



Intolerance of uncertainty and adolescent sleep quality: The mediating role of worry



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ABSTRACT

This study explores the relationship between intolerance of uncertainty (IU) and adolescent sleep quality, and tests whether this relationship is mediated by worry. A total of 2286 Chinese adolescents with a mean age of 15.0 years ($SD = 1.7$) were recruited; they completed questionnaires relating to IU, worry, and sleep quality. The results showed that greater IU was positively correlated with poorer adolescent sleep quality, and this relationship was mediated by worry. The mediating model of worry showed gender and grade invariances. The implications of this study were discussed.

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1. Introduction

Sleep quality is one of the most important indices of adolescent health (Shochat, Cohen-Zion, & Tzischinsky, 2014). In many countries, however, sleep quality in adolescents has been found to be poor, which have reflected insufficient sleep duration, low sleep efficiency, daytime dysfunction, and more (Gradisar, Gardner, & Dohnt, 2011; Lin, Yan, & Tang, 2010). Poor sleep quality can seriously affect adolescents' learning capacity, school performance, and neurobehavioral functioning (Shochat et al., 2014; Dewald, Meijer, Oort, Kerkhof, & Bogels, 2010). Therefore, it is important to determine the potential variables relating to adolescent sleep quality and identify means of improving this situation.

IU refers to a dispositional characteristic that results from a set of negative beliefs about uncertainty and its implications (Dugas & Robichaud, 2007). IU was originally observed in the domain of Generalized Anxiety Disorder (GAD); Dugas, Gagnon, Ladouceur, and Freeston (1998) and Dugas, Marchand, and Ladouceur (2005) defined it as a key factor in causing and maintaining GAD and worry. Studies with adolescent samples support the positive effects of IU on adolescent worry (Dugas, Laugesen, & Bukowski, 2012; Fialko, Bolton, & Perrin, 2012). In recent years, more and more research has shown that IU is also an important factor in other adolescent health problems, such as

cyberchondria (Fergus, 2015; Norr, Albanese, Oglesby, Allan, & Schmidt, 2015), eating disorders (Renjan, McEvoy, Handley, & Fursland, 2016; Wheaton, Abramowitz, Jacoby, Zwerling, & Rodriguez, 2016), and alcohol abuse (Kraemer, McLeish, & O'Bryan, 2015). It also influences adolescents' behavior-based decisions (Carleton et al., 2016), memory bias (Francis, Dugas, & Ricard, 2016), and personalities (Fergus & Rowatt, 2014).

To our knowledge, although the role of IU in many adolescent health problems has been remarked upon, the relationship between IU and adolescent sleep quality has been infrequently tested. Adolescents with greater IU manifest negative beliefs regarding uncertainty, avoidance or increased vigilance regarding perceived threats, and elevated negative emotional arousal (Meeten, Dash, Scarlet, & Davey, 2012), all of which lead to sleep-related problems (Harvey, 2002). Many studies of GAD patients showed that patients with greater IU suffer from sleep dysfunctions including longer Sleep Latency, decreased Sleep Duration, decreased total sleep efficiency, and increased waking periods during sleep time (Bélanger, Morin, Langlois, & Ladouceur, 2004; Tsypes, Aldao, & Mennin, 2013). Intervention studies have also indicated that when the level of IU is reduced, patients' sleep quality improves (Clementi & Alfano, 2014). This study will explore the relationship between IU and adolescent sleep quality and its mediating mechanism.

In this research, the effect of worry will also be considered, because worry is not only the other important cognitive factor for adolescent sleep difficulties, but also highly correlated with IU. Worry refers to repetitive thinking about future negative events that is both harmful and uncontrollable (Meeten et al., 2012). Worry is also an important

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cognitive component of anxiety (Dugas et al., 2012; Fialko et al., 2012). Although IU and worry are related to uncertainty, they are independent concepts. IU refers to a low threshold of tolerance for uncertainty, while worry is the repetitive thinking about ambiguous future events (Dugas & Robichaud, 2007). IU is a key factor in causing and maintaining worry; this has been proven to be the case in adults, patients with GAD (e.g., McEvoy & Mahoney, 2013; Norr et al., 2013), and adolescents (e.g., Dugas et al., 2012; Fialko et al., 2012; Thielsch, Andor, & Ehling, 2015). Previous studies with adolescents have showed that negative beliefs about uncertainty may result in difficulties dealing with ambiguity-inducing situations, which lead to excessive worry (Dugas et al., 2012). IU is also a higher-order vulnerability factor for adolescent worry, predisposing individuals to cognitive avoidance and negative problem orientation (Fialko et al., 2012).

Furthermore, worry is an important cause of poor adolescent sleep quality (Harvey, 2002; Carney, Harris, Moss, & Edinger, 2010; Yan et al., 2014). According to the cognitive model of Sleep Disturbance, worry is a potential underlying cause of sleep-related difficulties (Harvey, 2002). Excessive worry can elevate arousal above a critical threshold, interrupting the natural sequence of relaxation, drowsiness, and onset of sleep (Harvey, 2002). The effects of worry on adolescent Sleep Disturbances have been widely tested via empirical studies (e.g., Akerstedt, Kecklund, & Axelsson, 2007; Carney et al., 2010; Yan et al., 2014; for a review, see Pillai & Drake, 2015). Excessive worry belongs to cognitive hyperarousal, which directly increases the risk of poor sleep quality (Harvey, 2002). However, IU is a cognitive threshold or filter for an individual's perceptions (Dugas & Robichaud, 2007). Compared to worry, it is less directly associated with sleep difficulties, but may be associated with sleep disturbances via worry (Harvey, 2002). Therefore, the relationship between IU and adolescent sleep quality may be mediated by worry.

In sum, IU appears to be an important element of cognitive vulnerability affecting adolescent sleep quality. From the cognitive perspective, this study will empirically explore the relationship between IU and sleep quality with considering the mediating role of worry. In this study, IU, sleep quality, and worry in adolescents were measured by the short version of the intolerance of uncertainty scale (IUS-12), Pittsburgh Sleep Quality Index (PSQI), and Worry Tendency Questionnaire for Chinese Adolescents (WTQ-CAs), respectively. Two questions will be tested: (1) Is a greater IU positively correlated with poorer adolescent sleep quality? and (2) Is this relationship mediated by worry?

2. Methods

2.1. Participants

The participants in this research were recruited via a cluster sampling from six middle schools in Fuzhou, the seaside capital city of Fujian province in China. Because students in the 9th and 12th grades were preparing for the high school and college entrance exams, respectively, they were not recruited for this research. Participants completed their questionnaires in class; the surveys were administered by their psychological health education or head teachers. A total of 2400 participants' responses were collected. If more than half of the items were left unanswered or answered in the same fashion, the response was removed. Finally, 2286 surveys were validated, which accounted for 95.3% of the total administered. The 2286 participants had a mean age of 15.0 years ($SD = 1.7$, ranging from 11 to 18). There were 1076 early adolescents (aged 11–14) and 1180 older adolescents (aged 15–18). Of the total, 1030 were male and 1168 were female; 88 students did not report their gender. There were 714 participants from the 7th grade, 484 from the 8th grade, 595 from the 10th grade, and 493 from the 11th grade. Written informed consent was obtained from each participant, as well as his or her teacher and guardian. All procedures were approved by the Academic Ethics Committee of Fujian Normal University.

2.2. Measures

2.2.1. Short version of the Intolerance of uncertainty scale (IUS-12)

IU was measured using Carleton, Norton, and Asmundson's (2007) IUS-12. This measure includes 12 items, categorized to two factors: Prospective IU and Inhibitory IU. The Prospective IU measures intolerance of threat in regards to future uncertainty (e.g., *I always want to know what the future has in store for me*), and Inhibitory IU reflects behavioral symptoms which represent apprehension in the face of uncertainty (e.g., *the smallest doubt can stop me from acting*). Items are rated on a 5-point Likert scale ranging from 1 to 5, with higher scores indicating greater IU. The IUS-12 has demonstrated good internal consistency ($\alpha = 0.92$) and strong convergent correlations with both the original 27-item version and the related measures for anxiety and worry (Carleton et al., 2007). In this study, the internal consistency for the IUS-12 was 0.86, and that for Prospective IU and Inhibitory IU were 0.75 and 0.80.

2.2.2. Pittsburgh Sleep Quality Index (PSQI)

Adolescent sleep quality was measured by the widely-used PSQI (Buysse, Reynolds III, Monk, Berman, & Kupfer, 1989). This tool measures an individual's sleep quality for the previous month. It includes seven sub-scales: Subjective Sleep Quality, Sleep Latency, Sleep Duration, Habitual Sleep Efficiency, Sleep Disturbance, Used Sleep Medicine, and Daytime Dysfunction. Items are rated on a 4-point Likert scale ranging between 0 and 3, with higher scores indicating poorer sleep quality (e.g., *During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?*). The Chinese version of the PSQI was revised by Liu et al. (1996). Its internal consistency reliability was 0.84, split-half reliability was 0.87, and re-test reliability (after two weeks) was 0.81. In this study, the internal consistency for the PSQI was 0.74, and that for the sub-scales ranged from 0.64 to 0.72.

2.2.3. Worry Tendency Questionnaire for Chinese Adolescents (WTQ-CAs)

The WTQ-CA, developed by Lin, Yan, Tang, and Cai (2012), was used to measure the adolescents' level of worry. This measure includes five sub-scales: Learning Worry, Health Worry, Relationship Worry, Uncertainty about the Future, and Lack of Confidence. It consists of 32 items (e.g., *I worry about my health; I worry about the low confidence in myself*) that are rated on a 5-point Likert scale between 1 and 5, with higher scores indicating higher levels of worry. The WTQ-CA has shown excellent internal consistency ($\alpha = 0.92$) and test-retest reliability over two weeks ($r = 0.74$; Lin et al., 2012). In this research, the internal consistency for the WTQ-CA was 0.95, and that for the sub-scales ranged from 0.75 to 0.90.

2.3. Statistical analysis

The statistical analysis was conducted using SPSS 16.0 and LISREL 8.70. Group differences for the PSQI, IUS-12, and WTQ-CA were analyzed by gender and grade using an independent-sample *t*-test and one-way analysis of variance, respectively. Pearson's correlation and partial correlation analyses were conducted to test the correlations among the latent variables. Structural equation modeling (SEM) was employed to examine the relationship between IU and PSQI, as well as the mediating effect of worry. According to the standards for producing mediating analyses (MacKinnon, 2008), we first constructed a direct effect model of IU to examine the direct effect of IU on PSQI, and then constructed a mediating model of worry to test the mediating effect of worry. The invariances of the mediating model of worry across different gender and grade sub-samples were examined by multiple-group SEM models analysis. When forming the SEM models, IU, PSQI, and worry were identified as latent variables, and their measuring indicators were sub-scales.

The model fit was estimated with four primary fit indices, as recommended by Hau, Wen, and Cheng (2004): χ^2/df ratio (values should be

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