of various diseases.

Among young women, regular physical activity serves as a potent preventive measure and therefore helps maintain a healthy body composition, positive self-image and outward confidence. In terms of physical health, moderate physical activity is considered the most beneficial to maintain a good lifestyle [(9)]. Numerous tests and measurement are accessible to determine the components of core stability. Among the core endurance assessments, particularly the McGill core endurance tests are considered highly reliable measures. Endurance refers to the ability to sustain activity or maintain a particular amount of force over a period of time. Accordingly, core endurance tests involve maintaining unsupported static positions of trunk for specific durations. The McGill endurance tests are simple, cost-effective, safe and easy to perform isometric assessment techniques that can be used by clinicians and therapists in various settings. These endurance tests have demonstrated average to excellent reliability. Additionally, each test is considered trustworthy and sensitive for assessing trunk muscle endurance, and useful in predicting and evaluating individuals with low back pain [(10)].

The need of this study arises from the growing prevalence of physical inactivity

among young females and, it's probable impact on the core muscle endurance, and through it on spinal stability, balance, posture, physical conditioning and functional strength.

In the recent times, physical inactivity amongst young adults have increased, especially of females due to many factors. Although, several studies have been done to accentuate the role of core endurance in athletic performance and rehabilitation, very few scientific studies have explicitly evaluated the influence of core endurance in physically active and inactive young females. The study is therefore done to understand the relation between physical activity levels and core muscle endurance in young females.

MATERIALS & METHODS

A comparative cross-sectional observational study was conducted among healthy females aged between 18-40 years to analyse the core endurance and physical activity levels. The study was done under the principles of the Declaration of Helsinki (2013 revision). The sample size was calculated using results from a previous published study with similar outcome measure [(11)]. The participants were initially screened according to the inclusion and exclusion criteria, and a total of 64 apparently healthy females were selected who fulfilled the eligibility criteria. The females were informed about the whole procedure. They signed the informed consent form for the same and were then included in the study. Individuals with recent musculoskeletal injuries or spinal disorders, neurological or cardiopulmonary conditions, pregnancy, ongoing physiotherapy or rehabilitation, professional athletic training, or pain during testing were excluded from participation. The females were informed regarding the tests used in the study; McGill core endurance tests (all 3 components) – Trunk Flexion endurance test, Trunk Lateral endurance test (left and right), Trunk extensor endurance test and the RAPA (rapid assessment of physical activity). Physical activity levels were assessed using Rapid assessment of physical activity questionnaire, following which participants were classified as physically active and inactive.

According to the rapid assessment of physical activity, physical activities are the activities or movements which increase the heart rate above its resting rate, whether done for pleasure, work, or transportation. The RAPA questionnaire was administered to assess the amount and intensity of physical activity routinely performed by the participants. It consists of questions related to light, moderate, and vigorous physical activities, along with activities aimed at improving strength and flexibility. Light physical activities include leisure walking, stretching, household activities, or light yard work, during which participants could comfortably talk or sing while performing the activity. Moderate physical activities include brisk walking, aerobic exercises, gentle swimming, and strength training, where the heart rate increases noticeably and participants could talk comfortably but were unable to sing. Vigorous physical activities include gym exercises, jogging, running, stair climbing, and sports activities such as badminton, tennis, and pickleball, during which breathing became rapid and speaking is difficult due to increased exertion or the talking is broken up by large breaths. The questionnaire is divided into two according to the type of activities done. It includes RAPA-1 which consists of Aerobic activities and RAPA-2 which consists of Strength and flexibility activities. Scoring of the RAPA questionnaire was performed according to the highest level of physical activity marked positively by the participant. Candidates scoring <=3 in RAPA-1 were categorized as inactive or under-active, whereas candidates who scored >=4 in RAPA-1 (or the doing 150 minutes of physical activity per week (30 minutes of at least moderate physical activity per week for 5 days a week and vigorous physical activity) were categorized as active individuals. RAPA-2 consists of

two additional questions assessing participation in muscle strengthening and flexibility exercises. Participants were asked whether they performed activities such as weight training or calisthenics to improve muscle strength and activities such as stretching or yoga to improve flexibility at least once weekly. Responses were scored separately as strength activity, flexibility activity, both, or none. The obtained RAPA scores thereafter were recorded and used to classify participants into physically active and physically inactive groups for further statistical analysis. The Rapid Assessment of Physical Activity (RAPA) is an easy-to-administer and reliable and valid tool for assessing physical activity participation among adults [(8)].

In the McGill core endurance tests, 3 isolated tests were performed to check the endurance of the core. For the trunk extensor endurance test, participants were positioned prone on a treatment table with the upper border of the iliac crests aligned at the edge of the table, while the pelvis, knees, and ankles were stabilized. With the arms crossed over the chest and hands resting on the opposite shoulder, participants were instructed to maintain the upper body in a horizontal unsupported position for as long as possible and the time was checked using a stopwatch. The test was terminated when the participant was unable to sustain the horizontal alignment.

During the trunk flexor endurance test, participants were positioned in a seated posture with the trunk supported at an angle of 60 degrees from the floor. The hips and knees were maintained at 90 degrees flexion. After crossing the arms over the chest, the back support was slightly withdrawn, and participants were instructed to maintain the unsupported position for the maximum possible duration. The test concluded once the participant could no longer sustain the posture and the time was recorded.

For the side bridge endurance test, participants assumed a side-lying position with both legs extended and the upper foot placed anterior to the lower foot for stabilization. Support was provided through the elbow and feet while the opposite arm remained crossed over the chest. Participants were instructed to elevate the pelvis off the surface and maintain a straight body alignment for as long as possible. The test ended when proper alignment could no longer be maintained or when the pelvis dropped from the position.

The duration for which each test position was maintained was recorded in seconds and documented for analysis. The McGill Core Endurance Test is a valid and highly reliable tool for assessing trunk muscle endurance and core stability, demonstrating excellent intraclass correlation coefficients for trunk flexor (ICC = 0.97), extensor (ICC = 0.97), and lateral musculature endurance tests left and right (ICC = 0.99) [(12)].

Statistical Analysis

The data that collected was analysed using SPSS v2o software. Descriptive statistics were presented as mean ± standard deviation (SD). The Shapiro-wilk test for four variables of core endurance test demonstrated a not normal distribution. Therefore, Mann-Whitney U test was used for comparison between physically active and inactive groups.

RESULT

Total 64 participants were recruited and based on the Rapid Assessment of Physical Activity (RAPA) questionnaire, out of which 34 participants were in the physically active group, while 30 participants were in the physically inactive group. The demographic characteristics of both groups are presented in table 1.

Table 1: Demographic characteristics of both groups (physically active and inactive) Comparison of McGill core endurance test scores between groups is demonstrated in table-2.

Variables	Physically active group n=34 (Mean ± SD)	Physically inactive group n= 30 (Mean ± SD)
Age(years)	26.00 ± 5.44	26.83 ± 7.33
Body mass index(kg/m^2)	22.14 ± 2.35	24.01 ± 3.12
RAPA-1	4.5 ± 0.96	2.4 ± 0.77
RAPA-2	1.8 ± 1.3	0.46 ± 0.86

Table 2: Descriptive statistic and Comparison of components of McGill Core Endurance Test.

Core endurance test	Physically active group (Mean ± SD)	Physically inactive group (Mean ± SD)	U- value	p-value
Trunk flexor endurance(sec)	119.47 ± 66.22	45.73 ± 19.05	84.5	< 0.001
Trunk extensor endurance(sec)	138.88 ± 69.18	35.00 ± 16.64	182	< 0.001
Right side plank (sec)	93.20 ± 56.93	37.80 ± 18.15	182	< 0.001
Left side plank(sec)	78.00 ± 49.33	55.066 ± 28.30	211.5	< 0.001

DISCUSSION

The purpose of this study was to compare the core endurance and physical activity levels in apparently young females ranging from age group of 18-40. Total of 64 participants were included in the study. They were divided into two groups with respect to the physical activity levels with physically active women being 34 in number and physically inactive females being 30. The findings showed a statistically significant difference in all the components of the McGill Core Endurance Test, including trunk flexor endurance test, trunk extensor endurance test, and side plank endurance (left and right), between the two groups. The physically active group demonstrated superior core endurance performance as compared to the physically inactive group, supporting the association between increased physical activity and improved trunk muscle endurance.

Previous studies have shown that core stability is frequently incorporated into athletic conditioning, injury prevention, and rehabilitation programs because of its role in maintaining trunk control and facilitating force transfer between the upper and lower extremities. Although the direct contribution of core stability to injury prevention and performance enhancement remains inconclusive. Additionally, adequate core endurance is considered essential for optimal movement patterns and postural control [(13)].

Evidence from a study by Behm DG et al. also suggests that adequate trunk muscle endurance is essential for effective core stabilization and improved fatigue tolerance. Reduced endurance capacity may compromise the ability of the core musculature to maintain prolonged postural support and functional stability. In agreement with these observations, the present study demonstrated significantly lower endurance performance among physically inactive participants compared to their physically active counterparts, highlighting the potential role of regular physical activity in enhancing core endurance and sustaining trunk stability [(2)].

A study done by Marta Silva Santos et al., suggests core endurance is associated with improved movement quality, functional performance, and fatigue resistance. Herein, trunk muscle endurance plays an important role in maintaining efficient movement patterns and may have a greater influence on functional capacity among physically inactive individuals [(1)].

On the contrary, a study done by Nesser, Thomas et al.,2008 portrayed that core endurance was significantly related to strength and power performance, although the relationships were relatively weak. They further highlighted that the core muscles work synergistically as a functional unit and that adequate core endurance contributes to trunk stability, movement efficiency, and fatigue resistance [(14)].

Though the study compared the core endurance in physically active and inactive females, the effect of core endurance on various outcomes like spinal stability, balance, posture, and functional strength was not seen. Future studies on these relations can be conducted, as well as studies to see the effect of incorporating physical activity on core endurance can be done.

CONCLUSION

The findings of the present study show that significant difference was observed across all components of McGill Core Endurance Test between physically active and physically inactive young females, with the physically active participants exhibiting superior core endurance performance and stability as compared to their physically inactive counterparts. The result suggests that regular participation in physical activity may play an important role in enhancing the endurance capacity of the core musculature. Improved core endurance can contribute to better postural control, spinal stability, and the ability to sustain functional activities over prolonged periods. Therefore, promoting regular physical activity may be an important strategy for optimizing the core functions and preserving musculoskeletal health and physical well-being among young females.

Declaration by Authors

Ethical Approval: The study was done under the principle of declaration of Helsinki.

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Conflict of Interest: The authors declare no conflict of interest.

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