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Psychological distress and trajectories of sleep duration among Australian adolescents: a prospective cohort study

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ABSTRACT

Objectives This study investigated the association between indicators of psychological distress and well-being and trajectories of sleep duration among a cohort of Australian adolescents.

Design A prospective cohort of adolescents was followed over 27 weeks (8 November 2019–14 May 2020). Data on sleep duration and psychological distress were collected via smartphones, based on ecological momentary assessments.

Setting Sydney population catchment, Australia.

Participants Young people aged 13–19 years were recruited via social media (Instagram or Facebook).

Primary outcome measure Self-reported sleep duration in the past 24 hours. Sleep duration was dichotomised into 'less than 8 hours' and 'at least 8 hours', to represent those participants not meeting the recommended minimum amount of daily sleep.

Results Participants with high psychological distress had higher odds of sleeping less than 8 hours (OR 1.51 (95% CI 1.17 to 1.96)), compared with those with low psychological distress. Social media use (OR 1.34 (95% CI 1.01 to 1.79)) and longer periods spent on homework (OR 1.37, (95% CI 1.07 to 1.75)) were also associated with a sleep duration of less than 8 hours. Also, decreasing sleep trajectories were associated with increased psychological distress (β=0.069, (95% CI −0.010 to 0.149)) and increased homework hours (β=0.078 (95% CI 0.036 to 0.120)).

Conclusion Findings highlight the adverse impact of psychological distress and high levels of social media use on sleep duration among adolescents. Longitudinal studies with longer follow-up periods are warranted to further explore the temporal associations between sleep duration and different health outcomes among varying populations.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study employed innovative smartphone measurement of markers of psychological distress and sleep duration among Australian adolescents.
⇒ This study enabled an investigation of determinants of sleep duration allowing for clear temporal associations between exposures and outcomes.
⇒ Study participants were predominantly female and older age adolescents (16–18 years), and therefore, did not represent the population.
⇒ High attrition with just over 25% of those recruited responding to at least one follow-up sleep ecological momentary assessment.

INTRODUCTION

Adolescence is a crucial phase of the life course involving significant social, emotional and biological development, which have lasting impacts on adult health.[1] Sleep deprivation, generally defined as less than 8–9 hours of sleep per night for adolescents,[2 3] has been associated with a number of adverse health outcomes among adolescents including increased risk of obesity, injury, depression, and suicidal ideation and behaviour.[4–6] Despite the negative effects of sleep deprivation, studies report a lack of adequate nocturnal sleep among many adolescents while also noting an increase in sleep problems in these age groups.[7–9] A recent study conducted in Australia reported about a quarter of adolescents aged 12–15 years, and more than half aged 16–17 years, get less than 8 hours of sleep per day.[10]

Prior evidence highlights the presence of mental health problems among adolescents with shorter sleep duration including increased risk of psychological distress,[11] anxiety and depression.[6 12] While the association between mental health and sleep deprivation among adolescents has been previously investigated, most of the evidence is based on cross-sectional surveys,[12–24] which limits the temporal interpretation between mental health exposures and sleep deprivation. Recent studies have used mobile phones to follow up with subjects over time and conduct ecological momentary assessments (EMAs) in (near) real time to better assess temporal trends in key exposures associated with adverse health outcomes, including well-being and psychological distress.[15] Accordingly, this study investigates the association between indicators of psychological distress

and sleep duration among a cohort of adolescents in Western Sydney (Australia).

METHODS

Participants

This study was conducted as part of the Western Sydney Adolescent Health Study, a prospective cohort study investigating determinants of health and well-being among the general population aged 13–19 years from the Sydney (Australia) population catchment. A detailed description of the methods has been published elsewhere.[15] Briefly, young people aged 13–19 years were recruited via social media platforms (Facebook and Instagram) from the general population. A youth Advisory Group was established to seek feedback on the design and implementation of project materials. The social media campaign ran from 8 November 2019 to 8 January 2020 to recruit participants and they were prospectively followed for 16 weeks. Data collection of the study spanned 27 weeks from the first participant's recruitment to the last follow-up (from 8 November 2019 to 14 May 2020) and recruited a total of 1295 participants of which 80% were females aged 16–18 years (table 1), reflecting higher engagement in social media among females compared with males more generally.[16 17]

The study used the Ethica Data smartphone app (https://ethicadata.com/) to collect data from questionnaires, EMAs and smartphone sensors. Geolocation information (via Wi-Fi, Bluetooth and GPS) was collected automatically through the Ethica app among participants who provided consent. Following enrolment, each participant received a baseline questionnaire and a 16-week schedule of follow-up EMAs, with questions sent directly to their smartphone. There were a total of six EMAs relating to mental health factors and sleep duration (described below), sent to participants as part of a 16-week schedule of EMAs over the follow-up period. EMAs were sent to participants at random times and on varying days of the week (Monday to Saturday and one EMA per day), between 8:00 and 10:00 hours or between 15:00 and 20:00 hours, to avoid school hours and sleep periods. Among those recruited at baseline, 343 (26.5%) participants responded to at least one follow-up sleep duration EMA (table 1 and online supplemental figure 1). Participants who responded to at least one follow-up sleep duration EMA were not significantly different from the entire sample recruited at baseline (online supplemental table 1).

Outcome variable

The primary outcome variable for this study was self-reported sleep duration in the past 24 hours which was collected at baseline, via weekly EMAs for 16 weeks. Sleep duration was dichotomised into 'less than 8 hours' and 'at least 8 hours', to represent those participants not meeting the recommended minimum amount of daily sleep.[3]

Psychological distress

The main exposure of psychological distress was collected at monthly intervals for each participant and was measured using the Kessler Psychological Distress 6-item scale (K6).[18] Responses for each K6 item were marked on an ordinal scale including 'none of the time', 'a little of the time', 'some of the time', 'most of the time' and 'all of the time' and were scored from 1 to 5, respectively. A K6 score ≥19 was used as indicative of a 'probable serious mental disorder' as described previously.[18]

Social media and homework

Social media use and homework were also included as potential factors associated with sleep duration.[19 20] Self-reported social media use was collected via a weekly EMA that asked: In the past 24 hours, did you spend any time on the internet, social media (like Instagram, Youtube or Facebook). For participants who answered 'yes' to this question, a follow-up question was asked: 'If Yes, how long did you spend on the internet, social media'. Self-reported number of hours completing homework was also collected via a weekly EMA that asked: 'In the past 24 hours, how many hours have you spent studying or doing homework outside of class time?'

Baseline variables

The study collected a range of sociodemographic and other health factors at baseline. For this study, baseline characteristics included sex ('male', 'female', 'other'), age (in years), socioeconomic status (SES) and body mass index (BMI) (based on self-reported height and weight and categorised into 'underweight', 'normal', 'obese', overweight'). Individual SES was estimated using the area level Index of Relative Socio-economic Disadvantage based on the postcode of residence.[21] Postcode of residence was not included in the baseline questionnaire and was imputed from mobile phone GPS signals and was based on the most frequent GPS position between 1:00 and 5:00 hours for all available GPS data.

Data analysis

Preliminary analyses investigated counts and percentages for sleep duration activity and descriptive plots of trajectories of sleep activity were examined over the baseline and 27-week follow-up period based on weekly self-report EMAs. Multilevel mixed effects logistic regression models were used to examine the univariate and multivariate associations between time variants (psychological distress, social media use, homework hours) and invariant covariates (gender, age, BMI, employment, SES) and sleep duration. Multivariate associations between psychological distress, social media use, homework and sleep activity were examined using two separate confounders adjusted models. One of the above models was adjusted for gender, age, BMI category and SES whereas SES was excluded from the second model due to missing values in nearly 50% of the participants. A subanalysis was also conducted to examine trajectories of social media usage, hours spent

Table 1 Sociodemographic characteristics of study participants (13–19 years) at baseline (N=1295)

Characteristics	Males (N=228)	Females (N=1045)	Total (N=1295)*
Age			
Median (IQR)	17 (16–18)	17 (16–18)	17(16–18)
BMI			
Median (IQR)	22.2 (19.84–25.04)	22.04 (19.92–24.98)	22.07 (19.95–25.1)
BMI category			
Underweight	12 (5.43)	88 (8.72)	100 (8.08)
Normal	137 (61.99)	635 (62.93)	775 (62.6)
Overweight	57 (25.79)	185 (18.33)	245 (19.79)
Obese	15 (6.79)	101 (10.01)	118 (9.53)
Year of school			
Year 7	1 (0.44)	1 (0.1)	2 (0.15)
Year 8	11 (4.82)	19 (1.82)	30 (2.32)
Year 9	22 (9.65)	51 (4.88)	74 (5.71)
Year 10	34 (14.91)	125 (11.96)	162 (12.51)
Year 11	20 (8.77)	79 (7.56)	101 (7.8)
Year 12	50 (21.93)	223 (21.34)	280 (21.62)
Not at school	9 (3.95)	37 (3.54)	47 (3.63)
Finished school	81 (35.53)	510 (48.8)	599 (46.25)
Trade certificate			
No	76 (84.44)	441 (80.77)	525 (81.4)
Yes	14 (15.56)	105 (19.23)	120 (18.6)
Work at a job			
No	117 (51.77)	411 (39.48)	539 (41.82)
Yes	109 (48.23)	630 (60.52)	750 (58.18)
Looking for a job			
No	59 (50.43)	156 (37.96)	220 (40.82)
Yes	58 (49.57)	255 (62.04)	319 (59.18)
Work for salary			
No	18 (16.51)	57 (9.05)	78 (10.4)
Yes	91 (83.49)	573 (90.95)	672 (89.6)
Weekly work hours			
Median (IQR)	10 (6–16)	12 (7–20)	12 (7–20)
Language at home			
English	187 (82.02)	891 (85.43)	1097 (84.84)
Other	41 (17.98)	152 (14.57)	196 (15.16)
Socioeconomic status			
5 least disadvantaged	45 (37.82)	170 (32.76)	220 (33.69)
4	25 (21.01)	97 (18.69)	126 (19.3)
3	11 (9.24)	89 (17.15)	100 (15.31)
2	23 (19.33)	75 (14.45)	99 (15.16)
1 most disadvantaged	15 (12.61)	88 (16.96)	108 (16.54)

*Gender other than male and female was not presented separately in the table and the totals of male and female are therefore not equal to the total. Additionally, each variable may present missing values and some variables may not be applicable for certain groups (eg, 'work for salary' was only applicable to those who reported having a job).
BMI, body mass index.

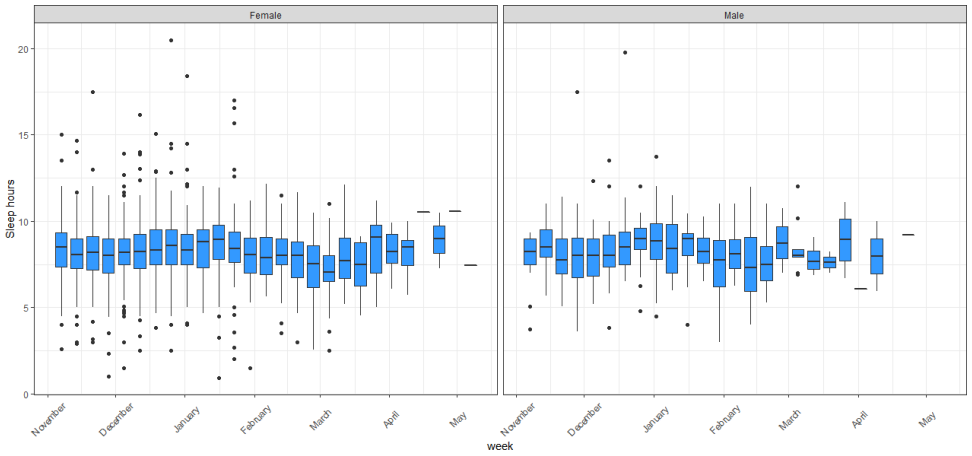

Figure 1 Sleep hours by week for adolescents aged 13–19 years (N=1295). The horizontal line for each box plot in figure 1 is the median number of hours of sleep, the blue bars represent the IQR, and the vertical line is the minimum and maximum (outliers excluded).

on homework and K6 score by dividing sleep trajectories among participants into 'decreasing', 'increasing' and 'stable' groups. Linear regression analysis was conducted for individuals with more than two sleep records (n=214) and were classified as (1) 'increasing' if regression coefficients were positive and p≤0.25; (2) 'decreasing' if the regression coefficients were negative and the p≤0.25 and 'stable' if p>0.25. All the analyses were conducted by using STATA V.16[22] and R software, V.3.6.0.[23]

RESULTS

Substantial variation in sleep duration was observed among individuals over the follow-up period. The median number of weekly sleep hours was 8.33 for males (IQR 7.12–9.25 hours) and 8.25 for females (IQR 7.18–9.20 hours) (figure 1). Sleep duration was slightly higher during mid-December and the end of January, a period coinciding with the school holidays.

Those with high psychological distress had higher odds of sleeping less than 8 hours (OR 1.51 (95% CI 1.17 to 1.96)), compared with those with low psychological distress (table 2, online supplemental figure 2). Higher levels of social media use (OR 1.34 (95% CI 1.01 to 1.79)) and longer homework hours (OR 1.37 (95% CI 1.07 to 1.75)) were also associated with a sleep duration of less than 8 hours (table 2, online supplemental figure 2 (panel 2)). Effect sizes of associations were similar between unadjusted and adjusted models (table 2, online supplemental figure 2 (panel 2)).

An inverse association was also observed between sleep hour trajectories and psychological distress, with a decreasing trajectory of sleep hours associated with increasing psychological stress (figure 2). This was also evident in the regression models, which showed a decreasing sleep trajectory was associated with increased psychological distress (β=0.069, (95% CI −0.019 to 0.149)) and increased homework hours (β=0.078, (95% CI 0.036 to 0.120)) (table 3). An increasing sleep trajectory was weakly associated with decreased psychological distress (β=−0.015 (95% CI −0.121 to 0.092)) and decreased homework hours (β=−0.006, (95% CI −0.079 to 0.066) (table 3).

DISCUSSION

This study investigated the association between indicators of time-varying mental health factors and trajectories of sleep duration among adolescents (aged 13–19 years) in Sydney (Australia). The study found that high levels of psychological distress were associated with a higher risk of sleeping less than 8 hours. Similarly, more hours spent on social media and on homework were also associated with a higher risk of sleeping less than 8 hours.

Previous studies have found psychological distress to be associated with shorter sleep duration among young adults.[11 24] There is also evidence of a reinforcing relationship between sleep duration and depression, that is, lack of sleep increases the risk for major depression which in turn increases the risk of sleep deprivation.[25] Our analysis also found evidence of this relationship with decreasing sleep trajectories associated with increased psychological distress (and vice versa). While there is a strong association between sleep difficulties and psychological disorders,[26 27] recent evidence suggests that insomnia (inability to fall asleep and/or sleep through) might also be a causal factor for the occurrence of mental health problems.[28] This negative impact of lack of sleep on mental well-being can be explained through brain functioning where proper sleep promotes mental and emotional resilience while lack of sleep has the opposite impact.[29]

While cross-sectional studies have reported the adverse impacts of heavier social media use on sleep hours and sleep quality among young adults and adolescents,[20 30 31] the prospective design of this study was able to clearly delineate the temporal nature of this association. The adverse impact of social media usage on sleep hours can be interpreted in at least three ways.[32] First, heavier social media use may displace sleep hours (eg, staying up

Table 2 The association between hours of sleep duration and psychological distress (K6), social media use, hours of homework and other sociodemographic factors among adolescents aged 13–19 years

Characteristics	Unadjusted models	Adjusted model 1* (N=1017, n=585)	Adjusted model 2* (N=1625, n=1140)
K6 score			
6–18	1 (1, 1)	1 (1, 1)	1 (1, 1)
19–30	1.64 (1.29, 2.08)	1.53 (1.09, 2.14)	1.51 (1.17, 1.96)
Social media			
≤3 hours	1 (1, 1)	1 (1, 1)	1 (1, 1)
≥4 hours	1.31 (0.99, 1.73)	1.72 (1.21, 2.47)	1.34 (1.01, 1.79)
Homework			
≤2 hours	1 (1, 1)	1 (1, 1)	1 (1, 1)
≥3 hours	1.45 (1.16, 1.81)	1.42 (1.03, 1.96)	1.37 (1.07, 1.75)
Gender			
Male	1 (1, 1)	1 (1, 1)	1 (1, 1)
Female	1.19 (0.88, 1.61)	0.92 (0.61, 1.38)	0.94 (0.68, 1.30)
Other	0.66 (0.27, 1.62)	0.16 (0.02, 1.06)	0.41 (0.08, 2.09)
Age	1.00 (0.92, 1.09)	1.02 (0.91, 1.15)	1.02 (0.93, 1.12)
BMI			
Normal	1 (1, 1)	1 (1, 1)	1 (1, 1)
Underweight	0.91 (0.57, 1.44)	0.73 (0.36, 1.48)	0.85 (0.52, 1.38)
Overweight	1.22 (0.90, 1.65)	0.99 (0.66, 1.49)	1.19 (0.86, 1.63)
Obese	1.38 (0.91, 2.09)	1.49 (0.83, 2.69)	1.45 (0.93, 2.24)
Working			
No	1 (1, 1)	1 (1, 1)	1 (1, 1)
Yes	1.02 (0.81, 1.29)	1.15 (0.82, 1.60)	1.17 (0.90, 1.51)
Socioeconomic status			
5 least disadvantaged	1 (1, 1)	1 (1, 1)	NA
4	1.26 (0.82, 1.94)	1.11 (0.70, 1.77)	NA
3	1.05 (0.66, 1.67)	0.98 (0.59, 1.60)	NA
2	1.78 (1.11, 2.84)	1.47 (0.89, 2.41)	NA
1 most disadvantaged	1.83 (1.16, 2.87)	1.86 (1.13, 3.07)	NA

*Adjusted model 1 included all the variables as covariates whereas adjusted model 2 did not include socioeconomic status as a covariate. Socioeconomic status was missing for approximately 50% of participants and was excluded from adjusted model 2 to maximise the use of available data in the complete case analysis.
BMI, body mass index; K6, Kessler Psychological Distress 6-item scale; NA, not available.

late posting pictures and commenting on social media). Second, social media may stimulate emotional and/or psychological arousal which might impede sleep (eg, engaging in social media interaction). Third, mobile phones are light-emitting devices and using them before bedtime might prolong the time takes to fall asleep.[33]

This study also found evidence of more hours spent on homework increasing the probability of sleeping less than 8 hours, which is consistent with previous cross-sectional studies, showing more time spent on homework is associated with shorter sleep duration among adolescents.[34–36] The need to complete homework is likely ubiquitous for this age cohort who were attending school or beginning tertiary education. Longer duration of time spent completing homework may reflect higher levels of engagement and mastery of content, however, homework may also be a source of stress for some students, especially as homework might relate to academic performance. While excessive amounts of homework might compel students to spend more time on it, more time spent on homework might also be indicative of difficulties in completing the homework rather than the excessive amount of homework per se.

There are several limitations when interpreting findings from the current study, also discussed in detail elsewhere.[15] Briefly, study participants were predominantly female (80%) and older age adolescents (16–18 years). Despite this, the distribution of responses by key

Figure 2 Distribution of sleep hours and monthly psychological distress (average K6 score) by type of sleep trajectory among adolescents aged 13–19 years (n=214). The horizontal line for each box plot in figure 2B is the median number of hours sleep, the blue bars represent the IQR and the vertical line is the minimum and maximum (outliers excluded). K6, Kessler Psychological Distress 6-item scale.

well-being outcomes was not substantially dissimilar to other representative prevalence studies of adolescents.[37 38] Additionally, the high attrition rate is a potential source of selection bias and limits the generalisability of findings. Just over 25% of those recruited responded to at least one follow-up sleep EMAs. However, the baseline characteristics of the subgroup responding to follow up sleep EMAs did not significantly differ from those recruited at baseline.[15] Furthermore, because the measurement of some exposures was based on self-report, recall bias must be considered as a potential source of limitation. However, the (near) real-time nature of the EMAs potentially reduced the likelihood of recall bias as questions related to the immediate period (usually the previous 24 hours), as opposed to longer index periods. Finally, part of the follow-up period also coincided with the initial period of the COVID-19 pandemic (March–April 2020), a period associated with decreased well-being and physical activity, and increased psychological distress and screen time in this cohort.[15] However, the mixed models employed in the current study implicitly accounted for participant variation and period effects, and psychological distress

Table 3 Change in hours of social media, hours of homework and psychological distress (K6) score by type of sleep trajectory

Sleep group	Social media	Homework	K6 score
Increasing (n=20; 9%)	0.004 (–0.039, 0.047)	–0.006 (–0.079, 0.066)	–0.015 (–0.121, 0.092)
Stable (n=158; 74%)	0.048 (0.027, 0.069)	0.014 (–0.013, 0.042)	0.008 (–0.035, 0.052)
Decreasing (n=36; 17%)	0.018 (–0.016, 0.051)	0.078 (0.036, 0.120)	0.069 (–0.010, 0.149)

Univariate multilevel mixed effects linear regression models were employed by including week as the independent variable. Those who reported spending over 12 hours on social media and homework were excluded from the models.
K6, Kessler Psychological Distress 6-item scale.

and social media use were mutually adjusted for in the final statistical model.

In conclusion, the findings of this study highlight the adverse impacts of higher psychological distress and greater numbers of hours spent on social media and homework on trajectories of sleep duration. While prior cross-sectional studies have reported similar findings, our study was able to explore the temporal nature and reinforcing feedback loops in these associations, that is, high psychological distress was associated with less sleep duration and decreasing sleep duration trajectories was associated with increased psychological distress. The results of this study need to be replicated in larger longitudinal studies, especially with longer follow-up periods and in different geographic and cultural settings. Also, while it is a challenging task to modify health behaviours, health education programmes in schools focusing on the advantages of mental well-being and adequate nocturnal sleep may be beneficial.

Contributors VA wrote the first draft. SMu, SS and AP conducted the data analysis. VA, SMu, SS, SMa, EC, LF and AP contributed to the interpretation of the data, revising the first draft and finalising the manuscript. AP is the guarantor of the study. All authors have reviewed and approved the final version of the manuscript.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and institutional ethics approval for the study was obtained from the Western Sydney University Human Research Ethics Committee (HREC Approval Number: H13302). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. Data are not publicly available according to the ethics approval. Data may be available on reasonable request.

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REFERENCES

1 World Health Organization. *Health for the world's adolescents: a second chance in the second decade: summary*. World Health Organization, 2014.
2 Carskadon MA, Acebo C, Jenni OG. Regulation of adolescent sleep: implications for behavior. *Ann N Y Acad Sci* 2004;1021:276–91.
3 Hirshkowitz M, Whiton K, Albert SM, *et al*. National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep Health* 2015;1:40–3.
4 Liu X. Sleep and adolescent suicidal behavior. *Sleep* 2004;27:1351–8.
5 Owens JA, Weiss MR. Insufficient sleep in adolescents: causes and consequences. *Minerva Pediatr* 2017;69:326–36.
6 Crouse JJ, Carpenter JS, Song YJC, *et al*. Circadian rhythm sleep-wake disturbances and depression in young people: implications for prevention and early intervention. *Lancet Psychiatry* 2021;8:813–23.
7 Ohayon MM, Roberts RE, Zulley J, *et al*. Prevalence and patterns of problematic sleep among older adolescents. *J Am Acad Child Adolesc Psychiatry* 2000;39:1549–56.
8 Roberts RE, Roberts CR, Xing Y. Restricted sleep among adolescents: prevalence, incidence, persistence, and associated factors. *Behav Sleep Med* 2011;9:18–30.
9 Inchley J, Currie D. *Growing up unequal: gender and socioeconomic differences in young people's health and well-being. Health Behaviour in School-aged Children (HBSC) study: international report from the 2013/2014 survey*. World Health Organization, 2016.
10 Evans-Whipp T, Gasser C. *4 Are children and adolescents getting enough sleep?. Growing up in Australia: The Longitudinal Study of Australian Children (LSAC). Annual statistical report*.2018:29–46.
11 Glozier N, Martiniuk A, Patton G, *et al*. Short sleep duration in prevalent and persistent psychological distress in young adults: the DRIVE study. *Sleep* 2010;33:1139–45.
12 Ojio Y, Nishida A, Shimodera S, *et al*. Sleep Duration Associated with the Lowest Risk of Depression/Anxiety in Adolescents. *Sleep* 2016;39:1555–62.
13 Fitzgerald CT, Messias E, Buysse DJ. Teen sleep and suicidality: results from the youth risk behavior surveys of 2007 and 2009. *J Clin Sleep Med* 2011;7:351–6.
14 Sarchiapone M, Mandelli L, Carli V, *et al*. Hours of sleep in adolescents and its association with anxiety, emotional concerns, and suicidal ideation. *Sleep Med* 2014;15:248–54.
15 Munasinghe S, Sperandei S, Freebairn L, *et al*. The Impact of Physical Distancing Policies During the COVID-19 Pandemic on Health and Well-Being Among Australian Adolescents. *J Adolesc Health* 2020;67:653–61.
16 Office_of_the_ESafety_Commissioner. *State of play - youth, kids and digital dangers*. Canberra: Australian Government, 2018. Available: https://www.esafety.gov.au/sites/default/files/2019-10/State%20of%20Play%20-%20Youth%20kids%20and%20digital%20dangers.pdf
17 Yellow. *Yellow social media report*. Melbourne: A Sensis Company, 2020. Available: https://2k5zke3drtv7fuwec1mzuxgv-wpengine.netdna-ssl.com/wp-content/uploads/2020/07/Yellow_Social_Media_Report_2020_Consumer.pdf
18 Mewton L, Kessler RC, Slade T, *et al*. The psychometric properties of the Kessler Psychological Distress Scale (K6) in a general population sample of adolescents. *Psychol Assess* 2016;28:1232–42.
19 Fuligni AJ, Hardway C. Daily variation in adolescents' sleep, activities, and psychological well-being. *J of Res on Adolesc* 2006;16:353–78.
20 Scott H, Biello SM, Woods HC. Social media use and adolescent sleep patterns: cross-sectional findings from the UK millennium cohort study. *BMJ Open* 2019;9:e031161.
21 Australian Bureau of Statistics. Socio-economic indexes for areas (SEIFA)–technical paper. 2016. Available: https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/2033.0.55.0012016?OpenDocument
22 StataCorp. *Stata statistical software: release 16*. College Station, TX: StataCorp LLC, 2019.
23 R Core Team. *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing, 2019.
24 Seun-Fadipe CT, Mosaku KS. Sleep quality and psychological distress among undergraduate students of a Nigerian university. *Sleep Health* 2017;3:190–4.
25 Roberts RE, Duong HT. The prospective association between sleep deprivation and depression among adolescents. *Sleep* 2014;37:239–44.
26 Baddam SKR, Canapari CA, van Noordt SJR, *et al*. Sleep Disturbances in Child and Adolescent Mental Health Disorders: A Review of the Variability of Objective Sleep Markers. *Med Sci (Basel)* 2018;6:46.

27 Baglioni C, Nanovska S, Regen W, *et al*. Sleep and mental disorders: A meta-analysis of polysomnographic research. *Psychol Bull* 2016;142:969–90.
28 Freeman D, Sheaves B, Goodwin GM, *et al*. The effects of improving sleep on mental health (OASIS): a randomised controlled trial with mediation analysis. *Lancet Psychiatry* 2017;4:749–58.
29 Eugene AR, Masiak J. The Neuroprotective Aspects of Sleep. *MEDtube Sci* 2015;3:35–40.
30 Levenson JC, Shensa A, Sidani JE, *et al*. The association between social media use and sleep disturbance among young adults. *Prev Med* 2016;85:36–41.
31 Woods HC, Scott H. #Sleepyteens: Social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. *J Adolesc* 2016;51:41–9.
32 Cain N, Gradisar M. Electronic media use and sleep in school-aged children and adolescents: A review. *Sleep Med* 2010;11:735–42.
33 Chang A-M, Aeschbach D, Duffy JF, *et al*. Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. *Proc Natl Acad Sci U S A* 2015;112:1232–7.
34 Adam EK, Snell EK, Pendry P. Sleep timing and quantity in ecological and family context: a nationally representative time-diary study. *J Fam Psychol* 2007;21:4–19.
35 Zhang J, Li AM, Fok TF, *et al*. Roles of parental sleep/wake patterns, socioeconomic status, and daytime activities in the sleep/wake patterns of children. *J Pediatr* 2010;156:606–12.
36 Li S, Yang Q, Chen Z, *et al*. Homework schedule: an important factor associated with shorter sleep duration among Chinese school-aged children. *Behav Sleep Med* 2014;12:389–97.
37 Scully M, Morley B, Niven P, *et al*. Overweight/obesity, physical activity and diet among Australian secondary students-first national dataset 2009-10. *Cancer Forum* 2012;36:19–22.
38 Australian Bureau of Statistics. *National health survey: first results, 2017-18*. Canberra: Commonwealth of Australia, 2018.