

Evaluation of Body Fat Composition, Physical Activity, and Hand Grip Strength in University Students Having Polycystic Ovary Syndrome

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ABSTRACT

Polycystic ovary syndrome (PCOS) is a common endocrinal disorder among young girls and women. It refers to the irregularity of the menstrual cycle associated with excessive facial and bodily hair, rapid weight gain, and skin breakouts. Investigating the relationships between body fat composition, physical activity (PA), and hand grip strength (HGS) in PCOS may help determine the impact on the overall well-being of individuals. Therefore, the objective is to evaluate body fat composition, PA levels, and HGS among university students with PCOS. **Methods:** This cross-sectional study was carried out on 120 female university students (60= PCOS and 60= non-PCOS), aged 18 to 30 years. A skinfold caliper, dynamometer, and International physical activity questionnaire were used to measure the body fat composition, handgrip strength, and physical activity of the participants respectively. The independent t-test was used to find the mean difference and Chi-Square analysis was computed to determine the association between the variables. **Results:** Among 120 participants, about 49 (40.8%) had a high body fat percentage, and 47 (39.2%) were HEPA active. The mean hand grip strength of the right hand was 8.43 ± 5.15 kg. A statistically significant difference in body fat composition ($p=0.000$), and handgrip strength ($p=0.000$) was observed in both groups, whereas the mean of HGS was low in the case group. And no significant difference was seen in physical activity ($p=0.646$). **Conclusion:** The findings suggest that PCOS is associated with high body fat composition, and weaker hand grip strength compared to healthy participants. While physical activity level is not found to be associated with it.

Keywords: Body fat composition, Hand grip strength, Physical activity, Polycystic ovary syndrome, University students

INTRODUCTION

Polycystic ovary syndrome (PCOS) is one of the prevalent endocrinopathies that mostly affects women in their reproductive age, characterized by anovulation, ovarian cysts, and hyperandrogenism.¹ The underlying mechanism is complex and includes factors such as insulin resistance, ovarian and hypothalamic dysfunction, and genetic susceptibility.² It is also associated with various metabolic dysfunctions like diabetes type II, atherosclerosis, and girth obesity in the typical case.³ Its prevalence varies from 4 to 20 percent worldwide.⁴ According to one survey, 18% of adolescent girls and 26% of women suffering from PCOS are overweight.⁵

Research showed that women with PCOS exhibit higher adipose tissues, distributed to internal organs,

waist, arms, and abdomen^{6,7} and increased muscle strength attributed to androgenic influences on muscle mass accrual. However, higher testosterone levels negatively impact physical performance and cardiorespiratory fitness.^{8,9} Socioeconomic and demographic factors including age, occupation, and employment characteristics impact hand grip strength (HGS) and skeletal muscle strength. The relevance of various physical factors with lifestyle and health-related behaviors cannot be overlooked.¹⁰

With the increase in the prevalence of PCOS-related physical health issues among young females, there's a gap in understanding the interplay between key physiological indicators such as handgrip strength, body fat percentage, and fitness level within this population and only a little research evidence is available, especially in Pakistan. Therefore, this study

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assesses the association between these parameters and PCOS.

MATERIALS AND METHODS

This comparative cross-sectional study was conducted at Sehat Medical Complex from October 2023 to January 2024. The ethical approval for the study was taken from the Research Ethical Committee (REC) of Sehat Medical Complex (REC-SMC-174-12-2023). A non-probability convenient sampling technique was used to collect the sample of 120 female students studying at the different public and private sector universities of Lahore. The sample size was determined through OpenEpi software using the mean of body fat percentage group 1=39.69 ± 7.72 and group 2=32.45±8.24, 95% CI, 80% power of the study, and 1:1 ratio of sample size in group 2/1 using the given formula:

$$n_1 = (\sigma_1^2 + \sigma_{2/K}^2)(Z_{1-\alpha/2} + Z_{1-\beta})^2 / \Delta^2$$

$$n_2 = (K * \sigma_1^2 + \sigma_2^2)(Z_{1-\alpha/2} + Z_{1-\beta})^2 / \Delta^2$$

The minimum sample was calculated as 20 participants in each group, however, to maintain the accuracy of results 60 participants in each group were selected. The cases were polycystic ovary syndrome patients pre-diagnosed by a gynaecologist and controls were healthy participants. The study objective was clearly explained to the participants and the screening of students was done based on the study's eligibility criteria.

The inclusion criteria were participants aged between 18-30 years¹¹, married or unmarried, and having an irregular menstrual cycle for at least three months.¹² Participants with a history of endocrine disorders such as Cushing's syndrome, uterine disorders¹³, a history of psychiatric disorders¹⁴, and any medications for hypertension, and diabetes¹⁵ were excluded from the study.

The outcome measures were the body fat composition, physical activity, and hand grip strength. Body fat composition was calculated by the skinfold caliper; an anthropometric instrument for the measurement of the chest skinfold plus subcutaneous fat thickness.¹⁶ Physical activity levels were identified using the International Physical Activity Questionnaire (IPAQ), which estimates sedentary behavior and physical activity¹⁷. Hand grip strength was measured using hand-held dynamometers (HHDs) to determine the strength of the hand muscles.¹⁸ The data was collected from the participants using a self-administered

questionnaire. The first part of the questionnaire consisted of demographic details and questions about polycystic ovary syndrome, the second set had measures of fat percentage, HGS, and the IPAQ.

Statistical analysis: The data was entered, coded and analysed on SPSS version 25. Categorical variables were expressed using percentages and frequencies, while mean and SD were calculated for the continuous variables. The independent sample t-test was applied to determine the mean difference in age, height, weight, and handgrip strength among the PCOS and non-PCOS groups. Pearson's Chi-Square analysis was used to find the association between fat percentage, physical activity and study groups. P-value was set at 0.05.

RESULTS

The mean age of participants was 23.40 ± 1.97 years, the height was 160.50 ± 7.83cm, and weight was 58.85 ± 8.33kg. The mean BMI was calculated to be 22.25 ± 2.94 (Kg/m²). The grip strength for the dominant right hand was 8.43 ± 5.15kg and the non-dominant left hand was 5.36 ± 5.09 kg. It was also recorded that the majority around 49 (40.8%) participants had an overfat body percentage and 47 (39.2%) were minimally active in their daily life routine in case of physical activity. All the baseline characteristics of menstrual history and outcome variables of study participants are shown in Table 1.

The menstrual data recorded for PCOS suggested that 52 (51.7%) participants out of 120 had been experiencing irregular menstruation for the past 3 months and 74 (61.7%) had a cycle length of 3 - 5 days. Spotting in between menstrual cycles was reported by 33 (27.5%) participants, while 75 (62.5%) participants were experiencing skin breakouts. Additionally, a significant number of participants, 80 (66.7%) and 67 (55.8%) reported hair loss from the head and recent weight gain, respectively.

Table 2 illustrated the results of the independent t-test. It represented no statistically significant difference in age (p=0.128) and height (p=0.37) in both groups. However, a significant association was observed in weight and handgrip strength (p=0.000), suggesting a substantial impact of polycystic ovary syndrome on hand grip strength. Pearson's Chi-Square analysis showed an association in BMI (p=0.003), and body fat composition (p=0.000). Whereas, no association was observed in physical activity (p=0.646) in PCOS and non-PCOS groups as depicted in Table 3.

Table 1. Descriptive Statistics of menstrual history and outcome variables

Menstrual history	Construct	N (%)
Length of menstrual cycle	3 – 5 days	74 (61.7)
	2 – 7 days	46 (38.3)
Heavy, irregular, or missed periods for the past 3 months	Yes	62 (51.7)
	No	58 (48.3)
Acne or skin breakouts during the last 3 months	Yes	75 (62.5)
	No	45 (37.5)
Spotting in between your menstrual cycles	Yes	33 (27.5)
	No	64 (53.3)
	Sometimes	23 (19.2)
Excessive facial or bodily hair than usual?	Yes	55 (45.8)
	No	65 (54.2)
Hair loss from the head	Yes	80 (66.7)
	No	40 (33.3)
Have you experienced a recent weight gain?	Yes	67 (55.8)
	No	53 (44.2)
	Lean	4 (3.3)
Fat Percentage	Ideal	29 (24.2)
	Average	38 (31.7)
	Overfat	49 (40.8)
	Inactive	43 (35.8)
Physical Activity	Minimally Active	47 (39.2)
	HEPA Active	30 (25.0)

Table 2. comparison of age, eight, weight, and HGS in both groups

Variable	Groups	Mean ± Std.	Mean Difference	t-value	p-value	95% CI of the Difference	
						Lower	Upper
Age	Non-PCOS	23.13 ± 1.99	-0.55	-1.53	0.128	-1.26	0.16
	PCOS	23.68 ± 1.93					
Height (cm)	Non-PCOS	159.86 ± 7.90	-1.28	-0.89	0.372	-4.12	1.55
	PCOS	161.15 ± 7.78					
Weight (Kg)	Non-PCOS	55.03 ± 6.27	-7.63	-5.62	0.000	-10.31	-4.94
	PCOS	62.66 ± 8.42					
BMI (kg/cm2)	Non-PCOS	20.85 ± 2.05	-3.15	-5.50	0.000	-4.25	-2.01
	PCOS	24.00 ± 2.97					
HGS	Right Hand	Non-PCOS	10.11 ± 5.90	3.36	3.76	0.000	1.59
		PCOS	6.75 ± 3.60				
	Left Hand	Non-PCOS	6.98 ± 6.13	3.24	3.66	0.000	1.48
		PCOS	3.74 ± 3.07				

Table 3. Group-wise comparison of fat percentage and physical activity

Variable	Groups		p-value
	Non-PCOS	PCOS	
Fat Percentage	Lean	4 (3.3%)	0 (0.0%)
	Ideal	26 (21.7%)	3 (2.5%)
	Average	24 (20%)	14 (11.7%)
	Overfat	6 (5.0%)	43 (35.8%)
	Inactive	20 (16.7%)	23 (19.2%)
Physical Activity	Minimally Active	26 (21.7%)	21 (17.5%)
	HEPA Active	14 (11.7%)	16 (13.3%)

DISCUSSION

PCOS is amongst the most common hormonal diseases in conceptive age in young females. The results of this study showed that a large proportion of females with PCOS had high body fat composition, low handgrip strength and lower levels of physical activity. Similar findings were observed in the study of Kazemi *et al.* (2023) on the composition and function of the musculoskeletal system in women with and without PCOS. The study's findings of quantitative musculoskeletal traits indicate poorer skeletal muscle mass, physical fitness, and overall health status in individuals with PCOS.¹⁹

BMI was also found high in PCOS females in this study. Likewise, a study by Ferrer *et al.* (2021) with a sample size of 266 through which 117 instances were identified as cases (PCOS) using the Rotterdam criteria²⁰. Anthropometric measurements, including subcutaneous skinfold (SKF) thickness, were conducted following the restricted profile protocol of the international standards for anthropometric evaluation as per the guidelines of the International Society of the Advancement of Kinanthropometry (ISAK). In comparison to the control group, women with PCOS exhibited elevated body mass index and fat mass percentage.

Baiocco *et al.* (2019) carried out observational research to investigate the possible effects of elevated testosterone levels on lean mass, muscular strength, and aerobic ability in individuals with polycystic ovarian syndrome (PCOS) in comparison to those without PCOS²¹. In terms of body mass index (BMI), age range (18–46 years), total body composition, and upper limb fat-free mass, the two groups were carefully chosen to assure comparability. The study's

conclusions showed several intriguing findings. First, after adjusting for lean mass in the arms, the PCOS group showed much stronger handgrips ($p=0.001$). Furthermore, the PCOS group showed an increased aerobic capacity.

A study by Sedighi *et al.* (2015) with 65 women who were diagnosed with Polycystic Ovary Syndrome (PCOS) and 65 healthy women who were between the ages of 18 and 45²². The study used the International Physical Activity Questionnaire, diet questionnaires, and unhealthy behaviours. The results showed that there was a significant correlation between PCOS and low physical activity ($p=0.009$) and inappropriate diet ($p=0.009$), but not between PCOS and unhealthy behaviors.

PCOS is a serious health concern for females that requires attention. Its symptoms vary greatly among individuals, so focusing on a specific aspect, such as body fat composition or handgrip strength, might not provide a comprehensive understanding of PCOS-related factors. Moreover, relying on self-reported data for physical activity or lifestyle factors may introduce bias or social desirability bias, potentially affecting the accuracy of the information collected. Therefore, it is recommended to reproduce the study on different PCOS phenotypes, and other aspects of PCOS-related health factors in females. Moreover, the assessment of symptoms of PCOS, including hormonal profiles and other relevant medical information should be broadened. The study was conducted at different universities in Lahore, which may reduce the generalizability of the findings to a wider population, particularly at different life stages, economic backgrounds, or populations outside of university students.

CONCLUSION

It was concluded that females with polycystic ovary syndrome tend to have a higher percentage of body fat, weaker grip strength and lower levels of physical activity than healthy female students.

DECLARATION

Conflicts of interest: The author declared no conflict of interest.

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Authors' Contribution: **AFK:** Concept & design, drafting of manuscript, final approval **AJ:** Data analysis, interpretation, final approval **IN:** Acquisition of data, critical revision of manuscript, final approval **SK:** Acquisition of data, data analysis, final approval

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