Morningness-Eveningness Preference, Sleep Variables and Academic Achievement of Children and Adolescents

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ABSTRACT

The aim of the current study is to examine the variables that predict the sleep quality and academic achievement of children and adolescents from Turkey. Within this aim, 3677 students attending 4th, 5th, 6th, 7th and 8th grades in Sakarya province were selected through random sampling method and data regarding the gender, age, academic achievement, sleep quality, motivation, morningness-eveningness preference and sleep variables were collected. As a result; age, average sleep length, social jetlag, motivation and sleep quality were found to be significant associative factors of academic achievement. In addition, the significant associative factors of sleep quality were morningness-eveningness preference, age, motivation, average sleep length and gender and associative factor of morningness-eveningness preference were sleep quality, midpoint of sleep, motivation, social jetlag and gender. These results show that the sleep patterns and sleep qualities of the children and adolescents during the week days and the weekend should be taken into account while examining academic success. Moreover, the fact that the morningness-eveningness preference is related to the sleep quality and motivation of the children and adolescents represents the importance of their morningness-eveningness preference preferences in academic outcomes, albeit indirectly.

Keywords:
Sleep quality; sleep length; midpoint of sleep; social jetlag; academic achievement; motivation; morningness-eveningness preference

Introduction

Predicting academic achievement is very important in regards to educational researches and various studies have been conducted for that purpose. In some of these studies, the intelligence level of the student, motivation, personality traits, self-discipline, learning style, learning approach, gender, readiness, education levels of the parents, socio-economical level of the family, the features of the environment of the neighborhood and the school, teacher qualifications, curriculum, teaching methods, physical-technical substructure of the schools and opportunities are shown as factors affecting the academic achievement (Richardson et al. 2012; Trockel et al. 2000). In recent years, studies concerned with examining the effects of sleep length, sleep quality, social jetlag, daytime sleepiness and sleep related variables together with their physiological and psychological effects on academic achievement raised in amount (Dewald et al. 2012; Meijer 2008; Wolfson & Carskadon 2003). Some of these studies are conducted with adults and some with children and adolescents. The effect of sleep and sleep related variables on academic achievement was found

to be more significant in children and adolescents (Dewald et al. 2012; Meijer 2008). Sufficient amount of sleep with good sleep quality affects positively the prefrontal cortex activities in children and adolescents (Dewald et al. 2012; Mitru et al. 2002). The prefrontal area is where the cognitive activities take place and is important for academic achievement.

Sleep quality and other sleep variables are affected by numerous factors such as the individual's physiological features (i.e. upper respiratory tract), psychological condition (i.e. anxiety level), social environment (i.e. lifestyle), life standards (i.e. whether they have their own room), and technological tools they used (i.e. lightening technologies, smart phones). Additionally, biological rhythm preferences largely affects the wake up and retiring times, sleep disturbances, sleeplessness and the sleep quality (Diaz-Morales & Escribano 2013). Individuals, regarding their daily rhythm preferences can be categorized into three types (chronotypes) such as "Morning Type", Neither Type" and "Evening Type" (Horzum et al. 2014; Randler 2013; Smith et al. 1989). The morning type individuals feel exhausted in the early evening hours and fall asleep, thus getting sufficient sleep and waking up fresh, early in the morning so the physical and intellectual performance of morning type individuals is high in the early hours of the day but this condition is reversed for evening types. In cases where the evening type individuals are required to wake up early in the morning, they will have low intellectual and physical performance in the morning due to insufficient and poor sleep quality. Meanwhile, the neither type individuals have characteristics in between morning and evening types and a great number of individuals have this kind of rhythm preference (Adan & Natale 2002; Hofstra & Weerd 2008; Horne & Östberg 1976; Vink et al. 2001).

The change in period of time when the physical and intellectual activities of the individuals reach high levels throughout the day affects their performances in school, work and daily lives. It has been stated that the timeframes the achievement test are applied in the schools affect the overall academic achievement and the success of the evening type individuals are usually affected negatively in the examinations that are generally held at early hours of the morning (Beşoluk 2011, Beşoluk et al. 2011, Randler & Frech 2009; 2006; Clarisse et al. 2010; Callan 1995; Dunn et al. 1989; Klavas 1994). The starting time of classes and schools can have positive or negative effects on the academic performances of the individuals. The deciding factor for whether the effect will be positive or negative is related to what extent the beginning time of the classes suits the morningness-eveningness preference (M-E preference) of the individual. The fact that the starting time of the classes are early and the students are forced to begin the education activities early, affects the overall productivity and GPA of the students (Beşoluk et al. 2011; Howell et al. 2004; Lima et al. 2002; Millman 2005; Randler & Frech 2006; 2009; Taras & Potts-Datema 2005; Wolfson & Carskadon 2003). While the schools beginning to perform the education activities at early hours can be considered as an advantage for the morning type individuals, it is clearly a disadvantage for the evening type individuals (Beşoluk et al. 2011; Borisenkov et al. 2010; Randler & Frech 2006).

Various studies indicate that the M-E preference of children is shifting from morning type towards evening type in the early puberty stage (Randler et al. 2014; Kim et al. 2002; Roenneberg et al. 2004). In addition, in this era, factors such as lightening technologies, information and communication technologies, and lifestyle seem to have an effect on the sleep-wake schedules and overall sleep length of individuals, thus increasing the amount of evening type individuals (Vollmer, Michel & Randler 2012). Moreover, due to the obligation of going to work or school during the weekdays, the individuals will be spending most of their weekends or holidays sleeping in order to compensate for the sleep deprivation they have suffered during the weekdays. The misalignment between biological and social time caused by school or work is called social jetlag (Roenneberg et al. 2012). Numerous studies indicate that social jetlag and sleeplessness negatively correlate with school success (Drake et al. 2003, Kelly et al. 2001; Lee et al. 1999; Medeiros et al. 2001; Wolfson & Carskadon 1998).

Motivation is another variable that affects the academic achievement and consists of biological, physiological, social and cognitive strengths (Fulmer & Frijter 2009), is an inner situation that stimulates, maintains and directs the behaviour (Woolfolk 1998). Motivation is one of the preconditions for learning (Akbaba 2006; Jurisevic et al. 2008), while affecting the academic and social life of the individual (Wentzel 1999; Oliver & Simpson 1988), contributing positively to the learning process and success (Akbaba 2006; İflazoğlu & Tümkaya 2008). Forcing students to get up early in the morning may cause some students to sleep insufficiently, skip their breakfast, and therefore their motivation toward academic activities may be

affected negatively. Therefore, in order to evaluate the effects of various factors on the academic achievement reliably, identifying the motivation levels is essential.

When it is taken into consideration that M-E preference, sleep quality and sleep variables affect the physical, intellectual and emotional features of the individuals, the necessity for conducting studies related to sleep and M-E preference comes to light. Therefore, current study first aims to examine whether the academic achievement of children and adolescents is predicted by age, gender, motivation, M-E preference, sleep quality and sleep variables. The second aim is to research whether the sleep quality is explained by age, gender, motivation, M-E preference and sleep variables. The third aim of the study is to investigate whether age, gender, sleep quality, sleep variables and motivation are associative factors of M-E preference.

Method

In the current study survey model is used. The survey model is a kind of a research where the opinions of individuals regarding a topic or event are identified (Fraenkel & Wallen 2006).

Population and Sample

The sample of the study consists of 3677 students of 4th, 5th, 6th, 7th and 8th grades of 71242 student population. Random sampling method was preferred in the process of selecting the schools and classes. First, 16 of the 269 schools in the Sakarya province were chosen randomly. Then, 30 classes from each grade level were chosen randomly in order to ensure balanced distribution from every grade level and students of each selected class participated into the research. Descriptive data regarding the sampling are shown in Table 1.

Data Collection Tools

The M-E preference of the 4th and 5th graders were identified with the use of age appropriate Morningness-Eveningness Scale for Children (MESC), while the Composite Scale of Morningness (CSM) was used on the 6th, 7th and 8th graders for the same purpose. Motivation scores were acquired through using Motivation toward Education Scale (EME). In addition, Sleep Quality Scale and Sleep Variables Questionnaire (SQS-SVQ) were used to elicit the data regarding sleep qualities and sleep variables (corrected midpoint of sleep in free days, average sleep length and social jetlag) of the students in every grade. The data related to academic achievement was taken from students' self-reports regarding their achievement.

Morningness-eveningness scale for children (MESC). The Morningness-Eveningness Scale for Children (MESC) was developed by Carskadon et al. (1993) and adapted into Turkish by Önder and Beşoluk (2013) and is often used to identify the M-E preferences of children. Scores obtained from the 10 item scale vary between 10 (evening type) and 42 (morning type). Carskadon et al. (1993) stated that MESC is valid and correlated to various sleep factors. Meanwhile, Önder and Beşoluk (2013) stated that the Turkish form of MESC is valid and reliable. The Cronbach's Alpha coefficient of the Turkish form of MESC was reported as 0,69. In the current study, the Cronbach's Alpha coefficient which indicates internal consistency of the scale was found as 0,710.

Composite scale of morningness (CSM). The Composite Scale of Morningness (CSM) developed by Smith et al. (1989) is used to identify the M-E preference of the 6th, 7th and 8th graders. The scale consists of a total of 13 items. The scores acquired from the scale vary between 13 (evening type) and 55 (morning type). The Turkish adaptation of the scale was conducted by Önder et al. (2013), and they also stated that the Turkish form is valid and reliable. In the current study, the Cronbach's Alpha coefficient was found as 0,709.

Motivation toward education scale (EME). The 12 item scale that was developed by Vallerand et al. (1989) was used by several researchers in order to measure intrinsic motivation, extrinsic motivation and amotivation. The adaptation process of the originally French scale into Turkish was carried out by Kara (2008). The scale is formed by four dimensions (extrinsic motivation-identified regulation, amotivation, extrinsic motivation-introjected regulation and intrinsic motivation) and with the help of these dimensions; it is possible to calculate the self-determination index. The Cronbach's Alpha coefficients of the dimensions of the scale are reported to vary between 0,62 and 0,86. In the current study the Cronbach's Alpha coefficients of the dimensions were found to vary between 0,712 and 0,849.

Sleep quality scale and sleep variables questionnaire (SQS-SVQ). SQS-SVQ was developed by Meijer and van den Wittenboer (2004), and the Turkish adaptation process was carried out by Önder et al. (2016). Seven scale items that measure the sleep quality and 8 questionnaire items that identify the parental control, total sleep time, mid-point of sleep and sleep efficiency are present in the SQS-SVQ. The sleep quality scale items each having 3 categories that are scored from 1 to 3, while the possible score that can be taken from the scale varies between 7 and 21. The Cronbach's Alpha coefficient which indicates internal consistency, regarding the reliability of the original scale was found as 0,67 (Meijer & van den Wittenboer 2004). For the adapted scale it was reported as 0,72. In the current study the Cronbach's Alpha coefficient was found to be 0,660.

Academic achievement data. Data regarding academic achievement was obtained by an item in which students were asked to categorize their overall achievement in basic courses (mathematics, science and language) as "unacceptable", "poor", "fair", "good" or "excellent". After examining the frequencies of each category, it was observed that the frequency in "unacceptable" category was low (see Table 1). Therefore, "unacceptable" and "poor" achievement categories were added and the new category was termed as "unsuccessful" and similarly "good" or "excellent" achievement categories were added and the new category was termed as "successful". Finally there were data regarding three achievement categories (unsuccessful, fair, and successful) that were used in the statistical analysis. Although collecting self-reported achievement is commonly considered to be a limitation, numerous scholars have acquired the academic achievement scores of students through self-reports (Hytti et al. 2010; Lo 2010) and declared that there is a high level of correlation between the self-reported scores and academic achievement scores (Brown et al. 2008; Dornbusch et al. 1987).

Data Analysis

PASW 18 software was used in the analysis of the data. Multinomial logistic regression analysis was carried out to examine whether variables such as age, gender, M-E preference, corrected midpoint of sleep in free days (MSFsc), average sleep length (ASL), social jetlag, motivation and sleep quality are associative factors of academic achievement. The reason for choosing multinomial logistic regression analysis is the fact that it allows a categorical dependent variable to be explained with the support of continuous (quantitative) and/or non-continuous (categorical) predictive variables (Field 2009). Because, the M-E preference scores were taken from two different measurement tools (CSM and MESC) before this analysis, the t-scores of points obtained from both of the measurement tools was calculated and these t-scores were used in all of the remaining analyses. MSFSC provides data regarding the midpoint of the sleep in hours. The data of MSFSC are also used to identify chronotype and the formula was developed by Roenneberg et al. (2004) [MSFsc =MSF− 0.5 * (SDF − (5 * SDW + 2 * SDF) ∕ 7); MSF: Midpoint of Sleep on Free days, SDF: Sleep duration on free days and SDW: Sleep duration on work/week days]. Hence in the analysis, the data was categorized (earlier and later chronotypes) in accordance with the recommendations of Genzel et al. (2013). Moreover, social jetlag and ASL data in hour were converted into minutes and added to the analysis. Social jetlag was obtained with the formula presented by Roenneberg et al. (2012), and ASL was calculated by the help of formula presented by Juda et al. (2013) [Social Jetlag = MSF − MSW; MSW: mid-sleep on work days; ASL = (5*SDW +2*SDF) ∕ 7]. Self-determination index was calculated by making use of the dimensions of the scale used to collect data regarding motivation toward education. The formula regarding the calculation of the self-determination index [2*(intrinsic motivation) + (extrinsic motivation-identified regulation) - extrinsic motivation-introjected regulation) - 2*(amotivation)] was obtained from Robert J. Vallerand, the developer of the original scale, via e-mail. The self-determination index is included under the motivation title in the analyses. In addition, in order for the self-determination index not to have negative values, 18 points were added to all of the scores as it is the maximum possible points that one can take. Meanwhile, the sleep quality scores were calculated where higher points represent good sleep quality and lower points represent poor sleep quality.

Whether the sleep quality is predicted by variables of age, gender, M-E preference, MSFsc, ASL, social jetlag and motivation is determined through using linear regression analysis. Similarly linear regression

analysis was conducted to investigate whether age, gender, sleep quality, MSFsc, ASL, social jetlag and motivation are associative factors of M-E preference. MSFsc data was used as continuous hour data in this analysis. No other action was taken regarding the other variables. All analyses were carried out at the 0,05 significance level.

Results

The descriptive statistics regarding M-E preference sleep variables, sleep quality, motivation and academic achievement for total, gender, grade, age and academic achievement groups were presented in Table 1.

Table 1. The descriptive statistics related to the M-E preference, sleep variables, sleep quality, motivation and academic achievement *(M±SD)*

| Variables | n | M-E preference | Sleep Variables | | | Sleep Quality | Motivation | Academic Achievement (*f*) | | | | |
			MSF_{SC}	*ASL*	Social Jetlag			Unacceptable	Poor	Fair	Good	Excellent
Total	3677	50.0±9.9	04:10±01:27	09:29±01:32	01:59±01:30	16.0±2.3	31.0±5.6	20	171	1535	1305	636
Gender												
Girl	1909	49.9±10.0	04:05±01:20	09:35±01:30	01:59±01:25	15.9±2.3	32.2±4.9	8	73	768	705	349
Boy	1737	49.9±9.9	04:14±01:31	09:22±01:34	01:58±01:33	16.0±2.3	29.7±6.1	11	96	757	588	281
Grade												
4	649	50.4±9.8	04:39±01:57	10:28±01:58	01:32±01:58	16.6±2.4	30.9±6.0	8	20	142	252	221
5	663	49.5±10.0	04:08±01:54	09:31±02:13	02:19±02:12	16.3±2.4	31.1±5.7	3	14	216	281	145
6	730	52.2±9.9	03:52±01:01	09:25±00:54	01:54±00:57	16.2±2.2	31.3±5.3	1	26	347	256	100
7	748	49.8±9.6	04:04±01:05	09:14±00:59	02:03±01:01	15.8±2.2	30.7±5.8	3	48	372	233	92
8	887	48.2±9.9	04:10±01:03	09:00±00:57	02:03±01:06	15.3±2.2	30.9±5.5	5	63	458	283	78
Age												
9	151	50.0±10.1	04:47±02:34	10:23±01:56	01:29±01:38	16.7±2.3	31.3±6.1	2	2	28	57	60
10	597	50.5±9.9	04:26±01:44	10:13±02:04	01:40±02:00	16.5±2.4	31.0±5.8	6	17	151	242	176
11	704	49.9±9.9	04:07±01:45	09:36±02:00	02:12±02:01	16.3±2.4	31.1±5.5	3	20	238	297	143
12	776	51.8±10.0	03:53±01:05	09:20±00:57	01:56±01:03	16.0±2.2	31.1±5.4	1	34	360	269	112
13	778	49.3±9.8	04:08±01:05	09:11±01:00	02:04±01:03	15.8±2.1	30.9±5.6	4	45	394	246	89
14+	634	48.0±9.8	04:11±01:03	08:59±00:56	02:03±01:06	15.3±2.2	30.6±5.7	4	49	346	184	51
Academic Achievement Groups												
Unsuccessful	191	47.6±10.2	04:11±01:48	09:27±01:33	02:06±01:06	14.9±2.7	26.5±6.9	20	171	-	-	-
Fair	1535	49.3±09.5	04:13±01:23	09:23±01:32	02:09±01:33	15.7±2.2	29.9±5.8	-	-	1535	-	-
Successful	1941	50.2±10.2	04:07±01:25	09:33±01:32	01:50±01:29	16.3±2.3	32.2±4.9	-	-	-	1305	636

MSF_{SC}: corrected midpoint of sleep in free days; *ASL:* Average sleep length; *f*: frequency; *n*: number of students; *M*: average; *SD*: standard deviation.

Academic Achievement

Multinomial logistic regression analysis was carried out to examine whether age, gender, M-E preference, MSFsc, ASL, social jetlag, motivation and sleep quality variables are associative factors of academic achievement. As a result of the analysis, in the comparison of the model consisting of eight associative variables and the model consisting of only the intercept (baseline model), it was observed that the eight associative variables fit better than baseline model [$\chi^2(16)=260.053$, p<0.001]. Meanwhile, the contribution of eight associative variables to the model is small (Cox and Snell R^2 =0.104, Nagelkerke R^2 =0.126 and McFadden R^2 =0.062). The regression coefficients (β), standard errors (SE), odds ratios and 95% confidence intervals for odds ratios of eight predictive variables are presented in Table 2.

Table 2. Multinomial logistic regression analysis findings regarding eight associative variables

Academic Achievement Groups	β (SE)	95% Confidence Interval for the Odds Ratio		
		Lower	Odds Ratio	Upper
Successful and Unsuccessful				
Intercept	-3.510 (1.689)*			
Age	0.411 (0.094)***	1.255	1.508	1.812
Gender	-0.187 (0.191)	0.569	0.829	1.209
M-E preference	-0.002 (0.010)	0.982	1.002	1.022
MSF_{SC}	0.338 (0.217)	0.917	1.402	2.144
ASL	0.005 (0.002)**	1.002	1.005	1.008
Social Jetlag	0.004 (0.002)**	1.001	1.004	1.007
Motivation	-0.153 (0.015)***	0.832	0.858	0.884
Sleep Quality	-0.152 (0.043)***	0.790	0.859	0.934
Successful and Fair				
Intercept	-1.664 (0.857)			
Age	0.246 (0.045)***	1.171	1.279	1.397
Gender	-0.041 (0.102)	0.749	0.895	1.070
M-E preference	-0.005 (0.005)	0.995	1.005	1.014
MSF_{SC}	-0.041 (0.102)	0.786	0.960	1.172
ASL	0.003 (0.001)**	1.001	1.003	1.004
Social Jetlag	0.003 (0.001)***	1.001	1.003	1.004
Motivation	-0.082 (0.009)***	0.905	0.922	0.939
Sleep Quality	-0.046 (0.022)*	0.916	0.955	0.997

MSF_{SC}: corrected midpoint of sleep in free days; ASL: Average sleep length;*:p <0.05; **: p <0.01; ***:p <0.001
Cox and Snell R^2 =0.104, Nagelkerke R^2 =0.126 and McFadden R^2 =0.062

The investigation of Table 2 reveals the fact that the age, *ASL*, social jetlag, motivation and sleep quality of the children and adolescents are statistically significant associative factors of being successful or unsuccessful. [age: $\beta=0.411$, Wald $\chi^2(1)=19.188$, p<0.001; *ASL*: $\beta=0.005$, Wald $\chi^2(1)=9.179$, p<0.01; social jetlag*:* $\beta=0.004$, Wald $\chi^2(1)=8.324$, p<0.001; motivation: $\beta=-0.153$, Wald $\chi^2(1)=98.369$, p<0.001; sleep quality: $\beta=-0.152$, Wald $\chi^2(1)=12.699$, p<0.05]. When the odds ratio for age (1.508) is considered, it is seen that with the increase of age, the unsuccessfulness raises, compared to successfulness. Similarly, with the increase of average sleep length and social jetlag, the unsuccessfulness raises, compared to successfulness (odds ratio for *ASL*: 1.005; odds ratio for social jetlag: 1.004). In contrast, with the increase of motivation and sleep quality, the unsuccessfulness decreases compared to successfulness (odds ratio for motivation: 0.858; odds ratio for sleep quality: 0.859). Besides, another finding in the analysis was that the gender, M-E preference and *MSFsc* are not statistically significant in regards of associating with successfulness or unsuccessfulness. [gender: $\beta=-0.187$, Wald $\chi^2(1)=0.948$, p>0.05; M-E preference: $\beta=0.002$, Wald $\chi^2(1)=0.027$, p>0.05; *MSFsc:* $\beta=0.338$, Wald $\chi^2(1)=2.435$, p<0.05].

Results of the multinomial logistic regression analysis show that age, *ASL*, social jetlag, motivation and sleep quality are the variables that associate with the successfulness or fairly successful [age: $\beta=0.246$, Wald $\chi^2(1)=29.993$, p<0.001; *ASL:* $\beta=0.003$, Wald $\chi^2(1)=11.263$, p<0.01; social jetlag: $\beta=0.003$, Wald $\chi^2(1)=12.368$, p<0.001; motivation: $\beta=-0.082$, Wald $\chi^2(1)=75.965$, p<0.001; sleep quality: $\beta=-0.046$, Wald $\chi^2(1)=4.482$, p<0.05;]. It is seen that with the increase in age, *ASL* and social jetlag, fairly successfulness raises, compared to successfulness (odds ratio for age: 1.279; odds ratio for *ASL*: 1.003; odds ratio for social jetlag: 1.003). On the other hand, the fact that fairly successfulness will decrease compared to successfulness in case of an increase in motivation and sleep quality was found (odds ratio for motivation: 0.922; odds ratio for sleep quality:

0.955). Furthermore, another finding shows that gender, M-E preference and MSF_{sc} are not statistically significant associative factors of successfulness or fairly successfulness [gender: β=-0.111, Wald $\chi^2(1)$=1.480, p>0.05; M-E preference: β=0.005, Wald $\chi^2(1)$=0.903, p>0.05; MSF_{SC}: β=-0.041, Wald $\chi^2(1)$=0.162, p<0.05].

Sleep Quality

Because of the linear regression analysis carried out in regards to the explanation level of the variance in sleep quality by age, gender, M-E preference, MSF_{sc}, ASL, social jetlag and motivation, it was revealed that M-E preference ($\beta = 0.352$), age (β=-0.352), motivation (β=0.117), ASL (β=0.057) and gender (β=0.050) explain 18.9% of the variance. [$F(5,3389) = 157.736$, p<0.001]. The effect size of the analysis was found to be 0.23 [$f^2 = R^2 / (1 - R^2)$] and this effect size is medium. The results of the analysis are given in the Table 3.

Table 3. Findings of the linear regression analysis regarding the associative variables of the sleep quality

Predictors of Sleep Quality	β	R^2	R^2 Change
M-E preference	0.352	0.150	0.150
Age	-0.352	0.173	0.023
Motivation	0.117	0.184	0.011
ASL	0.057	0.186	0.003
Gender	0.050	0.189	0.002

ASL: average sleep length; f^2 =0.23

The investigation of Table 3 reveals that the most important associative variable of sleep quality in children and adolescents is M-E preference. It is also seen that with the raise of the rhythm scores of the individuals, the sleep quality scores are increased as well. Therefore, as the morningness is increased, the sleep quality scores of the children and adolescents are also increased. Additionally, the decrease in sleep quality scores of the children and adolescents with the increase of age is observed. Moreover, the sleep quality scores of adolescents and children that have higher *ASL* and motivation are high. Meanwhile, the sleep quality scores of boys are higher.

M-E Preference

Linear regression analysis presented that sleep quality ($\beta = 0.326$), MSF_{sc} ($\beta = -0.241$), motivation ($\beta = 0.113$), social jetlag ($\beta = -0.077$) and gender ($\beta = 0.038$) are associative factors of M-E preference scores [$F(5,2292) = 159.279$, p<0.001] and these variables explained 25.6% of the variance in M-E preference scores. The effect size of the analysis was found to be 0.34 [$f^2 = R^2 / (1 - R^2)$] and this effect size is medium. The results of the analysis are given in the Table 4.

Table 4. Findings of the linear regression analysis regarding the associative factors of the M-E preference

Predictors of M-E preference	β	R^2	R^2 Change
Sleep Quality	0.326	0.156	0.156
MSF_{sc}	-0.241	0.241	0.085
Motivation	0.113	0.251	0.010
Social Jetlag	-0.077	0.255	0.004
Gender	0.038	0.256	0.001

MSF_{sc}: Corrected midpoint of sleep in free days; f^2 =0.34

Analysis results presented that the most associative factors are sleep quality, MSF_{sc} and motivation. The relation between M-E preference and sleep quality was presented before. MSF_{sc} is also used to determine chronotype, relates negatively with circadian preference as expected. Moreover, the M-E preference scores of adolescents and children that have higher motivation are high. Additionally, the decrease in M-E preference scores with the increase of social jetlag is observed and M-E preference scores of boys are higher compared to girls.

Discussion and Conclusion

The descriptive data of the current study, in which the associative variables of the academic achievement, sleep quality and M-E preference are examined, shows that the average sleep length of the children and adolescents are about half-an-hour more than the results of some meta-analysis studies (Dewald et al. 2010; Olds et al. 2010). However, when the fact that the average for social jetlag is a great value such as about two hours, it is understood that there is an important difference between the sleep-wake patterns of the children and adolescents in comparison of the weekdays and the weekends. This indicates that individuals in the sample experience sleep debt. In addition, while more than half of the participants report themselves to be successful, a considerable amount of them state that they are fair and some of them express themselves as unsuccessful. This is an expected finding, since unsuccessfulness is generally understood as fail a course in that age group. Throughout the examination of the descriptive data in regards of gender, it is noticed that the average rhythm scores of the boys and girls are equal, while girls go to sleep earlier and sleep more than boys and obtain a higher motivation score than boys. Additionally, the social jetlag and sleep quality scores were detected to be very similar. A tendency of increase in the social jetlag values and decrease in M-E preference scores, ASL and sleep quality scores with the increase of age was noted. When we evaluate these four variables together, it can be stated that sleep and the variables that affect sleep are affected negatively with the increase of age and this situation is in line with the literature (Olds et al. 2010). When we classify the academic achievement of the students as unsuccessful, fair and successful, it is understood that the successful group has higher average M-E preference scores and slightly more positive values regarding sleep variables and sleep quality, while the motivation scores are expectedly higher than the other two groups.

In this study, the variables of sleep quality, average sleep length, social jetlag, motivation and age are found as associative factors of the academic achievement in children and adolescents. In despite of several other studies (Giannotti et al. 1997; Önder et al. 2014; Preckel et al. 2011), two indicators of chronotype; M-E preference and MSF_{SC} were not significant associative factors of the academic achievement. This situation may have stemmed from the wide age range of the participants, and the fact that most of the participants of this age group had not entered puberty and the academic achievement scores had been collected through self-report. On the other hand, in the current study in accordance with numerous other studies (Curcio et al. 2006; Dewald et al. 2010; Fallone et al. 2002; Wolfson & Carskadon 2003), the fact that the academic achievement will increase with the increase of sleep quality, was observed. Sleeping well and of good quality will allow the individuals to begin their day and classes feeling fresh, therefore cause an increase in their intellectual performances (Bebee 2011; Meijer & van den Wittenboer 2004). The conducted studies state that the sleep quality has a positive effect on the cognitive, physical and affective performance of the individual (Bebee 2011; Lima et al. 2010). While some studies indicate an increase in the success rate with the increase of average sleep length (Dewald et al. 2010) and others state that there is no such relation between them (Eliasson et al. 2002), in the current study a decrease in the academic achievement of the children and adolescents was observed with the increase of average sleep length. This finding which is opposite to the literature may be caused by the students' sense of success, the individuals who stated themselves as unsuccessful may also have a lengthy sleep, or some of the successful individuals may have a short sleep schedule. In addition, the rate of the individuals that sleep for a long time but with poor quality due to their physiological and psychological issues may be causing this problem. The academic achievements of such individuals are expected to be low. Moreover, the success rate is decreased with the increase of the grade, while also sleep length and quality are decreased with age. The fact that the students' achievement rates are negatively affected from beginning to sleep later with the increase in their age and not being able to get sufficient sleep due to the obligation of attending school in the morning, is in line with the literature (Kelley et al., 2015; Fukuda & Ishihara 2001; Wolfson & Carskadon 1998). This result may be caused due to increase in workload of school by grade, and/or concentration problems due to puberty. The sleep debt caused by the early class start times and the students sleeping at late hours throughout the week days leads them to an attempt of compensating for this debt by sleeping more during the weekends. Thus, causing an increase in social jetlag especially in the evening types. This sleep disorder may have affected the academic achievement negatively. Moreover, results regarding motivation are in line with the literature and the academic achievement scores of the individuals are expectedly increased with the motivation scores (Anderman 2013).

The analyses that were conducted indicate that the most important associative factor of sleep quality among the existing variables is the M-E preference. It is understood that the sleep quality of the morning type individuals is better than those of the evening types. These individuals can begin their social/school life at earlier hours compares to the evening type individuals, due to having slept at earlier hours and having enough rest and therefore their motivation may be high. On the other hand, the evening type individuals are affected negatively by this matter and this situation reflects on their sleep quality and motivation. Additionally, with the increasing age of the students, their social life and lifestyles show changes and the tendency to go to sleep later increases. This situation explains the case of the students having poor sleep quality with the increase of their age. Besides, motivation and average sleep length are positive predictors of sleep quality. Average sleep length and sleep quality show parallelism in healthy individuals. However, the sleep of individuals who sleep excessively due to the various health problems cannot be defined as good quality sleep.

In conclusion the academic achievements of the children and adolescents in the study are related to the variables of sleep quality, motivation, social jetlag, ASL and age. It can be said that the sleeping hours and sleep quality of the individuals during the weekdays and weekends are required to be taken into consideration while evaluating academic achievement which is one of the important outcomes of education. Moreover, the fact that the M-E preference of individuals is related to their sleep quality and motivation indicates that the M-E preferences are important in the academic outcomes, albeit indirectly. Academic achievement is a complicated subject that cannot be simply explained with a limited number of variables. However, the difficulty of examining all the factors affecting academic achievement is also clear. Therefore, the benefits the variables examined in this and similar studies will contribute to explaining the factors that predict or affect the academic achievement is important, albeit limited. The findings that are derived from quantitative studies can be supported with qualitative findings in the future studies to gather more in-depth information.

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Ethical concerns

The study was conducted in accordance with ethical recommendations for scientific publication (American Psychological Association, 1992), and the study was approved by the Sakarya University Ethics Committee and informed consent was obtained from parents.

Conflict of interest

The authors have no conflict of interest related to this study.

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