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Subjective sleep problems and sleep hygiene among adolescents having depression: A case-control study

Prashant Gupta, Rajesh Sagar, Manju Mehta

All India Institute of Medical Sciences, New Delhi, 110005, India

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ABSTRACT

Sleep research has often focussed heavily on polysomnography while ignoring subjective sleep complaints of individuals, especially the young ones. Discordance has been seen between objective and subjective parameters of sleep among children and adolescents. There has been a trend towards worsening of sleep hygiene among adolescents, which may predispose to psychiatric disorders like depression. So, we compared the subjective sleep quality and sleep hygiene among depressed and normal adolescents. A sample of 31 depressed adolescents and 32 healthy controls were compared on sleep parameters using Adolescent Sleep Wake Scale (ASWS), Adolescent Sleep Hygiene Scale (ASHS) and School Sleep Habits Survey. Depressed adolescents were found to have significantly worse sleep quality [ASWS score 3.72 ± 0.952 vs 4.79 ± 0.552, $p < 0.001$], longer sleep onset latency [68.23 ± 62.98 vs 19.53 ± 19.48 minutes, $p < 0.001$], and shorter sleep duration [414.19 ± 110.78 vs 498.28 ± 56.86 minutes, $p < 0.001$]. Sleep quality significantly correlated with depression severity (measured on Children's Depression Rating Scale- revised), i.e., higher the severity of depression, poorer was the sleep quality ($r = -0.605$, $p < 0.01$). But sleep hygiene was statistically similar between the two groups [ASHS score 3.21 ± 0.60 vs 3.36 ± 0.51, $p = 0.293$], and was inadequate (< 3.8) among all adolescents irrespective of depression. Hence, despite the lack of evidence from objective sleep measures, there seem to be subjective sleep impairments among adolescents having depression. Future research needs to address the underlying etiological factors and causal directions for depression and sleep impairments among adolescents. Sleep hygiene education must be a part of broader primary prevention strategies for psychiatric disorders.

1. Introduction

An estimated 20–25% of adolescents have at least some form of sleep disturbance (Mindell et al., 1999). This prevalence is much higher among adolescents having depression. Some studies estimate that more than 70% of depressed adolescents may have some kind of sleep disturbances (Liu et al., 2007). Although sleep disturbance is a well-known symptom for depression, research also suggests that sleep problems (such as insomnia, short or long sleep duration, eveningness, etc.) may have a role as a risk factor or precipitating factor for depression, and may even interfere with response to treatment of depression (Au and Reece, 2017; Clarke and Harvey, 2012; Li et al., 2016; Pigeon et al., 2017; Zhai et al., 2015). Some studies have found a significant overlap between neurological regulation of sleep and mood (Adrien, 2002).

Given the close association between sleep and depression, a considerable amount of research has been undertaken in this area. But this research has been predominated by objective measurements of sleep such as polysomnography, while subjective reports from individuals are relatively neglected. This results from the notion that subjective measures are biased and inadequate, have questionable reliability and are prone to misreporting due to cognitive biases of depression (Mayers et al., 2009). Studies using objective sleep measures among depressed adults have found important sleep micro-architectural changes which may be used as markers for depression. But, contrastingly, similar studies in children and adolescents have failed to find any objective evidence of sleep dysregulation, even though subjective sleep complaints have been found to be highly prevalent in this age group (Rao, 2011). Hence, there exists some discordance between subjective and objective sleep parameters in depression in younger ages. Some authors hypothesize that sleep changes in children and adolescents might not be detectable by traditional EEG based polysomnography, or the objective findings may be masked by developmental factors influencing sleep, which might lead to these discordant findings (Lofthouse et al., 2009). Nevertheless, this highlights the need for independently studying subjective sleep problems among children and adolescents having depression. Moreover, objective measures of sleep may fail to capture the subjective sense or experience of having a problem, which can be well understood by using subjective measures. So, despite the limitations,

E-mail address: pg_aiims@yahoo.co.in (P. Gupta).

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subjective measures of sleep are equally important in this age group and need to be evaluated (Gregory and Sadeh, 2012).

Sleep hygiene refers to a variety of practices which are necessary to have quality nighttime sleep and full daytime alertness (National Sleep Foundation, 2019). Studies have shown deterioration of sleep hygiene among adolescents in recent times (Gradisar et al., 2011). This has in turn been associated with poorer sleep quality and psychiatric disorders such as depression (Dinis and Bragança, 2018). Sleep-related behaviours and practices seem to be heavily influenced by culture (Gradisar et al., 2011). So far no studies from South-East Asia, which has a unique cultural background, have evaluated sleep hygiene practices among adolescents or their association with sleep quality and depression.

Hence, we aim to compare the subjective sleep parameters and sleep hygiene practices in adolescents diagnosed with depression with a sample of non-depressed adolescents. Further, as a secondary objective, we try to understand the correlation of these sleep parameters with the severity of depression.

2. Methodology

The study was conducted at the Child Guidance Clinic in the Psychiatry outpatient department of All Indian Institute of Medical Sciences, New Delhi. Ethical clearance was taken from the institute ethics committee. In a case-control design, we compared subjective sleep-related variables among depressed (study group) and normal adolescents (control group).

2.1. Sample size

We included at least 30 participants in each group. Sample size calculation was done using a free online tool, EpiTools epidemiological calculators (Sergeant, 2019). A confidence level of 0.95 and power of 0.80 was assumed. The expected proportion of sleep problems (exposure) among the controls was fixed at 0.25 based on previous studies (Mindell et al., 1999). Also an assumed odds ratio of 4–5 was used in the calculations based on existing literature (Sivertsen et al., 2014). Purposive sampling was done for recruitment.

2.2. Participants

Recruitment was done only after a written informed consent from the guardians and an assent from the subjects. Subjects who were between 12 to 18 completed years of age, who could read and understand simple sentences in English, and had Major Depressive Episode as per DSM-IV-TR criteria, were included. Those having substance use disorders and any co-morbid psychiatric illness (other than anxiety disorders) were excluded using MINI-kid (Sheehan et al., 1998) Also, we excluded those having any current medical disorders which may interfere with sleep, based on the information provided by the participants. Those using sedative medications were also excluded; though we did not exclude the ones taking antidepressant medicines (a record of the same was kept).

The control group was recruited from the adolescents who accompanied the study group participants (siblings, cousins, and friends) and from the general community. Inclusion criteria for the control group were same as the study group except that they had to be free of any diagnosable psychiatric disorder (other than sleep problems) during their lifetimes. The relevant assessment was done by a Psychiatry resident after due training provided by professors in Clinical Psychology and Psychiatry. Participants completed the self-administered tools in presence of the Psychiatry resident who provided assistance as and when required.

2.3. Measures

2.3.1. Children's Depression Rating Scale- Revised (CDRS-r)

It is a 17-item scale with item scores ranging from 1 to 5 or 1 to 7 (range of total score = 17–113), rated by a clinician via interviews with the child and parent, used to rate the severity of depression. Score of ≥ 40 is cutoff for depression. Validity and reliability have been well established (Mayes et al., 2010; Poznanski et al., 1984; Poznanski and Mokros, 1996).

2.3.2. Subjective sleep measures

2.3.2.1. School Sleep Habits Survey (SSHS). SSHS (Owens et al., 2010; Wolfson et al., 2003) asks about typical sleep-wake behaviours during the last 2 weeks. Questions are either open-ended or on a Likert type scale. It has an established validity in comparison to sleep diary and actigraphy (Short et al., 2013; Wolfson et al., 2003). We used the survey to record the subjective report of presence or absence of sleep-related problems, time parameters associated with sleep (bed time, wake time, sleep duration, latency, night-time awakenings, etc.) and to assess the participants on the Morningness/Eveningness (M/E) subscale which is included within the survey. Morningness refers to preference for daytime activity, i.e., peak performance and alertness is during early morning hours, while the opposite is true for eveningness. The M/E scale (Carskadon et al., 1993) consists of 10 items, each rated on 4 or 5 Likert points. Possible range of scores is from 10 to 43. Higher scores indicate morningness, while lower indicate eveningness.

2.3.2.2. Adolescent Sleep Hygiene Scale (ASHS). ASHS is a self-report instrument, having 33 items on 6-point Likert scale that assess sleep hygiene practices. A validated 6 domain model (physiological, behavioural arousal, cognitive/ emotional, daytime sleep, sleep stability, and sleep environment) using 24 items was used in our study (Storfer-Isser et al., 2013). Scoring is done as mean domain scores and total mean sleep-hygiene score. Higher scores indicate better sleep hygiene (LeBourgeois et al., 2005).

2.3.2.3. Adolescent Sleep-Wake Scale (ASWS). ASWS is based on the Children's Sleep-Wake Scale (LeBourgeois et al., 2005). It has 28-items on a 6-point Likert scale, which are self-reported by the participants. It assesses sleep quality along five behavioural domains (going to bed, falling asleep, maintaining sleep, reinitiating sleep, returning to wakefulness). Scoring is done as mean domain scores and mean total sleep-wake score. Higher scores indicate better sleep quality. Validity and reliability are well established (LeBourgeois et al., 2005).

3. Results

3.1. Socio-demographic variables (Table 1)

A total of 31 subjects were recruited in the study group (depressed adolescents), and 32 in the control group. The two groups were similar in terms of mean age, gender distribution and education. But statistically significant differences were seen in monthly family income (higher monthly family incomes in control group). Only 19 (out of 31) depressed subjects were attending school regularly for the last two weeks at the time of assessment, while all control subjects were attending school.

3.2. Clinical variables

None of the control subjects had CDRS-R scores (mean = 20.78 ± 3.02) in the diagnosable depression range (score ≥ 40 indicate depression), while among the depressed subjects all had scores (mean = 57.03 ± 15.46) suggestive of depression. The difference between the mean CDRS-R scores was statistically significant ($p < 0.001$). Majority of the depressed adolescents (22/31) were

Table 1
Socio-demographic variables: Comparison between groups.

Variables	Mean (SD) or Frequency (%)		p value
	Depressed adolescents (n = 31)	Controls (n = 32)	
Age (years)	15.73 (1.72)	15.44 (1.66)	0.319*
Gender			
Male	19 (61.3%)	16 (50%)	0.81#
Female	12 (38.7%)	16 (50%)	
Education (completed classes)			
5th to 8th	12 (38.7%)	7 (21.9%)	0.146#
9th to 12th	19 (61.3%)	25 (78.1%)	
Monthly family income			
0–9999	11 (35.5%)	2 (6.2%)	**0.009**#
10,000–39,999	14 (45.2%)	25 (78.1%)	
≥40000	6 (19.4%)	5 (15.6%)	

* Mann Whitney U test (t-test was not used as distribution was not normal as per Shapiro-Wilk test of normality).
\# Chi Square test.

suffering from first episode depression, while the remaining had recurrent depressive disorder (second episode = 7; third episode = 2). The mean duration of the current depressive episode was 7.55 (± 6.15) months, while the median was 6 months (range 1 to 24 months). 12 (38.7%) of the depressed participants had never taken any antidepressants. Up to two weeks of SSRI use was present among 7 (22.6%) of the depressed subjects, while the remaining 12 (38.7%) were using SSRIs for more than two weeks at the time of the assessment. No other antidepressants were used by the participants.

3.3. Sleep-related variables (Table 2)

The odds of having at least some subjective sleep problem (as answered by the question "do you have a sleep problem?") among depressed adolescents vs normal controls were 62.5 (95% CI = 11.58–337.38). There were statistically significant differences in ASWS between the two groups in 4 out of 5 subscales and mean total score, indicating poorer sleep quality among the depressed. Further, when the total sleep duration, sleep onset latency and number of awakenings per night, were compared between the two groups, depressed adolescents were found to have significantly worse findings. Moreover, depressed participants were seen to have more evening preference as compared to controls on the M/E scale.

Sleep hygiene practices (mean total ASHS scores) among the two groups did not differ significantly. Statistically significant difference was seen only in one subscale (cognitive/emotional) of ASHS, where depressed group had worse scores. No differences were seen in the reported bed and wake up times and estimates of required duration of sleep between depressed and healthy adolescents.

3.4. Correlation analysis (Table 3)

Correlation analysis was performed between depression severity and subjective measures of sleep. Number of episodes and duration of index episode were operationalized as markers of depression severity, in addition to CDRS-r, based on literature review (Burcusa and Iacono, 2007). Only those sleep measures were chosen for correlation which had shown statistically significant difference between depressed and non-depressed.

Significant correlation was seen between CDRS-r scores and number of depressive episodes and most subjective measures of sleep. But, the duration of current depressive episode failed to show any correlation with sleep parameters, other than M/E subscale. CDRS-r scores were also found to be significantly correlated with number of episodes of depression (r = 0.435, p = 0.014) but not with duration of index episode (r = 0.278, p = 0.13).

Table 2
Subjective sleep parameters: Comparison between groups.

Variables	Mean (SD) or Frequency (%)		p value
	Depressed adolescents (n = 31)	Controls (n = 32)	
Adolescent Sleep Hygiene Scale			
Physiological	4.23 (0.61)	4.01 (0.54)	0.292
Behavioural Arousal	2.41 (0.94)	2.68 (0.75)	0.211
Cognitive/Emotional	2.30 (1.18)	3.13 (0.88)	**0.003***
Sleep environment	4.04 (0.68)	3.84 (0.72)	0.271
Sleep Stability	2.63 (1.29)	2.94 (1.02)	0.296
Daytime Sleep	3.68 (0.89)	3.58 (0.89)	0.660
Mean Total ASHS Score	3.21 (0.60)	3.36 (0.51)	0.293
Adolescent Sleep Wake Scale			
Going to Bed	3.75 (1.096)	4.90 (0.738)	< **0.001***
Falling Asleep	3.64 (1.177)	4.95 (0.672)	< **0.001***
Maintaining Sleep	3.79 (1.027)	4.78 (0.754)	< **0.001***
Reinitiating Sleep	4.62 (1.211)	4.93 (0.951)	0.265*
Returning to Wakefulness	2.78 (1.463)	4.37 (0.763)	< **0.001***
Mean Total ASWS Score	3.72 (0.952)	4.79 (0.552)	< **0.001***
School Sleep Habits Survey			
Presence of sleep problems			
Yes	25 (80.65%)	2 (6.25%)	< **0.001***
No	6 (19.35%)	30 (93.75%)	
Sleep timings			
Usual bed time	10:54 pm (58 min)	10:59 pm (55 min)	0.713*
Usual wake up time	7:44 am (54 min)	7:44 am (72 min)	0.545*
Usual sleep duration	414.19 min (110.78 min)	498.28 min (56.86 min)	< **0.001***
Usual sleep onset latency	68.23 min (62.98 min)	19.53 min (19.48 min)	< **0.001***
Number of awakenings per night			
≤ 1	11 (35.5%)	25 (78.1%)	**0.001**#
≥ 2	20 (64.5%)	7 (21.9%)	
Estimated sleep requirement per night	474.19 min (48.63 min)	476.72 min (38.62 min)	0.82*
Morningness-Eveningness Subscale	24.42 (4.34)	28.94 (4.08)	< **0.001***

**Fisher's exact test.
* Independent sample T-test.
\# Chi Square test.

Table 3
Correlation analysis#.

		$CDRS-R score	$Number of episodes	$Duration of episode
Total ASWS (n = 31)		**−0.605****	**−0.490****	−0.065
ASWS subscales (n = 31)	Going to bed	**−0.592****	−0.338	−0.054
	Falling asleep	**−0.600****	**−0.449***	−0.197
	Maintaining sleep	**−0.430***	**−0.595****	0.054
	$Reinitiating sleep	**−0.490****	**−0.390***	−0.010
	$Returning to wakefulness	−0.315	−0.128	−0.192
Morningness/Eveningness subscale (n = 31)		**−0.509****	−0.181	**−0.378***
$Total Sleep Duration (n = 31)		**−0.636****	**−0.430***	−0.045
Sleep Onset latency (n = 31)		**0.794****	**0.422***	0.189

\# Spearman's rank-order correlation analysis has been done in all cases.
$ Non-normal distribution of data as per Shapiro-Wilk test of normality.
* $p < 0.05$.
** $p < 0.01$.

Correlation analysis between SSRI use [less than 2 weeks of use (absent or up to 2 weeks of use) vs more than 2 weeks of use] with CDRS-r ($r = 0.290$, $p = 0.113$), ASWS ($r = -0.310$, $p = 0.09$) and ASHS ($r = 0.334$, $p = 0.067$) did not yield statistically significant results.

4. Discussion

In this study, we compared the sleep hygiene and subjective sleep parameters of depressed and healthy adolescents in a case-control design. Subjective measures of sleep quality were significantly worse among depressed adolescents as compared to healthy controls. These included difficulties faced while going to bed, falling asleep (such as problem in settling down, not feeling sleepy, long time taken to fall asleep, needing help to fall asleep, etc.), maintaining sleep (restlessness, tossing & turning and other body movements in bed, repeated awakenings, etc.) and returning to wakefulness (difficulty in getting up from bed and needing help to do that, etc.). Also, the sleep onset latency (time taken to fall asleep after going to bed) was significantly longer, total night-time sleep duration was shorter and there were greater number of intermittent night-time awakenings among depressed adolescents as compared to healthy controls. These findings are in keeping with the existing literature. A couple of recent meta-analyses (Baglioni et al., 2011; Lovato and Gradisar, 2014) reported significantly more subjective symptoms of sleep disruption (sleep disturbance, insomnia, hypersomnia and poor sleep quality) among adolescents with depression compared to the non-clinical group, though majority of the included studies used unstructured self-reports of sleep or questions about sleep derived from other psychiatric scales such as K-SADS, BDI, CIDI, CBCL, etc. None of these studies used any structured instruments specific for sleep assessment. This highlights the importance of our study which used comprehensive, multi-dimensional, and well-validated scales for sleep quality and sleep hygiene. Further, the studies among adolescents which have evaluated sleep objectively using polysomnography for associations with depression have provided conflicting conclusions (Appelboom-Fondu et al., 1988; Dahl et al., 1990; Khan and Todd, 1990; Rao, 2011). But, the ones which have shown a positive association have found increased sleep onset latency and increased number of awakenings to be the most consistent predictors of depression (Lovato and Gradisar, 2014), thus validating our findings.

There is some evidence to suggest that there is more evening orientation and preference for later sleep timings with increasing age among adolescents (Carskadon et al., 1993; Collado Mateo et al., 2012). Eveningness among adults has been shown to be associated with depression, but this association is relatively less explored among children and adolescents. A recent meta-analysis (Au and Reece, 2017) which demonstrated the relationship between eveningness and depression included 36 studies out of which only two (Alvaro et al., 2014; Tonetti et al., 2012) were conducted among children or adolescents. Another large sample size study found an association between eveningness and depression among Taiwanese children and adolescents; though the association seemed to be mediated by poor sleep quality (Chiu et al., 2017). Our study seemed to echo the results of these studies. We found that adolescents with depression had significantly more evening preference as compared to those without depression. Moreover, the M/E scale scores were significantly correlated with depression severity, i.e., more severe the depression, more was the evening preference.

An interesting finding in our study was that sleep hygiene practices did not vary significantly between depressed and healthy participants. It is known that better sleep hygiene significantly predicts better sleep quality (LeBourgeois et al., 2005). But, in our study, poorer sleep quality was seen among depressed adolescents despite similar sleep hygiene among depressed and non-depressed. Storfer-Isser et al (2013), reported that scores less than or equal to 3.8 on ASHS predicted poor sleep hygiene (Storfer-Isser et al., 2013). In our study, both cases (3.21 ± 0.60) and controls (3.36 ± 0.51) failed to meet this cut-off. One may hypothesize that there may be other vulnerability factors which may interact with poor sleep hygiene to lead to poor sleep quality and depression. Future studies will need to address this. Furthermore, several studies across the world have indicated towards worsening of sleep-related practices among children and adolescents (Gradisar et al., 2011; Gupta et al., 2008; Peter et al., 2017; Sweileh et al., 2011; Wilson et al., 2015). The onslaught of smartphones, internet and social media have significantly encroached upon the sleep time of many youngsters (Carter et al., 2016; Reid Chassiakos et al., 2016). Whether the sleep hygiene practices are universally poor among most adolescents, at least in the region where our study was conducted, is a question worth looking into as it may have implications for future development of sleep disorders and mental health problems. In case poor sleep hygiene practices are as common as suggested by our study, it may be advisable to shift sleep hygiene education from clinics to schools and families as a method of universal prevention.

In our study, we found that sleep quality worsened with increasing number of lifetime episodes of depression. This finding may stem from three potential explanations: 1) It is known that in the natural course of recurrent depression, the severity increases with increasing number of episodes (Roca et al., 2013). Hence, those participants in our study who had recurrent depression may have had greater severity, and hence greater sleep problems. This argument was supported when we did a correlation analysis of CDRS-r scores with number of current depressive episode and found a significant positive correlation, i.e., those having more than one episode of depression had more severe index episodes; 2) Several studies have suggested that sleep disorders are important predictors for not only onset but also for recurrence or relapse of depression (Benca and Peterson, 2008; Dew, 1997; Fang et al., 2019). Hence, higher levels of sleep problems may be more likely to lead to recurrence of depression; or 3) It has been suggested by some authors that sleep problems are one of the common residual symptoms of depression among individuals who have undergone remission or have responded to treatment (Benca and Peterson, 2008; Fang et al., 2019). There may be a possibility that residual sleep problems may accumulate over time, leading to greater sleep difficulties with each recurrence. So far literature doesn't provide answers to this question, which may be worth considering in future research.

The findings of our study should be seen in the light of some limitations. We recruited a convenience sample which limits the generalizability. Though the sample size was calculated to generate sufficient power of the study, it was not large enough to perform post-hoc regression analysis which may have provided some insights into the extent to which various variables impacted depression. As far as possible we tried to recruit controls from the healthy adolescents who accompanied the depressed adolescents to the clinic in order to control for environmental confounders, but this could not be done in majority of the cases. We did not perform a matching of cases and controls. Though the two groups were statistically similar in most demographic variables (except monthly family income), there may have been other unknown confounders which may have had a bearing on our results. Monthly family income itself may influence life stressors, quality of life, sleep environment, etc. In order to provide more flexibility for sample recruitment, we did not exclude the participants who were taking antidepressants (though we excluded all those who were taking sedative medications). All the adolescents in our study who were taking antidepressants were on SSRIs which are known to alter the sleep structure in some individuals (Ferguson, 2001). But when we did a correlation analysis between SSRI use with depression severity, sleep quality and sleep hygiene, we did not find any significant correlation, probably indicating that it did not have any effect on our study results. Moreover, including those who were taking SSRIs allowed us to recruit a more representative sample as a substantial number of adolescents are being treated with SSRIs as the first line for depression. Ours was a homogenous sample of adolescents and the findings may not be extrapolated to children. But it was important to recruit such a sample since the natural sleep of adolescents is different from children and their EEG

sleep changes are more similar to adults as compared to children. Moreover, depressed adolescents differ from children in neurobiological correlates and treatment response to depression (Urrila et al., 2012).

Despite the limitations, our study highlights some important findings. First, even though there is a lack of evidence of sleep disturbance in polysomnographic studies among children and adolescents, our study was able to establish the presence of subjective sleep problems among depressed adolescents. Even though insomnia is a known symptom of depression, little is known about other subjective parameters of sleep in depressed children and adolescents. Our study throws some light on these. Second, subjective parameters of sleep were significantly worse among depressed adolescents compared to healthy controls. Third, several of these parameters were also correlated with depression severity, i.e., the more severe the depression, greater the sleep problems. And lastly, sleep hygiene practices were universally poor among adolescents, irrespective of depression.

5. Conclusions

Sleep problems and depression are an important co-morbidity among adolescents, and increase in severity of one predicts increase in severity of the other, though causal associations are yet to be established. Subjective measurements of sleep parameters among adolescents provide important insights which supplement the information from polysomnographic studies. Sleep hygiene practices are commonly inadequate among adolescents irrespective of depression. Efforts need to be focused upon improving sleep hygiene among children and adolescents as a primary prevention strategy for sleep disorders and mental health problems.

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Declaration of Competing Interest

None to declare.

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