The Relationship of Neuroticism with Sleep Quality:

The Mediating Role of Emotional, Cognitive and Metacognitive Factors

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Abstract

Background: Poor sleep quality is associated with a broad range of psychopathology and is a common problem among college students. This study aimed to investigate the mediating role of metacognitive beliefs related to sleep, emotion regulation and a negative cognitive style related to anxiety (looming cognitive style) in the relation between neuroticism and subjective sleep quality.

Participants: Participants were 343 undergraduates from three universities in Tehran (56.3% females, Mean age = 22.01±2.74 years).

Method: Data were gathered with a questionnaire packet that included the Pittsburgh Sleep Quality Index (PSQI), Metacognitions Questionnaire-Insomnia (MCQ-I), Emotion Regulation Questionnaire (ERQ), Looming Maladaptive Style Questionnaire (LMSQ) and Neuroticism subscale of NEO-PI-R.

Results: Structural equation modeling analyses supported a proposed model (R^2=37%) which proposed that neuroticism both directly and indirectly linked to subjective sleep quality through

metacognitions related to sleep, cognitive reappraisal and looming cognitive style ($\chi 2$=1125.67, p<.001; CFI=0.95, NFI=0.90, RMSEA=0.063, GFI=0.94, SRMR=0.067, IFI=0.94).

Conclusions: The results provide evidence for the impact of neuroticism on subjective sleep quality through metacognitive, cognitive and emotional factors. The result suggest that special attention should be paid to these factors in the treatment and psychopathology of sleep quality.

Keywords: Sleep quality, Metacognition, Emotion regulation, Looming cognitive style, Neuroticism.

1. Introduction

Research has indicated that sleep is crucially important to cognitive, emotional, and behavioral health and well-being throughout the life span (Chennaoui, Léger, & Gomez-Merino, 2020; El-Sheikh, & Sadeh, 2015; Grimes, Camerota, & Propper, 2018). Subjective sleep quality is the extent to which sleep is perceived as uninterrupted and restful. These sleep perceptions include estimates of how people are feeling throughout the day as well as problems in falling asleep and maintaining sleep (Gray & Watson, 2002). Also poor sleep quality is associated with a variety of problems including decreased quality of life (Montazeri Lemrasky et al., 2019), decreased quality of health (Hita-Contreras et al., 2017; Reid et al., 2006), suicidal ideation (Nadorff, Nazem, & Fiske, 2011), increased rates of cancers, cardiovascular disease and gastrointestinal diseases (Hazeri & Farahzadi, 2014; Lie, Roessink, & Kjaerheim, 2006; Schernhammer, Kroenke, & Laden Hankinson, 2006). Therefore, according to the above points, it should be noted that the present study will focus on the subjective sleep quality rather than objective sleep quality.

1.1. Neuroticism and Sleep Quality

A review of the existing literature about sleep quality has shown that the Big Five personality traits (except openness) has a significant association with subjective sleep quality (Duggan et al., 2014; Hintsanen et al., 2014; Križan & Hisler, 2019). Neuroticism is an important aspect of personality that has been shown to be related to poor sleep quality (Calkins et al., 2013; Gray & Watson, 2002; Soehner, Kennedy, & Monk, 2007). It has been suggested by researchers that the underlying mechanisms that account for how personality factors such as neuroticism affect sleep remain unclear (Guastella & Mould, 2007; Harvey, 2005; Vandekerckhove et.al. 2010). Neuroticism is a personality factor that denotes chronic levels of emotional instability and liability to psychological distress. Neuroticism is associated with symptoms of anxiety, angry hostility, depression, self-consciousness, impulsiveness and vulnerability (Costa & McCrae, 1992; Millon, 2011). Slavish et al. (2018) followed individuals with repeated measurements over 14 days and focused on neuroticism as a direct predictor of reported sleep and as a moderator of the daily relationships between cognitive-emotional and reported sleep, found at the between-person level, neuroticism was associated with sleep quality, and difficulty falling asleep. As noted, despite prior studies that have established that neuroticism is related to poor sleep quality, there is a paucity of research on the metacognitive, cognitive, and emotion regulation variables that may mediate its impact on the subjective reporting of sleep behaviors.

1.2. Metacognitions related to sleep in Sleep Quality

According to Wells (2009), metacognition is an internal cognitive process that monitors, controls, and appraises the products and process of awareness. Sleep-related metacognitive beliefs and ongoing monitoring of the contents of thoughts may influence the cognitions and unwanted intrusive thoughts about sleep that come to mind at bedtime (Sella et al., 2019; Waine et al., 2009). Meta-cognitive concepts have been extensively investigated in

a variety of disorders, and there is limited work applying them to insomnia. Recent studies showed that sleep related metacognitive beliefs about sleep are common in insomnia patients and may play an important role in modulating sleep reactivity in insomnia (Palagini et al., 2016; Waine et al., 2009; Palagini et al., 2016). Palagini and colleagues (2014) showed that metacognitive beliefs about sleep were more prominent in primary insomnia that in snorers and healthy control groups. Sella et al., (2019) have also reported evidenced that sleep problems were linked to metacognitive beliefs about sleep. Related to our present focus, a study by Sella and colleagues (2020) indirectly suggests the role of metacognitive beliefs about sleep in mediating the impact of neuroticism. While they found no evidence of direct associations between emotional stability (a proxy for neuroticism) and self-reported sleep quality, metacognitive beliefs about sleeping difficulties mediated the effect of emotional stability on self-reported sleep quality.

1.3. Looming Cognitive Style in Sleep Quality

Although they have been given less attention, there are likely to be other dysfunctional cognitive factors may also affect sleep (e.g., Gomes, Tavares, & Azevedo, 2011; Tsapanou et al., 2017; Waller et al., 2016). One such cognitive factor is a well-documented negative cognitive style for anxiety and worry, called the Looming Cognitive Style (LCS; Riskind & Rector, 2018; Riskind et al., 2000), which also has significant secondary links to depression (Yeo, Hong & Riskind, 2020). Individuals who possess the LCS are biased to perceive mental simulations of possible threats as dynamically emergent phenomena that are rapidly growing, approaching, and expanding in negative consequences. These biased simulations are assumed to prompt ongoing fear and worry as well as other maladaptive coping responses (Riskind et al., 2000; Riskind & Kleiman, 2012; Riskind et al., 2007). Two recent meta-analyses of studies using the LCS have confirmed that it is robustly related to anxiety and depression (Hong &

Cheung, 2014; Yeo et al., 2020). Moreover, there is evidence that LCS is associated with decreased mental control over negative thoughts and emotions and an attendant fear of losing control over these (Riskind & Kleiman, 2012). Since anxiety, worry, and depression and stress exposure are all associated with poor sleep quality (e.g., Geng et al., 2018; Gould et al., 2018; Gregory et al., 2011; Pillai & Drake, 2015; Murphy et al., 2018; Norbury & Evans, 2019; Wigg, Filgueiras, & Gomes, 2014), the LCS should be expected to have significant associations with subjective sleep quality. However, no previous study to our best knowledge has examined this question.

1.4. Emotion regulation in Sleep Quality

In addition to the role of cognitive and metacognitive factors, a growing literature suggests that emotion regulation might also have an impact on sleep and sleep quality (Gruber & Cassoff, 2014; Gross, 2014; Fairholme & Manber, 2015; Palmer et al., 2018; Farnia et al., 2019). Gratz and Roemer (2004) defined emotion regulation as awareness, understanding and acceptance of emotions, the ability to control one's impulsive behaviors and behave according to one's desired goals when experiencing negative emotions, and the ability to use situationally appropriate strategies flexibly to modulate emotions. The absence of all or one of those indicates emotion dysregulation. In the present study we focused on two emotion regulation strategies, one of which is generally considered an adaptive strategy (cognitive reappraisal of stressors) and the other a maladaptive strategy (expressive suppression). According to the emotion regulation model of Gross and John (2003), cognitive reappraisal is an antecedent-focused strategy involving reinterpreting an emotion eliciting event in order to change its emotional impact while expressive suppression is a response-focused strategy that involves actively inhibiting the observable expression of emotional experience. There may also be an interplay between emotion regulation and sleep, such that good sleep quality is necessary for

adaptive emotion regulation and adaptive emotion regulation is an antecedent of good sleep (Kirwan et al., 2019; Tsypes, Aldao, & Mennin, 2013). Prior research has indicated that an individual's inability to use cognitive reappraisal to regulate negative emotions can contribute to disturbed sleep (Mauss, Troy, & LeBourgeois, 2013; Vantiegem et al., 2016), and there is also limited evidence that expressive suppression may be an emotion regulation strategy that is related to poor sleep (Vantieghem et al., 2016).

1. 5. Aim of the study

Despites studies that have confirmed that neuroticism is associated with sleep quality, the mechanisms that underlie this relationship and their links to factors such as metacognition, cognitive vulnerabilities, and emotion dysregulation remain understudied. We expected that neuroticism would be linked to poor subjective sleep quality through both a direct route and indirect routes mediated by metacognitions, looming cognitive style, and poor emotion regulation strategies. We expected that neuroticism would have direct effects due to the strong association between neuroticism and negative emotions such as anxiety, and depression. We also expected that it would have indirect effects through metacognitions, such as found by Sella et al. (2020), as well as through looming cognitive style, which engenders anxiety and negative emotions, as well as deficient emotion regulation. In this way, the study aimed to investigate a more integrative structural model of the roles of neuroticism, metacognitions related to sleep, looming cognitive style, and emotion regulation in relation to subjective sleep quality.

2. Methods

2.1. Participants and procedure

Participants included 343 undergraduate students (M_{age} = 22.01 years, SD = 2.74; age range: 18–32 years) from three universities in Tehran (Kharazmi, AmirKabir and Tehran) and

included 150 men and 193 women. Students were invited to participate in the study and were assessed by questionnaire through a digital app. One of the important assumptions of structural equation model is to examine the outlier data and remove them from the final analysis. In the present study, to identify univariate outlier data for observed variables, from the box plot and to identify multivariate outlier data, mahalanobis distance were calculated for each participant. According to the criteria of this method, the participants who were considered as outlier data (N=6) were not included in the final data analyses (the final total number of questionnaires was 337). Indeed, the removal of outliers was based on statistical rules, not in terms of demographics, psychosocial factors, or sleep differences. All participants were informed of the study aims and were given written informed consent before completing the battery of questionnaires, which were administered in balanced order to control the order effect. After signing the informed consent and answering every question about the aims of the research (see part 2.2), participants were assured that their demographic information would be kept confidential. They were informed that they could discontinue the research at any time. All procedures performed in studies involving human participants were in accordance with the ethical standards of the Ethics Committee of Kharazmi University of Tehran, Iran (IR.KHU.REC.1398.04.25) and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

2.2. Self-report instruments

All the measures were the Persian form of the original scales.

2.2.1. Pittsburgh Sleep Quality Index (PSQI)

Sleep Quality was assessed with the Iranian version of the PSQI that designed by Buysse and colleagues (1989). The PSQI consists of 19 items and 7 dimensions, including subjective sleep quality, sleep latency, sleep duration, sleep efficiency, and sleep disturbances,

use of sleep medications and daytime dysfunction. Items were rated on a 4-point scale. Higher score means poor sleep quality. The seven component scores of the PSQI had an overall reliability coefficient (Cronbach's alpha) of 0.83, for the original version of PSQI has been confirmed (Buysse et al., 1989). Sleep Quality in present study was assessed with the Persian version of the PSQI that was validated by Hasanzadeh and colleagues (2008). The Cronbach's alpha for the present study sample was 0.75.

2.2.2. Metacognitions Questionnaire-Insomnia (MCQ-I)

Sleep related metacognitions was assessed with the MCQ-I, which designed by Waine and colleagues (2009). The MCQ-I consists of 60 items rated on a 4-point Likert scale that assess insomnia related metacognitive beliefs. Waine and colleagues (2009) found a good test–retest reliability, and good face validity, concurrent validity, construct validity and discriminant validity for MCQ-I. They also found a significant positive correlation between the MCQ-I and MCQ-30 ($r = 0.69$). In present study we used the Persian version of the MCQ-I (Doos Ali Vand et al., 2010). The Cronbach's alpha for the present study sample was 0.95.

2.2.3. Emotion Regulation Questionnaire (ERQ)

Emotion regulation was measured using the Persian version of the emotion regulation questionnaire. The ERQ designed by Gross and John (2003). The 10 items were rated on a 7-point scale and have two opposing dimensions, 6 items measure the rate of cognitive reappraisal (e.g., I control my emotions by changing the way I think about the situation I'm in.) and the 4 other items measure the rate of expressive suppression (e.g., When I am feeling negative emotions, I make sure not to express them). The original version of the ERQ had a Cronbach's alpha of 0.79 for reappraisal and 0.73 for suppression. Test–retest reliability across 3 months was 0.69 for both scales. The Persian version of the ERQ was validated by

Ghasempur, ElBeigi, & Hasanzade (2012). The Cronbach's alpha for the present study sample for total score, cognitive reappraisal and expressive suppression was 0.74, 0.76, and 0.75, respectively.

2.2.4. Looming Maladaptive Style Questionnaire (LMSQ)

The LMSQ is a measure that is designed to assess a person's tendency to perceive mentally simulated threats as rapidly growing and approaching and expanding in negative consequences (i.e., the looming cognitive style) (Riskind et al., 2000). The LMSQ requires participants to read six brief vignettes describing potentially stressful situations involving physical threat (e.g., a potential car accident) and three stress situations involving rejection threat (e.g., perceiving odd looks from a lover) and then complete three questions for each vignette using a five-point Likert scale (1-5). A total looming cognitive style (LCS) score is calculated by aggregating responses to these three items across the six vignettes. Riskind and colleagues (2000) provided evidence for the predictive, convergent, and discriminant validity of the measure, as well as its internal consistency and test-retest stability over 7-months (r = 0.72). The Persian version of the LMSQ (Mahmoud Alilou et al., 2017) showed good psychometric properties also with an alpha coefficient for the LMSQ total score in the present sample of 0.91.

2.2.5. NEO-Personality Inventory- Revised (NEQ-PI-R)

The NEO-PI-R is a 240-item questionnaire designed by Costa and McCrae (1992), that assesses 30 specific traits (or facets), 6 for each of the five basic personality dimensions: Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Conscientiousness (C). Items are answered on a 5-point, ranging from strongly disagree to strongly agree (Costa & McCrae, 1992). The results of standardization revealed substantial

internal consistency, temporal stability, and convergent and against spouse and peer ratings (Costa & McCrae, 1992; McCrae & Costa, 2003). Costa & McCrae (1992) reported 0.74 to 0.89 (m= 0.81) for Cronbach's alpha. Alpha coefficients for Neuroticism was 0.84 (Furnham & Crump, 2014). In one study fit indices indicated acceptable fit for the Neuroticism (CFI= 0.99). Multi-group analysis showed invariant factor loadings for the Neuroticism dimension across gender (T_s = 5.95, df = 5, ns) as well as across educational group (T_s = 0.50, df = 5, ns) (Vassend & Skrondal, 2011). The Persian version that was used in present study, showed good psychometric properties for this subscale (Joshanloo et al., 2010). In present study only Neuroticism was assessed and included 48 items. The Cronbach's alpha of this subscale for the present study sample was 0.92.

2.3. Statistical analyses

First, correlations between latent variables of interest were calculated. Second, in order to test the theoretical model, the suggested two-step process of Anderson and Gerbing (1988) was used. Based on this method, first the reliability and validity of the research tools were verified by confirmatory factor analysis, and then the theoretical model was tested using a structural equation model as implemented in LISREL 8.80 software (Jöreskog & Sörbom, 2006). To evaluate the fit of a model, the following criteria are commonly considered: Comparative-Fit Index (CFI; good fit: ≥0.90); Normed Fit Index (NFI; good fit: ≥0.90); Root Mean Square Error of Approximation (RMSEA; good fit: ≤0.06); Goodness of Fit Index (GFI; good fit: ≥0.90); Standardized Root Mean Square Residual (SRMR; good fit: ≤0.08); Incremental Fit Index (IFI; good fit: ≥0.90) (Hu & Bentler, 1999). Also, the model path coefficients and the coefficients of determination of endogenous variables were investigated ($R^2_{N,MCQI}$= 0.19; $R^2_{N,LMSQ}$= 0.31; $R^2_{N,ES}$= 0.05; $R^2_{N,CRE}$= 0.11; $R^2_{N,SQ}$=0.37) and eventually, the bootstrap analysis (iteration number=200) was used in order to test the significance level of the indirect effects in the mediation model.

3. Results

3.1. Preliminary analysis

As shown in Table 1, the lack of multicollinearity between variables was confirmed (r<0.85; Kline, 2011). Selected markers for every variable have been shown in Table 3. The skewness index of the observed variables was between -0.504 and 3.190, in the acceptable range (±3), based on Chou and Bentler (1995). The kurtosis index was between −1.079 and 4.898, following in the acceptable range (±10), based on Kline (2011). Also, Table 1 shows means, standard deviations and correlations among variables of interest and Table 2 represents an inter-item covariance. Results show that neuroticism is positively correlated with the mediators. In addition, all mediators are significantly associated with sleep quality. Furthermore, fit indices confirmed an adequate fit of the measurement model (χ^2 = 1125.67, p < 0.001; CFI=0.95, NFI=0.90, RMSEA=0.063, GFI=0.94, SRMR=0.067, IFI=0.94).

<Please Insert Table 1 here>

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3.2. Test of mediation

Results of the SEM model indicate a good fit of the model (χ^2 =1179.63, p < 0.001; CFI=0.94, NFI=0.90, RMSEA=0.062, GFI=0.90, SRMR=0.077, IFI=0.94). The present model explains 37% of the variance of subjective sleep quality. As shown in the Figure and in Table 4, neuroticism related to MCQ-I (β=0.43, T-value=7.05), LMSQ (β=0.56, T-value=8.64), ESU (β=0.23, T-value=3.62) and CRE (β= -0.31, T-value=-4.72). On the other hand, MCQ-I (β=0.32, T-value=4.56), LMSQ (β=0.20, T-value=2.39) and CRE (β= -0.19, T-value=-2.90) related to sleep quality. The direct link between neuroticism and sleep quality (β=0.18, T-value=2.09) is significant.

<Please Insert Table 4 here>

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3.3. Bootstrapping

In the present study, bootstrap (Efron & Tibshirani, 1994) (iteration number=200) was used to evaluate the mediation model. As shown in Table 5, there is a significant pathway from neuroticism to sleep quality through, MCQ-I (β=0.137, SE=0.039, 95% CI 0.062 to 0.215, $p <$ 0.05), LMSQ (β=0.112, SE=0.048, 95% CI 0.015 to 0.202, $p < 0.05$), and CRE (β=0.058, SE=0.032, 95% CI 0.003 to 0.128, $p < 0.05$), while ESU (β= -0.011, SE=0.019, 95% CI -0.048 to 0.027, $p < 0.05$) does not play a mediating role in the in the model.

<Please Insert Table 5 here>

4. Discussion

While prior studies have shown that poor sleep quality is associated with higher levels of neuroticism and with metacognitive beliefs about sleep, the present study both extends these studies and tested an integrated structural model. Our integrated model expected that neuroticism can influence subjective sleep quality through both direct and indirect pathways. Neuroticism would have a direct effect on sleep quality because it is associated with emotional and physiological distress as well as an indirect mediated effect that was transmitted through metacognitive beliefs about looming cognitive style, and emotion dysregulation. The results of the SEM offer support for the expected integrative structural model. Supporting the findings of previous studies, neuroticism had a significant direct impact on sleep quality. In addition to the direct effect, neuroticism also had indirect mediated effects that were transmitted through its links to metacognitive beliefs, the LCS, and the cognitive reappraisal dimension of emotion regulation. As a whole, the present data not only replicate the effects of neuroticism but provide

support for the important role of multiple cognitive mediators in transmitting the indirect effects of neuroticism.

4.1. From Neuroticism to Sleep Quality

Consistent with previous studies (e.g., Calkins et al., 2013; Slavish et al., 2018), the present results confirmed the robust association between neuroticism and sleep quality. In their study, Calkins and colleagues (2013) reported that neuroticism was the statistically most important predictor of sleep dysfunction. They explained their findings by suggesting that individuals who are high in neuroticism tend to internalize negative emotions which then leads to heightened emotional and physiological arousal that in turn contributes to insomnia (Calkins et al., 2013; Kales et al., 1976). The present findings help to build on and extend Calkins et al.'s findings by suggesting that neuroticism may influence sleep by multiple pathways. Specifically, in addition to the direct pathway implied by Calkins' et al.'s (2013) "internalization" hypothesis, the present data showed that neuroticism may have significant indirect links to subjective sleep quality that are transmitted through three factors: metacognitive beliefs about sleep, looming cognitive style, and the cognitive appraisal component of emotion regulation.

4.2. The mediating role of sleep-related metacognitive beliefs in the relationship between neuroticism and Sleep Quality

Consistent with several previous findings (Palagini et al., 2016; Waine et al., 2009; Palagini et al., 2016; Sella et al., 2019), the present results confirmed that deficient metacognitive beliefs about sleep are associated with poorer subjective sleep quality. An important new aspect of the findings obtained in the present study is that they suggest that metacognitive beliefs about sleep may help to mediate the impact of neuroticism on sleep

quality. Neuroticism may have direct effects on sleep quality because it is associated with negative emotions and physiological arousal that can in themselves directly impair sleep; however, these symptoms of neuroticism may also activate deficient meta-cognitive beliefs that further exacerbate sleep problems. That is, metacognitive beliefs about sleep (e.g., about the "dangerousness" of not sleeping to one's health or work) may further exacerbate the distress that interferes with sleep quality. Of note, this type of dynamic is suggested by the original metacognitive model (Wells & Matthews, 1994) as well as prior suggestions that metacognitive beliefs may shape pre-sleep cognition that contributes to primary insomnia (Waine et al., 2009).

4.3 The mediating role of LCS in the relationship between neuroticism and Sleep Quality

Another novel finding of the present study is that the looming cognitive style, a cognitive vulnerability factor for anxiety and depression, has a significant relationship with poor subjective sleep quality. Such a relationship would be expected in principle given the extensive evidence that the looming cognitive style is related to anxiety, worry and depression. Nonetheless, the present study is the first to document evidence that it may represent a major cognitive antecedent that can impair sleep, however it is in line with several researches (e.g., Cellini et al., 2017) showing the importance of hyperarousal more generally and pre-sleep worries, which are similar to the looming cognitive style. Notably, the present results indicate that the impact of neuroticism on sleep quality appears to be partially mediated through its indirect effects on the looming cognitive style. One explanation for these findings is provided by research that documents that the looming cognitive style increases an individual's fears of internal emotional experiences and of loss of control over such experiences (Riskind & Kleiman, 2012). Therefore, and much like metacognitive beliefs about sleep, then, the looming cognitive style may interfere with sleep quality by heightening the individual's fears about the emotions he or she is experiencing.

The present findings are also consistent with the cognitive model of insomnia, which holds that worry and anxiety lead to an increased pre-sleep cognitive and physiological arousal, which, in turn, results in increased wakefulness (Harvey, 2003; Babson, 2015). Based on the present finding and theoretical considerations, the LCS may represent a significant cognitive antecedent of worry and emotional arousal that impairs sleep.

4.4. The mediating role of Emotion Regulation in the relationship between neuroticism and Sleep Quality

In the present study we also examined the impact of two emotion regulation strategies, one of which is generally considered an adaptive strategy (cognitive reappraisal of stressors) and the other a maladaptive strategy (expressive suppression). The present findings support cognitive appraisal as an emotion regulation strategy that can affect subjective sleep quality, but no evidence that expressive suppression plays a role in subjective sleep quality was evident. While a handful of prior studies have indicated that the inability to use cognitive reappraisal to regulate emotions is an important correlate of disturbed sleep (Mauss et al., 2013; Vantiegem et al., 2016), the present study contributes new findings showing that it may help to mediate the impact of neuroticism on sleep. According to the theory of Costa & McCrae (1992), individuals high in neuroticism have a distinctive feature of lack of confidence in their ability to cope stressors, also they are impulsive. Neuroticism reflects individual differences in negative bias in interpretation and recall of information (Ormel et al., 2013). Neuroticism may be a source for individual differences in use of adaptive/maladaptive emotion regulation strategies and it is likely that reappraisal is difficult for individuals high in neuroticism with a tendency for exaggerated responses to negative affect (John & Gross, 2004; Yoon, Maltby, & Joormann, 2013). As stated above according to research literature emotion regulation is correlated with sleep quality (e.g. Kirwana et al., 2019).

Contrary to some prior findings (e.g., Vantieghem et al., 2016), there was no evidence that expressive suppression played a role that contributes to sleep quality. One possible explanation is that while suppression may be ineffective in the long term, it may have fewer negative consequences when only used occasionally. Another explanation is that there are cultural differences between Iran and other cultures. Recent cross-cultural research suggests that differences in the use of reappraisal and suppression exist across different countries, with higher use of suppression in countries that value power, status differentials, and emphasize propriety and restraint; while, greater use of reappraisal may occur in countries that value more individualistic goals, such as the independent pursuit of well-being (Matsumoto, Yoo, & Nakagawa, 2008). Given that the student population used in this study may be more individualistic, and according to Matsumoto et al. (2008), individualistic people may use reappraisal to regulate their emotions, this might account for why suppression had no effects on sleep quality in this study.Some limitations of the present study are as follows: The sample consists of a nonclinical sample of university students and caution should be exercised when generalizing the results to other communities. Secondly, the cross-sectional nature of the study precludes inferences about causality. Furthermore, the cross-sectional design of the study precludes examining the possibility of mutual influences and reciprocal causation). Moreover, there may be other personality factors, and mediators and moderators not examined in this study.

Notwithstanding these limitations, this study takes an important step in clarifying the personality determinants and mediators of poor sleep and can provide a basis for future studies to pursue such questions. Ultimately, the results of such research can help in sharpening the focus of interventions to improve sleep quality. The results of the present study may be helpful for treatment interventions. According to the results of the present study, it can be suggested that the role of sleep metacognitions, looming cognitive style and cognitive reappraisal should

be considered in the arrangement of trans-diagnostic protocols. It seems that more attention should be paid to the role of these variables in sleep problems, because the results of the present study showed that these components can play a mediating role in the relationship between neuroticism and sleep. We suggest to assess objective sleep quality with polysomnography and actigraphy in order to assessing this path of neuroticism to poor sleep quality, as well as considering all big five traits for future researches. We also suggest a specific attention to the facets of neuroticism, which might make us new findings.

5. Conclusion

Over the past fifteen years, several researchers have suggested that the underlying mechanisms that account for how personality factors such as neuroticism affect sleep remain unclear (Guastella & Mould, 2007; Harvey, 2005; Vandekerckhove et.al. 2010). The present findings underscore the importance of the role of cognition in sleep. Furthermore, they indicate that cognition may not only directly contribute to poor sleep but appear to function in an additional role in transmitting the effects of more general personality factors on sleep. The integrative structural model supported by the present study suggests a more comprehensive overall picture of how several variables contribute to poor subjective sleep quality. Of these different factors, sleep related metacognitions emerged as having the strongest link to sleep quality and neuroticism had the most effect on sleep quality through this variable. It's notable that since the current study was relied to self-reports of university students, we tried to benefit of studies conducted with self-reports of the student and young adults to have support for our aims and findings.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability statement

The data that support the findings of this study are available from the corresponding author, [M. A], upon reasonable request.

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Table 1

Mean, Standard Division, Skewness, Kurtosis and Zero order correlations between research variables (N=337).

Variables	M	SD	Skewness	Kurtosis	1	2	3	4	5	6
1. N	94.59	27.91	-0.007	-0.036	1					
2. MCQ-I	116.92	28.25	0.357	-0.345	0.357**	1				
3. LMSQ	58.54	13.76	-0.457	0.247	0.456**	0.327**	1			
4. ESU	14.91	5.56	0.183	-0.500	0.150**	0.248**	0.192**	1		
5. CRE	27.83	6.79	-0.504	0.247	-0.303**	-0.039	-0.142**	0.151**	1	
6. SQ	6.58	3.37	1.246	0.815	0.398**	0.377**	0.324**	0.062	-0.264**	1

Notes: M=Mean; SD=Standard Division; N=Neuroticism; MCQ-I=Metacognitions Questionnaire-Insomnia; LMSQ= Looming Maladaptive Style Questionnaire; ESU= Expressive Suppression; CRE= Cognitive Reappraisal; SQ=Sleep Quality; ** $p < 0.01$, * $p < 0.05$.

Table 2

Inter-Item Covariance Matrix (N=337).

	1	2	3	4	5	6
1. N	779.474					
2. MCQ-I	281.852	798.620				
3. LMSQ	175.169	127.277	189.511			
4. ESU	23.371	39.000	14.736	30.975		
5. CRE	-57.523	-7.491	-13.276	5.710	46.147	
6. SQ	37.497	36.003	15.076	1.159	-6.067	11.405

Notes: M=Mean; SD=Standard Division; N=Neuroticism; MCQ-I=Metacognitions Questionnaire-Insomnia; LMSQ= Looming Maladaptive Style Questionnaire; ESU= Expressive Suppression; CRE= Cognitive Reappraisal; SQ=Sleep Quality

Table 3

Non-standardized coefficients, standardized coefficients and T-values of the observable variables in the measurement model.

Variables	Non-standardized coefficients	Standardized coefficients	T value
Neuroticism			
Anxiety	4.87	0.78	16.53
Angry Hostility	4.29	0.71	14.50
Depression	5.60	0.84	18.39
Self-consciousness	3.96	0.71	14.37
Impulsiveness	2.52	0.51	9.60
Vulnerability	4.99	0.82	17.75
MCQ-I			
MCQ-I 1	5.45	0.76	15.78
MCQ-I 2	5.68	0.84	18.54
MCQ-I 3	2.95	0.68	13.72
MCQ-I 4	2.61	0.72	14.83
MCQ-I 5	2.70	0.59	11.30
MCQ-I 6	2.73	0.74	15.32
MCQ-I 7	2.44	0.71	14.46
MCQ-I 8	2.11	0.59	11.49
LMSQ			
social rejection	6.43	0.83	14.44
physical threat	5.71	0.76	13.36
Expressive Suppression			
ERQ 2	1.47	0.81	15.71
ERQ 4	1.33	0.73	13.87
ERQ 6	1.34	0.72	13.81
ERQ 9	0.75	0.41	7.10
Cognitive Reappraisal			
ERQ 1	0.92	0.54	9.64
ERQ 3	1.03	0.60	11.03
ERQ 5	0.76	0.45	7.89
ERQ 7	1.17	0.70	13.35
ERQ 8	1.11	0.71	13.55
ERQ 10	1.04	0.68	12.71
Sleep Quality			
subjective sleep quality	0.53	0.69	12.41
sleep latency	0.48	0.49	8.29
sleep duration	0.48	0.56	9.68
sleep efficiency	0.52	0.59	10.28
sleep disturbances	0.25	0.49	8.42
sleep medications	0.23	0.32	5.34
day time dysfunction	0.36	0.39	6.47

Notes: MCQ-I=Metacognitions Questionnaire - Insomnia; LMSQ=Looming Maladaptive Style Questionnaire; ERQ= Emotion Regulation Questionnaire

Table 4

Direct effects among latent variables

Independent Variables	Dependent Variables	B	T	SE	P	R^2
N	MCQ-I	0.43	7.05	0.061	0.01	0.19
N	LMSQ	0.56	8.64	0.064	0.01	0.31
N	ESU	0.23	3.62	0.063	0.01	0.05
N	CRE	-0.31	-4.72	0.070	0.01	0.11
N	SQ	0.18	2.09	0.089	0.05	0.37
MCQ-I	SQ	0.32	4.56	0.071	0.01	
LMSQ	SQ	0.20	2.39	0.082	0.05	
ESU	SQ	-0.05	-0.73	0.064	0.05	
CRE	SQ	-0.19	-2.90	0.070	0.01	

Notes: N= Neuroticism; MCQ-I= Metacognitions Questionnaire-Insomnia; LMSQ= Looming Maladaptive Style Questionnaire; ESU= Expressive Suppression; CRE= Cognitive Reappraisal; SQ=Sleep Quality; SE=Standard Error; R^2= Coefficient of determination.

Table 5

Bootstrapping indirect effect and 95% confidence interval (CI) for the mediation model.

Independent Variables	Mediating Variables	Dependent Variables	Standard coefficient	Standard error	95% CI		P
					Lower	Upper	
Neuroticism	MCQ-I	SQ	0.137	0.039	0.062	0.215	0.001
Neuroticism	LMSQ	SQ	0.112	0.048	0.015	0.202	0.023
Neuroticism	ESU	SQ	-0.011	0.019	-0.048	0.027	0.580
Neuroticism	CRE	SQ	0.058	0.032	0.003	0.128	0.039

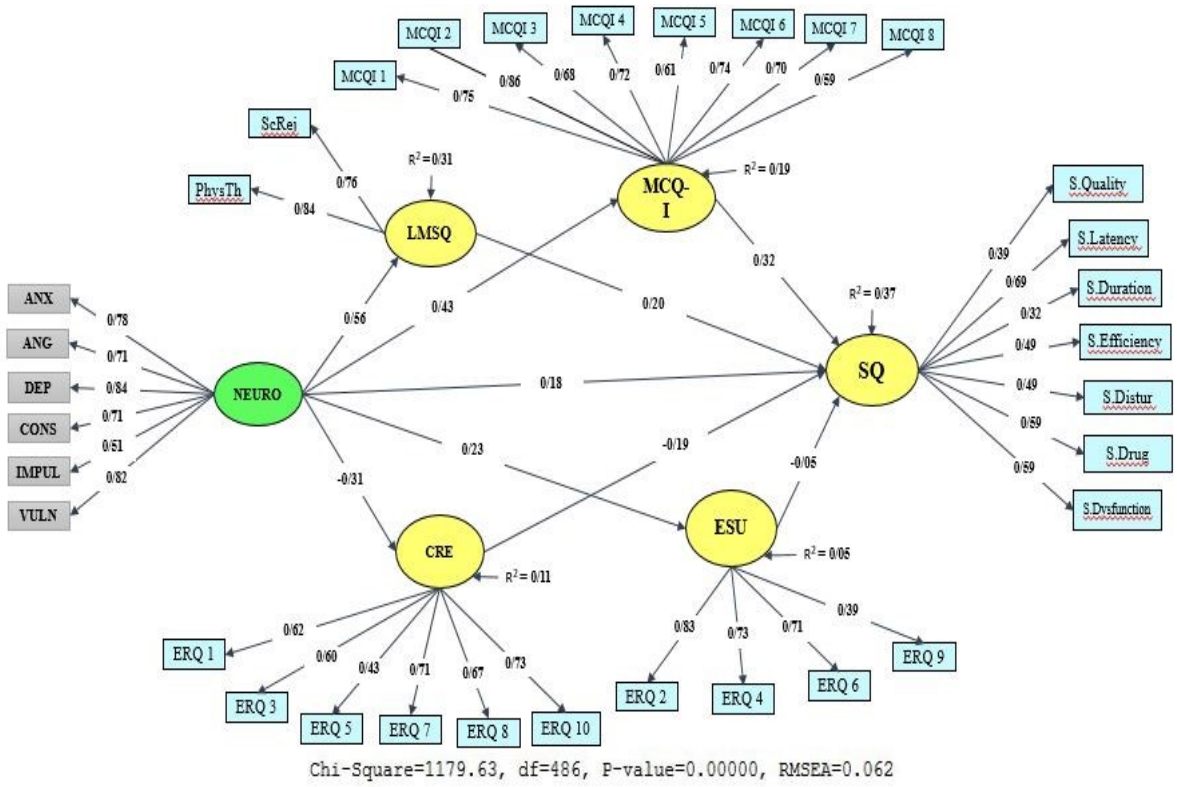

Fig. 1. Results of structural equation modeling analysis of the direct and indirect impacts of Neuroticism on Sleep quality through metacognitions, emotion regulation and looming cognitive style. Notes: Neuro= Neuroticism; ANX= Anxiety; ANG= Angry Hostility; DEP=Depression; CONS=Self-Consciousness; IMPUL= Impulsiveness; VULN=Vulnerability; MCQ-I= Metacognitions Questionnaire-Insomnia; LMSQ= Looming Maladaptive Style Questionnaire; ScRej=Social Rejection; PhysTh=Physical Threat; ESU=Expressive Suppression; CRE=Cognitive Reappraisal; ERQ=Emotion Regulation Questionnaire; SQ=Sleep Quality; S. Quality=Sleep Quality; S.Latency=Sleep Latency; S.Duration=Sleep Duration; S.Efficiency=Sleep Efficiency; S.Distur=Sleep Disturbances; S.Drug= use of sleep medications; S.Dysfunction= Day time dysfunction.