Original Article

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Physiotherapy Section

Association of Physical Activity with Sleep and Health-related Quality of Life in Patients with Polycystic Ovarian Syndrome: A Cross-sectional Study

JINCY SAMUEL[1], GC SWASTIKA[2], ASHARA MAHARJAN[3], SHREYA RAJU NIDAVANI[4]

ABSTRACT

Introduction: Polycystic Ovarian Syndrome (PCOS), a condition prevalent among women in their childbearing age has been seen to impact sleep, Health-related Quality of Life (HrQoL) and Level of Physical Activity (LPA). However, not enough studies shown that how being physically active affects sleep and HrQoL in PCOS. Finding an association of physical activity with sleep and HrQoL in PCOS may be beneficial in including physical activity to improve sleep and HrQoL in PCOS.

Aim: To explore an association of the LPA with sleep and to further explore an association between LPA and HrQoL in PCOS.

Materials and Methods: This cross-sectional study was carried out at Department of Physiotherapy, Krupanidhi College of Physiotherapy, Bengaluru, Karnataka, India, from March 2023 to March 2024 on 270 women with PCOS in accordance to the Rotterdam criteria and aged between 18-24 years. The recruited subjects were evaluated for LPA, sleep quality and HrQoL using self-reported scales that were the International Physical Activity Questionnaire (IPAQ) scale, Pittsburg's sleep quality scale and the Short Form Health Survey questionnaire (SF-36) scale respectively followed by statistically analysing the data using descriptive analysis, Kruskal Wallis test and Chi-square test. A p-value of less than 0.05 was considered as statistically significant.

Results: The mean age of the subjects was 21.82±1.65 years. Level of being physically active was associated with all the domains of SF-36 ($p<0.01$) other than role limitation due to emotion ($p=0.177$) and domain of emotional well-being ($p=0.142$) where the association was non significant. Sleep quality was also associated with the LPA ($p\leq0.001$).

Conclusion: The LPA does have an association with sleep quality as well as with the physical domains of HrQoL. Thus, the level of being physically active is a determining aspect in the quality of sleep and HrQoL in PCOS. Including education and awareness on the importance of having the right LPA thereby may have an impact on sleep and HrQoL in PCOS.

Keywords: Exercise, Insomnia, Lifestyle, Life quality, Oligomenorrhoea

INTRODUCTION

The PCOS is a condition widespread in women who are of childbearing age. PCOS can be diagnosed using the Rotterdam criteria. According to the Rotterdam criteria, a woman to be diagnosed as having PCOS should present with at least two of the listed three features: 1) ovulatory dysfunction characterised by menstrual cycles varying from 35 days to less than six months or an absence of menstruation for six to twelve months once the cyclic pattern is set; 2) clinical and/or biochemical signs of hyperandrogenism; or 3) polycystic ovaries described as the ovary containing 12 or more follicles measuring 2 to 9 mm in diameter or an ovary that has a volume of greater than 10 mL on ultrasonography [1].

The global prevalence of PCOS for women in their reproductive age is 8%-21% with a peak prevalence seen between 20-24 years of age [2]. The range varies based on the geographical locations, ethnicity and races. Wolf WM et al., in their review study on geographical prevalence of PCOS observed a prevalence of 6% to 6.5% in Asians and Hispanics, 8% among African American women whereas indigenous Australian presenting a prevalence of as high as 26% [3]. Within Asia, South Asian countries demonstrated higher prevalences with India having a high incidence of PCOS [4]. The variability in prevalence among the ethnicities could be attributed to genetic predisposition, Body Mass Index (BMI) and lifestyle changes [5]. The pathophysiology of PCOS is primarily concerned with hormonal imbalance, chronic low-grade inflammation, insulin resistance and hyperandrogenism further influenced by environmental pollutants, diet and lifestyle choices, genetic factors, obesity and gut dysbacteriosis [6]. Owing to its complex etiology and pathophysiology, the treatment focus in PCOS is often customised based on the patients' clinical features. Numerous pharmacological interventions are used to address the distinguished symptoms of PCOS such as irregular menstrual cycle, androgen related symptoms and infertility causing anovulation and the co-morbidities linked to PCOS. These include oral contraceptives, anti-androgens, insulin sensitisers, ovulation inducers, calcium and Vitamin-D supplements. Recent interventions also use Statins, Incretin hormones, micro-Ribonucleic Acid (RNA) therapy, Interleukin-22 therapy and drugs to restore gut microbiome [7]. Pharmacological interventions when combined with lifestyle changes such as dietary modification, exercises and behavioral changes can benefit the patient significantly [7,8]. Literature indicates strong link of obesity and PCOS with approximately 50% of women with PCOS being either overweight or obese. Obesity augments the risk of metabolic and cardiovascular abnormalities [9]. Insulin resistance is a crucial reason for obesity seen in PCOS. Physical inactivity, insulin resistance and obesity are components of a vicious cycle in PCOS [10]. Including exercises specifically vigorous intensity aerobic exercises for 150 min/week combined with resisted exercise improve outcomes in PCOS such as body composition, insulin sensitivity, free androgen index, cardiorespiratory fitness and risk of anxiety and depression [10].

Sleep disturbances in PCOS are generally characterised as insufficient sleep, insomnia, obstructive sleep apnea and excessive

day time sleepiness [11,12]. HrQoL addressing how a person's well-being is affected by a disability or disorder is negatively impacted in PCOS due to factors such as obesity, hirsutism and infertility [13]. Depression, stress and a low self-esteem are also contributing factors to a reduced HrQoL in PCOS [13,14]. A systematic review and meta-analysis on prevalence of depressive and anxiety symptoms in PCOS has shown that women suffering from PCOS had over five times the odds of anxiety when compared to the control and over three times the odds of depression than the controls [15].

It is becoming evident that sleep and HrQoL are affected in women with PCOS. Physical inactivity is found to be existing among patients with PCOS [9]. However, to the authors knowledge, not enough studies show that the LPA affects sleep and HrQoL in PCOS [16]. Finding an association of the LPA with sleep and HrQoL will be beneficial in educating the patient about the right dose of physical activity (in terms of low, moderate or vigorous intensity) to enhance sleep and HrQoL in PCOS.

The main aim of the study was to identify the association of LPA with sleep and with HrQoL in PCOS. The objectives of the study were:

- Assess LPA in PCOS using IPAQ-SF questionnaire.
- Assess sleep quality in PCOS using Pittsburg's Sleep Quality index.
- Assess HrQoL using SF-36 questionnaire in PCOS.
- Examine the association of LPA with sleep in PCOS.
- Explore the association of LPA with HrQoL in PCOS.

MATERIALS AND METHODS

This cross-sectional study was conducted from March 2023 to March 2024 at Department of Physiotherapy, Krupanidhi College of Physiotherapy, Bengaluru, Karnataka, India. The Institutional ethical clearance was taken for the study with the ethical clearance number PT/UG/ETH-2023/005 and subjects were recruited based on the selection criteria. The study was done in accordance with the 1964 Helsinki Declaration of Ethical Consideration. An informed consent was obtained after explaining about the study's purpose and procedure to the subjects on 270 women having PCOS.

Inclusion criteria: Women having PCOS in accordance to Rotterdam's criteria, aged between 18-24 years were included in the study [1,2].

Exclusion criteria: Subjects with previous history of pregnancy, childbirth and gynaecological conditions like fibroids, endometriosis and hypothyroidism were excluded from the study.

Sample size calculation: The sample size was calculated using the G*Power 3.1.9.4 statistical software. The alpha value was set at 0.05 with a power value of 0.8 for the linear bivariate regression model with one group analysis [17,18]. The samples were recruited using snow ball sampling technique.

Study Procedure

The questionnaires for physical activity, quality of sleep and HrQoL were individually explained to the subjects. The questionnaires were filled in front of the investigators.

Scales and questionnaire used:

- **International Physical Activity questionnaire-Short Form (IPAQ-SF):** This questionnaire was used for evaluating LPA in PCOS [19,20].

It is a valid and reliable tool to understand how active a person is physically and categorises the activity level as low, moderate and high LPA [19,20]. In the current study, the authors have attempted to establish which category of physical activity showed an association with sleep and HrQoL.

- **Pittsburgh Sleep Quality Index (PSQI):** PSQI evaluates sleep and shows the differences in 'poor' and 'good' sleep by assessing seven component scores over the last month. The total of the scores for all the seven components gives one global score. A score of five or less than five is categorised as good sleep whereas six and above denoted poor sleep [21]. This questionnaire was adopted for the current study as it covered a majority of sleep disturbances relevant to PCOS such as insomnia, obstructive sleep apnea and excessive daytime sleepiness [12].
- **SF-36 questionnaire:** The SF-36 questionnaire, a reliable measure of HrQoL is a common questionnaire often used to assess HrQoL in PCOS [14,22]. The questionnaire has 36 questions scored to assess eight main domains of quality of life. A score of below 50 in the domains of SF-36 is considered as poor wherein a score of higher than 50 is considered as a better HrQoL. The higher the score better is the HrQoL. The SF-36 was taken as the outcome measure in the present study as it assesses the effect on quality of life due to factors such as limitation in physical and social activity due to physical or emotional problems, fatigue, pain, general mental health etc. These factors are often an existing issue in PCOS.

STATISTICAL ANALYSIS

The descriptive statistics were calculated for all parameters. In order to compare the difference between LPA and the individual components of HrQoL, the Kruskal-Wallis test was applied. Chi-square analysis was performed to find the association between LPA and sleep quality and the results based on the tests were provided.

RESULTS

The descriptive statistics of age, SF-36 domains and PSQI and infers that the mean age was 21.82±1.65 is represented in [Table/Fig-1]. In the sample of 270 subjects, the mean for HrQoL component of Emotional Functioning (EF), General Health (GH), and Health Change (HC) were less than 50 implying a poor score or poor HrQoL in these domains. Physical Health (PH), Role Physical (RP), Role Emotional (RE), Emotional Well-being (EWB), and Social Functioning (SF) domains of HrQoL however were higher than 50 implying a better HrQoL in these domains. The average SF-36 was 53.73±14.63 signifying only a slight better overall HrQoL. However, none was the domains had a very high mean to signify excellent HrQoL. The PSQI score measuring the sleep quality had a mean score of 8.95±4.23 implying poor quality of sleep.

Variables	Mean±SD	Std. Err	N
Age (in years)	21.82±1.65	0.10	270
PSQI	8.95±4.23	0.26	270
PH	66.83±15.31	0.93	270
RP	53.15±28.95	1.76	270
RE	56.77±30.96	1.88	270
EF	41.98±17.99	1.10	270
EWB	51.56±9.68	0.59	270
Pain	67.82±14.51	0.88	270
GH	49.26±16.81	1.02	270
HC	40.03±29.60	1.80	270
SF	57.01±21.41	1.30	270
Average SF36	53.73±14.63	0.89	270

[Table/Fig-1]: Descriptive statistics of age, SF-36 components and PSQI.
*PSQI: Pittsburg sleep quality index; PH: Physical functioning; RP: Role limitation due to physical heath; RE: Role limitation due to emotional problem, EF: Energy/Fatigue; EWB: Emotional well-being; GH: General health; HC: Health change; SF: Social functioning

The median of the PH in the three groups of IPAQ from the Kruskal Wallis test and the association between LPA and the physical functioning domain of HrQoL is presented in [Table/Fig-2]. Significant association is observed between the both as inferred from the table with a p-value of 0.002. Physical functioning was highest in high physical activity category followed by moderate and low.

High	Moderate	Low		
70	60	55		
Chi-square	Value	DF 1	DF 2	p-value
	12.6	2		0.002
	Significant			'p'<0.01
F	6.579 (significant)	2	266	0.002

[Table/Fig-2]: Association between IPAQ and physical functioning.
†PH: Physical functioning; IPAQ: International physical activity questionnaire

From [Table/Fig-3], it is inferred that the RP median values were significantly different and was highest in high LPA category followed by moderate and low suggesting a significant association between LPA and role limitation due to physical function with a p-value of 0.002. HrQoL under the domain of role limitation due to physical function was better for the high LPA when compared to moderate and low LPA.

RP in three groups of IPAQ				
High	Moderate		Low	
60	50		35	
Chi-square	Value	DF 1	DF 2	p-value
	12.6	2	-	0.002
	Significant			'p'<0.01
F	6.543	2	266	0.002

[Table/Fig-3]: Association between IPAQ and RP.
§RP: Role limitation due to physical heath; IPAQ: International physical activity questionnaire

The median of RE in the three groups of IPAQ as shown in [Table/Fig-4]. No significant association is reflected between the LPA and role of limitation due to emotional function; the p-value being 0.177.

RE in three groups of IPAQ				
High	Moderate		Low	
60	33.3		35	
Chi-square	Value	DF 1	DF 2	p-value
	3.465	2	-	0.177
	Not significant			'p'>0.05
F	1.742	2	266	0.177

[Table/Fig-4]: Association between IPAQ and RE.
‡RE: Role limitation due to emotional problem; IPAQ: International physical activity questionnaire

In [Table/Fig-5], LPA is found to have a significant association with the health-related QoL under domain of energy/fatigue (p-value=0.000, 'p'<0.01) with the EF median highest in high LPA followed by moderate and low.

EF in three groups of IPAQ				
High	Moderate		Low	
45	30		20	
Chi-square	Value	DF 1	DF 2	p-value
	50.379	2	-	<0.001
	Significant			'p'<0.01
F	30.764	2	266	<0.001

[Table/Fig-5]: Association between IPAQ and EF.
EF: Energy/fatigue

The median of EWB to be highest in high LPA however it is the same for moderate and low LPA as shown in [Table/Fig-6]. Association between LPA and HrQol under the emotional well-being domain was not significant (p=0.142).

The median of HrQoL under pain domain to be highest in high LPA category followed by moderate and low category as shown in [Table/Fig-7]. A significant association was observed between LPA and HrQoL under pain domain. The Chi-square value 10.429 is significant (p=0.005).

EWB in three groups of IPAQ				
High	Moderate		Low	
51	48		48	
Chi-square	Value	DF 1	DF 2	p-value
	3.218	2	-	0.142
	Not significant			'p'>0.05
F	1.659	2	266	0.187

[Table/Fig-6]: Association between IPAQ and EWB.
**EWB: Emotional well being

PAIN in three groups of IPAQ				
High	Moderate		Low	
67.5	58		56.5	
Chi-square	Value	DF 1	DF 2	p-value
	10.429	2	-	0.005
	Significant			
F	5.385	2	266	0.005

[Table/Fig-7]: Association between IPAQ and pain.

The median of HrQoL under general health domain to be highest in high LPA category followed by moderate and low category as shown in [Table/Fig-8]. The median values were significantly different. There was a significant association of LPA and HrQoL under the general health domain with the Chi-square value of 16.952 (p<0.001, 'p'<0.01).

GH in three groups of IPAQ				
High	Moderate		Low	
55	45		40	
Chi-square	Value	DF 1	DF 2	p-value
	16.952	2	-	<0.001 'p'<0.01
	Significant			
F	8.979	2	266	<0.001 'p'<0.01

[Table/Fig-8]: Association between IPAQ and GH.
††GH: General health

The median of HrQoL under general health domain to be highest in high LPA followed by moderate and lowest in low LPA category as reflected in [Table/Fig-9]. The median values were significantly different. Significant association existed between LPA and HrQoL under the social functioning domain. The Chi-square value 16.942 was significant (p=0.000, 'p'<0.01).

SF in three groups of IPAQ				
High	Moderate		Low	
62.5	55		25	
Chi-square	Value	DF 1	DF 2	p-value
	16.942	2	-	<0.001 'p'<0.01
	Significant			
F	8.973	2	266	<0.001 'p'<0.01

[Table/Fig-9]: Association between IPAQ and SF.
‡‡SF: Social functioning

In [Table/Fig-10], LPA is found to have a significant association with the HrQoL under domain of perception of health change (p-value=0.000) with the HC median highest in high LPA category followed by moderate and lowest in low LPA category.

From [Table/Fig-11], it can be inferred that proportion observed in the 3 IAPQ categories differs between the good and poor categories of PSQI. Quality of sleep is associated significantly with LPA (p=0.000, 'p'<0.01). Out of the 60 subjects having a good sleep in PCOS,

46 were having a high LPA wherein non had a good sleep quality with a low LPA suggesting that LPA had an impact on sleep quality.

High	Moderate		Low	
50	40		25	
Chi-square	Value	DF 1	DF 2	p-value
	17.581	2	-	<0.001 'p'<0.01
	Significant			
F	9.335	2	266	<0.001 'p'<0.01

[Table/Fig-10]: Association between IPAQ and perception of health change.
§§ HC: Health change

IPAQ category	Good sleep Observations	Percentage (%)	Poor sleep Observations	Percentage (%)
High	46	17	74	27.4
Moderate	14	5.2	121	44.8
Low	0	0	15	5.6
Chi-square	Value	DF 1	DF 2	p-value
	33.279	2	-	<0.001
	Significant			'p'<0.01

[Table/Fig-11]: Association between IPAQ and PSQI.
|||PSQI: Pittsburgh sleep quality index

DISCUSSION

The PCOS is primarily characterised by irregular menses, ovarian cysts and Hirsutism however the effects of this syndrome extend beyond these symptoms. These effects may significantly impact the overall HrQoL not only during their reproductive age but also after their reproductive age [22]. The impact on sleep quality as a result of PCOS may further aggravate the incidence of sleep disturbances as age progresses [23].

In the present study, the authors have attempted to establish an association of LPA with sleep and HrQoL. Results showed that a major percentage of the subjects presented with a poor quality of sleep. The poor quality of sleep observed could be attributed towards the associated factors of PCOS such as insulin resistance, hyperandrogenemia, psychosocial factors such as negative body image, self-consciousness low social support and unhealthy lifestyle which may increase depression and anxiety thereby impacting sleep [12]. Similar findings have also been reported in earlier studies which reported reduced sleep as well as poor sleep patterns in PCOS [11,12].

In the present study, majority of the subjects had a low or moderate LPA (55.5%). Low or moderate LPA could be attributed to different factors ranging from anthropometric measurements, age, low Basal Metabolic Rate (BMR) as well as ethnicity. A study by Huang D et al., on physical activity in PCOS of different ethnicities found the physical activity level to be lower in South Asian ethnicity. They reasoned the finding as reduced education level, arthrometric measurements and socio-demographic factors [24]. Meanwhile in a study by Choukem SP et al., 97.9% women with PCOS in Yaoundé, Cameroon reported a high LPA [25]. Comparison with these studies directs towards a strong role of ethnicity and anthropometric measurements while reporting LPA.

The present study also showed a significant association between LPA and sleep suggesting that being physically active may impact the quality of sleep. This association can be attributed to an increase in endorphin release with physical activity which reduces anxiety and stress thereby promoting relaxation and better sleep. Fernandez RC et al., in their study found sleep quality to be impacted in PCOS as well as reported a decline in cardiac and metabolic health in the longer run. Type 2 diabetes risk was also reported to be high. Decline in cardiac and metabolic health in PCOS affect the cardiovascular endurance [12]. A reduced cardiovascular endurance is observed to be linked with quality of sleep [26]. The circadian system which regulates sleep is impaired in presence of poor cardiac and metabolic health as well reduced LPA [27]. These comparisons with previous literature suggest that LPA, cardiovascular endurance and sleep are a part of a vicious cycle wherein a decline in one has the potential to affect each other. To break this vicious cycle, further studies should focus on techniques to improve sleep and its effect on cardiovascular endurance as well as a focus on teaching cardiovascular endurance to improve sleep pattern.

The present study results showed that LPA was associated with all the domains of SF-36 other than role limitation due to emotion and the domain of emotional well-being where no significant association was seen. All the physical domains of HrQoL had an association with LPA however the psychological domains including limitation in role due to emotional problems and well-being did not demonstrate any significance suggesting that LPA impacts the physical dimensions of HrQoL more than the psychological components of HrQoL. From a physiological view, low physical activity increases the possibility of metabolic disturbances which becomes a crucial factor in the onset and poor prognosis of PCOS thereby increasing the symptoms of PCOS and in turn impacting the HrQoL under physical domains [27]. Non significant association between LPA and psychological domain of HrQoL could be attributed to the multidimensional nature of psychological impact in PCOS. PCOS presents with a wide variety of psychological issues ranging from anxiety, depression, eating disorders, low self-esteem, to disorders like somatisation, bipolar disorder, obsessive compulsive disorders [28]. This broad nature of psychological impact in PCOS may not necessarily be reflected through SF-36 probably resulting to a non significant association.

The present study findings help to focus on the need to include physical activity in PCOS and how individuals may benefit by incorporating lifestyle changes and increasing their QoL. The women with PCOS are to be educated on how simple ways of having an adjustment in the portion of daily physical activity both general day to day activities and prescribed exercises can be crucial in preventing the many effects of PCOS as well as improving the overall HrQoL.

Limitation(s)

The cross-sectional nature of study design made it difficult to establish a cause-and-effect relationship. The study used self-reported questionnaire which though reliable gives a subjective view of the outcomes. Further studies using objective measures may be beneficial to strengthen the association and long term follow-ups may be necessary to understand the cause-and-effect relationship.

CONCLUSION(S)

The consequences of PCOS are multifactorial. Physical activity, sleep quality and HrQoL are impacted by PCOS. Both sleep and HrQoL are significantly associated with the dose of physical work. Thereby increasing the significance of educating patients with PCOS about incorporating the correct dose of physical activity to bring down the symptoms of PCOS and enhance the sleep and HrQoL.

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PARTICULARS OF CONTRIBUTORS:
1. Professor, Krupanidhi College of Physiotherapy, Bengaluru, Karnataka, India.
2. BPT Intern, Krupanidhi College of Physiotherapy, Bengaluru, Karnataka, India.
3. BPT Intern, Krupanidhi College of Physiotherapy, Bengaluru, Karnataka, India.
4. BPT Final Year Student, Krupanidhi College of Physiotherapy, Bengaluru, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Jincy Samuel,
Professor, Krupanidhi College of Physiotherapy, 12/1, Chikka Bellandur, Carmelaram Gunjur Road, Hobli, Off Sarjapur Road, Varthur, Bengaluru-560035, Karnataka, India.
E-mail: pjincy19@yahoo.com

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