UNIVERSITY OF SUSSEX

# Cross-sectional and prospective associations between sleep, anxiety and depression in adolescents

DR FAITH ORCHARD, LECTURER IN PSYCHOLOGY

# Adolescent Sleep

Healthy sleep characterised by getting enough sleep, at appropriate times, in absence of any disturbance (Paruthi et al., 2016)

During adolescence, multitude of social, biological and psychological factors make sleep vulnerable (Crowley et al., 2018), including changes to two bioregulatory sleep processes:

1. Older adolescents take longer to build sleep homeostatic pressure resulting in increased alertness in evening (Taylor et al., 2005)
2. There is a delay in timing of adolescent circadian rhythm, with sleep timing signalled later in the evening by this ‘biological clock’

UNIVERSITY OF SUSSEX

# Sleep, anxiety and depression

Growing evidence of causal relationship between sleep, anxiety and depression

1. **Evidence of an association**: Sleep problems are amongst the most common symptoms of depression in young people (Orchard et al., 2018; Goodyer et al., 2017), and have high proportions amongst young people with anxiety (Alfano et al., 2007; Chase & Pincus, 2011)

2. **Evidence of a prospective relationship**: Studies have suggested sleep might be a precursor to the development of depression and anxiety in young people (e.g. Lovato & Gradisar, 2014)

3. **Evidence of manipulation effects**: Meta-analyses has suggested that treatments for insomnia reduce symptoms of depression and anxiety amongst adults (e.g. Gee et al., 2018)

# Gaps in the literature

**Anxiety vs depression**

It is not yet clear whether sleep disturbance is comparable across anxiety and depression, or whether there are differences

**Nature of disturbance**

Most research has examined sleep problems or sleep disturbance as a 'whole', it is not clear whether specific sleep problems are critical in the relationship with anxiety and depression

**Multiple time points and multiple measures**

Most longitudinal research typical reports on two time points, or one measure of mental health e.g. diagnosis or symptom severity.

UNIVERSITY OF SUSSEX

# Aims

The present study used data from the **Avon Longitudinal Study of Parents and Children (ALSPAC).** Two aims were identified.

1. To examine cross-sectional sleep habits at age 15 years and compare self-reported **sleep quality** and **sleep patterns** of those who met diagnostic criteria for an anxiety disorder and/or depression to those with no anxiety or depression.
2. To test the prospective association between sleep patterns and quality at 15 years and a) anxiety and depression **diagnoses** in late adolescence and early adulthood b) **symptoms** of anxiety and depression in early adulthood.


UNIVERSITY OF SUSSEX

# The ALSPAC Study

Based at University of Bristol, the Avon Longitudinal Study of Parents and Children (ALSPAC), also known as Children of the 90s, is birth cohort study.

Pregnant women in Avon, United Kingdom, with expected dates of delivery April 1991 to December 1992 invited to take part in the study. The initial number of pregnancies enrolled was 14,541.

The study was set up to investigate the environmental and genetic factors that affect a person's health and development.

UNIVERSITY OF SUSSEX

CHILDREN OF THE 90S

# Participants

Present study included a subset of participants who took part in a clinical assessment examining sleep and mental health diagnoses at age 15 years (between October 2006 and November 2008).

Of these 5,525 participants, 432 did not attend the sleep assessment session, and a further 37 participants did not complete the diagnostic interview. Data were also removed from 23 participants who withdrew consent.

This left a total sample of **N = 5,033** with diagnostic and sleep data at age 15. Participants were 53% female and 98% white

UNIVERSITY OF SUSSEX

# Sleep measurement - Patterns

Participants completed a sleep questionnaire as part of the Teen Focus Clinic at age 15 years.

**Sleep patterns**

- Questions explored sleep patterns on school days and on weekends.
- Sleep onset time and wake-up time measured using modified version of Sleep Habits Survey (Wolfson et al., 2003).
- Modification included addition of ‘What time do you USUALLY start trying to go to sleep?’ and ‘How long does it USUALLY take for you to fall asleep?’. These additions made it possible to compute total sleep time (TST).
- Chronotype defined as mid-point between sleep onset and offset on free days (i.e. weekends)

UNIVERSITY OF SUSSEX

# Sleep measurement - Quality

**Range of sleep quality variables**

- **Sleep onset latency** (mins) on school nights and weekends
- How many times a night participants **woke up** on 4-point scale (1 = never; 4 = >three times).
- Problems with **daytime sleepiness** on 5-point scale (1 = no problem; 5 = very big problem).
- **Ease of getting up** on 4-point scale (1 = very easy; 4 = hard).
- Finally, participants were asked how often they believed they got **enough sleep** on a five-point scale (1 = always; 5 = never).

UNIVERSITY OF SUSSEX

# Anxiety and depression measures

**Diagnoses:** Anxiety and depression diagnoses were assessed at focus clinics at ages 15, 17 and 24 years.

At age 15: Development and Well-Being Assessment (DAWBA) (Goodman et al., 2000) was used to group participants into no diagnosis of anxiety or depression (n = 4,921), diagnosis of one or more anxiety disorders (n = 74), diagnosis of depression (n = 78).

At age 17 and 24: Clinical Interview Schedule – Revised (CIS-R) (Lewis et al., 1992) was used at age 17 years (n = 5,081) and at age 24 years (n = 4026).

UNIVERSITY OF SUSSEX

# Anxiety and depression measures

**Symptoms**

Anxiety and depression symptoms were measured by self-report questionnaires at age 21 (n = 3,463).

- Anxiety symptoms were measured using the Generalised Anxiety Disorder Assessment (GAD-7) (Spitzer et al., 2006).
- Depression symptoms were measured using the adult version of the Short Mood and Feelings Questionnaire (SMFQ) (Angold et al., 1995).


UNIVERSITY OF SUSSEX

# Cross-sectional Results - Patterns

**Table 2** Subjective sleep patterns amongst those with and without anxiety and depression diagnoses at age 15 ($n$ = 4,790)

| Mean (SD) | No depression or anxiety ($n$ = 4,658) | Anxiety ($n$ = 65) | Depression ($n$ = 67) | $F$ (2, 4787) |
|---|---|---|---|---|
| Sleep onset time (hr:min) | | | | |
| School nights | 22:58 (77.78)[a] | 23:00 (79.28)[a] | 23:33 (112.95)[b] | 17.84*** |
| Weekend nights | 00:01 (109.85)[a] | 00:13 (111.79)[ab] | 00:31 (131.55)[b] | 7.58** |
| Wake-up time (hr:min) | | | | |
| School days | 07:05 (49.05) | 06:59 (60.20) | 06:57 (66.08) | 3.02* |
| Weekend days | 09:42 (131.25) | 09:59 (146.98) | 09:41 (163.62) | 1.53 |
| Total sleep time (hr:min) | | | | |
| School nights | 08:07 (0.82)[a] | 07:59 (0.84)[a] | 07:25 (1.27)[b] | 24.05*** |
| Weekend nights | 09:41 (1.27)[a] | 09:46 (1.46)[a] | 09:10 (1.78)[b] | 5.40** |
| Chronotype (hr:min) | 04:52 (1.03) | 05:07 (1.08) | 05:07 (1.19) | 3.48* |

*$p < .05$; **$p < .01$; and ***$p < .001$; Superscript letters have been used to indicate significant differences, where letters are the same across variables there is no difference, and where letters differ (i.e. $a$ and $b$) this denotes between-group Bonferroni-corrected significance.

UNIVERSITY OF SUSSEX

# Cross-sectional Results - Patterns

**Table 2** Subjective sleep patterns amongst those with and without anxiety and depression diagnoses at age 15 ($n$ = 4,790)

| Mean (SD) | No depression or anxiety ($n$ = 4,658) | Anxiety ($n$ = 65) | Depression ($n$ = 67) | $F$ (2, 4787) |
|---|---|---|---|---|
| Sleep onset time (hr:min) | | | | |
| School nights | 22:58 (77.78)[a] | 23:00 (79.28)[a] | 23:33 (112.95)[b] | 17.84*** |
| Weekend nights | 00:01 (109.85)[a] | 00:13 (111.79)[ab] | 00:31 (131.55)[b] | 7.58** |
| Wake-up time (hr:min) | | | | |
| School days | 07:05 (49.05) | 06:59 (60.20) | 06:57 (66.08) | 3.02* |
| Weekend days | 09:42 (131.25) | 09:59 (146.98) | 09:41 (163.62) | 1.53 |
| Total sleep time (hr:min) | | | | |
| School nights | 08:07 (0.82)[a] | 07:59 (0.84)[a] | 07:25 (1.27)[b] | 24.05*** |
| Weekend nights | 09:41 (1.27)[a] | 09:46 (1.46)[a] | 09:10 (1.78)[b] | 5.40** |
| Chronotype (hr:min) | 04:52 (1.03) | 05:07 (1.08) | 05:07 (1.19) | 3.48* |

*$p < .05$; **$p < .01$; and ***$p < .001$; Superscript letters have been used to indicate significant differences, where letters are the same across variables there is no difference, and where letters differ (i.e. $a$ and $b$) this denotes between-group Bonferroni-corrected significance.

UNIVERSITY OF SUSSEX

# Cross-sectional Results - Quality

**Table 3** Subjective sleep quality amongst those with and without anxiety and depression diagnoses at age 15 ($n$ = 4,680)

| Mean (SD) | No depression or anxiety ($n$ = 4,548) | Anxiety ($n$ = 67) | Depression ($n$ = 65) | $F$ (2, 4677) |
|---|---|---|---|---|
| Sleep onset latency (min) | | | | |
| School nights | 21.02 (16.28)[a] | 29.76 (27.23)[b] | 37.60 (35.67)[c] | 39.24* |
| Weekend nights | 17.38 (14.12)[a] | 21.94 (17.07)[b] | 26.03 (21.62)[b] | 14.89* |
| Number of times wakes at night | 1.83 (1.15)[a] | 2.07 (1.13)[ab] | 2.55 (1.17)[b] | 18.83* |
| Ease to get up | | | | |
| School days | 2.71 (0.83)[a] | 3.01 (0.86)[b] | 3.06 (0.90)[b] | 10.21* |
| Weekend days | 2.04 (0.70)[a] | 2.22 (0.78)[ab] | 2.35 (0.84)[b] | 8.75* |
| Daytime sleepiness | 1.72 (0.73)[a] | 2.18 (1.00)[b] | 2.58 (1.07)[c] | 55.92* |
| Frequency of enough sleep | 2.38 (0.84)[a] | 2.87 (1.09)[b] | 3.14 (0.90)[b] | 36.59* |

*$p < .001$; Superscript letters have been used to indicate significant differences, where letters are the same across variables there is no difference, and where letters differ (i.e. *a* and *b*) this denotes between-group Bonferroni-corrected significance; 'Ease to get up' measured on 4-point scale where 1 = easy and 4 = hard; 'Daytime sleepiness' measured on a 5-point scale from 1 = no problem to 5 = very big problem; 'Frequency of enough sleep' measured on 5-point scale where 1 = always and 5 = never.

UNIVERSITY OF SUSSEX

# Cross-sectional Results - Quality

**Table 3** Subjective sleep quality amongst those with and without anxiety and depression diagnoses at age 15 ($n$ = 4,680)

| Mean (SD) | No depression or anxiety ($n$ = 4,548) | Anxiety ($n$ = 67) | Depression ($n$ = 65) | $F$ (2, 4677) |
|---|---|---|---|---|
| Sleep onset latency (min) | | | | |
| School nights | 21.02 (16.28)[a] | 29.76 (27.23)[b] | 37.60 (35.67)[c] | 39.24* |
| Weekend nights | 17.38 (14.12)[a] | 21.94 (17.07)[b] | 26.03 (21.62)[b] | 14.89* |
| Number of times wakes at night | 1.83 (1.15)[a] | 2.07 (1.13)[ab] | 2.55 (1.17)[b] | 18.83* |
| Ease to get up | | | | |
| School days | 2.71 (0.83)[a] | 3.01 (0.86)[b] | 3.06 (0.90)[b] | 10.21* |
| Weekend days | 2.04 (0.70)[a] | 2.22 (0.78)[ab] | 2.35 (0.84)[b] | 8.75* |
| Daytime sleepiness | 1.72 (0.73)[a] | 2.18 (1.00)[b] | 2.58 (1.07)[c] | 55.92* |
| Frequency of enough sleep | 2.38 (0.84)[a] | 2.87 (1.09)[b] | 3.14 (0.90)[b] | 36.59* |

*$p < .001$; Superscript letters have been used to indicate significant differences, where letters are the same across variables there is no difference, and where letters differ (i.e. $a$ and $b$) this denotes between-group Bonferroni-corrected significance; 'Ease to get up' measured on 4-point scale where 1 = easy and 4 = hard; 'Daytime sleepiness' measured on a 5-point scale from 1 = no problem to 5 = very big problem; 'Frequency of enough sleep' measured on 5-point scale where 1 = always and 5 = never.

UNIVERSITY OF SUSSEX

# Cross-sectional Results - Quality

**Table 3** Subjective sleep quality amongst those with and without anxiety and depression diagnoses at age 15 ($n$ = 4,680)

| Mean (SD) | No depression or anxiety ($n$ = 4,548) | Anxiety ($n$ = 67) | Depression ($n$ = 65) | $F$ (2, 4677) |
|---|---|---|---|---|
| Sleep onset latency (min) | | | | |
| School nights | 21.02 (16.28)[a] | 29.76 (27.23)[b] | 37.60 (35.67)[c] | 39.24* |
| Weekend nights | 17.38 (14.12)[a] | 21.94 (17.07)[b] | 26.03 (21.62)[b] | 14.89* |
| Number of times wakes at night | 1.83 (1.15)[a] | 2.07 (1.13)[ab] | 2.55 (1.17)[b] | 18.83* |
| Ease to get up | | | | |
| School days | 2.71 (0.83)[a] | 3.01 (0.86)[b] | 3.06 (0.90)[b] | 10.21* |
| Weekend days | 2.04 (0.70)[a] | 2.22 (0.78)[ab] | 2.35 (0.84)[b] | 8.75* |
| Daytime sleepiness | 1.72 (0.73)[a] | 2.18 (1.00)[b] | 2.58 (1.07)[c] | 55.92* |
| Frequency of enough sleep | 2.38 (0.84)[a] | 2.87 (1.09)[b] | 3.14 (0.90)[b] | 36.59* |

*$p < .001$; Superscript letters have been used to indicate significant differences, where letters are the same across variables there is no difference, and where letters differ (i.e. *a* and *b*) this denotes between-group Bonferroni-corrected significance; 'Ease to get up' measured on 4-point scale where 1 = easy and 4 = hard; 'Daytime sleepiness' measured on a 5-point scale from 1 = no problem to 5 = very big problem; 'Frequency of enough sleep' measured on 5-point scale where 1 = always and 5 = never.

UNIVERSITY OF SUSSEX

# Prospective Results - diagnoses

Multiple logistic regression models tested whether sleep patterns and quality predicted a diagnosis of depression or anxiety at age 17 and 24. Diagnoses at age 15 entered in first step.

Anxiety models at ages 17 and 24

Model 1) **sleep patterns** predicting anxiety diagnoses – TST school nights*

Model 2) **sleep quality** predicting anxiety diagnoses – Daytime sleepiness*, night waking* & perception of enough sleep*

Depression models at ages 17 and 24

Model 3) **sleep patterns** predicting depression diagnoses – TST school nights*

Model 4) **sleep quality** predicting depression diagnoses – Daytime sleepiness*, night waking* & perception of enough sleep*

UNIVERSITY OF SUSSEX

# Prospective Results - symptoms

Multiple regression models tested whether sleep patterns and quality predicted symptoms of depression or anxiety at age 21. Diagnoses at age 15 were entered in the first step.

Anxiety models at age 21

Model 1) **sleep patterns** predicting anxiety symptoms - TST school nights*

Model 2) **sleep quality** predicting anxiety symptoms - Daytime sleepiness*, night waking*, perception of enough sleep* & SOL school nights*

Depression models at age 21

Model 3) **sleep patterns** predicting depression symptoms - TST school nights*

Model 4) **sleep quality** predicting depression symptoms - Daytime sleepiness*, night waking*, perception of enough sleep* & SOL school nights*

UNIVERSITY OF SUSSEX

# Prospective Results - symptoms

Multiple regression models tested whether sleep patterns and quality predicted symptoms of depression or anxiety at age 21. Diagnoses at age 15 were entered in the first step.

Anxiety models at age 21

Model 1) **sleep patterns** predicting anxiety symptoms - TST school nights*

Model 2) **sleep quality** predicting anxiety symptoms - Daytime sleepiness*, night waking*, perception of enough sleep* & SOL school nights*

Depression models at age 21

Model 3) **sleep patterns** predicting depression symptoms - TST school nights*

Model 4) **sleep quality** predicting depression symptoms - Daytime sleepiness*, night waking*, perception of enough sleep* & SOL school nights*

UNIVERSITY OF SUSSEX

# Strengths

(a) analysis of cohort enabled access to large sample

(b) both cross-sectional and prospective relationships between sleep, and anxiety and depression

(c) both sleep patterns and perceived sleep quality

(d) prospective relationships with categorical and continuous approaches to mental health measurement

(e) multiple time points across adolescence and in adulthood

# Limitations

There are however some important limitations.

1. Participants were mostly White British
2. Diagnostic groups were smaller than average point prevalence at age 15, and larger at ages 17 and 24. But somewhat alleviated by analyses of symptoms as well
3. Sleep was measured subjectively
4. Not all facets of sleep were assessed e.g. ‘wake after sleep onset’. This may be important because WASO may reduce total sleep time values, and therefore, total sleep time may have been overestimated.

UNIVERSITY OF SUSSEX

# Conclusions

Although there were significant differences in sleep between young people who had anxiety disorders and depression, predictors of future anxiety and depression were largely the same.

Data imply that managing amount, quality and perception of sleep during adolescence may have long-term benefits.

Future work should examine this, providing support for sleep behaviours in adolescence, and conducting long-term follow-ups to examine effect on development of anxiety and depression.

UNIVERSITY OF SUSSEX

# Thank you

The UK Medical Research Council, Wellcome and the University of Bristol for providing core support for ALSPAC. [a comprehensive list of grants funding is available on the ALSPAC website.]

The NIH (5R01MH073842-04; PI Tom O'Connor) and Wellcome Trust and MRC (076467/Z/05/Z; PI George Davey Smith) for the funding specific to this project.

We are extremely grateful to all the families who took part in this study, the midwives for their help in recruiting them and the whole ALSPAC team, which includes interviewers, computer and laboratory technicians, clerical workers, research scientists, volunteers, managers, receptionists and nurses.

**Orchard, F**., Gregory, A. M., Gradisar, M. & Reynolds, S. (2020). Self-reported sleep patterns and quality amongst adolescents: Cross-sectional and prospective associations with anxiety and depression. *Journal Child Psychology & Psychiatry*, 61(10), 1126-1137.

UNIVERSITY OF SUSSEX