



## Research paper

# Disentangling the effects of depression on trajectories of sleep problems from adolescence through young adulthood



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## ABSTRACT

**Background:** Little is known about the differential influences of between- and within-person effects of depression as well as its long-term impacts on sleep problems in adolescents. This study aims to disentangle these differences by estimating three effects of depression (i.e., long-term, immediate, and fluctuating).

**Methods:** The sample included 1345 males and 1283 females in Taiwan. In multilevel models, the between- (i.e., long-term and immediate) and within-person (i.e., fluctuating) effects were estimated by using the average and time-varying scores of depression, respectively. The interactions between long-term and the other effects were also tested to determine the moderating effects of long-term influences.

**Results:** Significant immediate and long-term effects of depression were found for both sexes, indicating that adolescents with higher levels of depression were at increased risks for future sleep problems. For females only, the long-term effects further exacerbated the negative influences of immediate effects of depression on sleep problems. Moreover, the fluctuating effects were found to change over time in females and the influences were more pronounced in young adulthood.

**Limitations:** The self-reported measures of both depression and sleep problems may produce common method variance and bias the results. Our measurements were adapted from various existing scales to increase their applicability; therefore, the internal consistency was not high.

**Conclusions:** Our findings provide insight regarding who is at risk for sleep problems and when this risk would occur based on the effects of depression. They also highlight the importance of both immediate and long-term effects of depression on development of sleep problems.

## 1. Introduction

Depression is a highly prevalent and disabling mental condition that often develops during childhood and adolescence (Zahn-Waxler et al., 2000). Research has demonstrated that 2.6% of children and adolescents worldwide (approximately 47 million) have any depressive disorders (Polanczyk et al., 2015). Evidence has further shown that depression is associated with other negative health and behavioral outcomes, including obesity (Goodman and Whitaker, 2002), substance use (Measelle et al., 2006), and antisocial behavior (Measelle et al., 2006). The substantial number of youths with depression and its associated negative consequences have made depression a public health priority (Whiteford et al., 2013).

Depression is also considered a potential risk factor for the development of sleep problems in children and adolescents (Alfano et al.,

2009; Johnson et al., 2000; Shanahan et al., 2014). However, only a few studies have prospectively examined whether depression predicts later sleep problems (Lovato and Gradisar, 2014), and the results are mixed. For example, the findings of a 10-year longitudinal study revealed that depression established in early adolescence predicted difficulty initiating sleep during young adulthood (Hayley et al., 2015). Similarly, another population-based longitudinal study showed that depression in adolescents was associated with development and persistence of sleep problems 4 years later (Patten et al., 2000). However, Kelly and El-Sheikh (2014) found no significant association between depressive symptoms and sleep problems. Another study (Johnson et al., 2006) utilizing a retrospective design also found that depressive symptoms did not predict the onset of insomnia. Two longitudinal studies (Kalak et al., 2014; Wang et al., 2016) examining bidirectional association between psychological well-being and sleep problems in adolescents also yielded

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inconsistent results. Specifically, one reported that sleep duration was a predictor of psychological well-being but provided no evidence for the reverse relationship (Kalak et al., 2014), whereas the other found that early depression were predictive of higher levels of sleep problems (Wang et al., 2016). Because of the inconsistent findings across studies, the prospective association between depressive symptoms and sleep problems remains unclear (Lovato and Gradisar, 2014).

In addition, studies that have examined the association between depression and sleep problems in children and adolescents have almost exclusively focused on testing a severity hypothesis, investigating whether youths with higher levels of depression are at increased risk for sleep problems than are those with lower levels of depression, and thus inform *who* is at risk. However, current research has seldom determined *when* adolescents are at risk. Specifically, it is unclear whether adolescents will demonstrate more sleep problems during times when they experience a relative increase in depression. To enhance the understanding of the relationship between depression and sleep problems and to better inform intervention strategies, examining both *who* is at risk (i.e., between-person differences) and *when* the risk occurs (i.e., within-person differences) is suggested (Curran and Wirth, 2004; Hussong et al., 2010).

To date, only a few studies have examined the relative influences of between-person and within-person effects of mental health symptoms on sleep problems. For example, Kouros and El-Sheikh used a daily diary method and actigraphy to examine the association between daily mood and sleep problems in a sample of 142 children and found a significant within-person effect of mood on sleep (Kouros and El-Sheikh, 2015). Specifically, adolescents with worse mood than their average levels had significantly higher levels of sleep activity and longer time to fall asleep, yet there were no significant between-person associations between mood and sleep problems. In contrast, Van Dyk and colleagues found that the between-person effects of mental health symptoms on sleep problems were more influential than within-person effects in children (Van Dyk et al., 2016). The equivocal findings and methodological limitations (e.g., study design that only allows for examination of short-term prospective associations) of the existing studies reveal the necessity for more research to understand the between-person and within-person effects of depression on sleep problems in adolescents.

Moreover, because depression at younger ages may increase the risk and severity of depression later in life (Hankin, 2006; Nolen-Hoeksema et al., 1992), it is important to consider the effects of childhood depression (i.e., the long-term effects of depression) when examining the association between depression and sleep problems during adolescence and young adulthood. Specifically, in line with the perspective of the diathesis-stress model (Ingram and Luxton, 2005), depressed adolescents who also experienced symptoms of depression during childhood may be at increased risk for developing sleep problems than are those who did not have childhood depression. Differential risk profiles found among individuals with varying histories of depression (e.g., individuals who had depression during childhood and adulthood versus those who only had depression during adulthood) (Jaffee et al., 2002) further implied the possibility of heterogeneity in sleep problems attributed to depression that occurred during childhood and/or adolescence (Weissman, 2002). However, sleep research that has considered the synergy of long-term and immediate effects of depression is currently lacking.

### 1.1. The current study

To fill the gaps in the literature, we aimed to examine three effects of depression on sleep problems that we referred to as fluctuating, immediate, and long-term effects to determine the influences of *within-person* (i.e., fluctuating effects) and *between-person* (i.e., immediate and long-term effects) differences in depression. Specifically, the fluctuating effects of depression is a within-person effect that represents time-

varying fluctuations in depression from one's average level of depression and thus is examined to determine whether adolescents display increased (or decreased) depression from their average levels at one point in time will influence the levels of sleep problems at later point in time. The immediate and long-term effects of depression are between-person effects that capture averaged depression during adolescence and childhood, respectively, and are examined to determine whether an adolescent's averaged depression during a certain period can influence later development of sleep problems. Therefore, the fluctuating effects focus on the timing of effects and thus inform *when* adolescents are at risk whereas immediate and long-term effects focus on individual differences, which inform *who* is at risk. We further tested whether long-term effects interacted with other effects of depression in predicting sleep problems.

Depression and sleep problems were assessed in a subsample participated in a prospective study spanning 2001 through 2014 in northern Taiwan. Previous studies using the same dataset have explored determinants and health consequences of several adolescent health outcomes including substance use, suicidal ideation, antisocial behavior, social anxiety, and body mass index (Chang et al., 2016, 2017; Chen et al., 2014; Chiang et al., 2013; Hung et al., 2011; Lee et al., 2006; Lin et al., 2014; Lue et al., 2010; Wu et al., 2007, 2016). Among them, six publications are more related to the current study, with four (Lee et al., 2006; Lue et al., 2010; Wu et al., 2007, 2016) examined potential predictors of depression (i.e., social capital, family interaction, expressed emotion, and unhealthy eating) and another two (Chang et al., 2016, 2017) examined the direct and indirect effects of sleep problems on antisocial behavior. No study has yet explored the longitudinal association between depression and sleep problems using the same dataset.

Based on the above literature, our hypothesis related to the fluctuating effects is that adolescents display increased levels of depression, over their average levels, at one point in time will show higher levels of sleep problems at later point in time. Our hypothesis regarding the immediate effects is that adolescents show higher levels of depression during adolescence will have elevated levels of sleep problems during later study period compared to adolescents who have lower levels of depression during adolescence. For the long-term effects, we hypothesized that adolescents with higher levels of depression during childhood will have higher levels of sleep problems in the future than others who show lower levels of depression during childhood. We further hypothesized that the long-term effects will exacerbate the negative influences of the other two effects of depression on development of sleep problems such that the fluctuating and immediate effects of depression on trajectories of sleep problems will be stronger for adolescents with higher levels of childhood depression than those with lower levels of childhood depression. Because of the developmental differences during adolescence across sexes, and because the evidence suggests sex differences in the manifestation and prevalence of various psychiatric disorders in youths (Hankin, 2006; Van Damme et al., 2014), we examined the effects of depression on trajectories of sleep problems separately for males and females. However, we had no specific hypothesis regarding sex differences in the effects of depression on sleep problems, given findings from the existing studies are scarce and inconsistent (Sivertsen et al., 2014; Wang et al., 2016; White et al., 2016).

## 2. Methods

### 2.1. Data and sample

The study data came from the Child and Adolescent Behaviors in Long-term Evolution (CABLE) project (Yen et al., 2002), a multi-wave longitudinal study of health and risk behaviors in children and adolescents. A total of 18 elementary schools were selected from urban and rural areas in northern Taiwan. The first and fourth grade students

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