The role of basic psychological need satisfaction, sleep, and mindfulness in the health-related quality of life of people living with HIV

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Abstract
Research has not yet examined the relationship between psychological need satisfaction, sleep, mindfulness, and health-related quality of life in people living with HIV. This cross-sectional study (N = 101; 84% male; mean age = 45.48, SD = 12.75) found need satisfaction to relate positively to physical and mental health. Sleep quality fully mediated the association with physical health and partially mediated the association with mental health. Furthermore, mindfulness related to higher sleep quality through higher need satisfaction. Findings underscore the role of need satisfaction in determining health-related quality of life and sleep quality in people living with HIV and suggest that mindfulness may facilitate need satisfaction.

Keywords
Health-Related Quality of Life, HIV, Mindfulness, Self-Determination Theory, Sleep

Introduction
The advent of continuous antiretroviral therapy (cART) greatly transformed the outlook for people living with HIV (PLHIV). While once considered a death sentence, HIV is now a chronic yet manageable disease (Oberjé et al., 2015). However, despite these advances, living with HIV still presents many challenges including life-long adherence to medication, adverse treatment side effects, and psychosocial difficulties often resulting from stigma and discrimination (Bravo et al., 2010; Gakhar et al., 2013). Because living longer does not necessarily equate to “living well” health-related quality of life (HRQOL), defined as perceived physical and mental health over time (Centers for Disease Control and Prevention [CDC]), 2016), has become an important outcome in HIV research (Degroote et al., 2013; Lin et al., 2002). Moreover, an increasing number of studies have begun to examine the role of psychosocial factors, such...
as social support (Uphold et al., 2007) and stigma (Peltzer, 2012) in predicting HRQOL.

In this study, we draw upon self-determination theory (SDT; Deci and Ryan, 2000; Vansteenkiste and Ryan, 2013), a broad theory of human motivation and the factors that promote versus impede human flourishing. SDT provides a useful framework for examining predictors of HRQOL as it specifies the universal and inherent psychological needs for autonomy, competence, and relatedness as essential for optimal functioning. Autonomy involves experiencing a sense of volition and self-endorsement in one’s behavior; competence involves feeling capable and effective in achieving desired outcomes; and relatedness involves experiencing reciprocal care and closeness with others. The relation between these psychological needs and wellness is well documented with various studies showing need satisfaction to be positively related to well-being (e.g. life satisfaction) and negatively related to ill-being (e.g. depression, anxiety) (Deci and Ryan, 2000). Similar findings have emerged across diverse domains and cultures and at both the inter- and intra-personal level (Vansteenkiste and Ryan, 2013).

There is some evidence that these fundamental psychological needs play a role in determining the HRQOL of PLHIV. For example, social support, which is likely conducive to the need for relatedness, relates positively to HRQOL (Uphold et al., 2007), whereas stigma, which likely thwarts all three needs, is negatively associated with HRQOL (Peltzer, 2012). Furthermore, a qualitative study of HIV-positive women indicated that feeling competent in managing one’s condition and experiencing warmth with one’s caregiver were important determinants of the decision to enter into care, whereas re-establishing autonomy emerged as a key element for long-term engagement in treatment (Quinlivian et al., 2013). Moreover, caregiver support for HIV-positive patients’ need for autonomy has been shown to predict treatment adherence (Kennedy et al., 2004). Finally, in a qualitative study of HIV-positive youth, decisions to disclose HIV status were dependent on whether the youth perceived the context of the disclosure as being supportive of their psychological needs (Gillard and Roark, 2013). This is an important finding given that status disclosure yields several benefits including increased social support (Wong et al., 2009) and the development of more adaptive coping strategies (Medley et al., 2009).

Although psychological need satisfaction is robustly related to well-being (Deci and Ryan, 2000; Vansteenkiste and Ryan, 2013), mechanisms accounting for this association are yet to be examined. One possible pathway may be through quality and quantity of sleep. Approximately, 58% of PLHIV are estimated to suffer from sleep disturbances (Wu et al., 2015), a problem which has been linked to a number of adverse outcomes including fatigue, depression, and reduced quality of life in HIV-positive individuals (Phillips et al., 2004, 2005, 2006). These sleep disturbances reported by PLHIV may be at least in part due to their confrontation with need frustrating experiences (e.g. stigmatic or hostile reactions). For example, psychological need frustration resulting from unjust treatment or discrimination after HIV status disclosure likely leads to stress which may negatively impact on quality and quantity of sleep.

In line with this, previous research in a non-clinical heterogeneous sample indicated that individuals with low psychological need satisfaction reported poorer sleep quality and somewhat shorter sleep duration (Campbell et al., 2015). Furthermore, a longitudinal study among university students indicated that increases in psychological need frustration were associated with increases in poor sleep quality and a reduction in sleep quantity through increases in perceived stress (Campbell et al., 2016). However, despite the relevance of basic psychological needs to sleep, these associations have not been examined in PLHIV.

Given the preliminary evidence suggesting that psychological need satisfaction may play a salutary role in the sleep and HRQOL of PLHIV, the question can be raised as to which factors relate to enhanced psychological need satisfaction. One likely predictor of need satisfaction, which has received growing attention within
the health psychology literature, is mindfulness. One reason for this rising interest in mindful-
ness, which is conceptualized as an open and
receptive awareness of present moment experi-
ences (Brown and Ryan, 2003), is that it has
consistently been shown to display salutary
relations with indicators of both physical and
mental health within a variety of clinical (e.g.
Costa et al., 2016) and non-clinical populations
(e.g. Brown and Ryan, 2003; Xu et al., 2016).
Moreover, although the evidence is still some-
what inconsistent, recent findings suggest that
mindfulness may also be linked to bio-markers
of well-being, including cortisol levels (e.g.
O’Leary et al., 2016).

With regard to psychological need satisfac-
tion, the increased awareness typical of mindful
individuals likely allows for the selection of
more need-satisfying activities, for better attune-
ment to activities such that greater need satisfac-
tion is derived and also for less emotional
reactivity to need frustrating experiences.
Accordingly, a few previous studies found mind-
fulness to be positively associated with need sat-
isfaction (Brown and Ryan, 2003; Campbell
et al., 2015). Furthermore, need satisfaction was
found to account for the relation between mind-
fulness and poor sleep quality (Campbell et al.,
2015). Although mindfulness has been shown to
be negatively related to ill-being (e.g. depres-
sion) in PLHIV (Moskowitz et al., 2015), the
relation with need satisfaction and sleep-related
functioning has not yet been examined.

In sum, although previous research examin-
ing sleep and HIV-related outcomes within the
SDT literature is rather limited, there is some
evidence to suggest that mindfulness and psy-
chological need satisfaction may be implicated
in the sleep and HRQOL of PLHIV. Thus, in
this cross-sectional study, we aimed to shed fur-
ther light on these issues by examining two
aims in a sample of PLHIV. In line with Kline’s
(2005) recommendations, due to our limited
sample size, we examined our aims in two parts
to reduce the number of parameters in our mod-
els and limit model complexity. The first aim
was to examine the outcomes associated with
need satisfaction in PLHIV. Specifically, first,
we examined whether psychological need satis-
faction related to indicators of HRQOL and,
second, whether quality and quantity of sleep
would account for (i.e. mediate) the relation
between need satisfaction and the indicators of
HRQOL. We expected need satisfaction to
relate to higher physical and mental health
(Hypothesis 1). Furthermore, we expected need
satisfaction to relate to the two indicators of
HRQOL through higher quality and quantity of
sleep, although in line with Campbell et al.
(2015), we expected the relation with sleep
quantity to be less pronounced (Hypothesis 2).
The second aim was to examine the role of
mindfulness in predicting need satisfaction and
quality and quantity of sleep. Consistent with
Campbell et al. (2015), we expected mindful-
ness to be uniquely related to higher sleep qual-
ity (Hypothesis 3) through higher psychological
need satisfaction (Hypothesis 4).

Method

Participants and procedure

All participants were recruited during a routine
check-up by their physician at the AIDS
Reference Centre within the Department of
General Internal Medicine at Ghent University
Hospital. After registering interest in the study,
all participants were referred to a research assis-
tant who explained the purpose and require-
ments of the study in greater detail. Participants
were eligible for inclusion if they were HIV+,
older than 18 years of age, Dutch-speaking, and
had a CD4 T-lymphocyte count >250 cells/µL.
Individuals were excluded if they had children
under the age of 3 or were employed in shift
work, given their likely detrimental impact on
sleep. Signed informed consent was provided
by all participants and the study was approved
by Ghent University Hospital’s Ethical Review
Board.

Measures

Demographic and clinical variables. Age, gender,
level of education, nationality, marital status,
and employment status were reported by all participants. Clinical data (i.e. CD4+ cell count) was assessed as part of routine clinical care.

**Basic Psychological Need Satisfaction and Need Frustration Scale.** Satisfaction of the basic psychological needs for autonomy, competence, and relatedness was assessed using the Basic Psychological Need Satisfaction and Need Frustration Scale (BPNSNFS) (Chen et al., 2015). All participants rated whether they felt their needs for autonomy, competence, and relatedness were satisfied or frustrated over the past month on a scale of 1–5. The scale consists of 24 items, 8 items per need, 4 of which assess need satisfaction and 4 of which measure need frustration. Because the mean score of the 12 items assessing need satisfaction and the 12 items assessing need frustration showed similar relations with all study variables, yet in the opposite direction, we proceeded by using a composite score of need satisfaction in all subsequent analyses. This was done by reverse scoring the 12 items assessing need frustration and then creating three separate need scores by averaging the eight items assessing autonomy ($\alpha = .87$), competence ($\alpha = .84$), and relatedness ($\alpha = .84$). Next, consistent with previous research, a composite score of need satisfaction ($\alpha = .93$) was created by averaging the sum of the three need variables (Campbell et al., 2015; Deci et al., 2001).

**Medical Outcomes Study 36-Item Short Form Health Survey.** Physical and mental health was assessed using the Medical Outcomes Study 36-Item Short Form (MOS SF-36) (Ware and Sherbourne, 1992), which taps into eight different health domains. A global score for physical health was created by averaging the scores on physical functioning, role limitations due to physical health, bodily pain, and general health, whereas a global score for mental health was created by averaging the scores on role limitations due to emotional problems, emotional well-being, social functioning, and energy/fatigue. Higher global scores represent better physical/mental health status.

**Pittsburgh Sleep Quality Index.** The Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) was used to assess quality and quantity of sleep over the past month. The PSQI consists of 19 items which generate seven component scores: poor subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of hypnotics, and daytime dysfunction. However, because our primary interest was in qualitative and quantitative indicators of sleep, the daytime dysfunction component was omitted from subsequent analyses. Because higher scores on the PSQI components are indicative of poorer sleep, the sleep duration and habitual sleep efficiency components were reverse coded such that higher scores represented a higher amount of the labeled construct.

**Mindfulness Attention Awareness Scale.** Dispositional mindfulness was assessed using the Mindfulness Attention Awareness Scale (MAAS) (Brown and Ryan, 2003). The scale consists of 15 items which were rated on a scale of 1–6. The MAAS had good reliability ($\alpha = .93$).

**Statistical analyses**

The two research aims were examined by testing path models (with manifest variables) using Mplus7 with maximum-likelihood as estimator. Model fit was assessed using the $\chi^2$ 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 $\chi^2$/degrees of freedom (df) ratio of 2 or below, CFI values of .90 or above, and SRMR and RMSEA values of around .08 or below (Hu and Bentler, 1999; Kline, 2005). Patient characteristics (i.e. age, gender, CD4 count, and employment status) were controlled for in all models.

We began by testing Hypotheses 1 and 2, thereby examining the outcomes associated with need satisfaction. In the first model, we examined the relation between need satisfaction and physical/mental health (Hypothesis 1) and in a second model we investigated the intervening...
role of quality and quantity of sleep in these associations (Hypothesis 2). Next, we proceeded to test Hypotheses 3 and 4, thereby examining the role of mindfulness in predicting need satisfaction and the sleep outcomes. Specifically, we tested a third model in which we examined the relation between mindfulness and quality and quantity of sleep (Hypothesis 3), and a fourth model in which we examined the intervening role of need satisfaction in these relations (Hypothesis 4). To test for mediation (i.e. Hypotheses 2 and 4), we followed Holmbeck’s (1997) recommendations by testing (a) a direct effect model by adding paths between the independent variable and the dependent variable (i.e. Hypotheses 1 and 3), (b) a full mediation model by only including indirect paths via the mediator, and (c) a partial mediation model by adding the direct paths between the independent variable and the dependent variable back in. Full mediation is demonstrated when the addition of direct paths in model three does not lead to an improved fit compared to the second model.

In line with previous research (Campbell et al., 2015; Deci et al., 2001) when testing the role of need satisfaction, we used a composite score of need satisfaction by averaging the mean score of the three needs. Furthermore, also consistent with Campbell et al. (2015), a composite score was created for poor sleep quality, by computing the mean of the sleep quality, sleep disturbances, sleep latency, and use of sleep medication component scores from the PSQI, and for sleep quantity by computing the mean of the sleep duration and habitual sleep efficiency components from the PSQI.

Results

Preliminary analyses

Participants. A total of 144 patients met the inclusion criteria and agreed to participate. In total, 101 participants completed the questionnaire, resulting in a response rate of 70.14%. All participants were of Belgian nationality, 84% were male and 67.4% were homosexual. The average age of the sample was 45.48 years (ranging from 21 to 75 years; SD = 12.75). In total, 70% were employed and 46% had completed a form of higher level education. A total of 40% were single, 31% married, 2% widowed, and 4% divorced. Mean time since HIV diagnosis was 10.94 years, ranging from 2 to 33 years. The mean CD4 count of the sample was 640.25 (ranging from 271 to 1830; SD = 262.75).

Correlations. The means, SDs, and correlations between all the study variables are available in the supplementary file available at: http://hpq.sagepub.com/. The subscales for autonomy, competence, and relatedness were highly correlated and showed similar relations with mindfulness and the sleep and HRQOL outcomes.

Patient characteristics. The relation between the participants’ background characteristics and the outcomes was examined using a multivariate analysis of covariance (MANCOVA) with employment status and gender as fixed factors, age and CD4 T-lymphocyte count as covariates, and the sleep and HRQOL outcomes as dependent variables. Neither gender, $F(8,38) = .65, ns$, employment status, $F(8,38) = .44, ns$, age, $F(8,38) = 1.45, ns$, or CD4 T-lymphocyte count, $F(8,38) = .42, ns$, yielded a significant multivariate effect.

Primary analyses

Hypothesis 1: Examining the need satisfaction—HRQOL relation. First, a direct effect model was tested by allowing paths from the need satisfaction composite to global physical and mental health. The two HRQOL indicators were allowed to correlate. Need satisfaction related positively to both global physical ($\beta = .27, p < .01$) and mental health ($\beta = .54, p < .001$). Given that this model was fully saturated, the model fit was perfect.

Hypothesis 2: Examining the intervening role of quality and quantity of sleep. Next, we tested a full mediation model by introducing poor sleep quality and sleep quantity as intervening variables between the need satisfaction composite and the two
HRQOL outcomes. This model had the following fit: $\chi^2/df=2.49$, CFI=.87, RMSEA=.13, SRMR=.07. Next, a partial mediation model was tested by adding direct paths between the need composite and the two outcomes. Although the relation between the need composite and global physical health was fully accounted for by quality of sleep, the need composite continued to yield a direct positive association with global mental health, which led to a significantly improved fit, $\Delta\chi^2(1)=11.67, p<.001$. The fit of the final partial mediation model was $\chi^2/df=1.48$, CFI=.96, RMSEA=.07, SRMR=.06. This model is shown in Figure 1. The indirect association between the need composite and global physical (β=.23, p<.01; 95% CI [.12−.34]) and mental health (β=.20, p<.01; 95% CI [.10−.31]) via poor sleep quality was significant indicating that poor sleep quality fully mediated the relation with global physical health and partially mediated the relation with global mental health. In contrast, sleep quantity was unrelated to the need composite and global physical and mental health and thus failed to account for the association between need satisfaction and the two HRQOL outcomes.

Hypothesis 3: Examining the mindfulness—sleep relation. A direct effect model was tested by adding paths from mindfulness to poor sleep quality and sleep quantity, which were allowed to correlate. The results indicated that mindfulness related negatively to poor sleep quality (β=−.35, p<.01) but was unrelated to sleep quantity (β=.12, ns). This model was fully saturated and thus had a perfect model fit.

Hypothesis 4: Examining the intervening role of need satisfaction. Next, a full mediation model was tested by adding the need satisfaction composite as an intervening variable in the relation between mindfulness and the two sleep outcomes, resulting in the following fit: $\chi^2/df=1.49$, CFI=.97, RMSEA=.07, SRMR=.05. Results from this model indicated that mindfulness related positively to the need composite and that the need composite, in turn, was negatively related to poor sleep quality and unrelated to sleep quantity. We then tested a partial mediation model by adding direct paths between mindfulness and the two sleep outcomes. The fit of the partial mediation model was not significantly better than the full mediation model, $\Delta\chi^2(2)=.69, ns$, indicating that the association between mindfulness and poor sleep quality was fully mediated by need satisfaction. This indirect association was significant (β=−.31, p<.001; 95% CI [−.41−.21]). The final model is shown in Figure 2.

Figure 1. Need satisfaction predicting physical and mental health via quality and quantity of sleep. *p <.05, **p <.01, ***p <.001.
Discussion

Although previous work grounded in SDT (Deci and Ryan, 2000; Vansteenkiste and Ryan, 2013) has focused on the role of need satisfaction in sleep (Campbell et al., 2015) and on psychological well-being among PLHIV (Igreja et al., 2000), to the best of our knowledge, this cross-sectional study is the first to combine these two foci. That is, we examined the relation between the satisfaction of the psychological needs for autonomy, competence, and relatedness and PLHIV’s HRQOL via their sleep. In addition, we investigated the role of mindfulness in contributing to the satisfaction of these basic psychological needs. Findings confirmed our hypotheses. Specifically, PLHIV who experienced higher need satisfaction also reported higher HRQOL which was largely explained through a negative relation with poor sleep quality. The findings further suggest that mindfulness facilitated higher psychological need satisfaction, which in turn contributed to better sleep quality. To the best of our knowledge, this study is the first to demonstrate such associations in PLHIV.

The finding that psychological need satisfaction relates to higher physical and mental health is consistent with previous research in non-clinical populations which showed need satisfaction to relate positively to indicators of well-being (Deci and Ryan, 2000) and testifies to the universal character of these needs by extending previous findings to PLHIV. Although previous studies examining the relation between psychological needs and well-being have tended to focus more exclusively on the relation with psychological well-being, the number of studies demonstrating relations with indicators of physical health is steadily increasing (e.g. Di Domenico and Fournier, 2014; Gonzalez et al., 2016; Ryan et al., 2010). The present results add to this body of work by providing further evidence that the benefits of psychological need satisfaction also extend to physical health, this time among PLHIV. Furthermore, given that we controlled for CD4+ cell count in all of the models tested, the present results indicate that need satisfaction related to higher perceived physical health over and above an objective marker of health status. This finding is especially relevant for PLHIV given that their physical health, in particular, is compromised.

Interestingly, poor sleep quality, rather than sleep quantity, was uniquely associated with lower need satisfaction and lower mental and physical health and further accounted for the association between psychological need satisfaction and the two indicators of HRQOL. This finding is consistent with a previous study of university students which found sleep quality to be more strongly related to measures of physical and psychological health than sleep quantity (Pilcher et al., 1997). The current sleep quality component is a multifaceted construct that includes sleep latency, number of nocturnal awakenings, use of sleep medication, as well as subjective appraisals of the quality of sleep. Thus, while sleep quantity simply constitutes total time asleep, sleep quality is more an indication of uninterrupted sleep that likely allows the individual to go through the various sleep stages that restore emotional and physical health.
However, it should be noted that while poor sleep quality completely accounted for the relation between need satisfaction and physical health, it only partially accounted for the relation with mental health suggesting that sleep quality is only one pathway through which need satisfaction contributes to mental health and that other explanatory mechanisms should be considered. One other potential pathway is through the use of more adaptive emotion regulation styles such as emotional integration which is characterized by an openness to experiencing and exploring emotions (Roth et al., 2014). Indeed, one previous study indicated that maternal support for their adolescent child’s need for autonomy predicted increases in adolescent self-esteem through increases in emotional integration 1 year later (Brenning et al., 2015). However, more research is needed to explore emotion regulation styles as intervening processes in the relation between need satisfaction and a broader range of mental health outcomes.

The second global aim of this study was to examine the role of mindfulness. Consistent with past work in a non-clinical sample (Campbell et al., 2015), a more mindful approach was related positively to psychological need satisfaction which, in turn, facilitated better sleep quality. Together, the present results imply that one way caregivers can help to improve the HRQOL of PLHIV is by helping them to cultivate mindfulness. This in turn is likely to aid their awareness of and receptivity to cues for psychological need satisfaction thereby also enabling better sleep quality. Encouragingly, there is evidence that mindfulness can be improved with meditation practice as evidenced by significant increases in dispositional mindfulness following mindfulness-based stress reduction (MBSR) interventions (e.g. Creswell et al., 2012). Moreover, previous studies examining the efficacy of MBSR interventions with PLHIV found participants to display improvements in both physical and psychological well-being post-intervention (Creswell et al., 2009; Gayner et al., 2012; Seyed Alinaghi et al., 2012). However, these studies did not consistently assess changes in mindfulness following the interventions; thus, the underlying mechanisms accounting for these changes remain unclear. Indeed, the present results suggest that in addition to increasing mindfulness, MBSR may improve health outcomes through facilitating need satisfaction and better quality sleep.

This study has a number of limitations. First, this study is cross sectional, which prevents us from drawing any causal conclusions. For example, poor sleep quality may not only contribute to but may also stem from poor physical and mental health. Future experimental or longitudinal research is needed to address this issue. Second, all of our primary measures were based on self-reports which can inflate the observed associations due to shared method variance. Future studies could overcome this problem by using objective sleep measures such as polysomnography and actigraphy. Finally, our sample size was limited which prevented us from testing an integrative model with all of the assessed study variables. Furthermore, our sample was fairly homogeneous (e.g. predominantly male and Caucasian). Future research is needed to examine the generalizability of the present findings to the larger spectrum of PLHIV.

In sum, this study underscores the role of basic psychological need satisfaction in determining the HRQOL of PLHIV. Specifically, the results indicate that HIV-positive individuals who feel volitional and effective in their behavior and close and connected to important others are likely to experience higher physical and mental health through better sleep quality. The results further suggest that dispositional mindfulness plays a role in facilitating need satisfaction and higher quality of sleep. Overall, the current findings provide initial evidence that healthcare professionals seeking to improve the HRQOL of PLHIV may focus on helping to develop a more mindful approach while also providing support for basic psychological needs.

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Notes
1. CD4+ cell count was not significantly related to any of the assessed variables. One potential explanation for this null relation was that there was little variation in the objective health condition of the studied sample. The majority of the sample was under stable antiretroviral therapy, had full virologic suppression and stable recovered cellular immunity. Thus, their physical health status was fairly stable.

2. We also tested an alternative model in which paths were added from need satisfaction to mental and physical health and from mental and physical health to poor sleep quality and sleep quantity. Results indicated that need satisfaction related positively to physical ($\beta = .31$, $p < .01$) and mental health ($\beta = .52$, $p < .001$) and that in turn, physical ($\beta = -.19$, $p < .05$) and mental health ($\beta = -.22$, $p < .05$) were negatively related to poor sleep quality but unrelated to sleep quantity. Furthermore, need satisfaction continued to yield a direct association with poor sleep quality ($\beta = -.40$, $p < .001$). However, comparison of the Akaike information criterion (AIC) fit indices indicated that the model testing need satisfaction predicting HRQOL via the sleep outcomes had a better fit (AIC = 1891.60) than the model testing need satisfaction predicting sleep via the HRQOL indicators (AIC = 2071.97).

References


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