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LIFESTYLE PATTERNS IN ADOLESCENT GIRLS WITH POLYENDOCRINE METABOLIC OVARIAN SYNDROME VERSUS HEALTHY CONTROL

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ABSTRACT

Background: Polyendocrine Metabolic Ovarian Syndrome (PMOS) previously named as Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder associated with reproductive, metabolic and psychological complications. Reduced physical activity and poor sleep may further increase its clinical burden. This study compared physical activity and sleep quality between females with PCOS and healthy controls.
Methods: This comparative cross-sectional study was conducted at the Department of Obstetrics and Gynaecology, Holy Family Hospital, Rawalpindi. Sixty participants were recruited through non-probability consecutive sampling, including 30 participants with PCOS and 30 healthy controls. Anthropometric characteristics were recorded using a structured data-collection form. Physical activity during the preceding seven days was assessed using the International Physical Activity Questionnaire Long Form and expressed as metabolic equivalent of task minutes per week (MET-min/week). Sleep quality during the preceding month was evaluated using the Pittsburgh Sleep Quality Index (PSQI). A global PSQI score greater than 5 indicated poor sleep quality. Between-group comparisons were performed using appropriate statistical tests, with $p \leq 0.05$ considered statistically significant.
Results: Age and height were comparable between the PCOS and control groups. Participants with PCOS had significantly greater median weight than controls [73.2 kg (IQR: 67.7–79.6) versus 61.7 kg (IQR: 55.9–70.3); $p<0.001$] and a higher mean BMI (28.6 ± 4.6 versus 23.9 ± 2.7 kg/m²; $p<0.001$). Mean physical activity was significantly lower in the PCOS group ($1{,}232.7 \pm 699.3$ versus $2{,}121.0 \pm 825.4$ MET-min/week; $p<0.001$). The mean global PSQI score was significantly higher among participants with PCOS (9.7 ± 3.3 versus 5.0 ± 2.1; $p<0.001$). Poor sleep quality was observed in 86.7% of the PCOS group and 46.7% of controls ($p=0.003$).
Conclusion: Participants with PCOS demonstrated higher weight and BMI, lower physical activity and poorer sleep quality than healthy controls. Routine PCOS management should incorporate physical activity promotion, weight-sensitive counselling and sleep assessment.

KEYWORDS: Polyendocrine Metabolic Ovarian Syndrome, Polycystic ovary syndrome; physical activity; sleep quality; PSQI; IPAQ; body mass index.

INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is a common endocrine disorder affecting 5–10% of women of reproductive age worldwide and is characterized by hyperandrogenism, ovulatory dysfunction, and polycystic ovarian morphology.[1, 2] It is associated not only with reproductive complications such as infertility, menstrual irregularities, and hirsutism but also with significant metabolic and psychological concerns, including insulin resistance, obesity, mood disorders, and increased cardiovascular risk.[3, 4] Management of PCOS requires a multifaceted approach addressing hormonal imbalance, lifestyle modification, and long-term risk factors.[5, 6] Among modifiable factors, eating habits, physical activity, and sleep quality have emerged as important non-pharmacologic dimensions that can influence both symptom control and quality of life in PCOS patients.[7, 8]

Several studies have assessed individual lifestyle factors in PCOS, yielding diverse results. Sedighi et al. compared physical activity levels using MET scores and found significantly lower activity in PCOS women (809.85 ± 629.19) compared to healthy controls (1916.8 ± 1708.88), with a p-value <0.001, indicating reduced engagement in physical exertion among PCOS patients.[9] In contrast, Chouhan et al. assessed sleep quality using the Pittsburgh Sleep Quality Index (PSQI) and found PCOS patients had a higher (worse) global score (7.97 ± 3.61) compared to controls (5.42 ± 2.73), suggesting a greater burden of poor sleep.[10] These findings reflect a growing concern about the interplay of lifestyle factors in PCOS, especially when compared systematically with healthy counterparts.

The rationale of the current study is to systematically evaluate and compare physical activity and sleep quality between adolescent girls diagnosed with PCOS and healthy controls. Despite the recognition of lifestyle factors in PCOS management, there is limited local data that explores both sleep and physical activity concurrently. Given that both factors independently affect hormonal regulation, weight, mood, and overall reproductive health, identifying distinct patterns among PCOS patients can inform preventive strategies and targeted interventions. The findings of this study aim to support clinicians in tailoring lifestyle counseling and may influence the development of structured non-pharmacological management plans for PCOS in resource-constrained settings.

METHODOLOGY

This comparative cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, Holy Family Hospital, Rawalpindi, from 15 November, 2025 to 15 May, 2026 following approval of the synopsis. The calculated sample size was 60 participants, comprising 30 females with polycystic ovary syndrome (PCOS) and 30 healthy controls. The sample size was calculated at a 5% level of significance and 80% statistical power, based on mean physical activity scores of 809.85 ± 629.19 MET-minutes/week among females with PCOS and 1,916.8 ± 1,708.88 MET-minutes/week among healthy controls (Annexure C). Participants were recruited using a non-probability consecutive sampling technique. Female first- and second-year medical students at Rawalpindi Medical University aged 18–25 years were eligible to participate. The case group included students diagnosed with PCOS according to the study's operational definition. The control group comprised apparently healthy females who reported regular menstrual cycles and had no known chronic medical or hormonal conditions, as determined from their clinical history. Participants were excluded if they were pregnant or breastfeeding; were taking hormonal medications, sleep aids or medications affecting metabolism; had a diagnosed psychiatric illness, endocrine disorder or any other condition that could influence physical activity or sleep; or had participated in a weight-loss, dietary or structured exercise programme during the preceding three months.

Data were collected using a structured data-collection form designed to record participants' demographic characteristics, anthropometric measurements, study-group classification, physical activity and sleep quality. Before enrolment, potential participants were screened against the predefined eligibility criteria. Eligible participants were approached in a private setting, informed about the objectives and procedures of the study, and given an opportunity to ask questions. Written informed consent was obtained before data collection. Each participant was assigned a unique serial number and classified as either a PCOS case or a healthy control. Classification was confirmed according to the study's operational definitions and was not based solely on self-reported symptoms. The date of assessment, age in completed years, study-group classification, height, weight and body mass index (BMI) were recorded.

Height was measured in centimetres using a calibrated stadiometer, with participants standing upright without shoes and with their heads positioned in the Frankfort horizontal plane. Weight was measured in kilograms using a calibrated digital weighing scale while participants wore light clothing and no shoes. BMI was calculated by dividing weight in kilograms by the square of height in metres and was expressed as kg/m^2.

Physical activity undertaken during the preceding seven days was assessed using the International Physical Activity Questionnaire Long Form (IPAQ-LF). This 27-item questionnaire assessed activity across work, transportation, domestic and household tasks, recreation and leisure, as well as time spent sitting. The same questionnaire-administration procedure was followed for all participants. Before completing the questionnaire, participants were instructed to report only activities performed for at least 10 continuous minutes. Vigorous activity was explained as activity requiring substantial physical effort and causing much heavier breathing than usual, whereas moderate activity was defined as activity requiring moderate effort and causing somewhat heavier breathing than usual. Walking was recorded separately.

For each activity, participants reported the number of days on which it had been performed and the usual number of hours or minutes spent undertaking it on one of those days. Work-related activity included vigorous activity, moderate activity and walking performed as part of paid or unpaid work. Transportation questions assessed travel by motor vehicle, bicycle and walking. Domestic activity included vigorous or moderate activity performed in the home, garden or yard. Leisure-time activity included walking and moderate or vigorous exercise undertaken specifically for recreation, sport or fitness. Participants also reported their usual sitting time on a weekday and a weekend day.

Reported hours were converted into minutes, and weekly activity duration was calculated by multiplying minutes per day by days per week. MET-minutes per week were calculated by multiplying weekly activity duration by the relevant MET coefficient specified in the IPAQ scoring protocol. Total MET-minutes per week were obtained by summing walking, moderate and vigorous activity scores across the relevant domains. Participants were subsequently classified into low, moderate or high physical activity categories according to the selected IPAQ scoring criteria.

Sleep quality during the preceding month was assessed using the Pittsburgh Sleep Quality Index (PSQI). The instrument evaluated subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction. Each component was scored from 0 to 3, with higher scores indicating greater sleep difficulty. The seven component scores were summed to generate a global PSQI score ranging from 0 to 21. A global score greater than 5 was classified as poor sleep quality, whereas a score of 5 or below

was classified as good sleep quality. Bed-partner observations were recorded where applicable but did not contribute to the global score.
Completed questionnaires were reviewed immediately for missing, inconsistent or implausible responses. Activity days were restricted to zero to seven, and reported durations were verified when unusually high. Data were entered into a password-protected database using participant serial numbers. Predefined coding rules, range checks and standardised scoring procedures were applied, and selected electronic records were compared with the original forms to minimise data-entry errors.

Statistical Data Analysis
All data were entered and analysed using IBM SPSS Statistics, version 24.0. Numerical variables, including age, body mass index (BMI), total physical activity expressed as metabolic equivalent of task minutes per week (MET-min/week), and global Pittsburgh Sleep Quality Index (PSQI) scores, were summarised using means and standard deviations. The normality of numerical variables was assessed before inferential analysis. An independent-samples t-test was applied to compare mean age, BMI, total MET-min/week and global PSQI scores between the PCOS and control groups. A two-sided p-value of ≤0.05 was considered statistically significant. The data were stratified according to age and BMI, and post-stratification analyses were performed to assess their potential effects on the associations between PCOS status, physical activity and sleep quality.

RESULTS
A total of 60 participants were included in the analysis, comprising 30 participants with polycystic ovary syndrome (PCOS) and 30 healthy controls. The overall mean age of the participants was 28.0 ± 5.0 years, while the mean height was 162.2 ± 5.2 cm. The mean body mass index (BMI) was 26.3 ± 4.4 kg/m². As weight was not normally distributed, it was summarised using the median and interquartile range; the overall median weight was 68.4 kg (IQR: 59.8–74.2 kg). The mean physical activity level was 1,676.8 ± 880.9 MET-min/week. Most participants had a moderate level of physical activity (85.0%), whereas 10.0% had a low level and 5.0% had a high level of physical activity. The overall mean global Pittsburgh Sleep Quality Index (PSQI) score was 7.4 ± 3.6. Based on the PSQI classification, 20 participants (33.3%) had good sleep quality, while 40 (66.7%) had poor sleep quality (Table 1).

Table 1. Overall descriptive characteristics of study participants (N=60)

Variable	Category / unit	Overall result
Study group	PCOS	30 (50.0%)
	Control	30 (50.0%)
Age	years	28.0 ± 5.0
Height	cm	162.2 ± 5.2
Weight	kg	68.4 (59.8–74.2)
BMI	kg/m²	26.3 ± 4.4
Physical activity	MET-min/week	1,676.8 ± 880.9
Physical activity category	Low	6 (10.0%)
	Moderate	51 (85.0%)
	High	3 (5.0%)
Global PSQI score	0–21	7.4 ± 3.6
Sleep quality	Good (PSQI ≤5)	20 (33.3%)
	Poor (PSQI >5)	40 (66.7%)

The PCOS and control groups were comparable in terms of age and height. The mean age was 28.1 ± 5.4 years in the PCOS group and 27.9 ± 4.5 years in the control group, with no statistically significant difference between the groups (p = 0.898). Similarly, the mean height was 162.3 ± 5.7 cm among participants with PCOS and 162.2 ± 4.8 cm among controls (p = 0.928). These findings indicated that there were no significant baseline differences between the groups with respect to age or height. Participants with PCOS had significantly greater body weight and BMI than healthy controls. The median weight was 73.2 kg (IQR: 67.7–79.6 kg) in the PCOS group, compared with 61.7 kg (IQR: 55.9–70.3 kg) in the control group (p < 0.001). Similarly, the mean BMI was significantly higher among participants with PCOS than among controls (28.6 ± 4.6 versus 23.9 ± 2.7 kg/m²; p < 0.001). Mean physical activity was significantly lower in the PCOS group than in the control group (1,232.7 ± 699.3 versus 2,121.0 ± 825.4 MET-min/week; p < 0.001). The distribution of physical activity categories also differed significantly between the groups (p = 0.006). Low physical activity was observed in six participants with PCOS (20.0%) but in none of the controls. Moderate physical activity was reported by 24 participants with PCOS (80.0%) and 27 controls (90.0%). None of the participants with PCOS had a high level of physical activity, compared with three participants (10.0%) in the control group (Table 2).

Sleep quality was also significantly poorer among participants with PCOS. The mean global PSQI score was significantly higher in the PCOS group than in the control group (9.7 ± 3.3 versus 5.0 ± 2.1; $p < 0.001$), indicating greater sleep-related difficulties among participants with PCOS. Only four participants with PCOS (13.3%) had good sleep quality, compared with 16 controls (53.3%). Conversely, poor sleep quality was observed in 26 participants with PCOS (86.7%) and 14 controls (46.7%). The distribution of sleep-quality classifications differed significantly between the groups ($p = 0.003$) (Table 2).

Table 2. Comparison of PCOS cases and controls.

Variable	PCOS (n=30)	Control (n=30)	p-value
Age (years)	28.1 ± 5.4	27.9 ± 4.5	0.898*
Height (cm)	162.3 ± 5.7	162.2 ± 4.8	0.928*
Weight (kg)	73.2 (67.7–79.6)	61.7 (55.9–70.3)	<0.001**
BMI (kg/m²)	28.6 ± 4.6	23.9 ± 2.7	<0.001*
Physical activity (MET-min/week)	1,232.7 ± 699.3	2,121.0 ± 825.4	<0.001*
Global PSQI score	9.7 ± 3.3	5.0 ± 2.1	<0.001*
Physical activity category: Low	6 (20.0%)	0 (0.0%)	0.006***
Physical activity category: Moderate	24 (80.0%)	27 (90.0%)	
Physical activity category: High	0 (0.0%)	3 (10.0%)	
Sleep quality: Good	4 (13.3%)	16 (53.3%)	0.003^{+}
Sleep quality: Poor	26 (86.7%)	14 (46.7%)	

* Welch t-test, ** Mann–Whitney U, *** Fisher–Freeman–Halton exact, +Pearson chi-square

As presented in Figure 1, participants with PCOS generally demonstrated less favourable physical activity and sleep-quality profiles than healthy controls. Low physical activity was confined to the PCOS group, whereas high physical activity was observed only among controls. Furthermore, poor sleep quality was substantially more common among participants with PCOS. Overall, the findings demonstrated statistically significant differences in weight, BMI, physical activity and sleep quality between the PCOS and control groups, whereas age and height did not differ significantly.

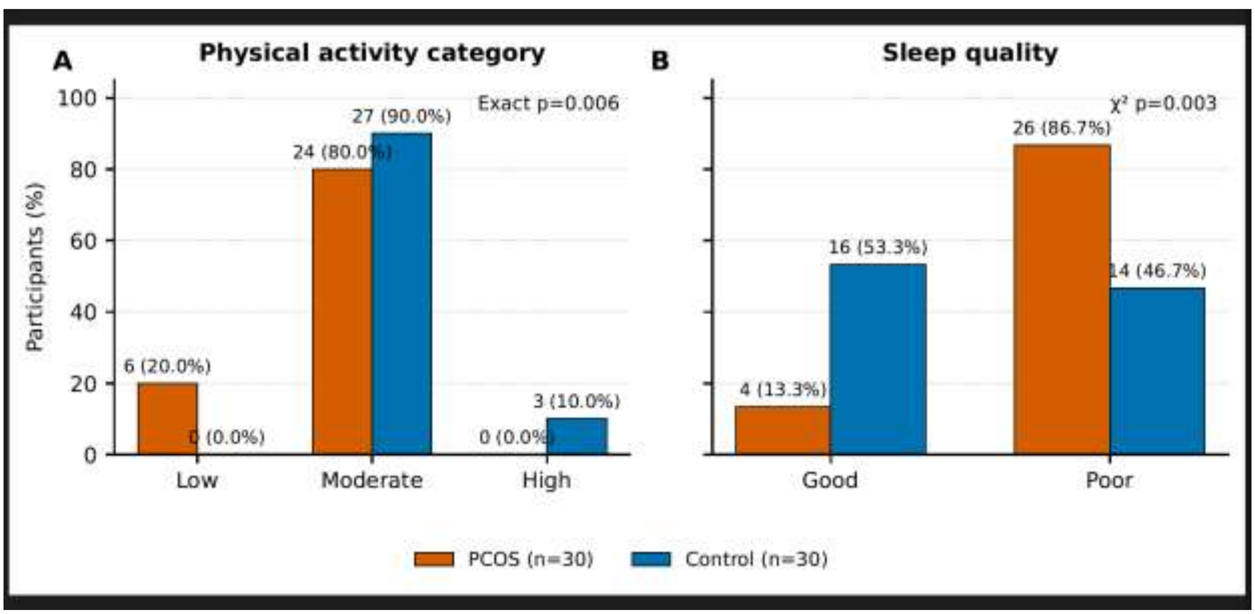

Figure 1. Comparison of physical activity levels and sleep quality between participants with polycystic ovary syndrome and healthy controls.

DISCUSSION

The present study compared anthropometric characteristics, physical activity and sleep quality between participants with polycystic ovary syndrome (PCOS) and healthy controls. The principal findings were that participants with PCOS had significantly greater weight and BMI, lower physical activity and poorer sleep quality than controls. Age and height were comparable between the groups, reducing the likelihood that these variables explained the observed differences. Overall, the results suggested that PCOS was associated with a less favourable lifestyle and anthropometric profile, although the cross-sectional design did not permit conclusions regarding causality.

Participants with PCOS had a significantly higher median weight than controls (73.2 versus 61.7 kg; p<0.001), while their mean BMI was also significantly higher (28.6 versus 23.9 kg/m²; p<0.001). These findings were consistent with the established association between PCOS and increased adiposity. Lim et al. reported in a systematic review and meta-analysis that women with PCOS had a greater prevalence of overweight, general obesity and central obesity than women without PCOS, although the magnitude of the association varied according to ethnicity and geographical location.[11] The current BMI difference may therefore represent an important metabolic feature of PCOS rather than merely a demographic difference between the groups.

Several biological mechanisms may explain the association between PCOS and increased body weight. Insulin resistance and compensatory hyperinsulinaemia can promote adipose-tissue accumulation and may stimulate ovarian androgen production. Higher androgen levels may, in turn, contribute to abdominal adiposity and further deterioration in insulin sensitivity. This relationship may create a cycle in which PCOS-related metabolic disturbances promote weight gain, while increased adiposity aggravates the hormonal and metabolic manifestations of PCOS. Nevertheless, the direction of this relationship could not be established in the present study because exposure and outcome variables were assessed at the same time.

The mean physical activity level was significantly lower among participants with PCOS than among healthy controls (1,232.7 versus 2,121.0 MET-min/week; p<0.001). This difference was supported by the categorical analysis. Low physical activity was observed in 20.0% of participants with PCOS but in none of the controls, while high physical activity was reported only among controls. Sedighi et al. similarly found substantially lower physical activity among women with PCOS than healthy women, with mean activity scores of 809.85 ± 629.19 and 1,916.8 ± 1,708.88 MET-min/week, respectively.[12] Although the mean activity level in the present PCOS group was higher than that reported by Sedighi et al., the direction and statistical significance of the between-group difference were comparable.

The current findings were also consistent with evidence from Pakistan. Butt et al. conducted a case–control study among women of reproductive age in Lahore and reported differences in physical activity and dietary behaviour between women with PCOS and age-matched controls.[13] The similarity between these findings and those of the present study may partly reflect shared social, cultural and environmental factors affecting women's participation in recreational exercise, access to suitable facilities and time available for structured physical activity.

However, the published evidence regarding habitual physical activity in PCOS has not been entirely consistent. Tay et al., in an Australian population-based study, examined physical activity and sedentary behaviour among women with and without PCOS and identified variations in adherence to physical activity recommendations.[14] By contrast, Lin et al. reported broadly comparable dietary and physical activity behaviours between women with and without PCOS.[15] Such differences may arise from variations in study populations, diagnostic criteria, socioeconomic conditions and physical activity instruments. Self-reported physical activity is also vulnerable to recall error and social-desirability bias. Furthermore, total MET-min/week may obscure differences in activity intensity, duration, occupational activity and sedentary time.

Lower activity among participants with PCOS could also be related to their higher weight, fatigue, poor sleep, psychological distress or dissatisfaction with body image. The relationship is likely to be bidirectional: PCOS-related symptoms may discourage physical activity, while insufficient activity may contribute to weight gain, insulin resistance and worsening metabolic health. Evidence indicates that habitual activity is associated with more favourable anthropometric and androgenic profiles among women with PCOS.[16] Consequently, reduced activity may have clinical relevance beyond energy expenditure alone.

Sleep quality represented another important difference between the groups. The mean global PSQI score was significantly higher in participants with PCOS than in controls (9.7 versus 5.0; p<0.001). As higher PSQI scores indicate poorer sleep, this difference suggested a substantially greater burden of sleep disturbance among participants with PCOS. Poor sleep quality was present in 86.7% of the PCOS group compared with 46.7% of controls, and the distribution differed significantly between the groups (p=0.003).

These findings were consistent with those of Chouhan et al., who reported a higher global PSQI score among patients with PCOS than controls (7.97 ± 3.61 versus 5.42 ± 2.73).[17] The mean PSQI score observed in the present PCOS group was higher than that reported by Chouhan et al., suggesting a potentially greater degree of sleep difficulty. Differences in age, BMI, disease severity, psychological health, academic demands and social circumstances may account for the variation between studies.

The sleep findings were also supported by broader evidence. Zhang et al. included 18 studies and 16,152 participants in a systematic review and meta-analysis. Women with PCOS had greater odds of sleep disturbance, higher PSQI scores and a shorter mean sleep duration than women without PCOS.[18] The pooled mean difference in PSQI score was 2.10 points, whereas the difference in the present study was 4.7 points. Although direct comparison should be made cautiously because of differences in sampling and study design, the current results indicated a particularly marked difference in perceived sleep quality.

Fernandez et al. also concluded that sleep disturbances, excessive daytime sleepiness and obstructive sleep apnoea occurred more frequently among women with PCOS.[19] Importantly, their review indicated that higher BMI explained only part of the relationship, as sleep difficulties were also reported among women with PCOS who had a normal body weight. Therefore, the poorer sleep observed in the present PCOS group should not automatically be attributed solely to greater weight.

Potential mechanisms linking PCOS with poor sleep include hyperandrogenism, insulin resistance, obesity, altered cortisol or melatonin secretion, menstrual disturbances and psychological conditions such as anxiety and depression. Sleep disturbance may subsequently worsen insulin sensitivity, appetite regulation and emotional well-being, thereby aggravating PCOS symptoms. Benham et al. reported a high prevalence of poor self-reported sleep among women with PCOS and examined its relationship with exercise and cardiometabolic health.[20] These findings support the possibility that physical activity, sleep and metabolic health interact rather than operating as independent factors.

The coexistence of lower physical activity, higher BMI and poorer sleep in the present PCOS group may be clinically important. Poor sleep can reduce daytime energy and motivation to exercise, while physical inactivity and increased adiposity can adversely affect sleep quality. These interrelated factors may reinforce one another and contribute to a cycle of worsening metabolic and psychological health. However, the present analysis did not adjust physical activity or sleep outcomes for BMI. It therefore remained uncertain whether PCOS was independently associated with these outcomes or whether part of the observed difference was explained by greater adiposity.

The findings supported the inclusion of physical activity and sleep assessment in routine PCOS care. Lifestyle and weight management are recognised as first-line components of PCOS management, and their benefits extend beyond weight reduction to cardiometabolic health and quality of life.[21] The 2023 International Evidence-based Guideline recommends encouraging physical activity in all women with PCOS and recognises the importance of identifying sleep-related symptoms, particularly those suggestive of obstructive sleep apnoea.[22] Healthcare professionals should therefore consider assessing activity patterns, sedentary behaviour, sleep quality and barriers to behaviour change when counselling patients with PCOS.

The study had several limitations. First, the relatively small sample of 60 participants reduced statistical precision and limited the ability to undertake adjusted or subgroup analyses. Secondly, non-probability consecutive sampling may have introduced selection bias and restricted the generalisability of the results. Thirdly, physical activity and sleep quality were assessed using self-reported questionnaires, which were subject to recall and reporting biases. Fourthly, the cross-sectional design prevented determination of whether low activity and poor sleep preceded PCOS or developed as consequences of its symptoms. Potential confounders, including socioeconomic status, diet, depression, anxiety, academic workload, screen time, caffeine intake, PCOS severity and obstructive sleep apnoea, were not examined. Finally, the higher BMI in the PCOS group may have partially confounded the relationships between PCOS, physical activity and sleep quality.

Despite these limitations, the study provided locally relevant evidence by assessing physical activity and sleep quality concurrently in participants with PCOS and controls. The use of validated instruments and an age- and height-comparable control group strengthened the findings. Future studies should include larger, randomly selected samples and use multivariable regression to adjust for BMI and other potential confounders. Objective measures, such as accelerometry for physical activity and actigraphy or polysomnography for sleep, would improve measurement accuracy. Longitudinal and interventional studies are also needed to determine whether improvements in physical activity and sleep produce meaningful changes in BMI, insulin resistance, menstrual regularity and quality of life.

CONCLUSION

In conclusion, participants with PCOS had significantly greater weight and BMI, lower physical activity and poorer sleep quality than healthy controls. The results were generally consistent with published evidence and highlighted the combined lifestyle and metabolic burden associated with PCOS. Integrating physical activity promotion, weight-sensitive counselling and sleep assessment into routine management may support a more comprehensive and patient-centred approach to PCOS care.

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