



Depression and aggression scores, reported sleep disorders status and their associated factors among adolescent girls in Northern Iran

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Abstract

Depressive disorders are a common cause of morbidity, globally. We have evaluated the prevalence of depression, aggression and sleep disorders, and their associations with each other and socio-economic characteristics, in adolescent girls from northern Iran. This cross sectional study was performed in 940 adolescent students, aged 12–18 years old. The Beck Depression Inventory II, Buss-Perry Aggression, Insomnia Severity Index, Epworth Sleepiness Scale and STOP-Bang sleep apnea questionnaires were used to evaluate depression, aggression, insomnia, sleepiness and sleep apnea among the participants, respectively. A total of 634 (67.4%), 216 (23.0%), 222 (23.6%) and 2 (0.2%) of subjects had some degree of depression, insomnia, sleepiness or sleep apnea, respectively. Girls who lived in a small family group had a significantly higher depression score than those living in a larger family group. Girls from families in which their parents were divorced had higher depression and sleepiness scores compared to their peer group. Participants with high depression scores had higher aggression, insomnia, sleepiness and sleep apnea scores than subjects without ($P < 0.05$). In female adolescents, emotional, behavioral and sleep disorders appear to be related to their demographic and socio-economic characteristics. Aggression score, insomnia, day time sleepiness and sleep apnea were significantly more common in individuals with a high depression score, and may be causally related, although this could not be formally assessed in this study. Individuals at risk of depression need to be identified, as this may allow interventions that may improve their quality of life outcomes.

Keywords Depression · Aggression · Insomnia · Adolescents · Iran

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Introduction

Adolescence is period of profound physical and psychological change, leading to sexual maturity (Ravi et al. 2015). The physiological changes associated with adolescence provide a context for the emergence of stress, aggression and mental and social disorders in some individuals (Friel 2004). Adolescents therefore have an increased vulnerability to depressive symptoms, and the gender differences in depressive symptoms is noticeable during early adolescence and increases further by late adolescence (McLaughlin and King 2015). In childhood, the prevalence of depression does not differ significantly between girls and boys, but levels of depression and higher cognitive/experiential sensitivity to serious stimuli among 13 to 15 year old children, are greater in girls than boys (Hyde et al. 2008; Yang et al. 2018). A recent systematic review indicates that the burden of internalizing symptoms is enhanced in adolescent girls (Bor et al. 2014). Depression in adolescence predicts a wide range of adverse consequences during the life-cycle, including an increased risk of recurrent episodes of depression (Costigan et al. 2013). The lifetime prevalence of depression increases dramatically from 1% in the population below age 12 years to 17–25% of the population at the end of adolescence (Kessler et al. 2001). This surge in incidence occurs between 15 and 18 years (Hankin et al. 1998). There are a growing number of youths with depression and its associated negative outcomes, and therefore the clarification of risk factors and the underlying mechanisms leading to depression in adolescents is a public health priority. Common symptoms of depression in children and adolescents include: a reduced interest in play activities, difficulties in concentration, behavior problems (anger and aggression), decreased appetite, sleep disturbance, anhedonia, poor mental and physical functioning (Razzak et al. 2019).

Sleep plays a crucial role in growth, development, and general health in adolescence (Zhang et al. 2016). Many adolescents have prolonged sleep-deprivation due to social, recreational, employment, academic pressures and biological changes in the sleep/wake cycle (Carskadon et al. 2004; Dahl and Lewin 2002). Sleep variables, particularly daytime sleepiness, lead to difficulty in concentration, and falling asleep in class, significantly influence school performance. Insufficient sleep is also a feature of several mental disorders, such as major depressive disorders (Dahl and Lewin 2002; DSM 5; American Psychiatric Association. 2013). Impaired sleep quality appear to relate to high negative and low positive affects (Baglioni et al. 2010), and is especially correlated with poorer emotional competence and empathy (Brand et al. 2016) and greater anxiety, catastrophizing thinking, worrying (Talbot et al. 2010) and oppositionality-irritability among adolescents (Baum et al. 2014). Female adolescents and adults suffer more from sleep complaints than males (Krueger and

Friedman 2009). In a community study among children and adolescents ($n = 175$), the correlation between symptoms of sleep disturbance and depression appears to be higher in adolescents ($r = 0.58$) compared to children ($r = 0.26$) (Alfano et al. 2009). The results of a meta-analysis showed that insomnia is a good predictor for the onset of depression (OR = 2.8, CI: 1.6–5.2), and anxiety (OR = 3.2, CI: 1.5–6.9) in adults (Hertenstein et al. 2018). Sleep deprivation is a common feature of depression and is characterized by increased REM sleep and decreased slow wave sleep (Benca et al. 1992). Sleep may be divided into rapid eye movement (REM) and non-REM (NREM) sleep. NREM is sub-categorized in the stages of N1, N2, and N3 (also known as slow wave sleep [SWS]). SWS seem to be “restorative” and is connected with the highest arousal threshold. SWS also has been involved in memory, learning, overnight enhancements in perceptual and visuo-motor performance, reduced sympathetic nervous system activation and elevated vagal tone (Fung et al. 2011). It is possible that insufficient sleep and insomnia adversely affect the function of the corticolimbic circuits i.e. the prefrontal cortex, striatum, and amygdala, and thus disturbed response to affective impulses, and negative impacts on mood (Roberts and Duong 2013; Soffer-Dudek et al. 2011).

Serotonin is a neurotransmitter, affecting several receptors which may be implicated in numerous processes related to both sleep and waking. Serotonin, directly affects the posterior pituitary, inducing the secretion of prolactin. It has been suggested that hypothalamic prolactin is involved in the modulation of neurotransmission during REM sleep generation (Ursin 2002). Sleep deprivation may modulate some components of central serotonin activity in healthy individuals; the prolactin secretion after serotonin stimulation is triggered after sleep deprivation and may predict the clinical response to sleep restriction in depressed individuals (Salomon et al. 1994).

Obstructive sleep apnea is another common disorder, that is a repetitive upper airway obstruction that occurs during sleep and is related to an increased morbidity and mortality and impaired quality of life (Harris et al. 2009). Obstructive sleep apnea syndrome leads to daytime manifestations, that include: loss of concentration, fatigue, and excessive daytime sleepiness and is potentially related with symptoms of anxiety and depression (Rezaeitalab et al. 2014). Furthermore, sleep disturbances (either difficulty sleeping or sleeping excessively) are a diagnostic criterion for major depressive disorder (DSM 5; American Psychiatric Association. 2013). Although the association between sleep disturbance and depression is unclear in adolescents, evidence suggests that sleep problems and depression may occur together in adolescence and the overlap between sleep disorders and depression may increase overtime (Patten et al. 2000; Benca et al. 1992; Johnson et al. 2000). Sleep-related problems may be more common in children compared to adolescent (Gregory and Sadeh 2012).

However, some longitudinal studies have reported that sleep-disordered in early childhood are associated with a poorer health-related quality of life, psychological and behavior problems such as peer relationship and externalizing difficulties in mid-adolescence (Brand et al. 2015; Quach et al. 2018; Quach et al. 2009).

Aggressive behavior in adolescents is a complex phenomenon that encompasses multiple elements and manifests in a several forms. Among the variables associated to this phenomenon are personal traits, socio-emotional, and cognitive variables (Estevez et al. 2016, Calvete et al. 2016, Pellerone et al. 2016). Abraham and Freud first proposed that depression was as a result of the introjection of aggressive stimuli which had initially been addressed externally (Abraham 1960; Freud 1955). Depression and aggression are the main elements of the internalizing and externalizing syndromes, respectively. Therefore, it is plausible that the associations between aggression and depression represent a connection between the broadband externalizing and internalizing problems, rather a particular association between aggression and depression (Weiss and Catron 1994). It has been suggested that exposure to particular forms of family violence may lead to aggressive or anxious/depressed behaviors in young people. The exposure to violence may be further differentiated regarding to whether it implied physical actions of aggression or psychological (verbal) actions of aggression (Litrownik et al. 2003). In women it has been reported that the psychological victimization has a greater negative impact on them compared to physical victimization which was related with higher symptoms of stigma, depression, and loss of self-esteem (Lawrence et al. 2009). It has been shown that psychological victimization may be more significantly correlated with depression and anxiety for women in comparison with men; also feeling of depression was associated with being a casualty of psychological aggression for women versus men (Stets and Straus 1990). It has been suggested that the prevalence of aggressive behaviors and conduct disorders are higher in adolescents with depressive disorders (Knox et al. 2000; Mccracken et al. 1993). There is accumulating evidence that there is a high prevalence of anxiety disorder (6.8% to 85%) (Quach et al. 2009) and oppositional defiant disorder (4.45%) among Iranian children and adolescents (Mohammadi et al. 2016).

Family structure and cohesion, and stressful life events such as socioeconomic disadvantage, poverty, less-educated parents, may be linked to the development of affective disorders and mental health problems in children (BøE et al. 2012; BøE et al. 2018; BøE et al. 2014; Sivertsen et al. 2017). However in adults there have been inconsistent results. In one report, “depressive symptoms” were more prevalent in social classes I/II, though affective psychoses were most common in social class V (Hollingshead and Redlich 1958).

Controversially, another study found that individuals with professional jobs were more susceptibility to affective psychoses than agricultural workers (Kendell 1970). Miech et al. observed the relationship between depression and education heightens with increasing age (Miech and Shanahan 2000). Conflict in familial relationships, higher levels of stress due to the lower socioeconomic status can affect the plasticity of the hippocampus, amygdala, and prefrontal cortex—processes together pointed to as neuroplasticity. Thus, variations in the neuroplasticity of these brain structures can affect emotional expression and regulation (Mcewen and Gianaros 2010). Furthermore, stressful life events in low-SES persons may stimulate the hypothalamo-pituitary-adrenal axis, which activates a cascade of neuroendocrine fluctuations which contributed in depression and hopelessness (Pickering 1999).

It has been suggested that income and parental education have protective effects against depression among adolescent women. It may be that education increases resilience to life stress events and therefore provides toughness. Income’s pathway may associate more to material goods which would not serve buffering systems for depressed teenagers (Goodman and Huang 2001).

Sleep patterns, well-being and psychological functioning of parents and their adolescent children reveal similarities and closely inter-related (Kalak et al. 2012; Brand et al. 2009; Bajoghli et al. 2013).

Hence depression, aggression and sleep problems are important problems in adolescence and there have been few studies that have evaluated the association between depression, aggression and sleep difficulties in the adolescent population (Cuffe et al. 2005). The aim of this exploratory study was to fill these research gaps by: 1) investigating the prevalence of these conditions and their inter-associations as well as 2) effect of socioeconomic status on these conditions in adolescent girls. The accumulating evidence for higher depression rates in women than men independent of culture, age groups, and region (Mirotnik 1998; Nolen-Hoeksema 1990; Inaba et al. 2005); so we only recruited girls for a simpler design.

The primary hypothesis was that scores for aggression, depression and sleep symptoms are related and may occur together more frequently than by chance, in adolescent girls.. A secondary hypothesis was that socioeconomic status of the parents of these girls, evaluated by the proxy indicators such as employment/occupation status and educational attainment, as well as family structure assessed by surrogate indicators such as family members, and parents’-marital status, –divorce, –death may be associated with the symptoms of depression, aggression and sleep problems in adolescence. Our results may lead to better understanding of the developmental progression of difficulties, assist researchers and physicians in the early diagnosis, prevention, treatment and management of these conditions and finally lower the prevalence of these disorders.

Methods

Study Population

This was a cross sectional study of 940 adolescent students aged 12–18 years old in January 2015, as described previously (Bahrami et al. 2018; Khayyatzadeh et al. 2017). Briefly, participants were recruited from six geographic areas in two cities in northeastern Iran (Mashhad and Sabzevar), using a multi-stage cluster sampling way. Four high schools from each of the six geographic areas were selected, and one class from each grade (3 classrooms from each school) was randomly chosen for inclusion. In each classroom nearly 15 students included. Schools, classes and students were recruited using computer-generated random numbers. Inclusion criteria were: an age between 12 and 19 years old, single, healthy (without acute or chronic disease), and written informed consents. A total of 1026 adolescents were initially recruited; of whom 940 met the inclusion criteria. All study protocols were approved by the Ethics Committee of Mashhad University of Medical Sciences. Participation of subjects was voluntary and written informed consent was obtained from subjects and their parents. All data were collected by two expert interviewers by direct interview and questionnaires.

Emotional Function Test

Depression

In order to assess the degree of depression, subjects were asked to complete Beck Depression Inventory II questionnaire (Beck et al. 1996). Subjects who scored 0–13 were considered to have no or minimal depression, 14–19 to have mild depression, 20–28 to have moderate depression and subjects who scored 29–63 were considered to have severe depression. The validity of BDI Persian version with high internal consistency (Cronbach's $\alpha = 0.87$) and test-retest reliability ($r = 0.74$) was established in Iranian students (Mohammadi 2006). In the present study, Cronbach's alpha was determined to be 0.87.

Aggression

The Buss-Perry Aggression Questionnaire (BPAQ) is a 29-items questionnaire which evaluating four aggression scores including physical aggression, verbal aggression, anger and hostility with 5-point rating system was used to determine the aggression level of the subjects (Elliott et al. 2007). A high BPAQ score indicates increasing aggression. Test-retest reliability and validity of this questionnaire (range of intra-class correlation coefficient for six subscales is 0.73–0.91 and Cronbach's Alpha was 0.79–0.91) which has been verified among the Iranian population (Motevalian et al. 2011). All

of the subscales had good reliability in the current sample, with a Cronbach's alpha of 0.77–0.88.

Sleep Assessment

Insomnia

Insomnia Severity Index (ISI) was used to assess the severity of insomnia (Morin 1993) using a validated Persian version (Cronbach's alpha >0.8 and intra-class correlation coefficient >0.7) (Yazdi et al. 2012). This questionnaire has 7-items with 5-point Likert rating scales from 0 (=not at all) to 4 (=very much). Based on ISI, cases with score of 0–7 have no clinically significant insomnia, others are categorized as mild (score of 8–14), moderate (15–21) and severe (22–28) insomnia. In the current sample, reliability was assessed by Cronbach Alpha which was 0.84.

Day Time Sleepiness

We also asked the participants to complete the Epworth Sleepiness Scale (to assess the day time sleepiness) (Johns 1991) which confirmed the validity and reliability for Iranian subjects (Cronbach's alpha = 0.8 and intra-class correlation coefficient = 0.8) (Haghighi et al. 2013). Total scores of the Epworth Sleepiness Scale (ESS) range from 0 to 24, and are interpreted as follows; normal (<10), mild to moderate obstructive sleep apnea (10–16), severe obstructive sleep apnea or narcolepsy (16 $>$). In the present sample, Cronbach's alpha was 0.70.

Sleep Apnea

STOP-Bang sleep apnea questionnaire was used for further evaluation of sleep apnea (Chung et al. 2008). This scoring model consisting of eight questions and is scored based on Yes/No answers (score: 1/0). Total scores range from a value of 0 to 8 which classified as; low risk (0–2), intermediate risk (3–4), and high risk (5–8). This questionnaires were translated into Farsi, and their validity and reliability were previously confirmed (intra-class correlation coefficient = 0.88) (Sadeghniaat-Haghighi et al. 2015). In the current sample, Cronbach's alpha was 0.71.

All of mentioned questionnaires were double checked to ensure all items were completed by participants. Any missing data followed by telephone to subjects.

Family Structure and Socioeconomic Status

In terms of family characteristics and socio-economic status, data were collected using a standard questionnaire that was formerly validated in the Progress in the International Reading Literacy Study (PIRLS) for Iran (Martin et al. 2007).

Regarding socio-economic characteristics, the highest maternal and paternal education attainments were assessed separately with three response choices; ‘basic (≤ 9 years)’, ‘intermediate (10–12 years)’, and ‘College/University (≥ 13 years)’. Furthermore, parent’s occupation was evaluated by asking parents to report their job by selecting one of the following response options:

Mother’s occupation: worker; employee; housewife; other; deceased.

Father’s education: worker; employee; tradesmen market; spiritual; other; deceased.

Other questions include type of house (Apartment or Independent home) and exclusive room (Yes or No).

In terms of family structure, participants were asked to report parent death (Yes or No) parent divorce (Yes or No). Participants also reported “with whom currently lives or roommate” with the response following options given: father and mother, father, mother, or other family. Also, they informed rate of family members by choosing following response: (2–4), (5–7) or (>8).

We have previously demonstrated that age, passive smoking, BMI and menstruation can affect emotional function, depression and aggression scores (Bahrami et al. 2017; Khorasanchi et al. 2018). So, demographic data, body mass index (BMI) and other information related to menstruation and having chronic disease (such as kidney disease, liver disease, thyroid disease and etc.) as potential confounders were also gathered or measured.

Statistical Analysis

All of assessed variables that were normally distributed were analyzed using parametric statistical tests. Descriptive statistics such as means and standard deviations as well as frequency and percentages are provided. Levene’s test for the homogeneity of variances between groups for all measures indicated variances were similar ($p > 0.05$) for all measures. Analysis of variance (ANOVA) and post hoc Turkey’s or independent-sample t-test were performed to compare scores for depression, aggression, insomnia, day time sleepiness and sleep apnea in different groups. Insomnia and sleepiness scores were logarithmically transformed (\log_{10}) before the analysis to obtain a normal distribution. The subjects with and without depression were compared using independent t-tests, and a linear regression model was applied to evaluate independent predictors (aggression score, insomnia score, sleepiness score, and sleep apnea score). The intra-cluster correlations at both the school and classroom levels are relatively small. So, we did not perform multi-level analysis. Indeed, we applied conducted two-sided, and P value below 0.05 was considered statistically significant. Statistical analyses were done with SPSS version 16.0 (SPSS Inc., Chicago, Ill., USA).

Results

A total of 940 adolescents aged 12–18 were enrolled. The mean age of the participants was 14.56 ± 1.53 years and the mean body index of them was 21.18 ± 4.3 (kg/m²). A summary of the depression, aggression, and sleep disorder scores are shown in Table 1. Of the whole group, 306 (32.6%), 216 (23.0%), 222 (23.6%) and 2 (0.2%) of subjects had some degree of depression, insomnia, sleepiness and sleep apnea, respectively. Regarding concordance, 75 (8%) had some degree of both depression and insomnia, 37(4%) had some degree of both depression and sleepiness, 21(2.3%) had some degree of both insomnia and sleepiness, and 39 (4.2%) were suffer from degree of depression, insomnia and sleepiness (data not shown).

Demographic and socio-economic characteristics of participants in relation to scores of depression, aggression, insomnia, day time sleepiness and sleep apnea are shown in Table 2.

Levene’s test showed that variances are equal ($p > 0.05$) for all measures. We did not identify outliers in any of the measurements apart from insomnia; but outliers of insomnia were real and would be in mean $\pm 2SD$ intervals, so we did not neglect them.

When participants were stratified based on age, only severity of sleepiness was significantly different between age

Table 1 Summary of the depression, aggression, insomnia, day time sleepiness and sleep apnea scores amongst the participants ($n = 940$)

Measurements	Mean \pm SD Number	(range) (%)
BDI-II Depression score	10.51 \pm 9.20	(4.0–16.0)
No or minimal depression, n	634	(67.4%)
Mild depression, n	149	(15.8%)
Moderate depression, n	117	(12.4%)
Severe depression, n	40	(4.3%)
Aggression score	78.23 \pm 20.13	(63.0–93.0)
Physical aggression Score	27.52 \pm 6.55	(23.0–32.0)
Verbal aggression Score	25.63 \pm 7.55	(20.0–32.0)
Anger Score	22.72 \pm 6.76	(18.0–28.0)
Hostility Score	28.35 \pm 9.92	(23.0–34.0)
Insomnia Severity Index (ISI)score	3.76 \pm 5.57	(0–7.0)
No clinically significant insomnia, n	724	(77.0%)
Sub threshold insomnia, n	163	(17.4%)
Moderate insomnia, n	47	(5.0%)
Sever insomnia, n	6	(0.7%)
Severity of sleepiness score	6.2 \pm 4.35	(3.0–9.0)
Normal, n	718	(76.4%)
Mild to moderate sleep apnea, n	206	(21.9%)
Severe sleep apnea or narcolepsy, n	16	(1.7%)
Sleep Apnea score	0.63 \pm 0.54	(0–1.0)
Low risk, n	938	(99.8%)
Intermediate risk, n	2	(0.2%)
High risk, n	0	(0%)

Table 2 Demographic and socio-economic characteristics of participants in relation to scores of depression, aggression, insomnia, day-time sleepiness and sleep apnea

Variables category	Figure in brackets indicates % of total group in category	Depression score	P value	Aggression score	P value	Insomnia severity score	Sleepiness severity score	P value	Sleep apnea score	P value
Age (years)	12-14 (53.4%) 14-16 (32.3%) 16-18 (14.2%) Yes (95.4%) No (4.6%) 2-4 (47.5%) 5-7 (48.7%) >8 (3.8%) Yes (52.9%) No (47.1%) Apartment (35.1%) Independent home (64.9%) Yes (4.2%) No (95.8%) Yes (4.5%) No (95.5%) Father & mother (92%) Father (0.9%) Mother (6.0%) Other family (1.1%) Worker (34%) Employee (18%) Tradesmen market (19.8%) Spiritual (0.8%) Other (27.1%) Deceased(0.3) Workert(0.9) Employees(4.1) Housewife (86.3%) Other (8.2%) Deceased (0.5%) 0-9(39.6%) 10-12(46.6%) >13(13.8) 0-9(47.7%) 10-12(38.5%) >13(13.8) Yes (8.7%) No (92.3%)	Ns	Ns	Ns	Ns	6.2±4.2 7.3±4.2 7.3±3.7 6.8±4.1 5.9±4.7 Ns	6.2±4.2 7.3±4.2 7.3±3.7 6.8±4.1 5.9±4.7 Ns	<0.001 ^α Ns	Ns	Ns
Pubertal	Yes (95.4%) No (4.6%)	Ns	Ns	Ns	Ns	Ns	Ns	0.035	Ns	Ns
Family members	2-4 (47.5%) 5-7 (48.7%) >8 (3.8%)	11.5±9.5 9.9±8.7 8.5±8.6	0.01 ^β	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Exclusive room	Yes (52.9%) No (47.1%)	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Type of house	Apartment (35.1%) Independent home (64.9%)	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Parent death	Yes (4.2%) No (95.8%)	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Parent divorce	Yes (4.5%) No (95.5%)	13.3±9.4 10.4±9.1	0.04	Ns	Ns	Ns	Ns	8.0±4.9 6.6±4.0	0.03	Ns
Roommate	Father & mother (92%) Father (0.9%) Mother (6.0%) Other family (1.1%) Worker (34%) Employee (18%) Tradesmen market (19.8%)	Ns	Ns	Ns	Ns	3.9±5.6 10.7±6.2 3.3±4.7 4.9±7.2	0.003 ^γ	Ns	Ns	Ns
Father's Occupation	Worker (34%) Employee (18%) Tradesmen market (19.8%) Spiritual (0.8%) Other (27.1%) Deceased(0.3) Workert(0.9) Employees(4.1) Housewife (86.3%) Other (8.2%) Deceased (0.5%)	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Mother's occupation	Housewife (86.3%) Other (8.2%) Deceased (0.5%)	Ns	Ns	Ns	Ns	4.7±5.9 9.2±1.4 3.8±5.4 3.4±5.0 12.7±9.3	0.004 ^λ	Ns	Ns	Ns
Father's education (year)	0-9(39.6%) 10-12(46.6%) >13(13.8)	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Mother's education (year)	0-9(47.7%) 10-12(38.5%) >13(13.8)	Ns	Ns	Ns	Ns	4.8±4.3 6.1±4.2 7.0±4.8	0.003 ^δ	Ns	Ns	Ns
Suffer from chronic disease	Yes (8.7%) No (92.3%)	Ns	Ns	Ns	Ns	5.5±6.1 3.6±5.5	0.001	7.6±4.1 6.1±4.3	0.001	Ns

P value obtained from one way ANOVA test and Post hoc Tukey or independent-sample t-test; Ns: Non-significant

α:significant between category 1 and 2, category 1 and 2 of age

β:significant between category 1 and 2 of family members

γ:significant between category 1 and 2, category 2 and 3 of roommate

λ:significant between category 3 and 5, category 4 and 5 of Mother's occupation

δ: significant between category 1 and 3, category 2 and 3 of Mother's education

Bold values are remained significant even after bonferroni corrections

groups ($p < 0.01$) which was lower in early adolescent compared to mid- and late adolescents. Girls who had been through menarche had significantly higher sleepiness severity compared to those that had not reached puberty ($p = 0.035$). Subjects who lived in small family groups (family member < 4) were found to be significantly more depressed than those living in large family (family member > 8) ($p = 0.01$).

Insomnia scores in girls from separated parents were significantly higher if the individuals lived with their father compared to those who lived with their mother, or those from unseparated families. Interestingly, depression, aggression, insomnia, day time sleepiness and sleep apnea scores was not related with type of home or number of rooms occupied among the study population ($P > 0.05$). Parental death did not affect depression, aggression, insomnia, day time sleepiness and sleep apnea scores, but girls with divorced parents had a higher depression and sleepiness scores compared to other groups (13.3 ± 9.4 vs. 10.4 ± 9.1 ; $p = 0.04$ and 8.0 ± 4.9 vs. 6.6 ± 4.0 ; $p = 0.03$, respectively). The educational or occupational status of the fathers was not associated with depression, aggression or the presence of sleep problems. However, the maternal education and occupation status was associated with sleepiness and insomnia scores.

Of the total group, 634 participants (67.4%) scored < 13 on the BDI-II questionnaire and were categorized as non-depressed; the others (32.6%) were considered to have some degree of depression (mild to severe). The mean aggression scores in the non-depressed and depressed participants were 72.9 ± 19.7 and 88.8 ± 17.8 respectively ($P < 0.01$). Log insomnia score, log sleepiness score and sleep apnea score were higher in girls with depression compared with non-depressed participants (Table 3). The linear regression analysis showed that all the variables including aggression score, insomnia score, day time sleepiness score and sleep apnea score may be predictors of depression ($R^2 = 0.234$) (Table 4).

Discussion

Depressive disorders are very common and are major causes of disability globally, causing impairment in inter-personal, social, and occupational functioning (Whiteford et al. 2013).

The prevalence of depressive symptoms may be as high as 30% in the general population and occurs more frequently in women (2:1) (Semple and Smyth 2013). Adolescents are more likely to suffer with irritability without excessive sadness compared to adults. Loss of positive affect which may present with sleep disturbance, lack of self-care, poor concentration, anxiety and lack of interest in everyday experiences is considered as the basic characteristic of depression (Sadock and Sadock 2011). In the current study, among 940 female adolescents with a mean age of 14.56 ± 1.53 year, 306 participants (32.6%) were considered to have depression (BDI score > 13). This is concordant with previous reports on prevalence which range from 20%–55% (Mori et al. 2014). Lewinsohn et al. have reported that among 1709 high school students (from 14 to 18 years), 23% of participants were considered to have major depressive disorder (MDD) of which 68.6% were females (Lewinsohn et al. 1998). In the aforementioned study, among the MDD symptoms, sleep disturbance was the most frequent symptom (13.9%), depressed mood was the second most frequent symptom (12.3%) and thoughts of death/suicide was the least frequent symptom (2.9%). The authors also reported that compared to depressed boys, depressed girls more often reported weight/appetite disturbance (77.0% vs. 58.5%) and worthlessness/guilt (82.5% vs. 67.5%). In females, the origin of depression is often temporally associated to menstruation (Patton et al. 1996) possibly due to the hormonal mechanism. Adolescent girls experience a significant increment in a subtype of depression associated with anxiety, sleep/appetite changes and fatigue (Silverstein 1999).

In a comprehensive systematic review of studies published between January 1990 and October 2010, reporting on depression among undergraduate university students, the authors found that the weighted mean prevalence of depression was 30.6% (Ibrahim et al. 2013).

In our study we also investigated the concurrence of depression and aggression which has also been suggested as a predictor of depression (Kazdin et al. 1983; Knox et al. 2000). Our results showed that the mean aggression scores in non-depressed and depressed participants were significantly different. Yang et al. on 5245 investigated Chinese university students, authors found that the depression scores correlated significantly with hostility, physical aggression, and anger in

Table 3 Associations between Depression, Aggression and Sleep disorders

Tests	Non-depression Score < 13 634 (67.4%)	Depression Score > 13 306 (32.6%)	t-score	P value
Aggression score(BeckII)	72.9 ± 19.7	88.8 ± 17.8	-12.1	< 0.001
Log insomnia score(ISI)	1.9 ± 0.6	2.2 ± 0.6	-5.5	< 0.001
Log sleepiness score(ESS)	1.8 ± 0.6	2.1 ± 0.5	-6.5	< 0.001
Sleep apnea score(Stop Bang)	0.55 ± 0.50	0.80 ± 0.53	-5.9	0.037
By using independent t-test.				

Table 4 Linear regression of depression, and other dependent variables

Dependent variables	Beta Coefficient	R ²	SE	CI	P value
Aggression score	0.144	0.104	0.013	0.118–0.170	<0.001
Log insomnia score	0.308	0.010	0.74	0.207–0.385	<0.001 ^α
Log sleepiness score	0.209	0.007	0.067	0.075–0.340	0.005 ^β
Sleep apnea score	1.360	0.006	0.504	0.371–2.349	0.007

α: Adjusted for roommate, mother's occupation and suffer from chronic disease

β: Adjusted for age, pubertal, parent divorce, mother's education and suffer from chronic disease

both genders and among female participants verbal aggression scores correlated strongly with depressive scores ($r = 0.985$, $p < 0.05$) (Zhang et al. 2014).

In our population, 23.0% had some degree of insomnia and 222 (23.6%) reported mild to severe sleepiness. Different factors have been suggested as risk factors, predictors and contributors to depression. The interaction between sleep complaints and psychiatric illness suggested a remarkable critical aspect of child and adolescent associated mental health. The association between sleep and mood/anxiety problems is complicated and also bidirectional. Sleep disturbance are a diagnostic criterion of depressive or anxiety disorders, but insomnia is also believed to cause both depressive and anxiety disorders (DSM 5; American Psychiatric Association. 2013; Gillin 1998). Baglioni et al. in their meta-analysis evaluated 21 longitudinal epidemiological studies simultaneously investigating insomniac complaints and depressed psychopathology (Baglioni et al. 2011). Their results showed an overall odds ratio for insomnia to predict depression of 2.10 (95%CI: 1.86–2.38) and they concluded that non-depressed people with insomnia have a two-fold risk to develop depression, compared to people with no sleep difficulties. The authors suggested that early treatment programs for insomnia might reduce the risk for developing depression in the general population. Our results also indicate significantly higher insomnia and sleepiness score in students with depression, and that insomnia and sleepiness might be considered as a positive predictor of depression (β -coefficient = 0.394; $p < 0.001$ and β -coefficient = 0.189; $p = 0.05$, respectively). Results from a community-based, two-wave cohort study reported that sleep deprivation was a strong risk for major depression (~3-fold) among adolescents (Roberts and Duong 2014). In another study performed on 60 patients with obstructive sleep apnea syndrome (OSAS) excessive daytime sleepiness (EDS) and depression (Akashiba et al. 2002) were evaluated. ESS and self-rated depression scale (SDS) were impaired in patients with OSAS compared to the control group. We also found that sleep apnea score is significantly higher in depressed participants (0.8 ± 0.5 vs. 0.5 ± 0.4). Our results suggest that sleep apnea might be considered as a predictor of depression (beta-coefficient = 1.36, $p = 0.001$). Bixler and colleagues assessed the association between EDS and sleep apnea in 1741 participants (Bixler et al. 2005). Their results indicated that

depression was the most significant risk factor for EDS followed by BMI, age, sleep duration, diabetes, smoking and sleep apnea. Considering these results together with our own, it may be suggested that excessive daytime sleepiness almost always co-occurs with depression, although longitudinal studies are required to confirm this. The relationship between sleep, and behavioral-emotional difficulties seem to be reciprocal, with sleep disturbance triggering emotional and behavioral problems; and, mood complaints, irritability, concern, violence and aggression compromising sleep patterns (Gregory and Sadeh 2012).

We also evaluated the association between demographic and socio-economic/family characteristics of participants with depression, aggression, and sleep disorders. Subjects who lived in small family units were had a significantly higher depression score than those from large family units. It seems that large family with a larger number of children, provided environment for child that was happier, possibly due to the affection and intimacy among siblings. In small families for example single child families, children experienced more loneliness and less contentment. However, insomnia score of girls from divorced parents differed dependent on which parent they lived with; those living with their father had significantly higher insomnia scores compared to those live with both parents, only mother or other family. Girls from divorced parents had higher depression and sleepiness scores compared to others without it. It also is plausible that single-parent status acts as a proxy for other known risk factors of mental health problems. A previous study reported that girls tend to have greater emotional troubles following parental divorce (Zaslow 1988). Adolescents from single-parent homes are more prone to affect sleep disorders, because of feelings of insecurity in home environment. Lack of security in the home may lead to sleep disruption (Troxel et al. 2014). Family structure and processes are crucial for the regulation of healthy sleep patterns in school-aged children (Mannering et al. 2011; Kelly and El-Sheikh 2011). Marital conflict can disturb both the quality and quantity of sleep (El-Sheikh et al. 2006). Gregory and coworker found a mild but significant longitudinal relationship between family conflict and insomnia at late adolescents (Gregory et al. 2006). Several studies have previously reported that divorce, separation, or parent loss are significantly risk factors for sleep disruption such as insomnia,

daytime sleepiness, more frequent weekend napping and the need to of sleeping medications (Hara et al. 2004).

In spite of the previous studies of this issue, the explanations why divorce has prolonged emotional effects are not completely understood. It has been suggested that divorce is worrying for children because it is accompanied by and is the origin for other problems and stresses such as chronic family conflict and economic hardship which enforce more desperate threats for well-being of offspring.

However, maternal education and occupation affects sleepiness and insomnia scores, respectively. It has been reported previously that sleep disruption is greater with falling socioeconomic status. Low levels of education and family income were significantly associated with manifestation of insomnia in a large population study of adolescents (Sutton et al. 2001). But, Von Ruden et al. reported parental education was related to psychological and emotional wellbeing in children, but this was not the case in the adolescents (Von Rueden et al. 2006) and Huisman and coworkers demonstrated that only maternal education was connected with externalizing problems (Huisman et al. 2010). Sleep phase delay is considered to be a normal physiological phenomenon at the onset of puberty (Carskadon et al. 2004). However, we found that higher educational attainment of mother (>13 years) was related to higher levels of sleepiness score which may be due to the higher education related to mother's occupation and possibly these mothers experienced more psychosocial stress from the heavy workloads which may be of importance for their children's sleep quality. On the other hand, many parents may be oblivious of their adolescent's sleep needs and how many hours sleep their children really are getting. Indeed, many parents go through poor sleep model such as uneven sleep time tables, sleep late on weekends, and falling sleep with the television on in the bedroom (Meltzer and Mindell 2006). Behavioral contracts to change inappropriate sleep pattern may be an effect approach in assisting children and their families target sleep behaviors.

Our results must be interpreted cautiously due to some limitations of this study. Our items related to sleep, mood and aggressive behavior probed whether individuals had experienced symptoms usually every day during the past 4 weeks. Thus, we were not able to recognize either the date of onset and therefore grouping our population into those with acute compared to those suffered long-term from these disorders. Furthermore, we did not interview parents about emotional and behavior of their children, because previous reports suggest a significant contradiction in parent-child rated problems. Also, We did not to perform multi-level modeling in our analysis due to the lack of any correlation between them. Finally, the cross-sectional design cannot prove causality.

Our study showed that the emotional, behavioral and sleep disorders are possibly related to demographic and socioeconomic characteristics of individuals. Also, aggressive behaviors, insomnia, day time sleepiness and sleep apnea are significantly more frequent in depressed individuals. Also all of these may be considered as predictors of depression. In order to

elucidation the relationships emotional and behavioral and sleep difficulties, further prospective and intervention studies are needed to examine the of underlying mechanisms and possible linkage between them as well as it is of great importance to identify the subjects at risk, since diagnosis and adequate treatment of their depression may prevent behavioral and sleep outcomes. Furthermore, the impact of family characteristics on sleep may reflect confounding environmental factors, hence further studies are needed to address specific determinants of the home and neighborhood environment that may be goals for interventions to improve sleep, like home density, number of person sharing sleeping space, or parental shift work schedules.

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Data Availability The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the Mashhad University of Medical Science (Code: 931188) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Consent for Publication Not applicable.

Competing Interests The authors declare that they have no competing interests.

Abbreviations *BPAQ*, Buss-Perry Aggression Questionnaire; *BMI*, Body mass index; *EDS*, Excessive daytime sleepiness; *ESS*, Epworth Sleepiness Scale; *ISI*, Insomnia Severity Index; *MDD*, Major depressive disorder; *OSAS*, obstructive sleep apnea syndrome; *SDS*, Self-rated depression scale

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