Sleep Aberrations in Polycystic Ovarian Syndrome:
An Observational Study of 38 Women

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Abstract

Introduction and Aim: **Polycystic Ovarian Syndrome (PCOS), one of the non-communicable diseases is reaching an epidemic proportion in India. Sleep insufficiency is known to contribute to obesity and the associated non-communicable diseases like type two diabetes mellitus, cardio-vascular diseases and cancer. Therefore, the aim of the present study was to assess the sleep patterns in patients with PCOS.**

Material and Methods: **Thirty-eight women with PCOS (diagnosed as per Rotterdam criteria) attending a specialty clinic in Mumbai were evaluated for their sleep patterns specifically for its duration, latency, fragmentation and alignment with diurnal rhythm.**

Results: **The age group of the women varied from 17 to 40 years with a mean age of 25 yrs. Twenty-eight of 38 women were overweight (42.1%) and obese (31.6%). Hyperinsulinemia, (fasting and/or two hours post glucose) were observed in 14 (36.8%) patients. Majority of PCOS patients had sleep insufficiency (57.9% slept less than 7 hours a day); of these 12 women slept for 6 to 7 hours while 7 women slept for only 5 to 6 hours a day and 4 women slept less than 5 hours a day. Sleep latency was observed in 8 women and sleep fragmentation in 5 of them. Sleep misalignment with diurnal rhythm was observed in 14 patients.**

Conclusion: **The present study reports high degree of sleep insufficiency among subjects with PCOS.**

Key words: **Sleep deprivation, Polycystic Ovarian Syndrome (PCOS), Insulin resistance**

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Introduction:

Polycystic Ovary Syndrome (PCOS), an endocrine disorder with reproductive, metabolic and dermatological features, has grown as an epidemic in India with a high prevalence. The prevalence varies from 3.7 to as high as 22%.[1-3] Thus, PCOS is currently a public health issue of great concern. It demands urgent attention of national health agencies and health policy makers.[4,5] However, hyperinsulinemia and insulin resistance in association with obesity/adiposity are considered as key inciting and/or perpetuating pathological factors for this endocrine-metabolic disorder.[6-8] Sleep-insufficiency is considered as one of the important triggering life-style factors for the metabolic dysfunction in many non-communicable diseases (NCDs) like type 2 diabetes mellitus, atherosclerotic cardio-vascular diseases and cancer.[9-11] In the current article we present data on sleep in patients of PCOS with a review of literature.

Material and Methods:

The study population was women with Polycystic Ovarian Syndrome attending a Speciality clinic in Mumbai, serving subjects with reproductive endocrine disorders. Sixty women with complains of menstrual dysfunction, with or without obesity had attended the clinic in the year 2016. They were screened for thyroid dysfunction, hypo/hyper gonadotropic status, hyperprolactenemic and other endocrine disorders like Cushing's disease/ syndrome. Thirty-eight women were diagnosed to have PCOS as per Rotterdam criteria for the diagnosis of PCOS after exclusion of the endocrine disorders.[12] They were surveyed for their sleep patterns.

The syndrome was defined by Rotterdam Criteria namely two of the following three features: 1) oligo or anovulation 2) clinical biochemical signs of hyperandrogenism 3) polycystic ovarian morphology at ultrasonographic (USG) examination.

The survey for sleep pattern included the following criteria:

1) **Sleep Duration:** Optimal sleep of 7-8 hours per night in adults is considered normal.[13] The sleep duration of less than 7 hours per night was considered as insufficient.

2) **Sleep Onset Latency:** It was calculated from the time patient reported going to bed (lying down to sleep) minus falling off to sleep i.e. the time to fall asleep from the time retiring to bed. In the classical definition for Sleep onset Latency, it is falling asleep after the lights are switched off.[14] However,

in Mumbai, the reason why we preferred as the time to retire to bed at night with intention to sleep is because of the continuous diffused street lights that permeate through windows.

3) **Sleep Fragmentation:** It was defined as waking episodes after falling off to sleep.[14]

Detailed history of the patients was taken and thorough clinical examination was done. The subjects were examined for their anthropometric measurements namely height, weight and BMI. Women were weighed using a digital weighing scale to the nearest 0.1 kg. Height was measured using stadiometer to the nearest 0.1 cm. Body Mass Index (BMI) was calculated. Asian classification of obesity was used.[15] Blood pressure was also measured in these women using a sphygmomanometer.

Biochemical Analysis:

Blood glucose and insulin levels were measured after 12-hour of overnight fasting. An oral glucose tolerance test with 75g glucose was applied to evaluate glycemia by glucose oxidase method (Biosystems). Fasting insulin and 2 hours insulin were also measured (Immunotec). Prediabetes was defined as fasting plasma glucose between >100 mg/dl and <126 mg/dl and 2 hours after oral glucose administration as between 140 mg/dl and 199 mg/dl. Diabetes was defined as fasting plasma glucose ≥126 mg/dl. Fasting serum insulin levels above 18μIU/ml and 2 hour insulin above 80 μIU/ml. Insulin resistance was assessed using FG: FI ratio less than 4.5.

Total cholesterol (TC), triglycerides (TG), high density lipoprotein cholesterol (HDL-C) and low density lipoprotein cholesterol (LDL- C) were analyzed using semi-automated enzymatic analyser. Classification of lipid profile was done according to National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) guidelines.[16]

Results:

Among the 38 PCOS patients, twenty-nine belonged to age group of 20-30 years with one-third of them having a strong family history of diabetes. More than half of these PCOS patients were overweight and obese (Table 1). Blood pressure was normal in most women with exception of 3 women having high BP above 130/80. Majority of them had either irregular periods or had hirsutism or PCOS morphology in their ultra sonography (Table 2).

Sleep deprivation in terms of duration was observed in more than 70% of PCOS patients (Figure 1). The recommended normal 7-8 hours of sleep was

Table 1: Profile of 38 PCOS Patients

Profile of Subjects	N (%)
Age (in years)	
<20	5 (13.2)
20-30	29 (76.3)
31-40	4 (10.5)
BMI (kg/m²)	
Underweight (≤18.50)	0 (0)
Normal (18.5-22.99)	9 (23.6)
Overweight (23.0-24.99)	16 (42.1)
Obese (≥25)	12 (31.6)
Diabetes Family History	
1st Degree	8 (21.0)
2nd Degree	12 (31.6)
Both 1st and 2nd degree	13 (34.2)
None	4 (10.5)

Table 2: Rotterdam Criteria For 38 PCOS Patients

Rotterdam Criteria for PCOS	N (%)
Clinical Hyperandroinism	
Acne	5 (13.2)
Hirsutism	18 (47.4)
Acne + Hirsutism	8 (21.0)
No Acne/ Hirsutism	7 (18.4)
Menstrual Cycles	
Regular	9 (23.7)
Irregular	28 (73.7)
Secondary Amenorrhea	1 (2.6)
Ultra Sonography	
Normal	2 (5.2)
PCO Morphology (PCOM)	34 (89.6)
Not Done	2 (5.2)

observed in only 11 (28.9%) PCOS patients. Twenty-three patients slept for less than 7 hours. Further, 4 patients (10.5%) slept for less than 5 hours (Figure 1). The younger group of 17-21 years (n=5) slept only for 2-3 hours during the week of their mid-term or final exams. Further, 8 women reported sleep onset latency while 5 reported fragmented sleep pattern. Overall 14 women had sleep misalignment with diurnal rhythm.

Biochemical Analysis

Among these 38 PCOS patients, 4 PCOS prediabetic and 2 were diabetic. Overall, it was observed that 3
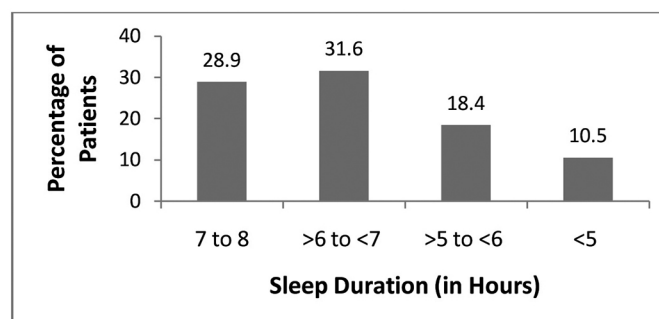

Figure 1: Sleep Duration in 38 PCOS Patients

patients had fasting blood sugar above 100 mg/dl and 6 patients had 2 hour post glucose levels above 140 mg/dl. Hyperinsulinemia was detected in 17 PCOS patients, fasting insulin was high in 4, 2 hour insulin was high in 4 and both were high in 9 patients. Insulin resistance was defined as FG/FI ratio less than 4.5 which was observed in 11 PCOS patients. Two of the PCOS patients who were prediabetic and had delayed hyperinsulinemia had FG/FI ratio at borderline (4.6-5.0).

Discussion

PCOS is an endocrine disorder with metabolic dysfunction. Endocrine system plays a major role governing the sleep-wake cycle and therefore it may alter the normal sleep cycle in PCOS. Previous studies have mainly focused on risk and prevalence of obstructive sleep apnea among PCOS.[17-19] However, we studied the then current sleep patterns of the patients with PCOS. The findings of the present study reveals that PCOS women had lower sleep duration (<7 hours/ day) than that recommended by National Sleep Foundation wherein, one- fifth of them reported sleep onset latency.

Studies have reported that in women with insufficient sleep (<6 hours), there was a higher risk of menstrual disturbances[17] and in particular the PCOS women had a poorer sleep quality and reduced REM sleep time when compared to the control group.[20] In a study on college women poor sleep hygiene was observed to be significantly associated with sleep quality and excessive day time sleepiness which can put young college students at health risk in future.[21,22] In the present study, the younger group of PCOS was severely sleep deprived during the period of their internal or mid-term exams. This sleep debt often continues in later life having severe health implications. As stated in earlier report "They are sleep-deprived because of their commitment to highly competitive scholastic pursuits or a desire for climbing the career ladder at an accelerated

pace".[5] This clinical observation of sleep deprivation amongst our youth has prompted us to investigate whether the sleep curtailment in the present study echoes a widespread practices during school and college years in general and at occasions of peak academic pressure, professional compulsions and career demands. We have thus explored sleep patterns among secondary school children and adolescents during an academic year in general and for those preparing for board exams in particular at two schools in Mumbai, one catering to high socio-economic group and the other to children from under privileged background. (manuscript under preparation).[23] In this study of sleep patterns among school children and adolescents we observed that at least 50% of the children slept less than 7 hours. More than 5-6% of students slept for less than 5 hours. Disrupted, fragmented and mal-aligned sleep were also observed in many due to distractors like noise pollution, street lights, television and easy availability and popularity of applications on mobiles. (unpublished data).[24]

In a cross-sectional study on 9251 adolescents aged 11 to 15 years reported a significant decrease in total sleep time among these adolescents, almost 16.0% of children aged of 11 years and 40.5% of those of 15 years age.[25] Similarly, in another Indian study among the adolescents in Delhi, it was observed that they did not get adequate sleep and that bed time shifted to later hours with increasing age, however the time to get up was the same which resulted in increasing sleep debt.[26] If this trend continues and if awareness about importance of sleep is not reached out to the community particularly the younger age groups, then sleep deprivation will be one of the main reasons for all the rising NCDs like diabetes, cardiovascular diseases, cancer and also PCOS among women.

Disturbed sleep particularly short, low-quality, and mistimed sleep contributes to obesity and insulin resistance[27] which occurs either by alterations in glucose metabolism, upregulation of appetite or decreased energy expenditure.[28] In a recent review study, it was reported that individuals who slept less than 7 hours per day had higher BMI and decreased leptin and insulin sensitivity.[29] In the present study lower sleep duration and insulin resistance were both observed in the PCOS patients. About one- third of the PCOS patients were obese and had delayed hyperinsulinemia. It has been observed that obesity and thin fat syndrome i.e. central adiposity even within the normal BMI ranges is higher in PCOS patients[30] and that successful weight loss in obese can help to restore regular menstrual cy-cle and thereby reduce the symptoms of PCOS. [31]

Insulin resistance is one of the important features of PCOS and therefore, may be associated with sleep disturbance in PCOS. Experimental and epidemiological studies have stated that recurrent nights of insufficient sleep can cause insulin resistance even in healthy individuals.[32-33] Even a single night sleep restriction up to 4 hours reduces insulin sensitivity by 19–25% of hepatic and peripheral glucose metabolism in healthy individuals.[34] Considering this, sleep deprivation in PCOS which is an endocrine disorder with metabolic dysfunction needs detailed study and may be used as a diagnostic criterion for assessing hyperinsulinemia.

The limitation of the present study is that there was no control group of non-PCOS which are age group controlled with other menstrual disorder or other gynecological complaints. Also, daytime sleepiness was not recorded for the study participants. However, the strength of the study was that there was a well- defined group of PCOS patients where fasting insulin and two hour post glucose insulin were done to determine hyperinsulinemia.

Therefore, in conclusion, sleep might be an important and a promising therapeutic target for prevention and treatment of metabolic dysfunctions in PCOS including obesity and hyperinsulinemia and it would be worthwhile to consider assessment of sleep disturbance as a part of medical screening in women with PCOS.

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