

Bullying involvement in adolescence: Implications for sleep, mental health and academic outcomes.

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Acknowledgment

We want to thank the Bergen Child Study group and most importantly we are grateful to all participants that made this study possible

Abbreviations: BCS= Bergen Child Study, SES= Socioeconomic status , EMM=Estimated Marginal Means, GPA =Grade point average, TIB= Time in bed, SOL= Sleep onset latency, WASO= Wake after sleep onset, DIMS= Difficulties initiating and maintaining sleep OBVQ= Olweus Bully/Victim Questionnaire SCARED= the Screen for Child Anxiety Related Emotional Disorders, YCD= Youth Conduct Disorder, DPS= Diagnostic Interview Schedule for Children Predictive Scales

ABSTRACT

Purpose: Adolescents' involvement in bullying is associated with both sleep and mental health problems, but the nature of this association remains unclear; further, its association with academic outcomes has received little attention. Thus, the aims of the current study were to: 1) determine whether involvement in bullying as a victim, bully, or bully-victim was associated with greater sleep and mental health problems; and 2) explore the potential mediating effect of sleep and mental health problems on the association between bullying and academic outcomes.

Methods: A large 2012 population-based study in Hordaland County, Norway, surveyed 10,220 adolescents (16-19 years; 54% girls) about bullying involvement using the revised version of the Olweus Bully/Victim Questionnaire, detailed sleep assessment and mental health questionnaires. Academic outcomes were obtained from official administrative registries.

Results: 1.7% of the adolescents (n=156) reported being victims of bullying, 1.0% (n=92) reported being a bully, and 0.5% (n=50) reported being a bully-victim. All categories of bullying involvement had higher rates of mental health problems compared to adolescents not involved in bullying. Victims reported more symptoms of anxiety and depression, whereas bullies reported higher rates of conduct problems. All bullying categories also reported significantly shorter sleep duration and higher prevalence of insomnia as well as lower grade point average (GPA) compared to adolescents not involved; however, school absence was not associated with bullying involvement. Bullying involvement and GPA showed complete mediation for bullies and bully-victims and partial mediation for victims through sleep duration, conduct problems, and symptoms of depression and ADHD.

Conclusions: Bullying is strongly associated with mental health and sleep problems, in addition to lower academic performance. Findings support the importance of addressing bullying involvement during this important developmental period.

INTRODUCTION

Experiencing bullying is prevalent during the school years, with a declining rate from early childhood to late adolescence.^{1,2} Still, a survey of adolescents from 40 countries found that a sizeable number of adolescents experience bullying³, but the prevalence rates vary according to methodology and across countries⁴

Bullying is related to a range of negative health outcomes,⁵ and this holds true both for those who experience bullying (the victims), for those who perform bullying behavior (the bully), and for those who have a double role; the bully-victim.⁵⁻⁷ Specifically, sleep problems and short sleep duration are prevalent in adolescence.⁸ A recent meta-analysis concluded that there was a strong link between peer victimization and sleep problems.⁹ However, most studies have focused on victims of bullying, whereas less is known about sleep in the other bullying roles. There are some notable exceptions, including a Scottish study of 5420 adolescents with a high rate of insomnia symptoms among victims, bullies, and bully-victims between 11-17 years of age.¹⁰ A higher rate of insomnia as well as bedtime fears were also found among victims and bully-victims in comparison to those not involved in bullying among 887 14 -17-year-old high school students.¹¹ Similarly, all the groups of bullying involvement were at higher risk of sleep problems compared to non-involved adolescents in a study of high school students in China.¹² In contrast, a Greek study that included children and adolescents aged 10-18 years demonstrated that some sleep problems were specific for different bullying roles; irregular sleep patterns and short sleep duration were more frequent among bullies, while insomnia symptoms were more often reported by bully-victims.¹³

The association between bullying involvement and sleep may be specific to certain developmental levels, as indicated in a recent meta-analysis in which the association between peer victimization and sleep was stronger for the younger age groups.⁹ Some studies have not found this association in the high school years,² and this may be related to the higher rate of bullying in younger years. In contrast, sleep patterns undergo major changes from early childhood through late adolescence, with the rate of sleep problems increasing,¹⁴ and sleep duration becoming shorter¹⁵. Thus, the association between bullying and sleep needs to be addressed specifically in late adolescent samples. Another concern with

previous studies is that they have often assessed sleep problems using a single item and crude measures.¹⁶ Few have assessed insomnia according to diagnostic criteria, and a good measure of sleep duration is rarely included. A further concern is that both victims and bullies are more likely to be from a low SES background¹⁷ and a social gradient is also demonstrated in adolescents' sleep¹⁸, thus, adjusting for SES is important.

The association between bullying and mental health problems is more established. Mental health problems are higher among those involved in bullying compared to non-involved peers across a range of mental health indicators.^{19,20 21} Still, there are differential patterns of mental health problems between bullies, victims, and bully-victims. Victims have been shown to have more internalizing problems (especially anxiety and depression) than their peers²²⁻²⁵. In contrast, bullies are more often characterized by externalizing problems (such as conduct problems and antisocial behavior^{25,26}), and bully-victims are likely to have both internalizing and externalizing problems.²⁰

With respect to academic outcomes, experiencing bullying as a victim, bully, or bully-victim is associated with poor school achievement.^{20,27,28} Bullying involvement may be directly related to school performance or potentially mediated by known risk factors for reduced school performance, such as mental health problems.²⁹ Short sleep duration may be another likely mediating mechanism, given that sleep deprivation is associated with learning and memory difficulties, and confirmed by the association between sleep and GPA in the adolescent years.³⁰ To our knowledge, factors that may mediate the association between bullying involvement and academic outcomes among adolescents have not been previously examined.

Based on the above considerations, the aims of the current study were to further investigate the association between bullying involvement, sleep and mental health problems, and school performance during late adolescence. Specifically, the study addressed conceptual and methodological gaps in previous studies by including all aspects of bullying involvement (i.e. bully, victims, and bully-victims), obtaining adolescents' GPA from registers as an objective academic outcome, and using a comprehensive sleep measure that assessed both sleep duration and symptoms of insomnia. Further,

the current study extended prior research by evaluating the potential mediating effect of sleep and mental health problems on the association between bullying involvement and academic outcomes.

METHODS

Procedure

This population-based study used data from the youth@hordaland-survey of adolescents in Hordaland County in Western Norway. All adolescents born between 1993 and 1995 were invited in 2012 to reach all adolescents in late adolescent and high school age . The main aim of survey was to assess the prevalence of mental health problems and service use in adolescents. Adolescents in upper secondary education received study information via e-mail, and one classroom school hour was allocated for completing the questionnaire. Those not in school received information by postal mail to their home address. The questionnaire was web-based and covered a broad range of mental health issues, daily life functioning, use of health care and social services, and demographic characteristics, as well as a request for permission to obtain school data and to link the information with national health registries and parental reports on a corresponding questionnaire. Uni Research Health collaborated with Hordaland County Council to conduct the study.

Sample

All adolescents born between 1993 and 1995 were invited (N=19,430) to participate during the first months of 2012, of which 10,220 agreed, yielding a participation rate of 53%. All sleep variables were manually checked for validity with subjects providing obvious invalid responses being omitted from further analyses. Invalid responses included 1) sleep onset latency (SOL) or wake after sleep onset (WASO) more than 12 hours, 2) SOL +WASO longer than time in bed (TIB), and 3) negative values of sleep duration and sleep efficiency. This resulted in 374 adolescents (3.7%) being omitted. Among the 9,846 remaining adolescents, 1,499 (15.2%) did not give consent to link their data to the official register on school absence, thus yielding a sample size of 8,347 for the linked dataset.

Instruments

Sociodemographics

Gender and date of birth was identified through personal identity number in the Norwegian National Population Register. Exact age was estimated by calculating the interval of time between date of birth and date of participation. Socioeconomic status (SES) was assessed both by parental education. Maternal and paternal education were reported separately with three response options: “primary school”, “secondary school”, and “college or university”.

Bullying

Bullying was measured by two global questions from the revised version of the Olweus Bully/Victim Questionnaire (OBVQ); one question on being bullied by peers (bullying victimization) and one question on bullying peers (bullying perpetration)³¹ The revised version of the OBVQ contains a definition or explanation of bullying which precedes the two global questions. The explanation is designed to capture all three main elements of the definition of bullying: the intention to harm the victim; the repetitive nature of bullying; and the imbalance in power between the victim and the perpetrator(s). A shorter version of the explanation of bullying was used in the present study. The question on being bullied (“How often have you been bullied at school in the past couple of months?”) and bullying peers (“How often have you taken part in bullying another pupil(s) at school the past couple of months?”) had five response alternatives: “I haven’t been bullied/bullied other students at school in the past couple of months”, “only once or twice”, “2 or 3 times a month”, “about once a week”, and “several times a week”. By combining the two global questions adolescents were divided into four groups: bullies, victims, bully-victims and non-involved.^{31,32} OBVQ is one of the most widely used bully questionnaires in the world and has shown generally favorable psychometric properties^{31,33}

Sleep measures

Adolescents' self-reported usual bedtime and rise time were indicated in hours and minutes using a scroll down menu; data were reported separately for weekdays and weekends using a consensus sleep diary³⁴. Time in bed (TIB) was calculated as the difference between bedtime and rise time. Sleep onset latency (SOL) and wake after sleep onset (WASO) were indicated in hours and minutes, and sleep duration was defined as TIB minus SOL and WASO. Sleep efficiency was calculated as sleep duration divided by TIB multiplied by 100 (reported as percentage; higher scores reflecting greater sleep efficiency). Subjective sleep need was reported in hours and minutes, and sleep deficit was calculated separately for weekends and weekdays by subtracting total sleep duration from subjective sleep need. This measure has been used in previous studies¹⁵

Insomnia was operationalized according to the DSM-5 criteria for insomnia³⁵. Difficulties initiating and maintaining sleep (DIMS) were rated on a three point Likert-scale with response options “not true”, “somewhat true” and “certainly true”. If confirmed (i.e., “somewhat true” or “certainly true”), adolescents were then asked how many days per week they experienced problems either initiating or maintaining sleep. Adolescents also provided information on the duration of DIMS. A joint question on tiredness/sleepiness was rated on a three point Likert-scale with response options “not true”, “somewhat true” and “certainly true”. If confirmed, adolescents then reported the number of days per week they experienced sleepiness and tiredness, respectively. To meet the DSM-5 criteria for insomnia, adolescents had to report DIMS at least three times a week, with a duration of three months or more, as well as tiredness or sleepiness at least three days per week.

Mental health problems

Depression symptoms were measured using the short version of the Mood and Feelings Questionnaire (SMFQ).³⁶ The SMFQ consists of 13 items focusing on cognitive and affective symptoms rated on a 3-point Likert scale. The Norwegian translation of the response categories corresponds to the original categories of “not true”, “sometimes true” and “true”. The SMFQ has been found to have high internal consistency and essential unidimensionality in a population based study³⁷ and a study based on the

sample from youth@-hordaland.³⁸ Cronbach's alpha for the SMFQ in the current study was 0.91.

Anxiety symptoms were measured using the short 5-item version of the Screen for Child Anxiety Related Emotional Disorders (SCARED).³⁹ This version consists of the 5 indicators that discriminate best between anxious and non-anxious children, assessed by a comprehensive symptom checklist for all DSM-IV diagnoses. Further, it has shown similar psychometric properties to the 41-item SCARED.³⁹ Cronbach's alpha for the 5-item SCARED in the current study was 0.69.

ADHD symptoms were measured using the World Health Organization adult ADHD Self-Report Scale (ASRS).⁴⁰ ASRS consists of 18 items: 9 measure symptoms of inattention and 9 measure symptoms of hyperactivity-impulsivity. Symptoms are rated on a 5-point Likert scale ranging from 'never' to 'very often'. The ASRS has shown high internal consistency and construct validity when used with adolescents.⁴¹ Cronbach's alpha for the ASRS in the current study was 0.91.

Conduct problems were measured using the Youth Conduct Disorder (YCD) instrument, consisting of 8 items which are part of the Diagnostic Interview Schedule for Children Predictive Scales (DPS)⁴². The DPS scale has been shown to accurately identify adolescents who are at high probability of meeting diagnostic criteria for conduct disorder. Cronbach's alpha for the YCD in this study was 0.79.

Academic outcomes

Grade point average. Official registers from Hordaland County provided information on academic grades. In Norway, secondary schools use a scale from 1 to 6, with 6 as the highest grade (outstanding competence), 2 (low level of competence) as the lowest passing grade, and 1 as failure. Grade point average (GPA) was calculated as the average of the student's grades for the last semester.

School attendance. Official register-based data on school non-attendance were provided by Hordaland County Council, and included both days and school-hours of absence for the last semester (six

months).

Representativeness

Compared to national and regional statistics provided by the Norwegian Directorate for Education and Training ⁴³, the mean GPA of all mandatory courses for adolescents in the current study (mean 3.57) was identical to the national GPA in 2012 in this age cohort (mean 3.57) but slightly lower than the GPA in the Hordaland county (mean 3.61) ³⁰

Ethics

The study was approved by the Regional Committee for Medical and Health Research Ethics (REC) in Western Norway. In accordance with the regulations from the REC and Norwegian health authorities, adolescents aged 16 years and older can make decisions regarding their own health (including participation in health studies), and thus gave consent themselves to participate in the current study. Parents/guardians have the right to be informed, and in the current study, all parents/guardians received written information about the study in advance. School attendance were the official reports from the registers of Hordaland County. The registry data was linked to the youth@hordaland-survey for participants who consented to participate in the study as a whole (including school registry information) or specifically consented to the use of their registry information.

Statistical analyses

Independent samples t-tests and chi-squared tests were used to examine differences in demographic variables and school absence and school performance. For comparison of mental health problems (SMFQ, ASRS, YCD and SCARED) and sleep duration (on weekdays and weekends) across the four groups of bullying involvement we used Analysis of covariance (ANCOVA), estimating marginal

means (EMM) adjusting for age, gender and parental education. The mental health scales were standardized and Cohens d effect sizes were calculated.

The association between bullying involvement (i.e., being a bully, a victim, or a bully-victim versus no involvement) and GPA was further examined by estimating a structural equation model, allowing for mediation by: sleep duration; conduct problems; and symptoms of anxiety, depression and ADHD.

Analyses controlled for age and sex. Separate analyses were conducted for each of the bullying involvement groups, comparing them to the non-involved participants. The variance inflation factor (VIF) for the mediators ranged from 1.05-1.60, well below the recommended cut-off $VIF > 10$ for SEM analyses.⁴⁴ All analyses were conducted using the robust maximum likelihood estimator and missing data was handled by full information maximum likelihood (FIML). Indirect effects were investigated using the built in function IND in Mplus. A significant mediation effect was determined using 95% bias-corrected bootstrap confidence interval⁴⁵. The standardized effect sizes are reported.

The t-tests, chi-squared tests, ANCOVA and multiple regression analysis (to obtain VIF) were conducted using of IBM SPSS statistics version x. Mplus (version 8) was used for the mediation analyses⁴⁶

RESULTS

Bullying involvement

In all, 1.7% of the adolescents (n=156) reported being victims of bullying, while 1.0% (n=92) reported being a bully, and 0.5% (n=50) reported being a bully-victim. The large majority (96.8%, n=8940) of the adolescents had not been involved in bullying behavior or been the target of bullying the last months. As detailed in Table 1, all three categories of bullying involvement were more prevalent among boys than girls ($P < .001$). The adolescents' age and parental education were not significantly associated with bullying status.

Please insert Table 1 about here

Bullying involvement and mental health problems

Figure 1 displays the estimated marginal means (EMM) of mental health problems in standardized t-scores by bullying involvement status, as well as Cohen's *d* effect-sizes (compared to non-involved). Both victims, bullies and bully-victims, reported more symptoms of depression compared to adolescents not involved in bullying. The highest level of depression was found for victims ($d=1.1$) and bully-victims ($d=1.0$). The same pattern was observed for symptoms of anxiety, but with smaller effect-sizes (see Figure 1 for details). In contrast, bullies had significantly higher levels of conduct problems ($d=1.4$), followed by bully-victims ($d=0.8$). Victims of bullying did not score higher on conduct problems than the non-involved group. In terms of symptoms of ADHD, all three categories of bullying involvement scored higher in the ASRS scale (d s from 0.5 to 0.7) than non-involved adolescents, but the bullying involvement groups did not differ significantly from each other.

Please insert Figure 1 about here

Bullying involvement and sleep problems

Figure 2 displays the sleep duration by bullying involvement. Both victims (5:44 hours), bullies (5:31 hours) and bully-victims (5:26 hours), reported significantly shorter sleep duration on weekdays compared to adolescents not involved in bullying (6:26 hours). A similar pattern was observed for weekend sleep duration (see Figure 2). The prevalence of DSM-5 insomnia was highest in victims of bullying (36.5%), but also elevated in bullies (27.2%) and bully-victims (26%) compared to adolescents not involved in bullying (18.2%; $P < .001$).

Please insert Figures 2 about here

Bullying involvement and academic outcomes

Victims, bullies and bully-victims had lower GPAs compared to adolescents not involved in bullying, with medium effect sizes ($d=0.49$, $d=0.56$ and $d=0.42$, respectively). However, the three bullying categories did not differ significantly from each other (see Table 1). Days of school absence were not significantly associated with bullying involvement.

Mediation analyses

The possible mediating effects of sleep duration and symptoms of mental health problems on the association between bullying involvement status and GPA were investigated. For all three groups, the mediation analysis showed significant indirect effects through sleep duration, symptoms of depression, and symptoms of ADHD, but not through symptoms of anxiety (see Figure 3a, b and c). For victims, there was no significant indirect effect through conduct problems (see Figure 3a). Further, the direct effect from victim to GPA was significant, suggesting partial mediation for the victims. In contrast, there were significant indirect effects on GPA also through conduct problems for bullies and bully-victims (see Figure 3b and 3c, respectively). However, for these two groups, the direct effect was not significant, suggesting complete mediation by sleep and mental health on the association between being a bully or a bully-victim and GPA. The correlations between the mediator variables for the mediation analysis involving victims are shown in Table 2. Very similar correlations (not shown) were found in the mediation analyses involving bullies and bully-victims (see Figure 3b and 3c, respectively).

DISCUSSION

In the present large-scale population-based study of Norwegian adolescents bullying involvement was relatively infrequent, with 1.7% of the adolescents reported being victims, 1% reported bullying others, and 0.5% reported both categories. Adolescents involved in bullying across the different roles had, in general, higher rates of mental health problems compared to adolescents not involved in bullying. While victims reported more symptoms of anxiety and depression, bullies had higher rates of conduct problems. All three categories had significantly shorter sleep duration and higher prevalence of insomnia as well as lower GPA compared to adolescents not involved in bullying. The bully-GPA link and bully-victim GPA link were fully mediated by sleep and mental health problems (except anxiety), while the victim-GPA link was partially mediated by the same variables.

The overall results suggest that even if the rate of bullying involvement in this age cohort is low in Norway, which is in accordance with the prevalence for the national pupil survey,¹ the consequences for those involved are substantial. This point was demonstrated by the strong associations between bullying involvement and both sleep and mental health problems, as well as reduced academic achievements. While the rate of bullying was similar to other Norwegian data, it is still lower than many international estimates^{3,4}. The Health Behaviour in School-aged Children (HBSC) study comprising pupils from 40 countries study a similar definition of bullying as the presents showed that the prevalence rates of bullying and victimization in Norway is lower than in many other countries.³ The lower prevalence in Norway and other Nordic countries may be a result of the high awareness of school bullying at the societal level as well as differences in national policy and implementation of interventions programs against bullying. The governmental response to bullying in Norway includes, compulsory annual pupil surveys in in three grade levels as well as increasing the responsibility of schools using the national Education Act.

The reliance on school registry data precludes us from conclusions regarding rates of bullying of adolescents who are not in school, and this may have impacted the relatively low level of bullying. The present study focused on the rate of bullying involvement in the general school population and did not specifically focus on high-risk groups, due to limited statistical power. The participants in the

youth@hordaland-survey are a diverse group with regards to for instance gender, socioeconomic status and ethnicity^{18,47}. We acknowledge that there might be some groups such as adolescents from minority groups⁴⁸ and others may be more at risk of for instance or homophobic bullying⁴⁹. Thus, the rate and the possible associations between bullying and school outcomes should be specifically addressed in such groups in future studies.

The expected differential patterns of mental health problems across bullying involvement was partly confirmed with higher externalizing problems for bullies and internalizing problems being more frequent for victims. While conduct problems were more frequent among adolescents that had bullied others, depressive symptoms and anxiety were higher among all groups compared to their non-involved peers, with the highest rates among the victims. The ADHD symptoms were higher across all types of bullying involvement in comparison to peers. Although ADHD may be expected to be related to conduct problems, and thus be more frequent among those who bully others, ADHD symptoms in this age group are closely related to depressive symptoms and internalizing problems as well, and thus may explain the lack of differences across the bullying involvement groups.⁵⁰

Interestingly, bully-victims did not report more symptoms of mental health problems compared to the bullies and victims, which is in contrast to previous studies describing bully-victims a particular risk group²⁵. This discrepancy could be due to the age of the present sample, as it is possible that the most troubled bully-victims are no longer present in school by late adolescence.

Victims, bullies, and bully-victims all reported more sleep problems than peers, with shorter sleep duration and more insomnia. These results are in accordance with a meta-analysis suggesting more sleep problems among bully-victims⁹, and previous studies- that have confirmed an increased rate of sleep problems across bullying involvement^{11,12 13}. The results are particularly important as they further extend previous findings by confirming the bullying/sleep problem association using multiple insomnia criteria (i.e., not limited to a single item assessment of sleep). This finding may be especially relevant for adolescents given the high rate of insomnia in this age group.¹⁵ Similarly, the inclusion of short sleep duration, another hallmark of adolescent sleep problems, may also be age appropriate. Thus, the use of developmentally appropriate sleep measures in the present study might

be one of the reasons why we found strong associations between bullying involvement and sleep problems, whereas prior literature suggested that this association might be weaker in adolescents than in younger children,⁹ or perhaps not present at all².

The present study confirmed the functional impact associated with adolescents' involvement in bullying, finding lower GPAs among the adolescents involved in bullying compared to peers, in line with previous studies of younger students²⁷. For the adolescents that bullied others and the bully-victims, the association between bullying and GPA was mediated fully by sleep duration and mental health problems across all categories except anxiety. In contrast, though a similar pattern was present for victims of bullying concerning sleep duration, depression and ADHD, there was no mediation effect through conduct problems and a direct association between being bullied and having a lower GPA persisted. This suggests that there might be additional pathways to lower GPA for the victims, for instance through self-esteem⁵¹. Interestingly, the association between bully status as a bully-victim and GPA more closely resembled that of bullies compared to victims. This might be due to the total effect between bully status and GPA being smaller for this group, as the sum of indirect effects was smaller for bully-victims compared to victims, despite the significant indirect effect through conduct problems. Thus, conduct problems seems to especially important to understand the association between bullying status and GPA for the bully-victim group. The results underscore the importance of a broad approach in understanding adolescent bullying involvement and school achievement. The interplay between sleep and externalizing⁵² and internalizing problems⁸, as well as the interplay between sleep, bullying, and mental health over time^{53 16} suggest that sleep problems, mental health difficulties, and poor school functioning should be considered and evaluated when adolescents are involved in bullying. It was somewhat surprising that victims of bullying did not have higher absence rates compared to the other groups, as previous studies have identified victimization and being bullied as risk factors for school absence⁵⁴. Still, it is possible that these associations are more pronounced in younger age groups, as our findings are in line with a previous study of adolescents²⁸.

Overall, the strengths of the present study are the broad and detailed assessment of sleep problems and mental health, in addition to the inclusion of victims of bullying, bullies, and bully-victims. Further,

the use of administrative registries on academic performance and school attendance reduces the risk of informant bias for these analyses. Nevertheless, there are study limitations that should be noted. All data on sleep and mental health were obtained by self-report, and thus the lack of clinical interviews restricts information on clinical diagnosis. Although self-reported sleep parameters, including SOL and WASO typically differ from those obtained from objective assessments,⁵⁵ recent studies have showed that such self-report sleep assessments can be recommended for the characterization of sleep parameters in both clinical and population-based research.⁵⁶ Also, the accuracy of self-reported SOL and WASO are generally better among adolescents than in older adults,⁵⁷ and a study of young adolescents in Hong Kong found good agreement between actigraphy measured and questionnaire reported sleep durations.⁵⁸

The generalizability of the study may be limited to one county in Norway, although the distribution of urban and rural areas in this county reflects that of Norway as a whole. In particular, the mean GPA of study participants was identical to the mean GPA for Norway, suggesting that the sample may be representative of adolescents in Norwegian schools. Due to school records being one of the outcomes in the present study the results are restricted to those who had been in school the last year. The cross-sectional nature of the study precludes conclusions regarding temporal order, and longitudinal studies are needed to increase the understanding of the interplay between sleep, bullying involvement, mental health and school performance over time.

The present study confirms that bullying involvement is an infrequent but serious condition in late adolescence. For those involved (as victims, bullies, or both), all show more sleep problems, mental health problems, and lower academic performance than their peers. Further studies should investigate whether these associations also are present for young adults. Interventions targeting late adolescent age groups should consider a broad perspective including both mental health and sleep and their school performance.

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Table 1. Demographic characteristics by bullying involvement in the youth@hordaland survey.

	Non-Involved (96.8% - n=8940)	Bullies (1.0% - n=92)	Victims (1.7% - n=156)	Bully- victim (0.5% - n=50)
Gender, % (n)***				
Girls	98.0% (4916)	0.4% (18)	1.5% (75)	0.1% (7)
Boys	95.3% (4024)	1.8% (74)	1.9% (81)	1.0% (43)
Age in years, mean (SD)	17.0 (0.9)	17.0 (0.9)	16.8 (0.8)	17.0 (1.0)
Paternal education, % (n)				

Primary	10.4% (694)	9.0% (6)	16.5% (18)	17.1% (6)
Secondary	46.1% (3069)	56.7% (38)	48.6% (53)	51.4% (18)
College/university	43.5% (2895)	34.3% (23)	34.9% (38)	31.4% (11)
Maternal education, % (n)				
Primary	10.0% (679)	10.3% (7)	15.8% (18)	18.4% (7)
Secondary	41.1% (2799)	47.1% (32)	40.4% (46)	42.1% (16)
College/university	48.9% (3325)	42.6% (29)	43.9% (50)	39.5% (15)
Grade point average (GPA), mean (SD)***	3.88 (0.79)	3.44 (0.88)	3.49 (0.78)	3.55 (0.79)
School absence (days), mean (SD)	5.27 (6.02)	6.49 (6.61)	5.56 (7.23)	4.61 (3.93)

*** ($P > 0.001$)

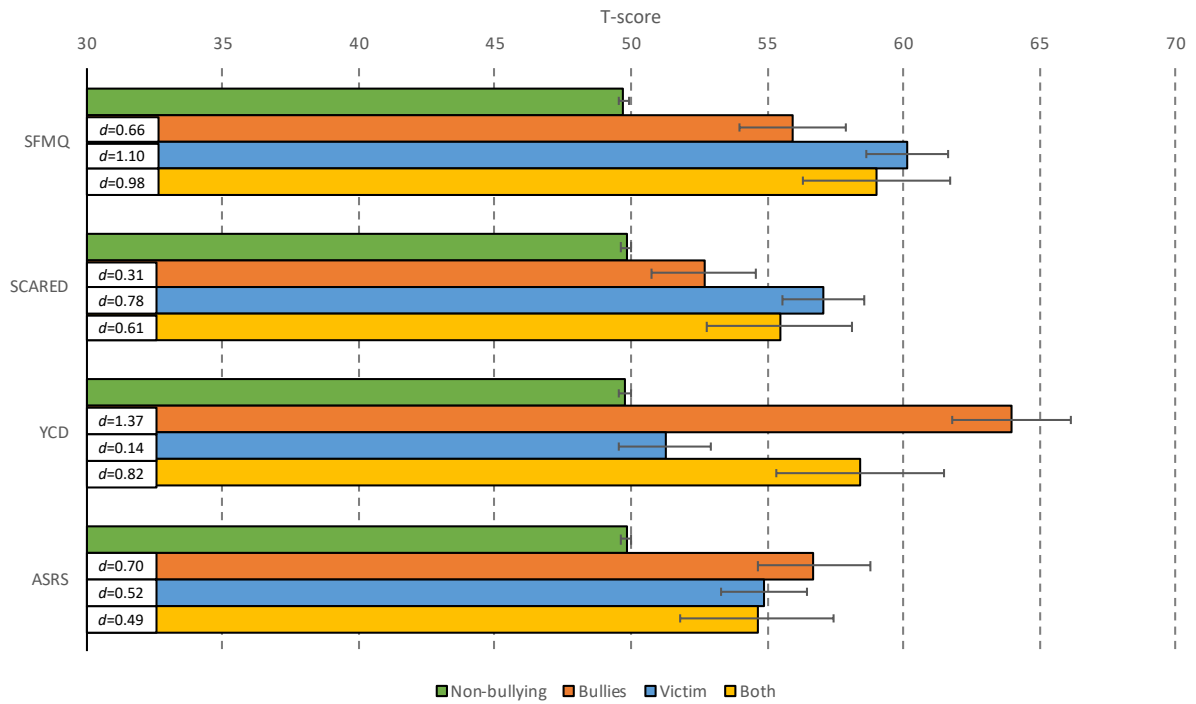


Figure 1. Estimated marginal means (EMM) of mental health problems in standardized t-scores by bullying involvement. EMM are adjusted for age, gender and parental education. White box value indicates Cohen's *d* effect-size by bullying status compared to non-bullying for each instrument. Errors bars represent 95% confidence intervals.

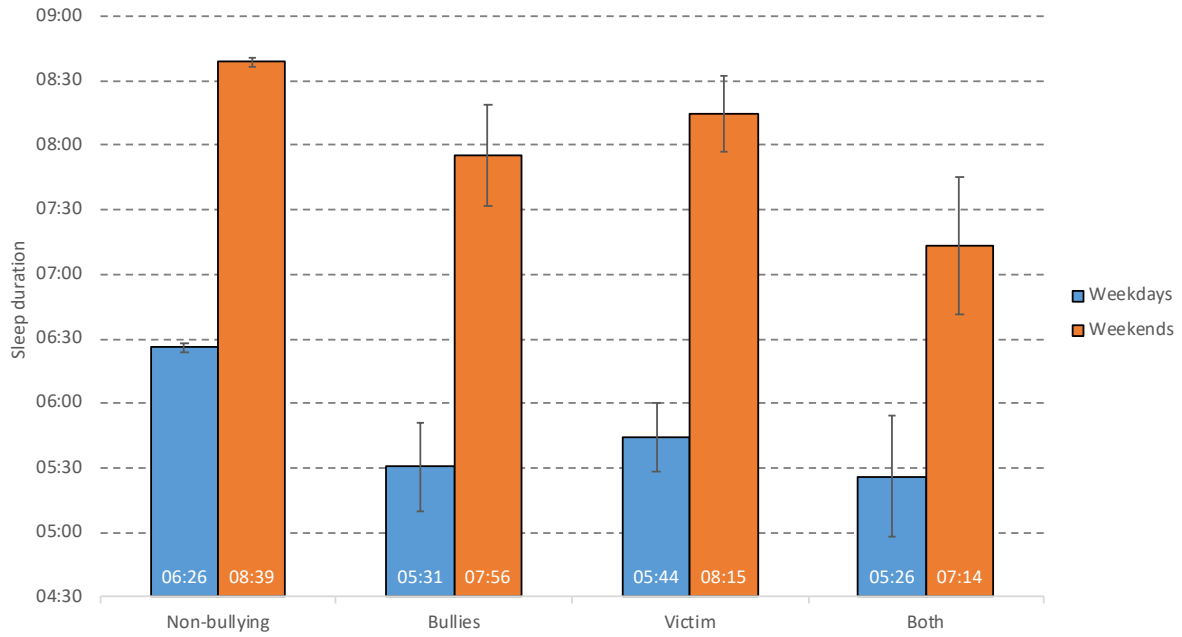


Figure 2. Estimated marginal means (EMM) of sleep duration on weekdays and weekends by bullying involvement. EMM are adjusted for age, gender and parental education. Errors bars represent 95% confidence intervals.

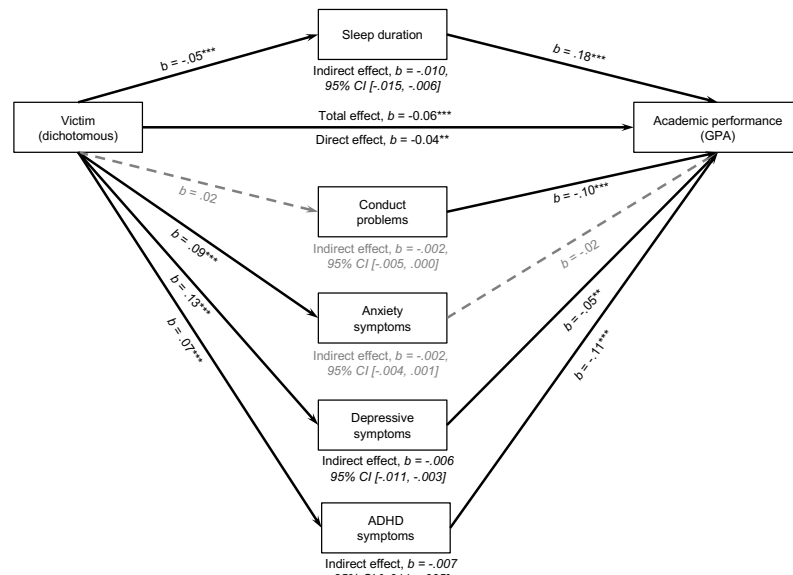


Figure 3a. Model of bully victim as a predictor of GPA, mediated by sleep duration, conduct problems, symptoms of anxiety, depression and ADHD, adjusted for age and sex. The confidence interval for the indirect effect is BCa bootstrapped CI based on 1000 samples. Standardized coefficients are reported. * $p < .05$, ** $p < .01$, *** $p < .001$

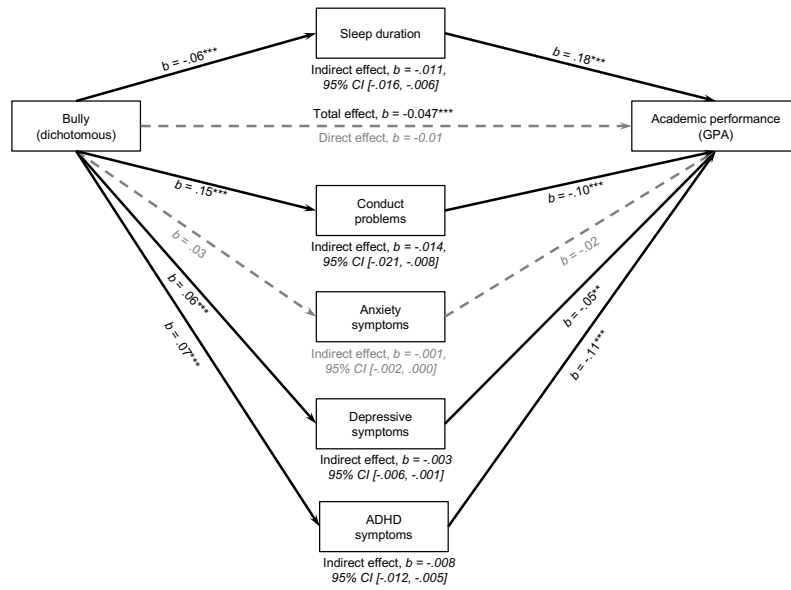


Figure 3b. Model of bully as a predictor of GPA, mediated by sleep duration, conduct problems, symptoms of anxiety, depression and ADHD, adjusted for age and sex. The confidence interval for the indirect effect is BCa bootstrapped CI based on 1000 samples. Standardized coefficients are reported. * $p < .05$, ** $p < .01$, *** $p < .001$

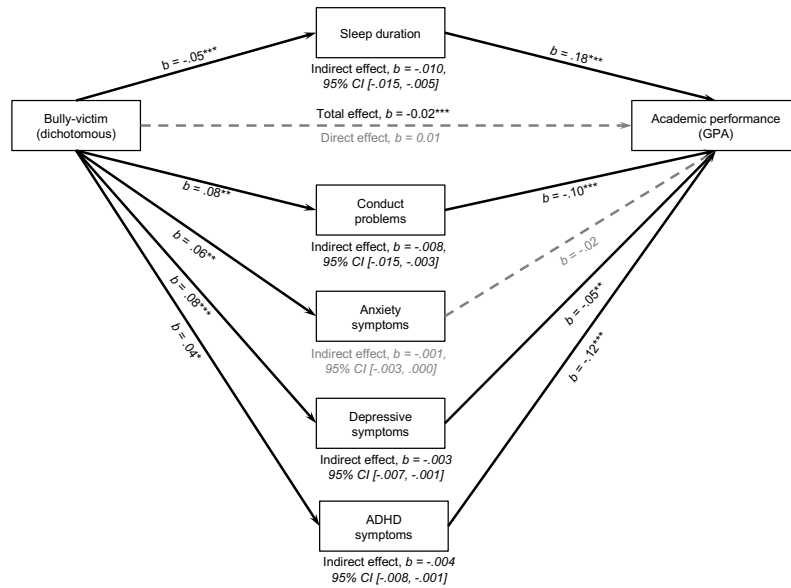


Figure 3c. Model of bully-victim as a predictor of GPA, mediated by sleep duration, conduct problems, symptoms of anxiety, depression and ADHD, adjusted for age and sex. The confidence interval for the indirect effect is BCa bootstrapped CI based on 1000 samples. Standardized coefficients are reported. * $p < .05$, ** $p < .01$, *** $p < .001$