Personality and Individual Differences 77 (2015) 199–204

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Examining the role of psychological need satisfaction in sleep: A Self-Determination Theory perspective

Rachel Campbell [a,*], Maarten Vansteenkiste [a], Liesbeth M. Delesie [b], An N. Mariman [b], Bart Soenens [a], Els Tobback [b], Jolene Van der Kaap-Deeder [a], Dirk P. Vogelaers [b]

[a] Department of Developmental, Personality, and Social Psychology, Ghent University, Ghent, Belgium
[b] Ghent University Hospital, Department of General Internal Medicine, 185 De Pintelaan, 9000 Ghent, Belgium

ARTICLE INFO

Article history:
Received 7 October 2014
Received in revised form 24 December 2014
Accepted 3 January 2015
Available online 21 January 2015

Keywords:
Sleep
Psychological need satisfaction
Self-Determination Theory
Mindfulness
Financial strain

ABSTRACT

Although ample research has shown the satisfaction of the basic psychological needs for autonomy, competence, and relatedness, as defined within Self-Determination Theory, to be related to well-being, the relation with sleep-related functioning has not yet been examined. Hence, the present study explored the association between basic psychological need satisfaction and subjective measures of sleep and daytime dysfunction, as well as the explanatory role of need satisfaction in the relation between mindfulness and financial strain and these outcomes, in an adult sample ($N = 215$, 61% female; Mean age = 31). The results indicated that low psychological need satisfaction related to poor sleep quality, lower sleep quantity, and more daytime dysfunction. Finally, mindfulness and financial strain related, respectively, negatively and positively to poor sleep quality and daytime dysfunction through need satisfaction, suggesting that need satisfaction represents a critical explanatory mechanism. The role of psychological need satisfaction in the adequate regulation and satisfaction of the physiological need for sleep is discussed.

1. Introduction

Poor sleep impairs cognitive functioning (Curcio, Ferrara, & De Gennaro, 2006) and is associated with various adverse health outcomes, such as diabetes, obesity, and cardiovascular disease (Reite, Ruddy, & Nagel, 2002). Such findings highlight the necessity to identify predictors of people's sleep. Previous studies found perceived stress (Fuligni & Hardway, 2006), loneliness (Cacioppo et al., 2002), financial strain (Burgard & Ailshire, 2009), and negative affect (Stewart, Rand, Hawkens, & Stines, 2011) to relate to poor sleep, while mindfulness (Howell, Digdon, Buro, & Sheptycki, 2008) and gratitude (Wood, Joseph, Lloyd, & Atkins, 2009) related to better sleep. However, although a broad range of theoretical explanations have been proposed as to why sleep and psychological functioning are related (e.g., Riemann et al., 2010), past work examining psychological predictors of sleep has not always been grounded in an overarching psychological framework.

Self-Determination Theory (SDT; Deci & Ryan, 2000; Vansteenkiste, Niemiec, & Soenens, 2010) provides such a framework as it specifies principles that may help to explain why previously identified predictors of sleep relate to sleep outcomes. SDT identifies three basic psychological needs which are essential for psychological and social wellness and physical health: Autonomy involves the experience of a sense of volition and self-endorsement in one's activity; competence refers to the experience of effectiveness when interacting with one's environment; and relatedness involves the experience of reciprocal care and concern for others. Akin to drive theory (Hull, 1943) which focuses on the study of physiological needs (e.g., food, sleep), SDT conceives these psychological needs as inherent, universal, and essential for well-being. Various studies have found psychological need satisfaction to relate positively to well-being (e.g., life satisfaction), and negatively to ill-being (e.g., depressive symptoms and anxiety) (Deci & Ryan, 2000). These findings emerged across diverse life domains and both at the between-person and within-person level (Vansteenkiste et al., 2010).

More recently, a few studies began to explore the role of psychological need satisfaction in the regulation of physiological needs. For example, on days when basic psychological needs are frustrated, problems with eating regulation are more likely to occur (Verstuyf, Vansteenkiste, Soenens, Boone, & Mouratidis, 2013). In addition, psychological need satisfaction has been found to play a role in peoples' sexual experiences (Smith, 2007). However, to date no study has focused on the interplay between psychological need satisfaction and the physiological need for sleep, although indirect evidence for this association exists. For example,

* Corresponding author.

http://dx.doi.org/10.1016/j.paid.2015.01.003
0191-8869/

loneliness and attachment anxiety, which presumably involve experiences of relatedness frustration, as well as financial strain, which likely engenders experiences of autonomy frustration, have been found to relate to poorer sleep (Burgard & Ailshire, 2009; Carmichael & Reis, 2005). Further, the frustration of psychological needs is associated with stress, negative affect (Deci & Ryan 2000) and reduced vitality (Chen, Yao, & Yan, 2014), all of which negatively relate to sleep outcomes (Fuligni & Hardway, 2006; Stewart et al., 2011; Visser, Hirsch, Brown, Ryan, & Moynihan, 2014). Presumably, when individuals fail to get their psychological needs met, they have more negative experiences to handle which may increase pre-sleep arousal through worry and stress and in this way negatively influence sleep.

We propose that the concept of psychological need satisfaction allows for a deeper understanding of the ways in which psychological factors relate to sleep. Indeed, the effect of previously identified antecedents of sleep outcomes, such as mindfulness and financial strain, may be explained through their association with need satisfaction. Mindfulness involves a non-judgmental stance and receptivity for present experiences (Brown & Ryan, 2003). With regard to sleep, mindfulness would allow for a greater attunement to bodily cues of fatigue and be conducive to a greater acceptance of sleep-related functioning. Rather than trying to get a grip on or alter disturbing sleep-related thoughts and feelings, the more observing stance characteristic of mindful individuals would be conducive to a greater detachment of everyday worries that impede restful sleep. In line with this, a few previous studies found mindfulness to relate positively to sleep (Howell, Digdon, & Buro, 2010; Howell et al., 2008). Herein, we propose that need satisfaction can explain the observed salutary effects of mindfulness on sleep. Because mindful individuals display a greater awareness of ongoing events, they may be more capable of deriving a sense of need satisfaction from these events, which, in turn would predict better sleep.

In addition to mindfulness, financial strain is likely to yield a negative association with sleep through need satisfaction. Financial strain is likely to restrict freedom in daily life, cause relational conflicts, and increase self-doubts as to whether one can competently run one's life, thus leading to low need satisfaction. Although previous research found financial strain to impair sleep (Burgard & Ailshire, 2009), the mechanism accounting for this association has not received attention yet.

The objective of the present cross-sectional study was to explore the relation between psychological need satisfaction and subjective measures of sleep. Two more specific aims were pursued. First, in contrast to previous research which often treated sleep as a non-differentiated category comprising diverse indicators (e.g., Howell et al., 2008), we examined whether need satisfaction would yield a similar relation to two sleep-related components, that is, sleep quantity (e.g., number of hours of sleep) and perceived sleep quality. Further, consistent with available measures in the field, such as the commonly used Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989), we also included various indicators of day-time dysfunction, including the Insomnia and Lassitude subscales of the Inventory of Depression and Anxiety Symptoms (IDAS) (Watson, O'Hara, Simms, Kotov, & Chmielewski, 2007), the Fatigue Severity Scale (FSS) (Rietberg, Van Wegen, & Kwakkel, 2010) and the General Vitality Scale (Ryan & Frederick, 1997). Although strictly speaking such measures are not indicative of individuals' sleep as such, because they tap into feelings of exhaustion and energy during the day, they are directly related to one's sleeping pattern. We hypothesized that need satisfaction would relate negatively to poor sleep quality and daytime dysfunction. With regard to sleep quantity, we had no formal hypothesis, but rather examined the association between psychological need satisfaction and sleep quantity in an explorative fashion. In examining this hypothesis, we first tested the role of a composite score of need satisfaction and then proceeded by testing the individual and unique contributions of each of the three needs.

Second, we examined whether psychological need satisfaction would account for the relation between mindfulness and financial strain and sleep outcomes and daytime dysfunction. By proposing the same mechanism (i.e., need satisfaction) to account for the previously observed effects of diverse antecedents of sleep (i.e., mindfulness, financial strain), the concept of psychological need satisfaction may allow for a deeper integration of findings from previous studies (e.g., Burgard & Ailshire, 2009; Howell et al., 2008, 2010).

2. Method

2.1. Participants and procedure

The original sample consisted of 245 Belgian adults; however, 30 were later excluded on the basis of the exclusion criteria resulting in a final sample of 215 (61% female; Mean age = 31, SD = 14.39). Participants were recruited through the social network of three Master students of Clinical Psychology at the University of Ghent. Participants were excluded if they were less than 18 years old, had children under the age of 3, worked in shifts, used hypnotics or had a self-reported diagnosis of depression, anxiety or primary sleep disorder. All participants gave informed consent and the sample was approved by the University's Institutional Review Board.

2.1.1. Measures

All variables were coded so that a higher value represented a higher amount of the labeled construct. Reliabilities of all measures can be found on the diagonal in Table 1.

2.1.2. Basic Psychological Need Satisfaction and Need Frustration Scale (BPNSNFS)

Psychological need satisfaction was assessed using the BPNSNFS (Chen et al., 2014). Participants rated on a scale of 1 (*not at all true*) to 5 (*very true*) as to whether they felt their needs for autonomy (e.g., "I feel my choices express who I really am"), competence (e.g., "I feel confident that I can do things well") and relatedness (e.g., "I feel connected with people who care for me and whom I care for") were satisfied during the past month. The scale consists of 24 items in total, 8 items per need, 4 of which tap into need satisfaction and 4 which tap into need frustration. Apart from creating three separate need scores by averaging the respective means for autonomy, competence, and relatedness, we also created an overall composite score by averaging the sum of the three need variables (see also Deci et al., 2001).

2.1.3. Mindful Attention Awareness Scale (MAAS)

Mindfulness was assessed using the MAAS (Brown & Ryan, 2003). The scale consists of 15 items which assessed the individual's awareness of his/her attention during the past month (e.g., "I found myself doing things without paying attention"). Participants rated responses on a scale of 1 (*almost always*) to 6 (*almost never*).

2.1.4. Financial strain

Eight items assessed the degree to which participants worried about their financial situation over the last month (e.g., "During the last month I worried about whether I would have sufficient financial resources to provide medical care for my family and for myself") (Vansteenkiste, Lens, De Witte, De Witte, & Deci, 2004). Participants were asked to rate each item on a 5-point Likert scale ranging from 1 (*Completely disagree*) to 5 (*Completely agree*).

Table 1
Means, standard deviations, and correlations between the study variables.

Measure	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Age	.13	.17*	.16*	.18*	.23**	−.26**	−.06	−.05	−.23*	.02	.12	−.14*	−.11	.02	−.33**	.06	−.02
2. Autonomy	.70	.67**	.55**	.87**	.36**	−.28**	−.24**	−.15*	.11	.10	−.17*	−.37**	−.26**	−.36**	−.46**	.51**	−.27**
3. Competence		.87	.56**	.87**	.33**	−.32**	−.33**	−.16*	.04	.17*	.06	−.33**	−.35**	−.37**	−.42**	.45**	−.31**
4. Relatedness			.88	.81**	.33**	−.25**	−.19**	−.20**	.08	.12	−.06	−.25**	−.23**	−.32**	−.28**	.29**	−.15*
5. Need composite				.89	.39**	−.33**	−.30**	−.19**	.09	.15*	−.12	−.37**	−.33**	−.41**	−.46**	.49**	−.29**
6. Mindfulness					.86	−.28**	−.22**	−.04	.10	.05	−.15*	−.48*	−.22**	−.24**	−.42**	.34**	−.31**
7. Financial strain						.91	.17*	.04	.03	−.14	.03	.23**	.17*	.09	.22**	−.27**	.30**
8. Subjective poor sleep quality							–	.46**	−.23**	−.20**	.33**	.37**	.45**	.59**	.36**	−.38**	.19**
9. Sleep latency								–	−.21**	−.27**	.24**	.21**	.45**	.42**	.14*	−.20**	.07
10. Sleep duration									–	.27**	−.11	−.19**	.03	−.26**	−.07	.19**	−.02
11. Habitual sleep efficiency										–	−.08	−.04	−.24**	−.16*	−.06	.04	−.04
12. Sleep disturbances											–	.24**	.36**	.37**	.21**	−.15*	.19**
13. Daytime dysfunction												–	.36**	.32**	.49**	−.54**	.38**
14. Negative reasons													.76	.48**	.26**	−.29**	.18**
15. Insomnia														.85	.37**	−.37**	.26**
16. Lassitude															.86	−.54**	.43**
17. Vitality																.86	−.45**
18. Fatigue severity																	.85
Mean	3.43	3.67	4.10	3.73	4.31	1.71	.99	1.20	2.51	2.67	1.11	.88	1.89	2.24	2.75	2.85	3.36
SD	.76	.76	.70	.64	.83	.87	.64	.80	.56	.60	.36	.75	.78	.94	.94	.79	1.15

Note: Internal consistencies are displayed on the diagonal.
* $p < .05$.
** $p < .01$.

2.1.5. Pittsburgh Sleep Quality Index (PSQI)

The PSQI (Buysse et al., 1989) was used to assess sleep quality and disturbances during the past month. The PSQI consists of 19 items which generate 7 component scores: subjective poor sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of hypnotics, and daytime dysfunction. In addition, we developed two items to tap into psychological reasons for sleep disruption which followed the classic PSQI items (i.e., "Worrying" and "Somber thoughts").

2.1.6. Insomnia and lassitude

Symptoms of insomnia and lassitude were assessed using the corresponding subscales from the IDAS (Watson et al., 2007). Both subscales consist of 6 items and were adapted so that they focused on the last month (e.g., During the last month I felt sleepy and drowsy). Items were answered on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*very much so*).

2.1.7. Fatigue Severity Scale (FSS)

The FSS (Rietberg et al., 2010) consists of 9 items which assessed the severity of fatigue in different situations over the past month. Participants rated responses on a scale of 1 (*completely disagree*) to 7 (*completely agree*).

2.1.8. General Vitality Scale

Vitality was assessed using the General Vitality Scale (Ryan & Frederick, 1997) which measured the extent to which participants felt alive and energetic over the last month (e.g., I felt very energetic; 7 items). Items were answered on a 5-point Likert scale ranging from 1 (*completely disagree*) to 5 (*completely agree*).

2.2. Statistical analyses

To examine the structure underlying the assessed sleep parameters a second order principal component analysis with promax rotation (oblique) was performed using SPSS® 20.00 (IMB Corporation, Armonk NY, USA), thereby inserting scale scores rather than individual items. Promax rotation was chosen because the underlying components were assumed to be correlated. Factor extraction was guided by examination of the scree plot and eigenvalues greater than 1. Component 6 of the PSQI (i.e., use of hypnotics) was omitted due to having zero variance as a consequence of the exclusion criteria.

To examine the relation between psychological need satisfaction and the retained components and to investigate whether psychological need satisfaction would account for the relation between mindfulness and financial strain and each outcome, structural equation models (SEM) were tested using Mplus7 with maximum-likelihood as estimator. In testing the role of need satisfaction, we first tested the role of a composite score of need satisfaction before examining the separate and unique contribution of each of the three needs. In the SEM analyses mindfulness, financial strain and the need for autonomy, competence and relatedness were represented by four parcels which were created through random selection of items from the corresponding scales. Parceling is considered to be an appropriate technique for creating indicators for latent variables from unidimensional scales and provides several advantages when investigating structural relations between variables (Little, Cunningham, Shahar, & Widaman, 2002). The need composite was represented by the subscales of autonomy, competence, and relatedness. Finally, the components that were retained from the second order principal component analysis were represented by the corresponding subscales.

When testing indirect effects, bootstrapping (using 1000 draws) was used to account for potential deviations from multivariate normality. Several indices were used to assess the model fit, namely the χ^2 test, the comparative fit index (CFI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA). An acceptable fit was indicated by χ^2/df ratio of 2 or below, CFI values of .90 or above, and SRMR and RMSEA values of around .08 or below (Hu & Bentler, 1999; Kline, 2005). In each of the models relevant background variables (i.e., age and gender) were controlled for.

3. Results

3.1. Preliminary analysis

3.1.1. Correlations

Table 1 presents the means, standard deviations, and correlations among all the study variables. The subscales for autonomy,

competence, and relatedness were highly correlated and yielded similar relations to mindfulness, financial strain and the outcomes.

3.1.2. Factor structure

Examination of the scree plot indicated a three-component solution, accounting for 60.33% of the variance. The eigenvalues were: 3.93, 1.59 and 1.11. Using a promax rotation, the retained components could be clearly interpreted as indicating the three hypothesized underlying factors, that is, poor sleep quality (component 1); daytime dysfunction (component 2); and sleep quantity (component 3). The factor loadings of the scales were all satisfactory yielding a minimal loading of .66 (see Table 2).

3.1.3. Background variables

Next, a MANCOVA was performed to examine the effect of age, gender, and education level on the sleep outcomes. Gender and education level had no significant associations with sleep outcomes, whereas age [F (10,179) = 5.11, $p < .000$, $\eta^2 = .20$] yielded a significant multivariate effect. Subsequent univariate ANOVAS showed that age was negatively related with daytime dysfunction [F (1188) = 4.19, $p < .05$, $\eta^2 = .02$], lassitude [F (1188) = 19.08, $p < .000$, $\eta^2 = .09$] and sleep duration [F (1188) = 4.4, $p < .05$, $\eta^2 = .02$].

3.2. Primary analyses

3.2.1. Aim 1: Examining the need satisfaction – sleep/daytime dysfunction relation

Prior to testing the structural models, we first inspected the measurement model, which yielded the following fit: $\chi^2/df = 1.4$, CFI = .96, RMSEA = .04, SRMR = .05. Next, paths were allowed from the need satisfaction composite to daytime dysfunction, poor sleep quality, and sleep quantity. The results of this model, $\chi^2/df = 1.9$, CFI = .91, RMSEA = .06, SRMR = .06, indicated that the need satisfaction composite related negatively to daytime dysfunction ($\beta = -.67$, $p < .001$) and poor sleep quality ($\beta = -.49$, $p < .001$) and was positively related to sleep quantity ($\beta = .19$, $p < .05$). Follow-up models indicated that each of the three needs, when entered separately, yielded similar relations to the outcomes as the ones observed for the composite score. When all three needs were entered simultaneously, $\chi^2/df = 1.8$, CFI = .91, RMSEA = .06, SRMR = .06, results indicated that competence related negatively to poor sleep quality ($\beta = -.27$, $p < .05$) and autonomy related negatively to daytime dysfunction ($\beta = -.48$, $p < .001$).

3.2.2. Aim 2: Testing the Proposed Integrative Model

To examine whether psychological need satisfaction would mediate the relation between mindfulness and financial strain and the outcomes, two additional SEM models were tested. First, a direct effect model was tested, thereby modeling mindfulness and financial strain as predictors of the three retained components. The results of this model, $\chi^2/df = 1.7$, CFI = .92, RMSEA = .06, SRMR = .07, indicated that mindfulness related negatively to poor sleep quality ($\beta = -.28$, $p = .01$) and daytime dysfunction ($\beta = -.54$, $p = .001$) but was unrelated to sleep quantity ($\beta = .18$, *ns*). Financial strain related positively to daytime dysfunction ($\beta = .19$, $p = .01$) and was unrelated to poor sleep quality ($\beta = .12$, *ns*) and sleep quantity ($\beta = .02$, *ns*).

Next, the need composite was introduced into the model as an intervening variable between mindfulness and financial strain and the three outcomes. Paths between mindfulness and financial strain and the three outcomes were gradually added and retained if the additional path led to an improved model fit. Mindfulness continued to yield a direct negative association with daytime dysfunction leading to an improved model fit, $\chi^2/df = 1.7$, CFI = .92, RMSEA = .06, SRMR = .07. The final integrative model is shown in Fig. 1.

The indirect associations between mindfulness and poor sleep quality ($\beta = -.20$, $p = .001$; CI 95% [−.316; −.086]) and daytime dysfunction ($\beta = -.22$, $p = .001$; CI 95% [−.340; −.090]) via the need composite were significant, indicating that the need composite served as a full (in the case of poor sleep quality) and partial (in the case of daytime dysfunction) mediator. The indirect effect of mindfulness on sleep quantity was not significant. The indirect effect of financial strain on poor sleep quality ($\beta = .13$, $p = .01$; CI 95% [.041; .213]) and daytime dysfunction ($\beta = .14$, $p = .01$; CI 95% [.043; .229]) was significant, while the indirect effect on sleep quantity was not. These results indicate that the need composite completely mediated the association between financial strain and daytime dysfunction and that financial strain had an indirect association with poor sleep quality through the need composite.

Next, when the individual needs were tested separately, the results of each need yielded a similar pattern of associations as the one found for the composite score, with the exception that none of the separate needs were related to sleep quantity. When all needs were entered simultaneously in the model to examine their unique explanatory role, the results of this model, $\chi^2/df = 1.6$, CFI = .91, RMSEA = .06, SRMR = .07, indicated that mindfulness and financial strain related, respectively, positively and negatively to each need. Although mindfulness continued to yield a direct negative association with daytime dysfunction, it yielded an indirect association with daytime dysfunction via autonomy ($\beta = -.15$, $p = .01$; CI 95% [−.261; −.031]).

Table 2
Factor Loadings after principal component analysis (PCA) with promax rotation.

	Poor sleep quality	Daytime dysfunction	Sleep quantity
Negative reasons	.83		
Sleep disturbances	.73		
Sleep latency	.73		
Subjective poor sleep quality	.69		
Insomnia quality	.66		
Vitality		−.82	
Lassitude		.79	
Fatigue severity		.75	
Daytime dysfunction		.72	
Sleep duration			.86
Habitual sleep efficiency			.70
Eigenvalue	3.93	1.59	1.11
Explained variance	35.75%	14.52%	10.06%

4. Discussion

To our knowledge, this study is the first to explore the interplay between the basic psychological needs for autonomy, competence, and relatedness, as defined within the Self-Determination Theory (Deci & Ryan, 2000), and the physiological need for sleep. A number of interesting findings emerged.

First, we performed a second order principal component analysis to examine the underlying structure of the battery of assessed sleep and daytime parameters. Three distinct factors representing poor sleep quality, sleep quantity, and daytime dysfunction were found. This finding is in line with previous studies which identified a 3-factor model of the PSQI as a better fit than a single-factor model in both clinical and non-clinical samples (e.g., Mariman et al., 2012). However, in contrast to previous studies we examined additional parameters in addition to the PSQI, each of which yielded a satisfactory loading onto one of the three factors. We deemed the inclusion of a positive indicator such as vitality, which has received quite a lot of attention within positive psychology

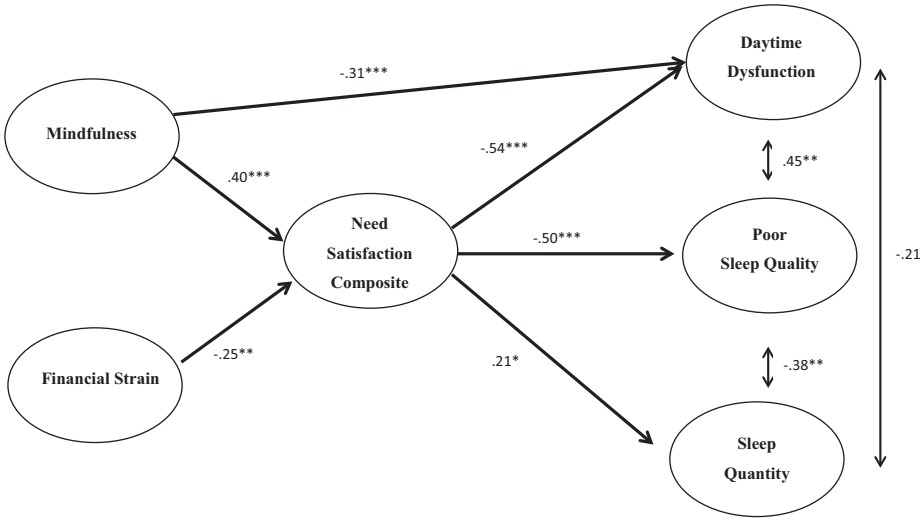

Fig. 1. Mindfulness and financial strain as predictors of sleep outcomes via need satisfaction. $^{*}p < .05$, $^{**}p < .01$,$^{***}p < .001$.

(Ryan & Fredericks, 1997), critical as to move away from a focus on fatigue by including positive indicators of energy. Overall, the separation of the PSQI into three distinct factors underscores the claim from previous studies that the global PSQI has limited usefulness as a single factor (Mariman et al., 2012). Indeed, a more heterogeneous approach involves the recognition that sleep and day-related parameters can be distinguished and that, in turn, sleep outcomes can be differentiated into more refined categories.

Next, we examined the relationship between the need satisfaction composite and the three retained components. First, psychological need satisfaction over the past month related negatively to poor sleep quality. One possible explanation for this finding is that individuals whose psychological needs are satisfied are more likely to encounter positive daily experiences and as a result, are more likely to have positive thoughts and less likely to have worries when falling asleep. This explanation is further supported by past work which found that positive pre-sleep cognitions relate to a better sleep quality, whereas negative pre-sleep cognitions relate to a poorer sleep quality (Pillai, Steenburg, Ciesla, Roth, & Drake, 2014; Riemann et al., 2010; Wood et al., 2009). Second, individuals who experienced greater psychological need satisfaction also reported less daytime dysfunction. This finding is consistent with previous studies (e.g., Ryan, Bernstein, & Brown, 2010), which indicated that psychological need satisfaction is associated with more subjective energy and vitality. Lastly, the need satisfaction composite was positively related to sleep quantity, although this association was less pronounced. Similarly, this is likely because need satisfaction may lead to more positive pre-sleep thoughts which, in turn, are likely to be conducive to an earlier sleep onset and cause fewer sleep disturbances throughout the night.

Next, we tested an integrative model to examine whether psychological need satisfaction would account for the relationship between mindfulness and financial strain and sleep-related outcomes. Extending past work which found mindfulness and financial strain to relate to sleep outcomes (Burgard & Ailshire, 2009; Howell et al., 2008, 2010), the need satisfaction composite accounted for the relation between both predictors and poor sleep quality as well as daytime dysfunction. Presumably, the open awareness characteristic of mindfulness likely facilitates attention to one's internal world and psychological functioning and in doing so, increases the likelihood that one will act in ways that fulfill basic psychological needs, which in turn enables better sleep outcomes. In addition, when encountering problems with falling asleep, mindful individuals may be more able to accept sleep-interfering thoughts rather than resist them, which would be further conducive to their sleep. In contrast, financial strain is likely to restrict the freedom to act in accordance with one's desires, undermine one's feeling of competence in providing for oneself and one's family and increase interpersonal conflict, therefore thwarting psychological needs, which in turn may impair sleep.

Although the present findings provide support for the need satisfaction composite as a critical explanatory mechanism in the relation between mindfulness, financial strain and sleep quality and daytime dysfunction, it should be noted that these effects were weakened when the unique contribution of each need was considered. Although both mindfulness and financial strain related to each of the three needs, the pattern of unique associations between the three needs and the outcomes was not very systematic. Given the lack of uniformity and the fact that this is the first study to shed light on this issue, it seems too early to speculate as to why a particular need might play a more prominent role for some outcomes and not for others. More research in both convenience and clinical samples is needed.

5. Limitations

A number of limitations warrant caution when interpreting the current findings. First, the cross-sectional design prevents us from drawing conclusions about the direction of effects. For example, perceived poor sleep quality may not only follow from low psychological need satisfaction but may also preclude future need satisfaction, an issue that can be pursued in future diary and experimental research. Second, although the relation between need satisfaction and sleep may be accounted for by stress and sleep-interfering thoughts, these specific mechanisms were not measured and, hence, await further testing. Third, all assessed measures were self-reported. For some measures (e.g., sleep duration) self-reports may have undermined validity due to its reliance on adequate recall, an issue that could be overcome by using objective measures to assess sleep parameters. Lastly, given we used a convenience sample, the proposed model needs to be replicated in a clinical sample of sleep disordered patients to see whether these associations are generalizable.

6. Conclusion

Using a differentiated approach, the present study revealed that the satisfaction of the psychological needs for autonomy, competence, and relatedness related negatively to poor sleep quality

and daytime dysfunction, while being positively related to sleep quantity. Further, need satisfaction was found to account for the relationship between mindfulness and financial strain and poor sleep quality and daytime dysfunction. Overall, these findings suggest that psychological need satisfaction may play a critical role in how we appraise the quality of our sleep and how we function throughout the day.

Acknowledgment

This work was supported by the Fund for Scientific Research Flanders (FWO.OPR.2013. 0140.01 – IV2). We would like to thank Liske Cromphout, Julie Van Der Jeucht, and Stefanie Martin for helping to collect the data for this study.

References

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*, 822–848.

Burgard, S. A., & Ailshire, J. A. (2009). Putting work to bed: Stressful experiences on the job and sleep quality. *Journal of Health and Social Behaviour, 50*, 476–492.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index – a new instrument for psychiatric practice and research. *Psychiatry Research, 28*, 193–213.

Cacioppo, J. T., Hawkley, L. C., Bernston, G. C., Ernst, J. M., Gibbs, A. C., Stickgold, R., et al. (2002). Do lonely days invade the night? Potential social modulation of sleep efficiency. *Psychological Science, 13*, 384–387.

Carmichael, C. L., & Reis, H. T. (2005). Attachment, sleep quality and depressed affect. *Health Psychology, 24*, 526–531.

Chen, B., Vansteenkiste, M., Beyers, W., Boone, L., Deci, E. L., Duriez, B., Lens, W., Matos, L., Mouratidis, A., Ryan, R. M., Sheldon, K. M., Soenens, B., Van Petegem, S., Van der Kaap-Deeder, J., & Verstuyf, J. (2014). Basic psychological need satisfaction, need frustration, and need strength across four cultures. *Motivation and Emotion*.

Chen, Y., Yao, M., & Yan, W. (2014). Materialism and well-being among Chinese college students: The mediating role of basic psychological need satisfaction. *Journal of Health Psychology, 19*(10), 1232–1240.

Curcio, G., Ferrara, M., & De Gennaro, L. (2006). Sleep loss, learning capacity and academic performance. *Sleep Medicine Reviews, 10*(5), 323–337.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Enquiry, 11*, 227–268.

Deci, E. L., Ryan, R. M., Gagné, M., Leone, D. R., Usunov, J., & Kornazheva, B. P. (2001). Need satisfaction, motivation, and well-being in the work organizations of a former Eastern Bloc country: A cross-cultural study of self-determination. *Personality and Social Psychology Bulletin, 27*, 930–942.

Fuligni, A. J., & Hardway, C. (2006). Daily variation in adolescents' sleep activities and psychological well-being. *Journal of Research on Adolescence, 16*, 353–378.

Howell, A. J., Digdon, N. L., & Buro, K. (2010). Mindfulness predicts sleep-related self-regulation and well-being. *Personality and Individual Differences, 48*, 419–424.

Howell, A. J., Digdon, N. L., Buro, K., & Sheptycki, A. R. (2008). Relations among mindfulness, well-being, and sleep. *Personality and Individual Differences, 45*, 773–777.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55.

Hull, C. L. (1943). *Principles of behavior*. New York: Appleton-Century-Crofts.

Kline, R. B. (2005). *Principles and practice of structural equation modeling*. New York: Guilford Press.

Little, T. D., Cunningham, W. A., Shahar, G., & Widaman, K. F. (2002). To parcel ornot to parcel: Exploring the question, weighing the merits. *Structural Equation Modeling, 9*, 151–173.

Mariman, A., Vogelaers, D., Hanoulle, I., Delesie, L., Tobback, E., & Pevernagie, D. (2012). Validation of the three-factor model of the PSQI in a large sample of chronic fatigue syndrome (CFS) patients. *Journal of Psychosomatic Research, 72*, 111–113.

Pillai, V., Steenburg, L. A., Ciesla, J. A., Roth, T., & Drake, C. L. (2014). A seven day actigraphy-based study of rumination and sleep disturbance among young adults with depressive symptoms. *Journal of Psychosomatic Research, 77*, 70–75.

Reite, M., Ruddy, J., & Nagel, K. (2002). *Concise guide to evaluation and management of sleep disorders* (3rd ed.). Washington, D.C: American Psychiatric Pub.

Riemann, D., Spiegelharder, K., Feige, B., Volderholzer, U., Berger, M., & Perlis, M. (2010). The hyperarousal model of insomnia: A review of the concept and its evidence. *Sleep Medicine Reviews, 14*(1), 19–31.

Rietberg, M., Van Wegen, E., & Kwakkel, G. (2010). Measuring fatigue in patients with multiple sclerosis: Reproducibility, responsiveness and concurrent validity of three Dutch self-report questionnaires. *Disability and Rehabilitation, 32*, 1870–1876.

Ryan, R. M., & Frederick, C. M. (1997). On energy, personality, and health: Subjective vitality as a dynamic reflection of well-being. *Journal of Personality, 65*, 529–565.

Ryan, R. M., Bernstein, J. H., & Brown, K. W. (2010). Weekends, work, and well-being: psychological need satisfactions and day of the week effects on mood, vitality, and physical symptoms. *Journal of Social and Clinical Psychology, 29*, 95–122.

Smith, C. V. (2007). In pursuit of 'good' sex: Self-determination and sexual experience. *Journal of Social and Personal Relationships, 24*, 69–85.

Stewart, J. C., Rand, K. L., Hawkens, M. A. W., & Stines, J. A. (2011). Associations of the shared and unique aspects of positive and negative emotional factors with sleep quality. *Personality and Individual Differences, 50*, 609–614.

Vansteenkiste, M., Niemiec, C. P., & Soenens, B. (2010). The development of the five mini-theories of self-determination theory: A historical overview, emerging trends and future directions. In T. Urdan & S. Karabenick (Eds.), *Advances in motivation and achievement. The decade ahead* (vol. 16, pp. 105–166). UK: Emerald Publishing. http://dx.doi.org/10.1108/S0749-7423(2010)000016A007.

Vansteenkiste, M., Lens, W., De Witte, S., De Witte, H., & Deci, E. L. (2004). The "why" and "why not" of job search behavior: Their relation to searching, unemployment experience and well-being. *European Journal of Social Psychology, 34*, 345–363.

Verstuyf, J., Vansteenkiste, M., Soenens, B., Boone, L., & Mouratidis, A. (2013). Daily ups and downs in women's binge eating symptoms: The role of basic psychological needs, general self-control, and emotional eating. *Journal of Social & Clinical Psychology, 32*, 335–361.

Visser, P. L., Hirsch, J. K., Brown, K. W., Ryan, R., & Moynihan, J. A. (2014). Components of sleep quality as mediators of the relation between mindfulness and subjective vitality among older adults. *Mindfulness, 5*(2), 111–222.

Watson, D., O'Hara, M. W., Simms, L. J., Kotov, R., & Chmielewski, M. (2007). Development and validation of the Inventory of Depression and Anxiety Symptoms (IDAS). *Psychological Assessment, 19*, 253–268.

Wood, A. M., Joseph, S., Lloyd, J., & Atkins, S. (2009). Gratitude influences sleep through the mechanism of pre-sleep cognitions. *Journal of Psychosomatic Research, 66*, 43–48.