Journal of Positive School Psychology
2022, Vol. 6, No. 5, 5916 – 5921 http://journalppw.com

The Core Flexibility, and Stability are Correlated with Pulmonary Functions in Physically Inactive Young Adult University Female Students in Qassim Region, KSA.

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ABSTRACT

Background: Modern technology has contributed to the decreased physical activity. This sedentary lifestyle may affect core flexibility and stability. Many studies have reported that core stability may affect lung function. The current study aimed to screen the high-risk group of adult female youths in Qassim Region, KSA, with low physical activity and determine the correlation of their pulmonary function with their core flexibility and stability. **Method:** 41 physically inactive young adult females, ages17-24years, participated in this study. For all participants, the pulmonary functions, including; Forced vital capacity (FVC) and Forced Expiratory Volume in one second (FEV1), were measured by a spirometer, and core flexibility and stability were measured by sit and reach and curl- up tests respectively. The correlation between core flexibility and stability with pulmonary function was estimated. **Results:** The results showed a significant suppression below average values in the measured parameters of pulmonary function, core flexibility, and stability ($p \leq 0.05$ for all).
Conclusion: The limitation in core flexibility and stability due to the sedentary lifestyle was significantly correlated with the pulmonary function parameters. We recommend a core stability exercise program as a valuable rehabilitation program for young adult females to enhance their pulmonary functions.

Keywords: Physical Inactivity, Core stability, Abdominal Endurance, flexibility, young females, FVC, FEV1.

1. Introduction

Recent automation and technological advancements contribute to the sedentary lifestyle and reduce daily activities like cloth washing, cleaning, and going to workplaces. The World Health Organization [WHO] recorded physical inactivity as the 4th leading risk factor for mortality [6%]. The first cause is hypertension [13%], smoking [9%], and diabetes [6%] [1]. The WHO (2007) reported that about two million people die every year from causes related to physical inactivity [2]. Unfortunately, inactivity is more prevalent among females than males. It appears that more than 60% of females do not participate in a regular amount of physical

activity that can improve the level of their physical fitness [3, 4].

Several health organizations consider a person sedentary if he/she does not exercise for at least 30 minutes three times per week, infrequently walk more than 10 minutes per day, remain staunch most of the working hours, and/ or hold a job that requires limited physical activity. Thus, a sedentary lifestyle means a person is not getting enough activities or routine aerobic exercise to boost the heart rate significantly for an extended period [5, 6].

The increasing rate of sedentary lifestyle nowadays results in weakened lumbar core stability in many individuals [7]. Studies have reported that core muscles may affect lung function, and the development of core muscles is essential for establishing cardiopulmonary function. The core muscles are anatomically described as a box, with the abdominal muscles at the front, gluteal and paraspinal muscles at the back, the diaphragm on the top, and the pelvic floor and hip muscles base [8]. The core muscles create a synergism between the lateral abdominal muscles and the diaphragm to adjust the abdominal pressure and support the trunk [9]. The diaphragm consists of two different muscles, the right and left hemidiaphragm, which approximate a dome. The diaphragm's coastal appendages are on the lower six ribs' inner surface and the sternal appendages on the xiphoid process. The right diaphragm's lumbar appendage is on the anterior parts of L1-L3, whereas the diaphragm's lumbar appendage is on the anterior parts of L1-L2. During inspiration, the diaphragm contracts, the dome flattens, and moves downward within the abdominal cavity. During the diaphragm contraction, its coastal fibers create a horizontal expansion. The plunger-like action of the diaphragm with the resistance created by the pelvic floor and an eccentric contraction of the abdominal wall creates a negative pressure in the thoracic cavity that pushes air into the lungs while raising the pressure in the abdominal cavity [10-12].

In addition, the flexibility of movement is required for maintaining the normal range of motion at each joint [13]. Flexible exercise gives the benefit of reducing damage to the musculoskeletal system by extending the shortened soft tissue and permitting a proper movement of every joint [14].

Data about the level of physical activity is available by using pedometers [15]. However, physical fitness is related to measuring a group of health-related attributes associated with performance. It includes aerobic fitness, muscular strength and endurance, muscle flexibility, and body composition [16]. Aerobic fitness concerns the capability of the cardiovascular system to supply oxygen to active muscles to accomplish their role and improve strength and endurance [17].

Monitoring the pulmonary function can determine the functional lung state in terms of how much gas (air) can move in and out of the lungs, how quickly it is moved, lung and chest wall stiffness, the diffusion features of the pulmonary membrane through which the gas flows, and how well the lungs respond to treatment [18]. Spirometry has become a vital tool in assessing respiratory function. It is a test that will always need patient effort and interaction; the forced vital capacity (FVC) is a primary component of the test, used to diagnose airway obstruction (reduced FEV1/FVC) and rule out a restrictive process [19].

Many recent studies determined the impact of core stability strengthening exercises on improving pulmonary function in different cases [20-23]. While, few studies were investigating the correlation between week core stability resulting from physical inactivity and pulmonary function. The present study investigates the impact of a sedentary lifestyle on core stability and flexibility and its correlation with pulmonary function in young females in Qassim, KSA.

2. Methods:

2.1 Subjects:

This study was conducted on 41 healthy young adult females aged between 17 and 24 years and attending Qassim University, KSA. The study design was accepted by the Qassim Research Ethics Committee, Registered at the National Committee of Bio& Med. Ethics (Registration No. H-04-Q-001). It was conducted

following the ethical standards of Helsinki's Declaration. All participants understood the purpose of the study and signed written informed consent forms. The participants were notified about the day and time of their evaluation. They were requested to fill a survey about their level of physical activity and general health before the start of the test. Their demographic information was taken at first. This study was a component of a research project aimed to *Screen the Adolescent and Adult Youth in the Qassim Region with sedentary lifestyles for Physical Fitness Levels and investigate its Correlation with Other Health Risk Factors to Develop Improvement Plans for Physical and General Health***.** It is funded by the Deanship of Research (contract No. 3528), Qassim University, Qassim, KSA.

2.1.1 Sample size determination:

We used the next equation to predict the Sample Size

Sample Size (SS)= [Z2 * (P) * (1-P)]/ C2

Where:

Z = Z value (1.96 at confidence level of 95%)

P = the percentage of picking up the choice

C = confidence interval expressed in decimal.

The expected number of participants is ≥ 40 students. We got the No. of the population at this age group approximately from the statistic reports of Ministry of Education & No. of students at Qassim University. Our confidence level is 95%, and the confidence interval is 4.

2.1.2 The inclusion criteria include: Healthy individuals, physically inactive (she does not participate in physical activity for thirty minutes or more for three times a week and sits for 6-8 hours/day without any interval of physical movement for at least 10 mins, or rarely walks more than 10minutes during the day) [5,6], and individuals who are willing to participate in the study.

2.1.3 The exclusion criteria include: Individuals with any history of spine pathology or fracture, abdominal or spine surgery, individuals involved in a gym or exercising regularly for 30 mins or more three times a week, and individuals with chronic diseases (COPD, cardiopulmonary diseases, hypertension, diabetes, obesity with body mass index (BMI) ≥30.

2.2 Measurements:

2.2.1 Weight and Height: we measured the participant's weight (in Kg) and height (in cm); these data are essential to measuring the BMI (participant with BMI≥30 was excluded). BMI was measured by the following equation: BMI =body weight (Kg)/hight^2 (m^2) [24].

2.2.2 Pulmonary Function Measurement: A skilled investigator measured the values of the pulmonary function [Forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and FEV1/FVC were measured with a portable spirometer (spirox pro spirometer) while the subject was seated comfortably with the trunk at a 90° angle. A nose clip was used to close the nose. The test was repeated three. There was two minutes rest interval between the trials to assure adequate recovery. The best trial result for each subject was used for analysis. Respiratory measurements were taken according to general guidelines [25].

2.2.3 Abdominal Strength and Endurance Measurements: The Curl-Up was used to assess abdominal endurance and strength. During the Curl-Up test, the participants lay on their back, and their knees bent at a 140o angle. Both palms and soles are flat and face mate. Participants were asked to curl up slowly and to slide their hands on the measuring tape. They stop after 4 minutes or after counting a 75 curl-Up. The rate of curling-Up is one every 3 sec. A participant was considered normal if she completed ≥18 Curl-Up and her value was 18 [26].

2.2.4 Flexibility (Sit and Reach): The Sit and Reach procedure measures the flexibility of the hamstring muscle. We ask the participants to reach the specified distance on the left and right sides of the body. Then we record the nearest distance reached in inches up to a maximum of 12 inches. The knee should be extended and straight. The participant was considered in the health fitness zone if she recorded 12 inches or more, and her value was recorded as 12 [26].

2.3. Data Analysis &Statistical design

The computer program SPSS (IBM SPSS, USA) version 20 was used to perform all statistical calculations. A Pearson correlation was computed between flexibility (Sit and Reach),

abdominal Strength, Endurance, and Pulmonary function. P values less than or equal to 0.05 on two-sided test and Pearson correlation test were considered statistically significant.

3. Results

3.1 Subject Characteristics:

A total of 50 adult females participated in this study; 41 were consistent with the inclusion criteria. Their general characteristics regarding age, height, weight, and BMI are outlined in Table (1). The mean value of BMI was 22.32 ± 0.32.

3.2 The measured pulmonary function parameters:

The mean values of the measured pulmonary function parameters were less than the normal range for the FVC and FEV1 (2.31±1.16, 1.97±0.94 respectively), while the mean of FEV1/FVC (85.35±0.62) was within the normal range (tables; 2). Thirty-seven out of 41participant (90.2%) showed restricted pulmonary values.

3.3 The measured parameters for the core flexibility and stability:

The mean values of trunk flexibility (sit and reach) and abdominal strength and endurance (curl-Up) were [8.78±1.6 (Rt), 8.41±1.7 (Lt), and 15.4±2.33 respectively; $P<0.05$ for all when compared with the average (Table; 3). All participants recorded values below normal for both tests.

3.4 The Correlation between the Pulmonary Function Tests with the Trunk Flexibility (Sit and Reach) and Abdominal Strength and Endurance

On evaluating the correlation between the pulmonary function tests with the Trunk Flexibility (Sit and Reach) and Abdominal Strength and Endurance (Curl- Up test), there were positive correlations observed for FVC, FEV1, PEFR with Flexibility (Sit and Reach) {r= 0.42, 0.31and 0.372 respectively and $P<0.05$ for all} and Abdominal Strength and Endurance (Curl- Up test) {r=0.231, 0.214, and 0.267 respectively and $P<0.05$} (Table, 4)

Discussion

This study was conducted to screen the high-risk group of female university students (adult youths) in Qassim Region who have less physical activity without any chronic illness. We investigated their pulmonary function (FVC, FEV1, and FEV1/FVC ratio), core flexibility and stability (Abdominal Strength and Endurance), and the correlation of pulmonary functions with core flexibility and stability to direct them for health advice. The prevalence of physical inactivity in Saudi nations ranged from 43% to as high as 99% in particular regions [27]. Females in KSA have considered the lowest reported prevalence of moderate and vigorously intensive PA (2%) worldwide [28].

This study recorded a significant decrease in the values of sit and reach and curl-Up tests that were used to measure core flexibility and stability correspondingly for all participants compared to the typical average values regarding their age [26]. This finding most probably due to their sedentary lifestyle. Bhore et al. (2019) indicated that among 99 selected bank employees who are healthy individuals without physical activity for 6-8 hours every day and exercising for less than 2 hours per week, there were72 employees who suffer from core weakness (72.73%) [7].

A study carried by Kolar et al. (2012) examined 18 patients with chronic low back pain and 29 without to demonstrate the correlation between back pain, core function, and diaphragm function. They demonstrated that those in the low back pain group had more minor diaphragm excursions and higher diaphragm positions [29].

Many studies approved that strong core stability (Abdominal Strength and Endurance) is always associated with better respiratory muscles and better pulmonary function. Thus, many researchers have used the core stability strengthening exercise for improving pulmonary function in different cases like adolescents with drug abuse [20], stroke patients [21], obese individuals [22], and children with Congenital Deafness [23]. However, our study was designed to investigate the impact of weak core stability and flexibility in young, healthy adult females with sedentary lifestyles on their pulmonary function. The results revealed that 37 out of 41participant (90.2%) showed restricted pulmonary function values. Additionally, the results indicated a significant positive correlation between the levels of core flexibility and stability with the pulmonary function values. This result is congruous with former studies showing a positive

correlation between core strength, endurance, and flexibility with pulmonary function [30,31].

Conclusion

Most of the young adult healthy sedentary females who participated in this study showed a limitation in their pulmonary fitness (decrease in FVC, FEV1 with normal FEV1/FVC), which was positively correlated with their trunk flexibility, abdominal strength, and endurance. The high-risk participants were advised to develop effective trunk muscles through core strengthening exercise programs to improve their pulmonary function that's necessary for daily living activities. Our results are presumed to be helpful as reference values when measuring lung function in sedentary young adult females.

Funding Statement

This study was a component of a research project aimed to Screen the Adolescent and Adult Youth in the Qassim Region with sedentary lifestyles for Physical Fitness Levels and investigate its Correlation with Other Health Risk Factors to Develop Improvement Plans for Physical and General Health. It is funded by the Deanship of Research (contract No. 3528), Qassim University, Qassim, KSA.

Authors' Contributions

All Authors contributed to the manuscript, revised the final version, and gave the final submission approval.

Acknowledgment

The authors thank all participants in the study. Thanks to Deanship of Scientific Research, Qassim University, Qassim, KSA for funding this research project and facilitating all means to accomplish it. And introduce greater thanks to (Fatimah Hamad Alasqah, Taghreed Abdulaziz AlMansour, Maram Ibrahim Almebrek), the Students of Doctor of Physical Therapy Program, College of Medical Rehabilitation, Qassim University who help in data collection and measurements during conducting this project.

Conflict of Interest: Authors report no conflict of interest.

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