The Relationship Between Sleep Quality with Body Mass Index and Blood Lipid Level in Adolescents

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BACKGROUND AND AIM: Inadequate sleep can lead to serious problems within physical and mental. The main purpose of this study is to investigate the correlation of sleep quality with Body mass index (BMI) and blood lipids level in adolescents.

METHODS: The main purpose of this study is to investigate the correlation of sleep quality with Body mass index (BMI) and blood lipids level in adolescents. In this descriptive cross-sectional study, 310 adolescents in age range of 15-20 years old were selected randomly. Data collection instruments include two questionnaires. For purpose of data analysis, SPSS21 and descriptive and inferential statistical methods have been applied.

RESULTS: Among adolescents, 11.3% have high triglyceride levels; 5.8% have high cholesterol level; 30% have High density lipoprotein (HDL) lower than 40 and 4.5% have Low density lipoprotein (LDL). The correlation between lipid profile and BMI with sleep quality is measured. In boys, LDL and sleep quality showed significant correlation; although in girls, the correlation was not observed. The correlation between BMI and sleep quality has been observed only in girls in final period of adolescence (P value=0.041).

CONCLUSION: According to obtained results, there is insignificant correlation between sleep quality and cardiovascular risk factors and significant correlation is observe only between sleep quality and LDL in boys and BMI in girls in final period of adolescence. It seems that sleep quality and cardiovascular risk factors are mostly under effect of other factors that should be considered. Through recognizing factors affecting the disorders, they could be reduced or inhibited.
The statistics have been higher than American 12-19 years old adolescents (20.3%) [9]. In addition to blood lipid disorders, obesity is also one of the most important risk factors of coronary arteries [3]. Adolescence is an important age for development of obesity [10]. During 2 past weeks, prevalence of obesity in children and adolescents has been significantly increased across the world [11], so that the value has reached to 31.8% by 2010 [12] and the value is about 30% in Asian countries [13]. As adolescents of the current world form adult population of future, future adults would be more successful [14]. Two important health problems of adolescents presented by American Medical Association for Children leading to diseases in adulthood include obesity and hyperlipidemia that can enhance risk of cardiovascular diseases in adulthood [3]. Similar studies in field of investigating the relationship between sleep quality and blood lipid with BMI have been conducted in countries such as America [15], Brazil [16], Switzerland [17], New Zealand [18], China [19] and Norway [20] with different results. In some studies, sleep has been in significant correlation with BMI and blood lipid [11,15,19,20]. In other studies, no correlation was observed [16,21-23]. In this regard, study of Azadbakht et al. showed that there is significant correlation between reduction of sleep time and increase in LDL and triglyceride; although there was no correlation between short time of sleep and increased BMI [24]. According to different results in different studies, scholars have decided to investigate the relationship between sleep quality with BMI and blood lipid in Ahvaz. Through reflecting the results of these studies to relevant authorities to use relevant strategies to meet relevant problems of wrong lifestyles of today's adolescents, implementation of such models can optimize effective costs for medical systems and institutes.

Methods

In this descriptive-analytical study, statistical population consists of all adolescents of 15-20 years old in Ahvaz City. 310 adolescents were selected using cluster sampling. From 25 health centers, 6 centers (2 centers in west and 4 in east) were selected randomly. After getting permission of Research Deputy of Medical University of Jundishapur of Ahvaz/Iran, the author entered to determined health centers, through investigating records of families with adolescents in 15-20 years old, several records were selected randomly. They were referred as cluster head and then, the families to level of 40 families were invited to participate in this study in case of having adolescents and agreed to be present in this project. In regard with details and goals of the study and data collection, data and written consent was received from the parents or adolescents based on volunteer participation in this study. Also, the participants were asked to be in fast 1 night before presence in health centers (12hrs before). After presence of adolescents in determined health centers, two questionnaires were fulfilled using interview by the author.

The first questionnaire was related to demographic and family information of adolescents to investigate age, gender and other personal factors. The second questionnaire has been Pittsburg Sleep Quality Inventory (PSQI). The inventory has measured sleep quality during 4 last weeks. Then, BMI indices like height and weight were measured. Weighting was done using Sika scale (made in Germany) with least clothes and without shoes with accuracy of 0.5cm. Weight was measured based on kg and height was measured per cm. For purpose of sampling, 5cc blood was extracted from their cubital artery. For purpose of coagulation, samples were remained in ambient temperature for 20min and then, tubes containing samples were centrifuged for 10min with 3000rpm and the isolated serum was placed in a separated micro tube and amount of triglyceride, HDL, LDL and blood cholesterol was measured. The data processing was done using SPSS21 and using descriptive and inferential statistics. Using descriptive statistics, frequency percent, standard deviation and mean values were obtained. Inferential statistics (chi square, Fischer, Mann Whitney, Kruskal-Wallis) have been also used to investigate and compare status of obtained mean values of lipid profile and BMI based on sleep quality. Significance level of tests (P<0.05) is specified with probability level of 95%.

Results

In this study, 310 adolescents in age range of 15-20 years old are studied and 52.3% of them were male. Mean age range of participants has been equal to 17.46±1.5. Half of adolescents were in age range of 15-17 and half of them in age range of 18-20. Among adolescents, 11.3% had high triglyceride level; 5.8% had high cholesterol; 30% had abnormal HDL and 4.5% had increased LDL (Table 1). In order to investigate sleep quality with BMI and lipid profile, chi square test is used and to compare mean value of sleep quality between different levels of BMI and lipid profile, Kruskal-Wallis test is used. Kruskal-Wallis test was used to compare mean value of sleep quality in different levels of LDL and significant difference was observed among 3 groups of studied samples (p=0.048). Through comparing mean values of the 3 groups using Mann Whitney test, significant difference was observed (p=0.013) (Table 2). However, significant correlation was observed between lipoprotein and low density and sleep quality (pvaleur=0.022) (Table 3). In boys and girls, separated for adolescence, significant correlation was observed in girls only between BMI and sleep quality (pvaleur=0.041) (Table 4).
### Table 1: Frequency of demographic variables of the studied samples.

| Percentage | Number | Background variables |
|------------|--------|----------------------|
| 52.3       | 162    | Male                 |
| 47.7       | 148    | Female               |
| 50         | 155    | 15-17                |
| 50         | 155    | 18-20                |
| 62.9       | 195    | Arab                 |
| 26/1       | 81     | Persian              |
| 11         | 34     | Other                |
| 6.1        | 19     | Primary              |
| 9          | 28     | Secondary            |
| 77.7       | 241    | High school          |
| 7.1        | 22     | University           |
| 4.8        | 15     | Underweight          |
| 80         | 248    | normal               |
| 9.7        | 30     | Overweight           |
| 5.5        | 17     | Obese                |
| 65.8       | 204    | normal               |
| 22.9       | 71     | borderline           |
| 11.3       | 35     | abnormal             |
| 79         | 245    | normal               |
| 15.2       | 47     | borderline           |
| 5.8        | 18     | abnormal             |
| 38.7       | 120    | normal               |
| 31.3       | 97     | borderline           |
| 30         | 93     | abnormal             |
| 84.2       | 261    | normal               |
| 11.3       | 35     | borderline           |
| 4.5        | 14     | abnormal             |

### Table 2: The mean score of sleep quality in different groups of BMI and lipid profiles and the relationship between sleep quality and these variables.

| P-value | Bad sleep quality | Good sleep quality | P-value | Average numeral sleep quality | Classification | variables |
|---------|-------------------|--------------------|---------|-------------------------------|----------------|-----------|
| 0.234   | 46.7(7)           | 53.3(8)            | 0.420   | 4.5±3±0.04                   | underweight    | BMI       |
| 0.815   | 46.7(14)          | 53.3(16)           | 0.330   | 4.5±3±0.33                   | Overweight     | Triglyceride |
|         | 70.6(12)          | 29.4(5)            |         | 5.3±1±1.86                   | Obese          |           |
| 0.925   | 45.6(93)          | 54.4(111)          | 0.835   | 4.66±2±88                    | Normal         | Cholesterol |
|         | 46.5(33)          | 53.5(38)           |         | 4.9±3±2.38                   | Borderline     |           |
|         | 51.4(18)          | 48.6(17)           |         | 5.3±2±2.57                   | Abnormal       |           |
| 0.314   | 46.1(113)         | 53.4(132)          | 0.048   | 4.96±3±2.96                  | Normal         | HDL       |
|         | 48.9(23)          | 51.1(24)           |         | 5.2±3±1.66                   | Borderline     |           |
|         | 44.4(8)           | 55.6(10)           |         | 5.1±2±2.63                   | Abnormal       |           |
Table 3: Distribution of sleep quality in studied samples with different lipid profiles based on age and gender.

| lipid factors | Age | sleep quality | Boys | Boys | Boys | Girls | Girls | Girls |
|---------------|-----|---------------|------|------|------|-------|-------|-------|
|               |     | classification | Normal | Borderline | abnormal | Normal | Borderline | abnormal |
| Triglyceride  | 15-17 | good          | 34(60.7) | 18(81.8) | 6(50) | 26(51) | 3(30) | 4(100) |
|               | 18-20 | Bad            | 22(39.3) | 4(18.2) | 6(50) | 25(49) | 7(70) | 0(0)   |
| Cholesterol   | 15-17 | good          | 51(66.2) | 7(53.8) | 0(0)  | 23(46) | 9(64.3) | 1(100) |
|               | 18-20 | Bad            | 26(33.8) | 6(46.2) | 0(0)  | 27(54) | 5(35.7) | 0(0)   |
| HDL           | 15-17 | good          | 36(58.1) | 2(50) | 6(100) | 24(42.9) | 10(62.5) | 2(18.2) |
|               | 18-20 | Bad            | 14(56) | 11(57.9) | 19(67.9) | 20(43.5) | 8(40) | 8(47.1) |
| LDL           | 15-17 | good          | 56(68.3)* | 2(25) | 0(0)  | 26(48.1) | 6(66.7) | 1(50) |
|               | 18-20 | Bad            | 26(31.7) | 6(75) | 0(0)  | 28(51.9) | 3(33.3) | 1(50) |

Table 4: Distribution of sleep quality in studied samples with different BMI based on age and gender.

| sleep quality | Boys | Boys | Boys | Boys | Girls | Girls | Girls | Girls |
|---------------|------|------|------|------|-------|-------|-------|-------|
|               | Under weight | normal | obese | Over weight | Under weight | obese | Over weight | obese |
| Good          | 4(66.7) | 42(64.6) | 9(75) | 3(42.9) | 2(50) | 28(51.9) | 2(40) | 1(50) |
| Bad           | 2(33.3) | 23(35.4) | 3(25) | 4(57.1) | 2(50) | 26(48.1) | 3(60) | 1(50) |
| Good          | 1(50) | 25(40.3) | 2(33.3) | 0(0) | 1(33.3)* | 42(62.7) | 3(42.9) | 1(16.7) |
| Bad           | 1(50) | 37(59.7) | 4(66.7) | 2(100) | 2(66.7) | 25(37.3) | 4(57.1) | 5(83.3) |

Discussion
Defect in blood lipid and obesity is under effect of lifestyle. One of the most important components of human lifestyle is sleep and resting [25]. Obtained results from this study with the purpose of determining correlation between sleep quality and BMI and blood lipid level in adolescents of Ahvaz, no significant correlation was observed between sleep quality and other variables. However, there has been significant correlation between sleep quality and BMI in girls in end period of adolescence and between sleep quality LDL in boys. Moreover, according to obtained results from this study, about half of adolescents had inadequate sleep quality; about 1 sixth of adolescents suffered from obesity and 40.3% of adolescents had at least one lipid disorder. In this study, according to information of Centers of disease control and prevention (CDC), prevalence of thinness has been equal to 4.8%, normal weight to 80%, overweight to 9.7% and obesity has been equal to 5.5%. Obesity and overweight have been increased to .6% and decreased to 0.4% in this study compared to 2009-2010 in study of Latifi [8]. In study of Klishadi et al. prevalence of thinness, overweight and obesity in 6-18 years old Iranian children has been obtained to 13.9%, 8.8% and 4.5% based on CDC [26]. In this study, prevalence of overweight and obesity is obtained respectively to 9.7% and 5.5% based on CDC, showing that prevalence of overweight and obesity in these adolescents (4.8%) is lower than prevalence of thinness in level of country. The observed difference in prevalence of overweight and obesity in adolescents may be because of lifestyle.
and their nutrition patterns. In a study in Kibris (2010), prevalence of obesity and overweight based on International obesity task force (IOTF) has been respectively obtained to 8.1 and 20.1% [27]. In study of Mota in Portugal and study of Spinker in European countries, prevalence of obesity based on classification of BMI in adults is in consistency with findings of this study [22,28]. According to expansion and geographical difference and different lifestyles in different cities of Iran and in different countries, different results have been obtained. Moreover, factors such as nutrition status and education level of parents can also affect the results.

In this study, according to Academic American Pediatrics (AAP), triglyceride, cholesterol, increased LDL and decreased HDL have been respectively to 11.3%, 5.8%, 4.5% and 30% in adolescents of Ahwaz. In study of Latifi, the values are obtained to 9.5%, 24.8%, 3.1% and 2.6% [8]. Prevalence of triglyceride, abnormal LDL and decreased HDL is increased compared to 5 years ago, especially abnormal LDL and HDL has had high prevalence; although high cholesterol level has had downward process to 19% Prevalence in study of Hosseini Isfahani (glucose and lipid of Tehran Phase 3) has been respectively obtained to 6.5, 6.2, 5.65 and 45 [29]. Prevalence of triglyceride and increased LDL is more than Tehran’s adolescents and the differences can indicate racial and ethnic differences and lifestyles in these two cities. Moreover, time interval between the two variables can be reason for these differences. In this study, there was no significant correlation between sleep quality and BMI; although it was observed that in girls in end of adolescence, more numbers of obese or overweighted individuals had experienced inadequate sleep.

Obtained results from different studies in this filed are different from each other. In study of Yeelmaz in Turkey showed negative correlation between sleep and BMI [30]. In some similar studies like study of Mota, no significant correlation was observed between sleep quality and BMI [21,22], which is in consistence with results of the present study. In studies such as studies of Mushkovich, Los Lee, Kalamero, Sung and Cohort Robert on investigating sleep time [23,31-34], no significant correlation was observed. In study of Azadbakht in Iran showed that cholesterol level is in positive correlation with sleep duration among boys and long sleeping time can increase cholesterol level. Moreover, boys with sleep time more than 8hrs showed higher level of HDL [24]. In Korea, people with sleeping hours more than 10hrs had higher level of triglyceride and the correlations in boys were clearer than girls [35]. In study of Sung on obese adolescents, it was found that increase in sleep duration is in significant correlation with reduction of HDL, and increase in triglyceride [23], which is not in consistence with results of this study. It seems that other factors such as environmental factors play more effective role in regard with determining blood lipid level, BMI and sleep quality. It is suggested to measure effect of environmental factors on these variables in further studies. One limitation of this study is cross-sectional nature of the study that lack of causal relationship can be derived from it. Hence, it is suggested to measure the correlation between sleep quality with blood lipid and BMI in long-term form (Cohort).

Conclusion

Obtained results from this study in relation with determining the correlation between sleep quality with BMI and blood lipid level in adolescents showed no significant correlation between sleep quality and other variables. However, sleep quality in girls in end of adolescence is in correlation with BMI and with LDL in boys. In this study, it was observed that about half of adolescents suffer at least from one lipid disorder and inadequate sleep quality and about 1 sixth of adolescents suffer from overweight and obesity. According to obtained results from this study, it seems that adolescents should
be studied in terms of sleep quality and cardiovascular factors, so that their emergence can be reduced and they can be prevented through recognizing factors affecting the disorders.

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