BSc in Psychology
Department of Psychology

Association between sleep duration, sleep quality and self-esteem in adolescents in Iceland

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Foreword

Submitted in partial fulfilment of the requirements of the BSc Psychology degree, Reykjavik University, this thesis is presented in the style of an article for submission to a peer-reviewed journal.

This thesis was completed in the Spring of 2021and may therefore have been significantly impacted by the COVID-19 pandemic. The thesis and its findings should be viewed in light of that.

Abstract

Sleep is essential for everyday functioning and it is especially vital for healthy development during adolescence. However, a significant percentage of children sleep less during adolescence, counteractive to their need for sleep. Simultaneously, studies show that self-esteem levels decline in adolescence. The current study aims to explore the association between sleep duration and sleep quality on self-esteem in students in 9th grade of an elementary school in Iceland (N = 22). The questionnaire included the Rosenberg Self-Esteem Scale, the Pittsburgh Sleep Quality Index, and other questions regarding sleep habits. Results showed that 11 participants slept less than eight hours (M = 7.62) on weekdays but nobody on non-school nights (M = 9.43), therefore they slept for approximately eight hours on average per night. Results also showed that the overall self-esteem score was rather low, indicating that participants had a rather high self-esteem. There was no association between overall sleep quality and self-esteem. However, correlation results showed a moderate association between overall sleep duration and self-esteem ($r(16) = -.56$, $p = .02$), indicating that self-esteem increases as sleep duration increases, which is corresponding to previous findings.

Keywords: sleep, adolescents, self-esteem, sleep duration, sleep quality

Útdráttur

Góður svefn er nauðsynleg forsenda heilbrigðs lífs. Þetta á sérstaklega við um unglinga þar sem nægur svefn stuðlar að eðlilegu þroskaferli. Þrátt fyrir það þá sofa börn minna á unglingsárunum og ekki í samræmi við ráðlagaðan nætursvefn. Að sama skapi þá sýna rannsóknir einnig að sjálfsálit lækkar á unglingsárunum. Tilgangur þessarar rannsóknar var að skoða samband svefnlengdar og svefngæða við sjálfsálit hjá unglingum í 9.bekk í grunnskóla á Íslandi (N = 22). Spurningarlistinn innihélt Rosenberg Self-Esteem scale, Pittsburgh Sleep Quality Index og spurningar um svefnvenjur. Niðurstöður sýndu að 11 þátttakendur sváfu minna en átta klukkustundir (M = 7.62) á nóttu á virkum dögum en enginn á frídögum (M = 9.43). Samanlagt sváfu þau rúmlega átta klukkustundir á nóttu að meðaltali. Niðurstöður sýndu einnig lág gildi á sjálfsálits kvarðanum, sem benti til þess að þátttakendur höfðu hátt sjálfsálit. Fylgnimælingar sýndu að ekkert samband var milli svefngæða og sjálfsálits. Hins vegar sýndu niðurstöður að miðlungs samband var á milli svefnlengdar og sjálfsálits ($r(16) = -.56$, $p = .02$), sem benti til þess að sjálfsálit jókst eftir því sem svefninn lengdist, sem er í samræmi við fyrri rannsóknir.

Lykilorð: svefn, unglingar, sjálfsálit, svefnlengd, svefngæði

Association between sleep duration, sleep quality and self-esteem in adolescents in Iceland

Adolescents' sleep

Sleep is essential for everyday functioning and is crucial for good physical and mental health (Gruber et al., 2014; Roberts et al., 2009). Sleep is especially vital in adolescence as it is an important developmental period for physiological and psychological changes (Dahl & Lewin, 2002; Roberts et al., 2009; Žukauskienė, 2014). Previous findings have shown that a significant percentage of children sleep less during adolescence (Gradisar et al., 2011), counteractive to their need for sleep (Carskadon & Acebo, 2002). The National Sleep Foundation recommends that children aged 6–13 years sleep for 9–11 hours per night and adolescents aged 14–17 years sleep for 8–10 hours per night (Hirshkowitz et al., 2015). Sleep deprivation in children and adolescents is defined as less than seven hours per night. Many studies have shown that adolescents do not fulfil their recommended sleep hours as well as having poor sleep quality (Carskadon, 2011; Dahl & Lewin, 2002).

Sleep patterns change instructively when puberty is reached (Carskadon, 1990). Delayed melatonin secretion (Carpenter et al., 2015) and lengthening of the circadian clock causes adolescents' internal days to be longer, compared to children and adults (Wright et al., 2001). Those changes are mainly characterized by a delayed bedtime and the need to sleep longer in the morning (Crowley et al., 2007). Contextual changes during adolescence can also play an important role in their sleep. For example, school start time does usually not change during adolescence which can result in discrepancy with their natural sleep regulation (Carskadon et al., 1998; Epstein et al., 1998). Other contextual changes can affect their sleep including, increased tendencies to have more late-night activities, or jobs (Dahl & Lewin, 2002), more school demands (Fredriksen et al., 2004) and increased late-night usage of social media (Levenson et al., 2016).

Icelandic research on adolescents' sleep showed that the majority of them did not get the recommended sleep each night (Gudmundsdottir et al., 2017; Rognvaldsdottir et al., 2017). Furthermore, Icelandic adolescents tend to go later to sleep compared to adolescents in most Western countries (Janson et al., 1995; Rognvaldsdottir et al., 2017; Thorleifsdottir et al., 2002). A possible explanation might be that the external clock is not in regulation with the biological clock in Iceland (Brychta et al., 2016; Friborg et al., 2012). Iceland is uniquely situated geographically (latitude 64-66° north) which results in a relatively large variation in daylight hours. Winter and summer months, therefore, vary from 4-21 hours of daylight, however, despite those differences, the external clock does not alter during the year. The clock is constantly in accordance with the daylight time during the summer, which is incongruous to the country's geographic location. This results in a 50-to-90-minute difference between the biological clock and the external clock. The discrepancy tends to affect adolescents more since their circadian rhythm is already delayed.

Studies show that sufficient sleep in adolescents is associated with many positive outcomes including, higher levels of subjective happiness (Otsuka et al., 2020), academic success (Wong et al., 2013), and psychological well-being (Kalak et al., 2014). On the contrary, insufficient sleep in adolescents has been associated with many negative outcomes regarding health and daily functioning (Shochat et al., 2014). This includes increased risk of obesity (Cappuccio et al., 2008), depression (Roberts & Duong, 2014), anxiety disorders (Roberts & Duong, 2017), poor school performance (Titova et al., 2015), risk-taking behavior (Short & Weber, 2018), aggression (Ireland & Culpin, 2006), poor well-being (Short et al., 2013), suicidal ideation (Roberts et al., 2001) and low self-esteem (Fredriksen et al., 2004).

Self-esteem

Self-esteem is a subject that has been well researched in many contexts. Self-esteem was defined by Rosenberg (1965) as a positive or negative assessment of oneself. It is a

subjective judgement of one's perceived value (Leary & Baumeister, 2000). Self-esteem is also considered as self-evaluation, internal psychological monitor and it is related to perceptions of others' assessment of oneself (Leary & Baumeister, 2000). However, self-esteem is not a reflection of a person's objective abilities nor how they are evaluated by others (Rosenberg, 1965).

Low self-esteem during adolescence can have serious consequences in the transition to adulthood, including increased chances of symptoms of internalizing symptoms (e.g. depression, anxiety, suicidal ideation, and disordered eating; Bosacki et al., 2007; Mann et al., 2004; Neumark-Sztainer et al., 2007), as well as externalizing symptoms (e.g. violent behavior and substance use; Mann et al., 2004; Strauss, 2000). Low self-esteem in adolescence can also negatively influence long-term outcomes, such as a greater likelihood of unemployment and financial difficulties (Waddell, 2006). In contrast, adolescents with a higher level of self-esteem are less prone to have symptoms of depression (Dumont & Provost, 1999), engage in sexual risk behavior (Butler & Gasson, 2005) and self-harm (Junker et al., 2019), which are all factors that tend to increase during adolescence (Birmaher et al., 1996; Patton et al., 2007; Steinberg, 2007).

As we go through life, our self-esteem has inevitable fluctuations that reflect environmental as well as physical changes, including the changes that occur during puberty (Birkeland et al., 2012). Studies show that self-esteem levels are high during childhood but they decline in adolescence (Robins et al., 2002; Twenge & Campbell, 2001). Researchers have not reached a consensus on why self-esteem decreases during adolescence. Therefore, it is important to consider various variables that might hinder proper self-esteem levels in adolescence, including insufficient sleep. A position statement was made among psychiatrists in Canada on pediatric sleep which revealed that adolescents who reported sleep problems

were notably more likely to additionally report symptoms of depression, anxiety, and poor self-esteem (Gruber et al., 2014).

Association between sleep and self-esteem

As previously noted, studies have associated insufficient sleep in adolescence with various health concerns such as symptoms of depression, anxiety, and poor well-being. However, relatively few studies have investigated the relationship between sleep and self-esteem. Fredriksen et al. (2004) revealed that a lower amount of sleep is correlated with lower self-esteem in early adolescence. However, this relationship is yet to be established in Iceland, as it is evident that Icelandic adolescents have shorter sleep duration compared to many European countries (Rognvaldsdottir et al., 2017). The present study aimed to examine the relationship of overall sleep duration, overall sleep quality, and self-esteem in adolescents in Iceland. It was firstly hypothesized that a lower score of sleep quality was associated with lower self-esteem. The second hypothesis was that shorter sleep duration was associated with lower self-esteem.

Method

Participants

The present study used data from ongoing research, *We as a team: Effects of a course on sleep, breathing, and self-empowerment on adolescents' well-being and sleep habits.* The participants were students in the 9th grade of an elementary school in Iceland, all aged 13 to 14 years. A total of 22 students participated in the study, 11 girls and 11 boys. All participants were volunteers. They received wearable activity trackers from Garmin (that were used to measure sleep) as a gift for participation as well as getting course credits.

Measurements

A self-report questionnaire was used, containing questions about sleep habits, knowledge about sleep, sleep quality, and self-esteem. In this present study, all questions in

the questionnaire were used except for questions regarding knowledge about sleep and some sleep habits questions.

Sleep quality

Participants answered a questionnaire regarding their sleep quality, which was measured with a modified version of the Pittsburgh Sleep Quality Index (PSQI). It consists of seven components that assess subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, sleep medication usage, and daytime dysfunction for the past month (Buysse et al., 1989). The overall score is made from these components and ranges from 0 to 21 and each component ranges from 0 to 3. A higher score indicates worse overall sleep quality. Participants that score higher than 5 are considered to have clinical sleep problems (Buysse et al., 1989). Questions regarding sleep latency, sleep duration, and habitual sleep efficacy were open-ended. Participants were asked to write an estimate of when they usually went to bed for the past month, how long it took them to fall asleep, when they got out of bed in the morning, and their overall sleep duration. This was done separately for school nights and non-school nights. A mean score was calculated to measure the overall score. Other questions had possible responses on a 4-point scale, as the score 0 was “not a problem the past month”, 1 was “less than once a week”, 2 was once or twice a week” and 3 was “three times or more in a week”.

An Icelandic version of the PSQI was used in this study, which was translated from the original questionnaire (Þórðardóttir, 2016). The translated version had good internal reliability of $\alpha = .82$. In this study the internal reliability for overall sleep quality was $\alpha = .45$, for sleep quality on school nights it was $\alpha = .40$ and for non-school nights it was $\alpha = .53$. These numbers indicate a low internal consistency.

Sleep duration

Garmin Venu SQ was also used to measure participant's sleep duration during school nights. Participants continuously used the wearable activity tracker during the onset of the course, for a total amount of eight weeks. To the author's knowledge, no studies have been made about the accuracy and validity of Garmin Venu SQ. However, most wearable activity trackers are a relatively accurate measurement of sleep duration (Scott et al., 2020). However, many of them do not indicate accuracy when detecting wake time, which is also the occurrence with most Garmin activity trackers (Chinoy et al., 2020; Lee et al., 2018). Therefore, sleep duration was also measured with a self-reported questionnaire about sleep patterns to compare the results from the trackers. The questionnaire included two open-ended questions from the PSQI. Participants were asked to estimate their sleep duration on school nights and non-school nights.

Sleep habits

Sleep habits were measured with three questions regarding caffeine intake, electronic device usage, and the number of exercising days. Participants were asked to state the amount of caffeinated drink they intake per day, either with tea, coffee, caffeinated energy drinks, or cola drinks (e.g. Coca-Cola, Pepsi). All drinks were computed together to see the overall caffeine intake. Each score represented one caffeinated drink. To measure smartphone usage, participants were asked to choose how many hours on average per day they use electronic devices. Possible options were "less than 1 hour" which was scored as 1, "1 – 2 hours" was scored as 2 and so on until the last option, which was "more than 14 hours", scored as 9. Participants were additionally asked to state how many days per week they exercised for at least 60 minutes, causing the heartbeat to increase and occasionally experience shortness of breath.

Self-esteem

Self-esteem was measured with an Icelandic version of The Rosenberg Self-esteem Scale (RSES; Rosenberg, 1965; Sigurjónsdóttir, 2012). RSES consists of ten statements, five of which were positively phrased (e.g. “On the whole, I am satisfied with myself”) and five were negatively phrased (e.g. “I certainly feel useless at times”). The statements were answered on a 4-point Likert scale (1 = “Strongly agree”, 2 = “Agree”, 3 = “Disagree”, 4 = “Strongly disagree”). The values on the positively phrased statements were recoded for all statements to have parallel values. All statements were computed together to make the variable overall self-esteem. The score on overall self-esteem took a value from 10 to 40, with a higher score suggesting symptoms of a lower self-esteem and a lower score suggesting symptoms of higher self-esteem. The RSES shows reliability and high validity in adolescents (Bagley & Mallick, 2011; Tinakon & Nahathai, 2012). The translated version of the Rosenberg scale is a valid and reliable measurement of overall self-esteem (Sigurjónsdóttir, 2012). In the present study, the scale had good internal consistency ($\alpha = .80$).

Procedure

All students in 9th grade in an elementary school in Iceland were invited to participate in the course which took place three times per week for eight weeks. Approval was made by school administrators, and an informed consent letter was sent to the parents of the participants, as they were all under 18 years. They answered a questionnaire on paper during the first week of the course and again in the eighth week. Only the first questionnaire was used in this study. Participants were ensured that full anonymity would be made and therefore they were asked to not mark the questionnaires with any information that could be traced to an individual. Supervisors mentioned they were not obligated to answer all questions and could stop their participation at any time. They were also instructed to reach out to the supervisors if their assistance was needed. Following completion of the questionnaire, participants received a wearable Garmin Venu SQ watch. They were instructed to place it on

their non-dominant wrist and keep it until they completed the second questionnaire, after eight weeks. All gathered data from the watch was only available to the researchers.

Data analysis

All data from the activity tracker was autonomously sent to the participant's smart phone via the application Garmin Connect. The application provided an estimation of sleep duration for each night. That data was used to see if the sleep pattern, was corresponding to the self-reported sleep duration. Participants' self-reported sleep duration was exclusively used to test the second hypothesis in this study and other analyses regarding sleep duration.

All statistical procedures were performed with the computer statistics program, the Statistical Package for the Social Sciences 27 (SPSS). Firstly, descriptive analysis was made to provide information on the independent variables and self-esteem. Secondly, to measure gender differences independent samples t-tests were made for the variables overall self-esteem and overall sleep duration. The same test was also used to see a difference in self-esteem scores for groups based on sleep duration. Gender differences were measured with the Mann-Whitney U test for the variables overall sleep quality, electronic device usage, overall caffeine intake, and exercising days. Thirdly a Wilcoxon sign test was used to test sleep duration and sleep quality discrepancy for school nights and non-school nights. Fourthly, Kendall's Tau-b correlation was made for the variables smartphone usage and caffeine intake, and Spearman's correlation was used for the variable exercising days, to test their correlation with overall sleep duration and overall sleep quality. Fifthly, to test the hypotheses, Pearson correlation was used for overall sleep duration and Kendall's Tau-b correlation was used for overall sleep quality, to test their associations with self-esteem.

Additionally, all sleep duration data were computed together to make the variable overall sleep duration and the same procedure was done for caffeine intake, sleep quality, and overall self-esteem. All assumptions were met.

Results

In this study, participants scored 19.72 (*SD* = 4.82) on average on the Rosenberg questionnaire, as table 1 exhibits. Therefore, the score on overall self-esteem was rather low, as the majority of the participants had relatively high self-esteem.

Table 1

Descriptive statistics of all variables

Variable	Overall mean (SD)	N	Range
Overall self-esteem	19.72 (4.82)	18	12-28
Overall sleep duration (hours)	8.14 (0.64)	21	6.86-9.07
Sleep duration on school nights (hours)	7.62 (0.77)	21	6-8.5
Sleep duration on non-school nights (hours)	9.43 (0.71)	21	8–10.5
Overall sleep quality	5.05 (2.30)	20	2-11
Sleep quality on school nights	5.05 (2.28)	20	2-11
Sleep quality on non-school nights	4.95 (2.37)	20	2-11
Overall caffeine intake (drinks)	1.80 (2.55)	20	0-8
Number of exercising days per week (days)	4.95 (2.03)	22	1-7
Electronic device usage per day	3.95 (2.03)	21	3-7

Participants slept on average a total amount of 8.14 (*SD* = 0.64) hours per night according to the self-reported questionnaire (see table 1). The mean score for overall sleep

quality was 5.05 (*SD* = 2.30), therefore participants had relatively moderate sleep quality (Buysse et al., 1989). The majority of participants only drank on average one caffeinated drink per day or less (68.18%), with a mean of 1.80 drinks (see table 1). With the exception of one participant, all caffeine intake was in the form of cola or energy drinks. Participants exercised on average for five days per week but all of them exercised at least one day per week. Eight participants (36.36%) reportedly exercised every day or seven days per week. They spent on average approximately 5 to 6 hours per day on electronic devices, but the range was from 3 to 4 hours to 11 to 12 hours. Results showed that the sleep habits variables did not have a correlation with either sleep duration or sleep quality ($p > .05$). However, Kendall's tau-b revealed a strong positive correlation with hours spent on electronic devices and overall sleep quality ($r_b = .52$, $p = .01$) showing that more hours spent on electronic devices was associated with a higher score on the PSQI, indicating lower overall quality of sleep.

At baseline, participants reportedly slept for a total of 7.62 (*SD* = 0.77) hours on average per night during weekdays but 9.43 (*SD* = 0.71) hours during weekends. The discrepancy between school nights and non-school nights was statistically different ($z = -4.03$, $p < .05$). Twelve participants had the discrepancy as more than or equal to two hours. Results showed that no participant slept overall on average more than the recommended sleep duration, which is ten hours, but seven participants slept less than eight hours on average each night (33.33%). All participants slept more than eight hours per night on non-school nights. However, eleven of them slept less than eight hours on average on school nights (52.38%), of which three were sleep deprived as they slept less than seven hours per night (Hirshkowitz et al., 2015). Four participants scored higher than 5 on the PSQI and therefore had poor sleep quality (20%), of which two scored 10 or higher. The discrepancy between

sleep quality on school nights (M = 5.05) and non-school nights (M = 4.95) was not statistically different (z = -0.31, p = .75).

The distribution of overall sleep quality was right skewed as the skewness was 1.45 (SE = 0.51) and it was also leptokurtic as the kurtosis was 1.81 (SE = 0.99). The distribution for self-esteem was nearly symmetric as the skewness was 0.13 (SE = 0.54). The distribution was also platykurtic as the kurtosis was -0.73 (SE = 1.04). Shapiro-Wilk test showed that the distribution of overall self-esteem was normal (W(17) = 0.96, p = .56) and there were no outliners. The distribution for sleep duration was fairly symmetric as the skewness was -0.46 (SE = 0.50) and it was also platykurtic as the kurtosis was -0.69 (SE = 0.97). Therefore, the Shapiro-Wilk test showed that the distribution of overall sleep duration was normal (W(17) = 0.95, p = .46) and included no outliners.

There was not a statistically significant difference in overall self-esteem score (t(15) = 1.31, p = .21, d = 0.66) between participants that slept overall more than eight hours (M = 18.45) and those who slept less than eight hours per night (M = 21.67). However, results showed that those who slept more than eight hours had higher self-esteem. Mean comparison for self-esteem was also made for categorical sleep duration on school nights and self-esteem. Participants that slept less than eight hours on school nights scored 21.89 (N = 9) on average but those who slept more than eight hours scored 17.00 (N = 8). It showed a statistical difference in overall self-esteem score, as participants that slept more than eight hours per night had higher self-esteem (t(15) = 2.29, p = .04, d = 1.11).

Levene's test showed that the variance for gender and self-esteem were equal (F(1,16) = 0.00, p = .97), as well as for gender and sleep duration (F(1,19) = 1.53, p = .23). There was a normal distribution for both genders in self-esteem and sleep duration, according to the Shapiro-Wilk test (p < .05). Table 2 shows that a mean comparison of gender did not reveal a

statistically significant difference in overall self-esteem score ($t(16) = 0.21$, $p = .83$, $d = 0.10$) and overall sleep duration ($t(19) = 0.09$, $p = .93$, $d = 0.04$).

Table 2

Mean gender comparison for all variables

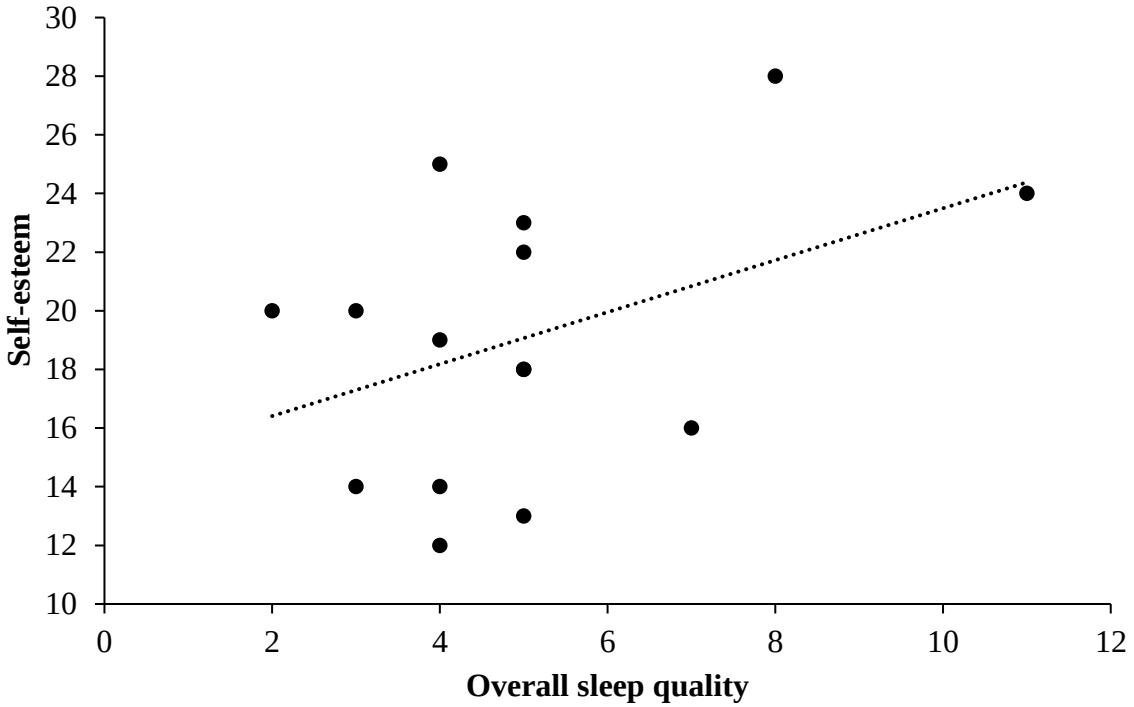
Variable	Girls mean (*SD*)	Boys mean (*SD*)	Mean gender comparison (*p*)
Overall self-esteem	19.50 (4.86)	20.00 (5.10)	.83
Overall sleep duration (hours)	8.12 (0.72)	8.15 (0.57)	.93
Sleep duration on school nights (hours)	7.59 (0.83)	7.65 (0.75)	.87
Sleep duration on non-school nights (hours)	9.45 (0.76)	9.40 (0.70)	.87
Overall sleep quality	5.60 (2.46)	4.50 (2.12)	.30
Sleep quality on school nights	5.50 (2.46)	4.60 (2.12)	.39
Sleep quality on non-school nights	5.60 (2.41)	4.30 (2.26)	.23
Overall caffeine intake (drinks)	2.00 (2.45)	1.64 (2.73)	.76
Number of exercising days per week (days)	3.91 (2.21)	6.00 (1.18)	.01
Electronic device usage per day	4.09 (1.14)	3.80 (0.63)	.48

Mean comparison of gender did not reveal a statistically significant difference in overall sleep quality ($p > .05$). Levene's test of homogeneity of variance showed that the variables exercising days, electronic device usage, caffeine intake, and sleep quality had equal differences in distribution for both genders ($p > .05$). There was a significant gender difference for exercising days ($U = 28.00$, $p = .03$), as the male participants reported more exercising days ($M = 6.00$) compared to the females ($M = 3.91$), as displayed in table 2.

Kendall's Tau-b test did not show a statistically significant positive correlation between overall sleep quality and overall self-esteem ($r_b = .24$, $p = .23$), as figure 1 exhibits.

Figure 1

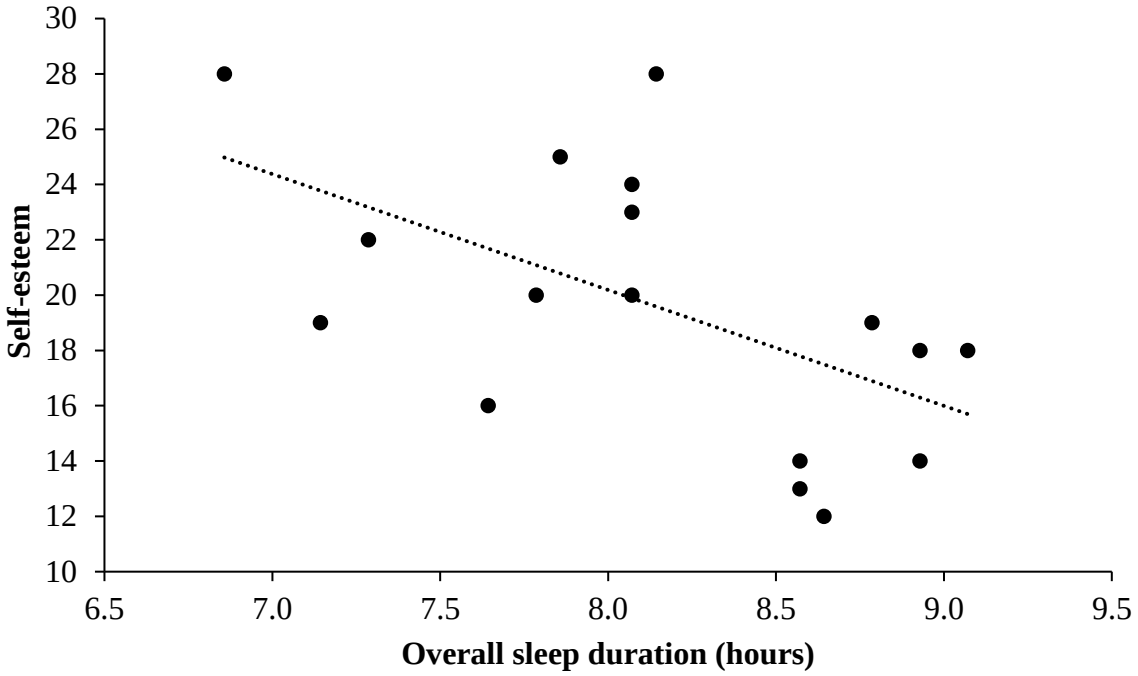
A scatter plot of the association between self-esteem and overall sleep quality



Pearson correlation test showed that a significant moderate negative correlation was between overall sleep duration and overall self-esteem score ($r(16) = -.56$, $p = .02$), as seen in figure 2. That showed that increased self-esteem was associated with increased overall sleep duration.

Figure 2

A scatter plot of the association between self-esteem and overall sleep duration



The activity tracker measured sleep duration for the first five days of the study, which were all school nights. Due to various complications, the tracker was unsuccessful as the data on sleep duration only showed valid results for eight individuals, which accounts for 36.36% of participants. The results from the tracker showed that the participants slept for an average of 8.92 hours per night. However, the results could not be traced to a single score in the questionnaire and therefore it could not be compared to self-reported sleep duration.

Discussion

The aim of this study was to examine if there was an association between sleep duration and sleep quality with self-esteem in adolescents in Iceland. The hypotheses were that a lower score of overall sleep quality was associated with lower self-esteem, and that shorter sleep duration was associated with lower self-esteem. The first hypothesis was not supported, as overall sleep quality did not correlate with overall self-esteem, which is

contrary to previous findings (Conti et al., 2014; Lemola et al., 2013; Tu et al., 2017; Yip, 2015). A study by Woods and Scott (2016) showed that lower levels of self-esteem were associated with poorer sleep quality. They suggested that poor sleep quality was the main mediator of the well-established relationship between high social media usage and low self-esteem (e.g. Bányai et al., 2017; Kelly et al., 2018; Tibber et al., 2020). The suggestion in that study is driven by the evidence that high social media usage and excessive usage of electronic devices is associated with poor sleep quality (e.g. Caumo et al., 2020; Donskoy & Loghmanee, 2018; Kelly et al., 2018; Levenson et al., 2016; Oliveira et al., 2020). The results of this study did not fully support those findings, as electronic device usage did not correlate with self-esteem. However, the results did show a correlation between electronic device usage and overall sleep quality, indicating that more hours spent on electronic devices was associated with poorer sleep quality, which is partly corresponding to previous studies (Oliveira et al., 2020; Woods & Scott, 2016). However, caffeine intake and exercising days did not affect sleep duration and sleep quality, contradictory to previous findings (Brand et al., 2010; Gong et al., 2017; Lodato et al., 2013; Pucci & Pereira, 2019).

The second hypothesis in this study was supported, as overall sleep duration correlated with scores on the Rosenberg self-esteem questionnaire. Therefore, results indicated that shorter sleep duration was associated with lower self-esteem in adolescents, which is in line with previous findings (Conti et al., 2014; Roberts et al., 2009; Tu et al., 2017). Although this relationship has not been extensively researched, several studies have indicated a relationship between sleep and self-esteem in adults (Conti et al., 2014; Lemola et al., 2013; Wong et al., 2013), children (Kim et al., 2012; Lemola et al., 2011), and adolescents (Fredriksen et al., 2004; Roberts et al., 2009; Tu et al., 2017; Woods & Scott, 2016). A well-established study by Fredriksen et al. (2014) showed a strong association between shorter sleep duration and lower self-esteem among adolescents. This relationship

was stronger when lack of sleep was obtained over time. It should be noted that the study initiated in 1997 when electronic device usage was not as integrated into public usage compared to the present moment. Other studies have noted the role of social media usage in the relationship between sleep and self-esteem (Woods & Scott, 2016).

As previously mentioned, studies have shown that adolescents do not get the recommended hours of sleep per night (Carskadon, 2011). These results are especially evident for adolescents in Iceland, and the results from this study comply with that (Gudmundsdottir et al., 2016; Rannsóknir og greining, 2020; Rognvaldsdottir et al., 2017). Participants slept on average for a little more than eight hours per night. However, they slept on average for roughly seven and a half hours on school nights. It indicates that during weekdays, half of the participants did not sleep enough according to recommendations. Previous findings have shown that the majority of adolescents do not fulfil their recommended sleep on school days (Gariepy et al., 2020; Rognvaldsdottir et al., 2017). Therefore, the results are roughly corresponding to those findings. Additionally, the majority of participants had sleep debt, which is defined as more than or equal to two hours of discrepancy in sleep on school nights and non-school nights (Matthews et al., 2014). Guidelines for adolescent's sleep recommends a consistent time for going to bed and waking up, as it is beneficial for overall health (Gruber et al., 2014). Results from the activity tracker showed that participants slept on average for roughly nine hours per school night, suggesting that participants' actual sleep pattern on school nights might be notably higher than their perceived sleep duration. However, the data from the watches could only be analysed for eight individuals, which accounts for 36% of all participants. Additionally, wearable activity trackers tend to overestimate total sleep duration (Chinoy et al., 2020). Therefore, this data could not be used as a generalization for the sample.

The results from this study indicate that there might be an association between sleep duration and self-esteem. However, the data could not provide information on causation. Several factors that might influence the association between sleep duration and self-esteem in adolescents. For instance, short sleep duration and poor sleep quality can lead to increased perceived stress (Buckley & Schatzberg, 2005). In fact, studies have shown that high self-esteem is an important factor to successfully cope with stressful situations (Pruessner et al., 1999; Scarpa & Luscher, 2002), as individuals who experience higher levels of stress possess lower levels of self-esteem (Hudd et al., 2000; Sakellari et al., 2018). Furthermore, adolescence is a period that often results in an increased amount of perceived stress (Friberg et al., 2012) as well as lower self-esteem (Robins et al., 2002). Adolescents might therefore try to enhance their lowered self-esteem by spending large amount of time in school activities, sports, employment opportunities, or fostering peer relationships (Conti et al., 2014). Although these activities are important for adolescents, they might interfere with their sleep.

Sleep deprivation is also known to have an impact on internalizing symptoms in youth (Kelly & El-Sheikh, 2014; Zeiders, 2017), including symptoms of anxiety towards one's self-worth (Uhde et al., 2009). Research suggests that this is a bidirectional relationship meaning that worries and concerns about one's self-worth may result in delayed or disturbed sleep (Uhde et al., 2009). Conti et al. (2014) argued that increased stress due to poor self-esteem may result in sleep deprivation as those people might lack the ability and strategies to relax, which often facilitates better sleep. Additionally, inadequate sleep in adolescence can increase the likelihood of depressive symptoms (Roberts & Duong, 2014), obesity (Cappuccio et al., 2008) and substance use (Strauss, 2000), which are all factors that are known to lower self-esteem (Greenberg et al., 1999; Goldfield et al., 2010; Keane & Loades, 2017).

To the authors knowledge, this is the first study to be conducted on the matter in an Icelandic population. As previously mentioned, Iceland's unique geographical location might be the reason why Icelandic adolescents go to bed later than their peers in Western countries (Rognvaldsdottir et al., 2017). However, the sample size in this study was low and the correlation was not strong, which causes the results to be unrepresentative for Icelandic adolescents. Another limitation is that the questionnaire was self-reported and therefore the participants might not have answered in accordance with their true score. In addition, the PSQI had low internal consistency which should be taken into consideration when interpreting the results. Considering all the limitations, this current study might encourage future studies to explore this new research area further. Future studies should firstly have a greater sample size to be able to generalize the results to the population. Secondly, they should explore the causal of the relationship. Thirdly, a well-established actigraph should be used to measure the sleep pattern.

This study might provide further support for the importance of sufficient sleep adequate self-esteem level. Studies consistently show that adolescents are not getting enough sleep (Rannsóknir og greining, 2020) and that problem has been steadily increasing for the past decades (Dollman et al., 2007; Twenge et al., 2017). The findings of this study can be used to prevent sleep deprivation in adolescents by providing education, as well as encouraging researchers to examine unexplored potential influencers.

In conclusion, self-esteem did correlate with overall sleep duration but not with overall sleep quality. The results suggested that increased self-esteem level was associated with increased sleep duration. Although this relationship has not been extensively explored, this study provides further support to the association.

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