The correlation between academic achievement, daytime sleepiness and sleep habits among students of the Faculty of health studies in Mostar

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Abstract

The objective of the study was to investigate sleep habits of students and examine their correlation with academic achievement. We investigated the relationship between the self-assessment of the level of daytime sleepiness and morningness-eveningness and the correlation of sleep habits with academic success. The study was conducted among 583 undergraduate students at the Faculty of Health Studies of the University of Mostar, Bosnia and Herzegovina [B&H]. The level of daytime sleepiness was tested with the Epworth Sleepiness Scale, morningness-eveningness was tested with the Morningness–Eveningness Scale and sociodemographic data of participants were obtained. Significant negative correlations between the morningness-eveningness and academic achievement were established, as the academic achievement of students was higher they were more morning types. The correlation of results on the scale of the level of sleepiness and the morningness-eveningness scale is significant and positive, the participants who expressed higher levels of daytime sleepiness were more evening types.

Key words: academic achievement, sleep habits, sleepiness, students

1. Introduction

The period of study is characterized by numerous obligations and duties that the students are exposed to and teaching and exams require concentration and readiness. The majority of students are under pressure and they also have a fear of failure and this sometimes results in psychological stress. Teaching activities and constant need for extensive and frequent learning lead to a reduction in free time and changes in eating habits and sleep patterns. Learning often extends to late night hours and thus shortens the sleep time resulting in poor sleep quality, daytime sleepiness and poor concentration. Cyclical changes of activities are the fundamental features of life and those changes are collectively called biorhythms. A cycle that lasts approximately one day has a circadian rhythm. The most important example of a biorhythm with a circadian rhythm is the sleep/wake cycle. Sleep has stages and each stage corresponds to a state of consciousness [or behavioural state] which is a set of physiological processes. The state of consciousness [or behavioural state] is defined by structure and interaction of those physiological processes. Furthermore, changes in the state of consciousness are followed by changes of physiological processes in the cerebral cortex which means that the electrical activity of the cerebral cortex is different in different phases and stages of the sleep/wake cycle [1]. At one end, there are individuals who have morning tendencies [morning types] and go to bed early, wake up early and show the maximum level of performance in early hours of the day, while on the other extreme there are individuals with evening tendencies [evening types] who will choose late night hours to go to sleep and late morning hours to wake up, and will reach their peak performances late in the afternoon or evening [2]. Several studies conducted on samples of adolescents and young people showed that evening types report on shorter sleep during weekdays, delayed bedtimes with extended sleep on weekends, increased sleepiness during the day, and many more sleep problems when compared to other circadian types [3–6]. Evening types also have a higher risk for depressive behaviour, suicidal thoughts and a lower positive impact [7–9].

1.1. Sleep

Sleep is a subject of many studies. Sleep is a biological need and all human beings sleep, from single cell organisms to the most complex ones. There are a number of rhythms that are shorter or significantly shorter than the day-night cycle. The day-night rhythm which lasts for approximately 24 hours is the fundamental synchronizer i.e. “time provider” for every biological fluctuation. Thus, this circadian rhythm that is mainly associated with the succession of day and night determines the alternation of activity and rest [10]. Night and day in humans and animals are related to the quite obvious and today exactly neuro-physiologically documented fundamental changes of the functioning of the central nervous system during sleep and wakefulness. Man is predestined for activity during day. Most people subjectively associate quality sleep with the feeling of freshness upon waking up and so often in the literature we find the notion of restful sleep and restitution [11]. Reduction of sleep quality results in various sleep disorders such as insomnia and this ultimately affects numerous physiological functions during wakefulness such as learning and memorization. The most common sleep disorder insomnia is often associated with bad mood and reduced functioning during the day [12]. A number of people are dissatisfied with sleep due to difficulties in falling asleep, maintaining sleep or untimely wake up [13]. Biological changes that happen during adolescence influence the regulation of sleep. There is a shift in evening melatonin secretion and more adolescents become evening types [14]. Sleep duration influences the health of children and adolescents. Shorter sleep is associated with low academic achievement, accidental injuries and obesity. A study published in 2009 showed that 91.9% of students had inadequate sleep duration. Lack of sleep leads to fatigue during the day and disturbs the concentration and it is associated with lower grades, increased levels of psychological stress and difficulties in communication with others. Some students also reported that they use sleeping pills, cigarettes or alcohol as sleeping aids. A significantly higher level of stress is associated with students who sleep less and these students are more susceptible to weight gain [15]. There are numerous changes in the pattern of wakefulness and sleep as children transfer from childhood to adolescence. The main objective of a study conducted in Korea in 2005 was to identify changes in adolescents that come with age. As students progressed through grades, they went to sleep later and woke up earlier. Later waking hours were observed during the weekends and there was an increasing difference in sleep hours on weekends when compared to the rest of the week. Older students had more daytime sleepiness, more difficulties with waking up and sleep, depressive behaviour and were evening types [16]. Sleep is most effective when it lasts for a few continuous hours after learning without long hours of wakefulness [17]. Chronic sleep deprivation significantly affects health, performance, behavioural safety, and financial situation. Shor-term consequences of sleep deprivation are reduced efficiency on various fields of functioning and constant state of caution, deterioration of memory and cognitive abilities, problems in personal relationships, poorer quality of life as well as workplace injuries and automobile accidents. In the long term, sleep disorders are associated with numerous serious illnesses such as hypertension, heart attack and stroke, heart failure, obesity, and mental problems [18]. The growth hormone in children and adolescents is triggered during sleep which makes sleep important for development in puberty. If there is sleep deprivation the brain cannot function properly which can negatively affect cognitive abilities and the emotional state. If sleep deprivation lasts long enough, it can reduce the body's resistance and increase the risk of developing chronic illnesses. In states of sleep deprivation effects of alcohol consumption are increased and there is a higher risk of accidents. Sleep deprivation is also dangerous for mental and physical health and can have a significant impact on the reduction of quality of life. A study conducted in Malaysia showed that students of medicine sleep less than the general population and this may be associated with poorer functioning during task performance, bad mood and a higher incidence of medical errors. The study showed a significantly higher degree of daytime fatigue among students during the clinical phase of their education and they were less satisfied with the quality of sleep and psychological condition which is considered a result of stressful clinical training [19].

1.2. Physiology of sleep

Wakefulness and different stages of sleep are determined by characteristic electroencephalographic [EEG] patterns recorded through the skull [20]. There are two types of sleep: sleep with non-rapid eye movement [NREM] and sleep with rapid eye movement [REM]. Both types of sleep have characteristic physiological changes. NREM represents 75-80% of total sleep time in adults. It consists of four stages as one goes into deeper sleep. The complete period from stage 1 to stage 4 and REM sleep is considered the cycle of sleep and sleep during night [ideally] typically includes several cycles [usually three to five], each lasting about 90 minutes. During a typical night, the nature of the cycles changes significantly [20]. It is often said that REM sleep has tonic and phasic components. Tonic REM activity usually consists of low-voltage EEG with significantly reduced skeletal muscle tonus which appears to mediate areas near the locus coeruleus. Phasic REM activity includes eye movements, periodic increase of muscle activity in the middle ear and episodic EMG activity [on generally suppressed EMG background]. This last activity seems to be in correlation with the content of dreams. REM periods usually end with short periods of alertness and/or re-transition into stage 2 of sleep [20].

1.3. Sleep, learning and memory

Learning and memory are examples of neuronal and synaptic brain plasticity which is the ability of the brain to dynamically adapt its structures and functions to new experiences. Depending on learning, the reorganization of cortical networks, disinhibition of neuronal structures, modification, and rearrangement of synaptic connections are neurophysiological examples of brain plasticity mechanisms in the creation and integration of memory during sleep/wake cycles [11]. Today, two models related to the connection between sleep and memory dominate on the neurophysiological level: the hippocampal-neocortical interactions theory and theory of synaptic homeostasis [21]. A common characteristic of these two models is that memory partially of fully forms processes during Non-REM sleep. However, it does not provide a satisfactory explanation for behavioural and functional neuroanatomical changes which indicates that processes during REM sleep also affect memory and memory integration [21]. The dual hypothesis indicates that processes in both stages of sleep, the Non-REM and REM, stimulate cascades of neurological processes that lead to memory and integration. Therefore, during Non-REM sleep, depending on the hippocampus, processes important for explicit or declarative memory are performed while during REM sleep, integration of procedural memory is performed [regardless of the hippocampus] [11]. According to type, memory is divided into: declarative or explicit and procedural or implicit. Declarative memory is a deliberate, conscious retrieval of information in memory and can be reported verbally. It includes sematic and episodic memory. Semantic memory refers to general knowledge and episodic memory refers to the memory of events that an individual has experienced. Implicit memory does not require conscious retrieval of data from memory. This type of memory includes for example memory of different motor skills. According to duration we distinguish: sensor, short-term and long-term memory. The dependence of declarative memory and sleep in children has been proven while the dependence of procedural memory still remains questionable [21].

1.4. Sleep habits of students

Quality sleep is essential for the health and well-being of an individual in the process of memory and learning. Many external and internal factors such as teaching and daily activities of students affect sleep habits which often lead to daytime sleepiness [22]. Inadequate sleep [insufficient sleep] is a major factor that affects mood and wakefulness, and sleep deprivation results in reduced neurocognitive and psychomotor capabilities [23]. Many studies focus their attention to sleep habits among students. Increased psychological pressure and academic requirements may lead to impaired quality and duration of sleep. Results of numerous studies have shown that students with regular alternation between sleep and wakefulness report on higher Grade Point Average [GPA], while students with lower GPA report on increased daytime sleepiness as a consequence of reduced sleep duration during the night [24–26].

1.5. Academic achievement

The level of acquired knowledge during education, academic achievement or the levels of proficiency are all important factors in an individual's life. Choice of future occupation depends on them as well as the possibility of future employment or education and the overall quality of future life. In studies on education and educational success one of key questions is to what extent and on the basis of which students' characteristics, family traits, school, or the wider social environment can we predict academic achievement. Cognitive or intellectual abilities are by far the best predictor of academic achievement [27,28]. In fact, there is a general agreement on moderate to strong connection of intelligence and academic achievement [29]. In early studies on the connection of intelligence and academic achievement there was a relatively high correlation, about 0.70, and it was concluded that up to 50% of individual differences in academic achievement could be explained by intellectual abilities of students. The results of recent studies indicate that the correlation of academic achievement expressed in grades and general intelligence is somewhat lower, typically around 0.5, which means that about one quarter of the variability of grades can be explained by general intellectual abilities [29–31]. The hypothesis of the study was that students with poorer academic achievement have a higher probability of being evening types and will have a higher degree of daytime sleepiness in relation to students with better academic achievement. Also that younger student will be more evening types when compared to older students and have a higher degree of sleepiness.

2. Method: procedure and sample

The study was conducted on a sample of 583 participants with an average age of 20.5 years [SD = 3.11], among which there were 140 [24%] men and 443 [76%] women. The participants were students of undergraduate studies of the Faculty of Health Studies in Mostar: 168 students of physiotherapy [28.8%], 148 students of nursing [25.4%], 134 students of radiologic technology [23%], 67 students of midwifery [11.5%], and 66 students of sanitary engineering [11.3%]. Academic achievement of students i.e. the average grade during their university education was 3.33 [SD = 0.543] while academic achievement during secondary school education was 4.13 13 [SD = 0.574]. The students were asked to participate in the study before the start of the new academic year. Participation in the study was voluntary and anonymous.

2.1. Instruments

We used a questionnaire with sociodemographic questions at the beginning [sex, age, social status of the household, academic achievement – grade average in the previous academic year, and the average grade from their secondary school education] as well as the Morningness-Eveningness scale [2] and Epworth Sleepiness Scale [32,33]. The Morningness-eveningness scale is intended for testing of the preferred sleep time and solving of tests, the level of fatigue in the morning and evening, functioning in hypothetical situations taking into account their rhythm and chronotype. It consists of 13 questions with 4 or 5 alternative answers and their task was to circle the answer most relevant to them. The scoring is done from 1 to 4 or 5 depending on the number of answers and the total result is obtained by adding the scores from individual questions. The range of results is from 10 to 55 where a higher score indicates a higher tendency toward eveningness. The reliability of this scale was calculated by the method of internal consistency which is based on the correlations between individual particles on the scale, and the first study in Croatia obtained a Cronbach's alpha α = 0.87 [2]. In this study the Cronbach's alpha was α = 0.78. All of the participants fulfilled the Epworth Sleepiness Scale consists of 8 questions in which students subjectively asses the level of daytime sleepiness in everyday situations. Every question could be answered with one of four offered answers: 0 - would never doze; 1 - slight chance of dozing; 2 - moderate chance of dozing; 3 - high chance of dozing. The total number of points leads to the final result that differentiates participants in two groups, those who have and do not have excessive daytime sleepiness. The sum of points on the scale from 1-6 indicates enough sleep, the result from 7-8 indicates average daytime sleepiness, and the result of 9 and more indicates to seek medical help due to a high level of daytime sleepiness. The reliability of internal consistency of Cronbach's alpha was α = 0.68.

3. Processing of results

The data were gathered and incorporated into the MS Excel database [version 11. Microsoft Corporation, Redmond, WA, USA] and for statistical analysis we used SPSS 20.0 statistical software program [IBM Corp., Armonk, NY, USA]. The data were processed using methods of descriptive statistics and categorical variables were presented as frequency and standard deviation. Normality of data distribution was analysed by graphical representation and the Kolmogorov–Smirnov test. We used the Hi quadratic test, the Kruskal-Wallis test, and the Man-Whitney U test to investigate the differences between categorical variables. The probability value of $p < 0.05$ was taken as statistically significant.

3.1. Normality of distributions

The average result [n = 583] on the Morningness-eveningness scale was M = 34.65; SD = 6.82. The lowest achieved score was 17 and the highest was 55. The distribution of results on the scale significantly deviates from the normal distribution [KS = 0.058, $p < 0.01$], it is shifted toward lower values indicating a higher tendency toward morningness. The correlation between results on the Morningness-eveningness scale and age showed to be significant but negative [r = -0.120] i.e. older participants showed higher tendency toward morningness. However, it is expected that there are differences in tendencies toward morningness and eveningness depending on age. We excluded the results from the participants [n = 14] who significantly deviated from the average age. The new average result [n=569] on the Morningness-eveningness scale was M = 34.62; SD = 6.44.

The average result on the Epworth Sleepiness Scale [n = 569] was M = 7.54; SD = 3.77; the minimal achieved score is 0 and maximal is 24. The distribution of results on the sleepiness scale significantly deviates from normal [KS = 0.126; $p < 0.01$], it is shifted toward lower values indicating a tendency of low sleepiness in participants. Due to the deviation of results from normal distribution, we used non-parametric procedures in data processing.

3.2. Differences in the level of morningness-eveningness and sleepiness according to sociodemographic characteristics of participants

There were no significant gender differences in the morningness-eveningness [p = 0.432] or the level of daytime sleepiness in students [p = 0.201]. The Kruskal-Wallis test did not show any significant differences in the morningness-eveningness regarding the year of study but there were significant differences in the level of sleepiness regarding participants' year of study [Table 1].

Table 1 - Testing the significance of differences in the morningness-eveningness and the level of sleepiness with regard to the year of study with the Kruskal-Wallis test

	Year of study	n	Rank	χ^2	p
Morningness -eveningness	1	211	287.92	1.252	.535
	2	195	291.77		
	3	163	273.12		
Sleepiness	1	211	306.27	10.864	.004*
	2	195	290.51		
	3	163	250.87		

*Significant on level p<0.05

In order to establish if there are differences in the level of daytime sleepiness between students with regard to the year of study, we performed a post hoc analysis with the Man-Whitney U test. The analysis showed that third year students have significantly higher levels of daytime sleepiness than students of the first and third year of study [Table 2].

Table 2 – Additional testing of differences in the levels of daytime sleepiness with regard to the year of study with the Man-Whitney U test

	N	Rank	Man-Whitney	p
First	211	208.80	19454.50	0.342
Second	195	197.77		
First	211	203.47	13826.00	0.001*
Third	163	166.82		
Second	195	190.74	13700.50	0.024*
Third	163	166.05		

* Significant of level p<0.05

Table 3 – Correlations between the level of education of parents and the morningness-eveningness of students and their level of sleepiness

	Father's education	Morningness-eveningness	Sleepiness
Mother's education	.317**	.143**	-.025
Father's education		.107*	.028

* Significant on level p<0.01; **Significant on level p<0.05

We established a significantly low positive correlation between mother's and father's education and the morningness-eveningness of the participants. Students whose parents completed a higher level of education show a higher tendency toward eveningness. The level of parents 'education was mutually significantly but moderately related.

Table 4 – Correlation of number of brothers and sisters and the number of family members with morningness-eveningness and the level of sleepiness in students.

	Number of family members	Morningness -eveningness	Sleepiness
Number of brothers and sisters	.258**	-.081	.008
Number of family members		-.001	-.033

**Significant on level p<0.01

There was no significant correlation between the number of brothers and sisters and the number of family members with estimates on the morningness-eveningness and sleepiness scale.

Table 5- Differences in the morningness-eveningness and the level of sleepiness with regard to mother's work status

	Work status	n	Rank	χ^2	p
Morningness -eveningness	Permanent employment	287	297.90	8.858	.031*
	Part-time employment	54	249.51		
	Unemployed	193	259.64		
	Retired	22	261.95		
Sleepiness	Permanent employment	287	280.83	2.718	.437
	Part-time employment	54	298.18		
	Unemployed	193	266.26		
	Retired	22	307.25		

*Significant on level p<0.05

There were significant differences in the morningness-eveningness with regard to the mother's work status. In order to determine the specific group of students with regard to the mothers' working status we conducted a post hoc analysis with the Man-Whitney U test.

Table 6- Post hoc analysis of differences in the morningness-eveningness with regard to mother's work status

	N	Rank	Man-Whitney	p
Permanent employment	287	175.58	6435.00	0.048*
Part-time employment	54	146.68		
Permanent employment	287	253.86	23860.50	0.010*
Unemployed	193	220.39		
Permanent employment	287	156.47	2736.50	0.297
Retired	22	135.89		
Part-time employment	54	119.85	4987.00	0.629
Unemployed	193	125.16		
Part-time employment	54	37.98	566.00	0.748
Retired	22	39.77		
Unemployed	193	107.85	2094.50	0.918
Retired	22	109.30		

*Significant on level p<0.05

There were significant differences in the morningness-eveningness between students whose mothers were permanently employed and those whose mothers were part-time employed and unemployed, in the direction that students whose mothers were permanently employed showed a higher tendency toward eveningness.

In the case of fathers' work status, there were no significant differences in the morningness-eveningness [p=0.066] and the levels of daytime sleepiness [p=0.543] in students.

3.3. The relation of current and past academic achievement with levels of daytime sleepiness and morningness-eveningness in participants

There were no significant differences in the level of daytime sleepiness and morningness-eveningness with regard to students' achievement during secondary school education [Table 7].

Table 7 – Analysis of significance of differences in the morningness-eveningness and the level of sleepiness in students with regard to achievement during secondary school education

[Kruskal-Wallis test]

	Achievement	n	Rank	χ^2	p
Morningness-eveningness	Sufficient	2		5.375	.068
	Good	55	285.77		
	Very good	378	293.79		
	Excellent	134	255.67		
Sleepiness	Sufficient	2		4.301	.116
	Good	55	307.38		
	Very good	378	288.99		
	Excellent	134	260.34		

Table 8 – Differences in the morningness-eveningness and the level of sleepiness of students with regard to their academic achievement [Man-Whitney U test]

	Achievement	n	Rank	χ^2	p
Morningness-eveningness	Sufficient	8		10.919	.006*
	Good	228	183.61		
	Very good	117	152.32		
	Excellent	5			
Sleepiness	Sufficient	2		11.536	.039*
	Good	228	180.90		
	Very good	117	157.60		
	Excellent	5			

*Significant on level p<0.05

In case of differences in the morningness-eveningness and the levels of daytime sleepiness with regard to students' achievement during university education we only considered the differences between students with good and very good academic achievement and this was done due to a small number of students with sufficient and excellent achievement. The study showed that students with good achievement show a higher tendency toward eveningness and higher levels of daytime sleepiness than students with very good academic achievement.

Table 9 – The correlation of participants' achievement during secondary school and university with morningness-eveningness and the level of sleepiness [The Spearman's Rank Correlation Coefficient]

	University achievement	Morningness-eveningness	Sleepiness
Secondary school achievement	.291**	-.079	-.087**
University achievement		-.163**	-.120*
Morningness-eveningness			.252*

*Significant on level p<0.05

The correlation of achievement during secondary school and university education is significant but low i.e. students who had better secondary school achievement also have better university achievement. The correlation between measures of morningness-eveningness and the level of sleepiness proved to be significant, i.e. students who show a tendency toward eveningness also show higher levels of sleepiness. A significant correlation between secondary school achievement and the level of daytime sleepiness was established. Students who had better achievement in secondary school show lower levels of sleepiness. The same trend has been demonstrated with regard to students' university achievement – students who have better achievement show lover levels of sleepiness. In addition, there is a significant correlation between the result on the morningness-eveningness scale and university achievement in students: students who have better achievement show higher levels of morningness and vice versa.

4. Discussion and conclusion

The study investigated the importance of sleep habits and their correlation with academic achievement among students of the Faculty of Health Studies of the University of Mostar, namely students of physiotherapy, nursing, radiologic technology, midwifery, and sanitary engineering. The obtained results showed no significant differences in the morningness-eveningness with regard to the year of study. Previous studies found that in the younger adult population individuals are more often identified as evening types when compared to the older population who are generally morning types [34,35]. Some studies have established the correlation between academic achievement and sleep duration [22,36,37]. Therefore, the impact of sleep on academic achievement remains unclear: sleep duration and quality may jointly or individually refer to academic achievement [38]. There were significant differences in the morningness-eveningness with regard to participants' academic achievement during secondary school but only between students whose academic achievement was very good or good. Significant differences in the morningness-eveningness were found only among students who have good and very good university achievement and in the direction that students who have good achievement show a higher tendency toward eveningness. The correlation between secondary school achievement and university achievement is significant but low [r=0.303; p<0.001], i.e. students with better secondary school achievement also have better university achievement. This study confirmed our hypothesis that junior year students' i.e. younger students show higher levels of sleepiness than older students, but there was no difference in the morningness-eveningness with regard to the year of study. We obtained significant differences in the morningness and sleepiness of students with regard to their academic achievement. The results of the study indicate that students with better academic achievement are more morning types. Although our results partially correspond with results from other studies, we consider further studies with larger samples necessary to additionally clarify the connection between chronotypes and studying.

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