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ORIGINAL PAPER

Self-Compassion, Other-Compassion, and Subjective Sleep Quality Indicators in a Clinical Population: An Experience Sampling Study

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Abstract

Objectives Higher compassion has been linked with greater subjective sleep quality indicators; however, within-person, longitudinal studies exploring this relationship are limited. We examined how self-compassion and other-compassion relate to subjective sleep quality indicators (sleep hours, sleep quality, and sleep recovery). Specifically, we analyzed the within-person link between compassion and sleep to assess both group-level nomothetic effects and the individual-level heterogeneity of these effects.

Method In total, 154 adult inpatients and outpatients experiencing chronic transdiagnostic disorders engaged in a 1-week study using experience sampling methodology (ESM). The ESM sampled self-compassion, other-compassion, sleep quality, and mood six times daily.

Results Self-compassion and other-compassion were positively correlated with subjective sleep quality indicators and mood in within- and between-person analyses. Sleep recovery was found to be the sleep indicator most strongly linked to compassion. Controlling for mood, within-person multilevel models revealed that higher daily average self-compassion predicted better sleep recovery the next day. Similarly, higher sleep recovery predicted greater self-compassion and other-compassion the next day. Multilevel model-based estimates of the within-person relationships between self-compassion and sleep recovery were found to be heterogeneous across the sample. Most of the sample, however, revealed a positive relationship between self-compassion and sleep recovery.

Conclusions These findings highlight the bidirectional relationship between self-compassion, other-compassion, and sleep recovery, and suggest that compassion-focused interventions may improve sleep recovery in clinical populations. This supports the soothing capacity of self-compassion and provides further evidence for the association of sleep with fundamental psychological processes like mood and compassion.

Preregistration This study was not preregistered.

Keywords Transdiagnostic disorders · Self-compassion · Other-compassion · Sleep quality · Longitudinal · Within-person · Experience sampling methodology · Ecological momentary assessment

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Sleep is universally regarded as an essential biological need. At least 60% of Western adults currently experience self-rated poor sleep quality at least three to four times per week (Reynolds et al., 2019). Poor sleep quality contributes to the onset, recurrence, and maintenance of most mental health difficulties (Atwood, 2022), and current evidence suggests that treating sleep disturbances reduces psychopathology, including depression, anxiety, stress, and psychosis symptoms (Scott et al., 2021). A better understanding of psychological constructs which may serve as mechanisms of action to promote better sleep patterns will likely lead to more targeted and effective intervention (Block et al., 2020). One such mechanism, compassion, refers to a sensitivity toward noticing suffering in self or others, combined with motivated action to alleviate this stress (Gilbert, 2014). Self-compassion has been identified as a modifiable psychological construct related to improved sleep quality (Brown et al., 2021; Butz & Stahlberg, 2018); however, compassion for others (termed other-compassion) has not yet been explored in relation to sleep quality. Current literature suggests that compassion for others and the self may impact several subjective indicators of sleep quality through the regulation of psychological and physical arousal (Kalmbach et al., 2020; Kim et al., 2020). Therefore, we longitudinally investigated how self-compassion, other-compassion, and subjective sleep quality indicators are associated in an adult sample experiencing transdiagnostic psychological disorders. Specifically, we assessed these relationships using a daily diary methodology to explore individual differences and the bidirectionality of relationships.

Sleep quality is an essential and complex health behavior which can be measured both objectively (e.g., number of hours asleep as measured by a useable device) and subjectively (e.g., perceived sleep recovery or perceived sleep quality; Nelson et al., 2022). An evolutionary concept analysis approach defines sleep quality as "an individual's self-satisfaction with all aspects of the sleep experience" (p. 1, Nelson et al., 2022). The subjective aspects of sleep quality involve the perceived recovery after sleep: essentially, how a person feels after waking and their daytime fatigue. The objective aspects, including total sleep time, arousals, sleep onset latency, and sleep efficiency, are measured using polysomnography and actigraphy.

Research has established that there is a robust, bidirectional relationship between mental and physical health indicators and subjective sleep quality (Brown et al., 2021). Individuals who experience inadequate subjective sleep quality experience a host of physiological, psychological, and cognitive consequences (Metse et al., 2023). Furthermore, subjective sleep quality is also affected by several physiological, cognitive, and psychological factors. For example, chronic pain, perceived stress, depression, anxiety, and self-criticism are significantly predictive of worse subjective sleep quality (Bar et al., 2020; Zaidel et al., 2021). Key prerequisites for sleep onset and sleep maintenance and, therefore, healthy subjective sleep quality are low physiological and psychological arousal (Kalmbach et al., 2020; Wuyts et al., 2012). High psychological and physiological arousal are key features of insomnia, as sleep onset and maintenance are facilitated by a dynamic interplay between the parasympathetic and sympathetic nervous systems (Gross & Borkovec, 1982; Porges, 2007). Subjective sleep quality is thus intrinsically linked to our psychological health; however, there is a need to better understand *modifiable* psychological factors that can be effectively targeted to improve subjective sleep quality indicators. One construct that has received increasing attention with regard to sleep quality is compassion.

As described in compassion-focused therapy, compassion is defined as a kindness and deep awareness of the suffering of oneself and others, coupled with the wish and effort to relieve that suffering (Gilbert, 2009). The main pillars of compassion —including the awareness of suffering and the attempt to relieve it —have robust therapeutic elements. Indeed, over the last two decades since the inception of compassion-focused therapy, literature has established that other-compassion (Klimecki et al., 2012) and self-compassion (MacBeth & Gumley, 2012) are linked to improved physical and mental well-being indices (Ferrari et al., 2019; Hofman & Sirois, 2017; Kirby et al., 2017; Millard et al., 2023; Neff & Germer, 2017; Phillips & Hine, 2021). A positive, moderate relationship between self-compassion and subjective sleep quality has been established in the literature (Brown et al., 2021; Butz & Stahlberg, 2018); however, the relationship with other-compassion remains overlooked.

Drawing from an evolutionary perspective, compassion-focused therapy theorizes that compassion is a capacity that evolved to maintain survival through social interaction (Gilbert, 2014). Compassion for others is theorized to regulate one's negative affect and distress through the increase of soothing, caring behaviors (Leaviss & Uttley, 2015). Relatedly, self-compassion is theorized to be a result of the development of human higher-order cognitive abilities such as self-awareness and imagination, which allows for intrapersonal relating, and therefore self-soothing, in the absence of others (Gilbert, 2014). The soothing nature of self- and other-compassion is key to understanding how compassion promotes well-being. On a psychological level, compassion is theorized to be an adaptive emotion regulation strategy that ameliorates negative and enhances positive emotional states. On a physiological level, compassion calms the sympathetic nervous system by activating the soothing (parasympathetic nervous) system (Gilbert, 2014; Porges, 2007; Steffen et al., 2021).

Meta-analyses on the relationship between self-compassion and subjective sleep quality indicators suggest that there is a significant, positive, and medium correlation between

the two constructs (Brown et al., 2021; Butz & Stahlberg, 2018). This conceptualization of compassion as an adaptive emotion regulation strategy that activates the parasympathetic nervous system provides the theoretical basis for understanding how compassion to the self and others is positively related to subjective sleep quality. Firstly, cognitive and physiological arousal (activation of the sympathetic nervous system) are related to increased sleep onset latency and decreased subjective sleep quality (Hassirim et al., 2019; Tang & Harvey, 2004; Wuyts et al., 2012; Zoccoli & Amici, 2020). Through regulating emotions, compassion is theorized to decrease physiological and psychological arousal before and during sleep. Relatedly, there is an abundance of literature demonstrating the bidirectional relationship between emotion regulation and subjective sleep quality indicators, where emotion regulation is associated with increased sleep quality, and poor sleep quality leads to worse emotion regulation (Vandekerckhove & Wang, 2017). Previous studies have established that increased compassion for the self and others is associated with an increased parasympathetic response, positive affect, and heart rate variability, and decreased negative affect (Kim et al., 2020; Matos et al., 2017). Taken together, it may be the case that increased compassion facilitates emotion regulation and parasympathetic response, which in turn facilitates better sleep quality.

Emerging research provides preliminary evidence for the positive impact of self-compassion and compassion-focused interventions on sleep quality. For example, in a randomized control trial conducted by Butz and Stahlberg (2018), college students who completed brief self-compassion tasks before bed reported significantly better sleep quality than the no-treatment control condition. Furthermore, a daily diary study by Hu et al. (2018) found that higher trait self-compassion in college students was related to lower levels of stress, which in turn predicted better sleep outcomes. In addition, higher self-compassion seemed to buffer the effects of daily stressor experiences and preserve better sleep outcomes. It is important to note that neither study assessed self-compassion and sleep quality in a sample of adults experiencing a clinical mental health diagnosis, despite evidence that self-compassion levels and sleep quality levels were found to be lower in clinical samples than in non-clinical samples (Athanasakou et al., 2020; Fabbri et al., 2021).

The relationship between other-compassion and subjective sleep quality indicators has not yet been directly assessed. Based on the theory underlying compassion-focused therapy, however, it is theorized that compassion towards others regulates emotions in the self and activates the parasympathetic nervous system, thus positively impacting subjective sleep quality indicators (Gilbert, 2014). Related research provides preliminary support for this hypothesis, as the positive impact of compassionate acts toward others on well-being has been established (Klimecki et al., 2012; MacBeth & Gumley, 2012). Furthermore, a recent study investigating the impact of poor sleep quality on prosocial behaviors and isolation found that poor sleep quality decreased prosocial behaviors and increased isolation tendencies (Palmer et al., 2023), thus demonstrating related evidence that the constructs may be positively associated.

Most research on the relationship between compassion and subjective sleep quality indicators is from a between-person, nomothetic approach. Recent research indicates that there is indeed substantial heterogeneity in the impact of self-compassion and other-compassion on well-being outcomes: for some, the impact is positive, for some, negative, and for some, they are unrelated (Sahdra et al., 2023). These findings provide impetus to explore the heterogeneity of the relationships between self-compassion, other-compassion, and subjective sleep quality indicators.

This study employed both nomothetic and idiographic approaches to enhance our understanding of these constructs. Nomothetic approaches seek to identify general laws or principles that apply across groups of individuals. This perspective allows for comparisons and generalizations about the relationships between compassion and subjective sleep quality indicators across a population. In contrast, idiographic approaches focus on the unique experiences and individual differences within a sample (Hayes, et al., 2022). This perspective emphasizes the importance of understanding how these relationships may vary from person to person, acknowledging the complexity of human behavior. Idionomic approaches combine elements of both idiographic and nomothetic perspectives, aiming to integrate findings from individual cases with broader trends. This approach facilitates a more nuanced understanding of how compassion and subjective sleep quality indicators interact at both the individual and group levels.

Experience sampling methodology (ESM) provides rich, within-person data to establish day-to-day changes in constructs and within- and between-person variability. Furthermore, rigorous tests of temporal directionality of sleep and compassion relationships are limited, and ESM data allows us to explore bidirectional links systematically. Specifically, the ESM data enables the examination of relationships between self-compassion, other-compassion, and sleep across individuals (between-person) and within individuals over time (within-person). The nomothetic approach uses between-person analyses to assess how average levels of self-compassion and other-compassion relate to sleep recovery across different individuals, allowing for comparisons between people. In contrast, the idiographic approach uses within-person analyses to focus on variations within a single individual over time, exploring day-to-day fluctuations in self-compassion, other-compassion, and sleep recovery, helping to identify how changes in these variables

for a specific individual influence one another. The between-person approach allows us to identify general trends and relationships applicable to the clinical population studied. At the same time, the within-person analysis provides insight into the dynamic interplay of these constructs on a daily basis. In addition, mood is an important variable that has been shown to covary with both compassion and subjective sleep quality indicators (Parsons et al., 2022; Triantafillou et al., 2019). Therefore, in the present study, we chose to control for mood in the data analyses, to examine if compassion offered explanatory power over and above mood.

Given that self-compassion and other-compassion are theorized to be significantly positively correlated with subjective sleep quality indicators, the present study aimed to assess these relationships using EMA longitudinal data in a clinical sample. Our hypotheses were as follows: first, we hypothesized that patients who reported higher self-compassion, higher other-compassion, and higher mood would report higher sleep quality indicators (sleep quality, sleep hours, and sleep recovery). Specifically, we hypothesized that sleep quality and sleep recovery will be more strongly correlated with compassion than sleep hours. Secondly, we hypothesized that these relationships would arise at both the within- and between-person levels. Turning to within-person hypotheses, thirdly, we hypothesized that patients who reported greater daily average self-compassion and other-compassion would report higher subjective sleep quality indicators that night. Fourthly, we hypothesized that patients who reported higher subjective sleep quality indicators would report higher self-compassion and other-compassion the next day. Finally, we hypothesized that the strength of associations between self-compassion, other-compassion, and subjective sleep quality indicators differs from person to person, that is, any within-person effects established would be stronger for some individuals than others.

Method

Participants

This study was conducted as a secondary analysis of data from the Choose Change effectiveness trial (see Gloster et al., 2023; Villanueva et al., 2019). The larger trial was a longitudinal adult inpatient and outpatient research project that measured several variables including subjective sleep quality indicators, self-compassion, other-compassion, and mood.

Sleep and self-compassion data were collected from 154 adult inpatients (47%) and outpatients (53%). The age of participants ranged from 18 to 64 years, and the mean age of participants was 35.41 years ($SD = 11.42$). In the sample, 53% of participants identified as female. Inclusion criteria included minimum 18 years of age, ability to speak German sufficiently, present for therapy and able to attend sessions, and previous treatment (i.e., ≥ 20 sessions of empirically supported psychotherapy and/or minimum dosage and length of an approved drug as recommended by international guidelines). Exclusion criteria included acute suicidal intent, acute substance dependency (where the primary treatment goal is detoxification), active mania, previous experience with Acceptance and Commitment Therapy, and inability to read or complete assessments. These inclusion and exclusion criteria pertain to the primary study from which the data for the current analysis were drawn, specifically the "Choose Change" effectiveness trial. For further detail about the participants, see Gloster et al. (2023) and Villanueva et al. (2019).

Procedure

The current study conducted a secondary analysis of a de-identified existing dataset. The original Choose Change study (Gloster et al., 2023; Villanueva et al., 2019) was registered with the ISRCTN (ISRCTN11209732) and approved by the Ethics Committee of northwestern and central Switzerland (Ethikkommission Nordwest- und Zentralschweiz; EKNZ: Project 165/13). The original dataset has also been analyzed in related publications (Block, et al., 2020). Informed consent was obtained from all study participants in written form after participants read written study information materials and had the opportunity to clarify any questions. Following intake and informed consent procedures, patients engaged in a 1-week fixed sampling schedule using a study-issued smartphone and answered questions regarding their mood, cognitions, and behaviors. Participants were assessed every 3 hr (therefore six times per day) for 7 days on their self-compassion, other-compassion, and mood. Upon waking each morning, participants were assessed on the number of hours slept (*sleep hours*), subjective sleep quality (*sleep quality*), and subjective wakefulness (*sleep recovery*). Additional measures were included in the original study, which are reported elsewhere (Gloster et al., 2023).

Measures

As the present study utilized a fixed experience sampling schedule, measures were chosen that best fit the ESM design. ESM questionnaires target momentary experience and thus serve a different goal to traditional cross-sectional, retrospective questionnaires (Myin-Germeys et al., 2018). Each item or cluster of items should reliably measure a target construct at a moment in time and be sensitive to changes within a day; for example, "Right now, I am feeling tired." Overall, completing an ESM questionnaire should not take

more than 2 min, and therefore brevity of items is crucial (Myin-Germeys et al., 2018).

State Self-Compassion and Other-Compassion

The ESM self- and other-compassion items were worded as follows: "Since the last prompt… I looked at myself with tolerance, goodwill, and care" and "I looked at others with tolerance, goodwill, and care," respectively. Participants responded to the items using a slider ranging from 0 (*not at all*) to 100 (*very much*). The reliability of each measure was estimated from intraclass correlation coefficient-2 or ICC(2) from a one-way analysis-of-variance model. This form of ICC in the context of an ESM study represents the reliability of within-person means and is different from ICC(1), which represents the amount of variance in the outcome variable that is due to differences between participants (Bliese, 2000). For self-compassion, the ICC(1) was 0.79 (95%CI 0.75, 0.84), suggesting that 79% of the variance in self-compassion was between-persons. Regarding the reliability of the measure, the ICC(2) was 0.96 (95% CI: 0.95, 0.97). For other-compassion, the ICC(1) was 0.69 (95%CI 0.63, 0.75) and the ICC(2) was 0.94 (95%CI 0.92, 0.95). Therefore, self-compassion and other-compassion measures had robust reliability.

Subjective Sleep Quality Indicator Measures

A recent review of the utility of subjective (i.e., self-reported) and objective (e.g., measured using polysomnography) sleep measures of overall sleep quality in psychosocial research concluded that self-report is a suitable methodology, since it is unclear which markers of objective sleep quality are most consistently accurate (Cudney et al., 2022; Kohyama, 2021). Kohyama (2021) argues that subjective sleep quality indicator measures (e.g., self-reported satisfaction and recovery) are more reliable indicators of healthy sleep than objectively measured duration of sleep, as literature suggests subjective sleep quality indicators are more robustly related to psychosocial outcomes than sleep quantity. Therefore, *subjective* measures are appropriate for assessing poor sleep quality in relation to well-being outcomes and were utilised in this study. Measures of subjective sleep quality and recovery are thus theorised to covary with compassion variables more strongly than sleep duration (Kohyama, 2021). A self-reported measure of sleep hours was included to clarify this hypothesis.

Participants' subjective sleep quality indicators of the previous night were measured the next morning using three separate items. *Sleep Hours* was evaluated using the item "How many hours did you sleep last night?" and answered numerically in hours. The ICC(1) was 0.59 (95%CI 0.52, 0.66), and the ICC(2) reliability estimate was 0.91 (95%CI 0.88, 0.93). Therefore, sleep hours demonstrated robust reliability.

Sleep Quality was evaluated using the item "How would you rate your sleep quality?" Participants responded using a slider ranging from 0 (*very bad*) to 100 (*very good*). The ICC(1) was 0.56 (95%CI 0.49, 0.63), and the ICC(2) reliability estimate was 0.90 (95%CI 0.87, 0.92). Therefore, sleep quality demonstrated robust reliability.

Sleep Recovery was evaluated using the item "How rested do you feel?" Participants responded using a slider ranging from 0 (*not rested at all*) to 100 (*very rested*). The ICC(1) was 0.63 (95%CI 0.56, 0.69) and the ICC(2) reliability estimate was 0.92 (95%CI 0.90, 0.94). Therefore, sleep recovery demonstrated robust reliability.

Mood Measure (Covariate)

Participants' current mood was evaluated using the item "How would you rate your current mood?" The response scale ranged from 0 (*very bad*) to 5 (*very good*). The ICC(1) was 0.63 (95%CI 0.57, 0.70), and the ICC(2) reliability estimate was 0.92 (95%CI 0.90, 0.94). Therefore, mood demonstrated robust reliability. Though a single mood item may not capture all nuances, this approach balances the need for brevity with collecting meaningful momentary data, and mood was included as a covariate in the current study.

Data Analyses

During data cleaning, sleep, compassion, and mood data were examined separately for missingness due to differing numbers of observations. There were 17% missingness in sleep data and 21% missingness in compassion/mood data, and missingness followed a monotone structure. Imputation was conducted using the CopyMean imputation method, which is specifically developed for addressing monotone missing values in longitudinal data (Genolini et al., 2016). Then, the imputed sleep data were merged with the imputed compassion/mood data to form the final dataset.

All analyses were conducted in R 4.2.2 (R Core Team, 2023). The NMLE package was used to model multilevel structure (Pinheiro et al., 2022). A control for autoregressive error structures was applied to all multilevel models. Preliminary analyses involved testing correlations between study variables to address the hypotheses regarding associations between compassion and sleep variables on a between-person level and a within-person level. Only significant within-person relationships were candidates for further within-person analysis. Given that ESM data adhere to a multilevel structure (repeated assessments nested within days, nested within participants), multilevel models are the typical choice for analysis. Mixed-effects models extend the standard regression model by allowing for the inclusion of

additional "random effects," which can be used to account for person-level differences in the model coefficients (intercepts and slopes) and to disaggregate between- and within-person relationships. We tested multilevel models examining the within-person, longitudinal relationships, and their heterogeneity (i.e., individual differences in the strength and direction of effects).

To test the longitudinal impact of daily average self-compassion and other-compassion on sleep recovery that night, we ran a random intercepts regression (Model 1) predicting sleep recovery. At Level 1, we modeled the within-person variation in the outcome variable (e.g., sleep recovery) as a function of daily predictors (e.g., self-compassion, other-compassion, mood) and a residual term. At Level 2, we modeled the between-person variation in the intercepts and slopes as a function of random effects. The general equations used in the analyses can be reviewed in the Online Resource.

There is ongoing debate about whether to use grand-mean or person-mean centering in longitudinal analyses (Lüdtke & Robitzsch, 2021). Both methods are valuable but serve distinct purposes and address different types of research questions. Grand-mean centering provides estimates of between-person effects by subtracting the sample average from each observation. This approach answers questions like: Do individuals who are generally more self-compassionate tend to sleep better than those who are less so? It reflects stable, trait-like differences between individuals, and is particularly useful when we are interested in how enduring individual differences relate to key outcomes.

In contrast, person-mean centering subtracts each individual's average from their observations, isolating within-person variability. This allows researchers to ask questions, such as the following: When a person reports more self-compassion than usual, do they also experience better sleep than usual? The focus here is on dynamic, moment-to-moment processes, often seen as more sensitive to interventions and changes over time. However, recent critiques (e.g., Lüdtke & Robitzsch, 2021) have questioned the causal interpretability and practical relevance of the person-centered focus. While the model does capture within-person effects, these reflect temporary deviations around an individual's mean, not changes from a fixed baseline or intervention-induced shifts. This may make the model less useful for causal inference if the research question is about altering a person's overall level of a construct (e.g., increasing self-compassion through an intervention).

Given the complementary value of these approaches, we chose to conduct and report both forms of analysis in our multilevel modelling.

Results

Preliminary Analyses

Means and standard deviations of study variables for the 154 participants are presented in Table 1. The mean sleep hours were below the average adult sleep time (7.3 hr) reported in a meta-analysis by Youngstedt et al. (2016). Mean self-compassion was lower than mean other-compassion, which is consistent with previous findings. Table 1 also presents key *between-person* correlations. Averaging across time and participants, self-compassion shared a significant and large correlation with sleep recovery ($r = 0.52$) and a moderate correlation with sleep quality ($r = 0.47$), but was not significantly related to sleep hours ($r = 0.14$; Cohen, 1988). Other-compassion shared a small and significant correlation with sleep recovery ($r = 0.25$) and sleep quality ($r = 0.23$), but not sleep hours. Mood shared a significant, moderate ($r = 0.24$) to large ($r = 0.64$) correlation with all variables of interest.

Table 2 shows the average *within-person* correlations between each individual's daily average compassion and mood scores and that night's sleep scores. Self- and other-compassion revealed small, significant correlations with sleep recovery ($rsc = 0.11$, $roc = 0.10$) but not sleep hours or sleep quality (Cohen, 1988). Both flows of compassion revealed a moderate correlation with mood ($rsc = 0.45$, $roc = 0.36$).

Table 1 Descriptive statistics and correlations for between-person study variables

Variable	*M*	*SD*	1	2	3	4	5
1 Self-compassion	58.30	22.50	1				
2 Other-compassion	76.23	17.28	0.31*	1			
3 Sleep recovery	50.29	21.95	0.52*	0.25*	1		
4 Sleep quality	57.40	22.06	0.47*	0.23*	0.64*	1	
5 Sleep hours	6.86	1.47	0.14	0.11	0.30*	0.62*	1
6 Mood	3.12	0.45	0.64*	0.44*	0.45*	0.58*	0.24*

M and *SD* represent mean and standard deviation, respectively

*$p < 0.01$

Table 2 Correlations for daily, within-person averages of study variables

Variable	1	2	3	4	5
1 Self-compassion	--				
2 Other-compassion	0.35*	--			
3 Sleep recovery	0.11*	0.10*	--		
4 Sleep quality	0.07	0.05	0.57*	--	
5 Sleep hours	−0.01	−0.04	0.34*	0.45*	--
6 Mood	0.45*	0.36*	0.08	0.01	0.02

*$p < 0.01$

Multilevel Modeling: Grand Mean Centered

The following linear mixed-effects models tested the longitudinal, within-person hypotheses that daily average self-compassion and other-compassion predict sleep quality indicators that night. Given that at an individual level, sleep recovery is the only sleep variable significantly associated with self- and other-compassion, the following multilevel models only included sleep recovery.

Models 1 and 2: Compassion Predicting Sleep Recovery

Model 1 is a random intercept model that tests the hypothesis that self-compassion and other-compassion predict sleep recovery that night. Self-compassion and sleep recovery lag were the only significant predictors of sleep recovery that night, so self-compassion (and not other-compassion) was allowed to vary in the random effects model (Model 2). Table 3 presents the regression results of Model 2 and the goodness of fit measures comparing Model 1 to Model 2. Model 2 yielded a significantly better fit, and the variability of the self-compassion beta coefficient is presented in Fig. 1.

Models 3 and 4: Sleep Recovery Predicting Self-Compassion

Model 3 is a random intercept model that tests the hypothesis that sleep recovery predicts daily average self-compassion the next day. The results are presented in Table 4. Sleep recovery, but not sleep hours, sleep quality, or mood, significantly predicted self-compassion the next day. As a result, sleep recovery was allowed to vary in the random effects model (Model 4). Table 4 also presents the goodness of fit measures comparing Models 3 and 4, which revealed that the random effects model did not yield a better fit.

Models 5 and 6: Sleep Recovery Predicting Other-Compassion

Model 5 is a random intercept model that tested the hypothesis that sleep recovery predicts other-compassion the next day. Sleep recovery, but not sleep hours, sleep quality, or current mood, significantly predicted other-compassion the next day, and so sleep recovery was the only coefficient allowed to vary in the random effects model (Model 6). Table 5 presents the regression results of Model 6 and the goodness of fit measures comparing Models 5 and 6. Model 6 yielded a significantly better fit, and the variability of the sleep recovery beta coefficient is presented in Fig. 2.

Multilevel Modeling: Person-Centered Analysis

This analysis focused on the extent to which self-compassion and sleep fluctuations around an individual's mean predicted future sleep and self-compassion, respectively. The first antecedent model yielded no significant results, with both self-compassion ($b = 0.07, SE = 0.05, t(725) = 1.3, p = 0.147$) and other-compassion ($b = 0.07, SE = 0.04, t(725) = 1.64, p = 0.083,$) failing to predict sleep recovery in the random slope model.

Table 3 Predicting sleep recovery as a function of self-compassion, other-compassion, mood, and sleep recovery lag (linear mixed effects model)

Sleep recovery					
	β	*SE*	*t*		*p*
Self-compassion	0.18**	0.05	3.62		< 0.001
Other-compassion	0.04	0.04	0.96		0.33
Mood	0.08*	0.04	2.15		0.03
Sleep recovery lag	0.12**	0.03	4.02		< 0.001
MLM goodness of fit and heterogeneity test statistics					
Model	*df*	*AIC*	*BIC*	*Log1IKE*	*LRatio test*
Model 1: Random intercepts	7	1900.01	1933.22	−943.00	N/A
Model 2: Random intercept and random slopes (self-compassion has different effects)	9	1896.36	1939.07	−939.18*	7.65

*$p < 0.05$; **$p < 0.001$

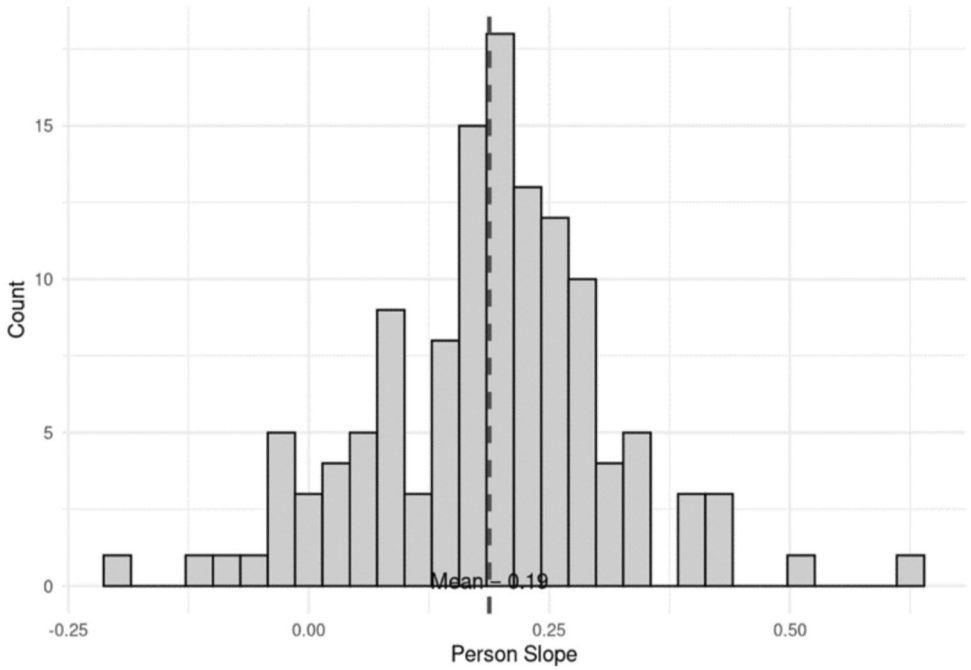

Fig. 1 Histogram of variability in the within-person association of self-compassion and sleep recovery. Histogram depicting the variability in the within-person association of self-compassion and sleep recovery. The x-axis represents the range of self-compassion person-level scores, while the y-axis indicates the frequency of these scores across participants. The distribution illustrates the relationship between self-compassion and sleep recovery, highlighting the variability in slopes

Table 4 Predicting self-compassion as a function of sleep hours, sleep quality, sleep recovery, and mood lag (fixed effects model)

Self-compassion					
	β		*SE*	*t*	*p*
Sleep hours	−0.05		0.02	−1.85	0.064
Sleep quality	0.04		0.03	1.29	0.196
Sleep recovery	0.11**		0.03	3.52	< 0.001
Mood (day before)	0.02		0.02	0.69	0.489
MLM goodness of fit and heterogeneity test statistics					
Model	*df*	*AIC*	*BIC*	*Log1IKE*	*LRatio test*
Model 3: Random intercepts	7	1481.51	1514.60	−733.75	N/A
Model 4: Random intercepts and random slopes (sleep recovery has different effects)	9	1481.16	1523.71	−731.58	4.34

*$p < 0.05$; **$p < 0.01$

Table 5 Predicting other-compassion as a function of sleep hours, sleep quality, sleep recovery, and mood lag (linear mixed effects Model 6)

Other-compassion					
	β		*SE*	*t*	*p*
Sleep hours	−0.04		0.03	−1.29	0.197
Sleep quality	0.01		0.03	0.31	0.752
Sleep recovery	0.08*		0.04	2.09	0.036
Mood lag	−0.02		0.03	−0.77	0.439
MLM goodness of fit and heterogeneity test statistics					
Model	*df*	*AIC*	*BIC*	*Log1IKE*	*LRatio test*
Model 5: Random intercepts	7	1778.88	1811.97	−882.44	N/A
Model 6: Random intercepts and random slopes (sleep-recovery has different effects)	9	1766.83	1809.37	−874.41***	16.05

*$p < 0.05$; **$p < 0.01$

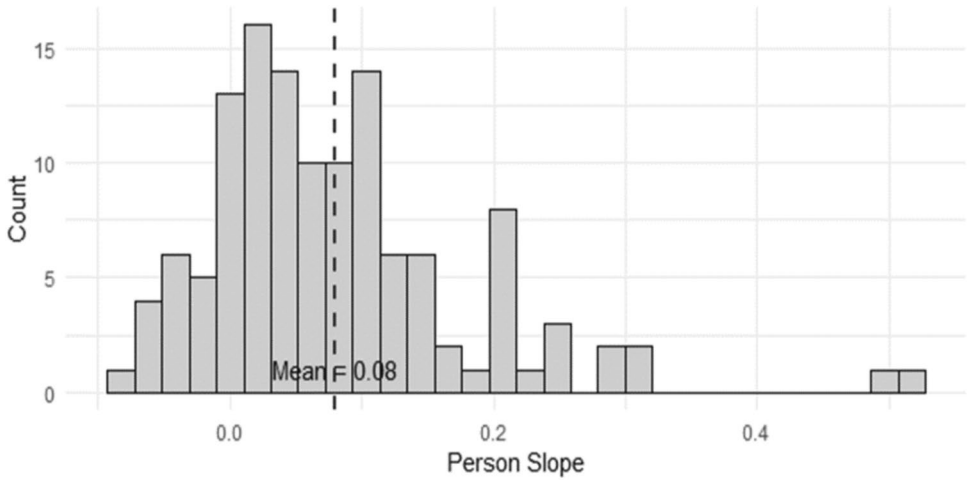

Fig. 2 Histogram of variability in the within-person association of sleep recovery and other-compassion. Histogram illustrating the variability in the within-person association of sleep recovery and other-compassion. The x-axis represents the range of sleep recovery person-level slopes, and the y-axis shows the frequency of these scores across participants. This distribution highlights the relationship between sleep recovery and other-compassion, emphasizing the heterogeneity of the individual-level estimates

However, the consequence model was significant. We found that the random slope model predicted better than the random intercept model (see bottom of Table 6). Further, sleep recovery was a reliable predictor of self-compassion. The heterogeneity of the effects is depicted in Fig. 3.

Discussion

The overall aim of this study was to investigate the bidirectional relationships between self-compassion, other-compassion, and subjective sleep quality indicators (sleep hours, sleep quality, and sleep recovery) in a clinical population. Consistent with the first hypothesis, between-person analyses revealed that self-compassion was strongly associated with sleep recovery and moderately associated with sleep quality. At the same time, other-compassion showed moderate associations with both sleep recovery and sleep quality. As predicted, sleep hours were not significantly associated with either flow of compassion. These findings align with prior research suggesting that subjective sleep quality indicator measures, such as sleep recovery, are more robustly linked to psychosocial variables than objective measures like sleep duration (Kohyama, 2021).

The stronger association between self-compassion and sleep recovery compared to other-compassion may reflect the unique role of self-compassion as an intrapersonal emotion regulation strategy that directly reduces psychological arousal and promotes relaxation (Gilbert, 2014). This finding extends previous research by demonstrating that self-compassion is particularly relevant to sleep recovery in clinical populations, where sleep disturbances are common (Athanasakou et al., 2020). These results suggest that interventions targeting self-compassion may be especially effective in improving sleep recovery in clinical settings.

We also hypothesized that the relationships between compassion and subjective sleep quality indicators would also emerge at the within-person level (Hypothesis 2). Our results partially supported this hypothesis. Within-person analyses revealed that daily fluctuations in self-compassion

Table 6 Predicting self-compassion as a function of sleep hours, sleep quality, sleep recovery, and mood lag (fixed effects model)

Self-compassion					
	β	*SE*	*t*	*p*	
Sleep hours	−0.01*	0.04	−1.97	0.049	
Sleep quality	0.05	0.04	1.11	0.27	
Sleep recovery	0.15*	0.05	3.08	0.002	
Mood (day before)	−0.01	0.04	−0.37	0.711	
MLM goodness of fit and heterogeneity test statistics					
Model	*df*	*AIC*	*BIC*	*Log1IKE*	*LRatio test*
Model 3: Random intercepts	7	2399.74	2432.83	−1192.87	N/A
Model 4: Random intercepts and random slopes (sleep recovery has different effects)	9	2393.93	2436.5	−1187.97	9.807

All data is person-centered

*$p < 0.05$; **$p < 0.01$

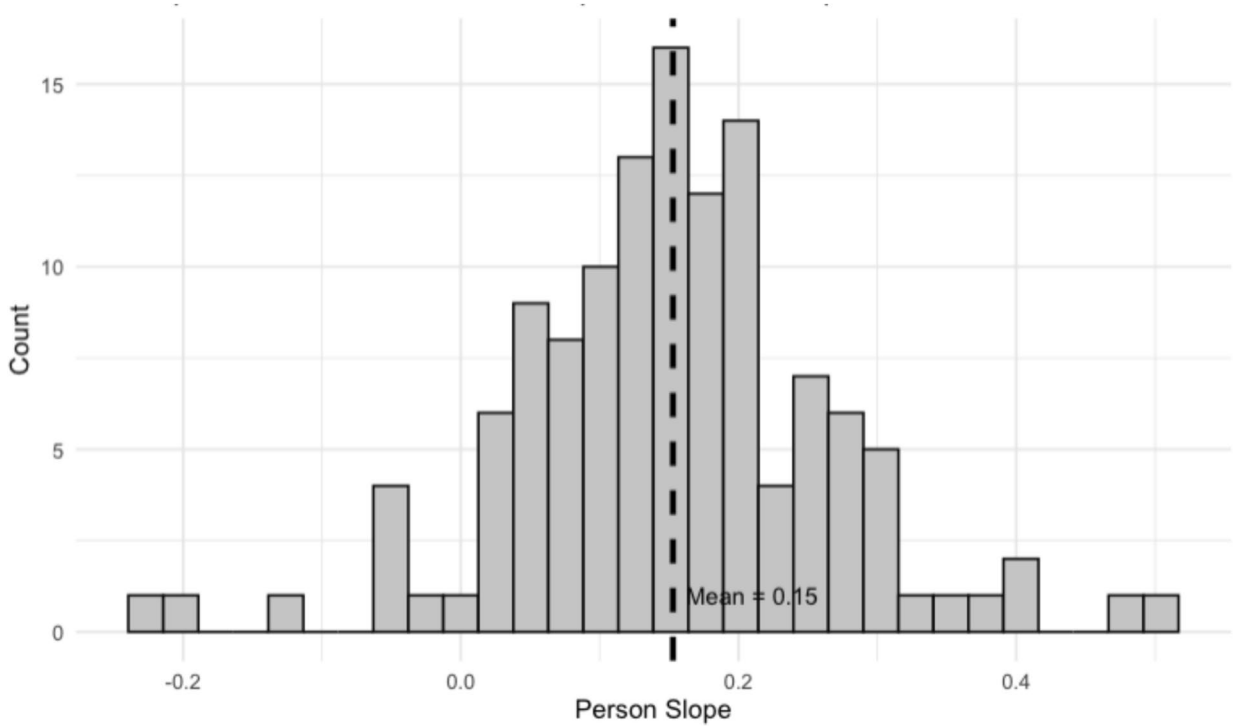

Fig. 3 Histogram of variability in the within-person association of sleep recovery and other-compassion: person-centered effects

and other-compassion were significantly associated with sleep recovery, but not with sleep quality or sleep hours. These within-person associations were small but significant, suggesting that day-to-day changes in compassion are meaningfully linked to how rested individuals feel after sleep.

The finding that sleep recovery, rather than sleep quality or sleep hours, was the only sleep indicator significantly associated with compassion at the within-person level highlights the importance of subjective recovery as a key aspect of the sleep experience. This aligns with prior research emphasizing the role of psychological and physiological arousal in sleep recovery (Kalmbach et al., 2020). These results suggest that interventions aimed at enhancing compassion may have immediate, albeit modest, effects on sleep recovery in daily life.

We hypothesized that higher daily average self-compassion and other-compassion would predict better sleep recovery that night (Hypothesis 3). Results were consistent with the hypothesis and suggested that patients who reported higher levels of self-compassion and other-compassion overall also tended to experience greater sleep recovery. This was true even after controlling for mood and the previous night's sleep recovery. However, other-compassion did not emerge as a significant predictor in these models. This finding suggests that self-compassion may play a more direct role in promoting sleep recovery than other-compassion, potentially due to its intrapersonal focus on self-soothing and reducing self-criticism (Gilbert, 2014; Neff, 2003).

Importantly, we observed significant heterogeneity in the within-person effects of self-compassion on sleep recovery, indicating that the strength and direction of this relationship varied across individuals. This finding aligns with recent research highlighting individual differences in the impact of self-compassion on well-being outcomes (Sahdra et al., 2023). Future research should explore the factors that contribute to this heterogeneity, such as baseline levels of self-compassion, personality traits, or the severity of sleep disturbances.

We hypothesized that higher sleep recovery would predict greater self-compassion and other-compassion the next day (Hypothesis 4). Consistent with this hypothesis, multilevel models revealed that sleep recovery significantly predicted both self-compassion and other-compassion, even after controlling for mood. These findings provide novel evidence for the bidirectional relationship between sleep recovery and compassion, suggesting that better sleep recovery enhances individuals' capacity to offer compassion to themselves and others.

This bidirectional relationship supports theoretical models proposing that compassion and sleep are linked through shared mechanisms of emotion regulation and

physiological arousal (Gilbert, 2014; Vandekerckhove & Wang, 2017). Specifically, better sleep recovery may enhance individuals' ability to regulate emotions and engage in compassionate behaviors, while higher compassion may reduce psychological arousal and promote restorative sleep. These findings contribute to the growing body of literature on the interplay between sleep and psychosocial processes, highlighting the potential for compassion-focused interventions to improve both sleep and emotional well-being.

Finally, we hypothesized that the strength of the associations between compassion and sleep recovery would vary across individuals (Hypothesis 5). Our results supported this hypothesis, revealing significant heterogeneity in the within-person effects of self-compassion on sleep recovery and, to a lesser extent, in the effects of sleep recovery on other-compassion. These findings suggest that while the overall pattern of results supports a positive relationship between compassion and sleep recovery, the strength of these effects is not uniform across individuals.

This heterogeneity underscores the importance of adopting personalized approaches to understanding and intervening in the relationships between compassion and sleep. For example, future research could use experience sampling methodology to identify individuals who are most likely to benefit from compassion-focused interventions for sleep disturbances. Such personalized approaches could enhance the effectiveness of interventions by tailoring them to the unique needs and characteristics of each individual.

Overall, our findings extend previous research by demonstrating bidirectional relationships between compassion and sleep recovery in a clinical population. These results highlight the importance of self-compassion as a key predictor of sleep recovery and suggest that interventions targeting self-compassion may have both immediate and long-term benefits for sleep and emotional well-being. Additionally, the observed heterogeneity in these relationships underscores the need for personalized approaches to intervention and research.

Overall, the novel findings indicate that both flows of compassion—especially self-compassion—are predictive of sleep recovery. More specifically, the findings extend previous research that suggests the potential benefits of compassion-focused therapy for improving subjective sleep quality indicators to a clinical population (Butz & Stahlberg, 2018). As preliminary research has established that compassion is amenable to change and that compassion-focused interventions facilitate better sleep quality, it is now important to further investigate these relationships using ESM. The depth of data available for each client in ESM research provides an ecologically valid tool for identifying clients best suited to a compassion-focused intervention for sleep quality. Finally, as greater sleep quality was demonstrated to lead to greater compassion the next day, clinicians are reminded of the impact of sleep on psychosocial outcomes like compassion.

Limitations and Future Directions

Although this study contributed to our understanding of flows of compassion and subjective sleep quality indicators in clinical populations, it has some limitations. First, all variables were self-reported by patients in this study. Subjective sleep quality indicators were chosen for theoretical reasons, making this an appropriate approach, but self-report measures are known to potentially introduce bias into results (Podsakoff et al., 2003). Future research should utilize objective sleep measures to explore if similar results are established. Secondly, our ESM data was available for 7 days. Ideally, additional data would provide increased statistical power and allow us to more accurately detect the true relationships and heterogeneity. Thirdly, although the present study provides evidence for the soothing nature of compassion and its effects on sleep quality, we did not directly test our "soothing" theory itself. Future research may use mediational analyses to assess the components of the model in this context (including measures of self-reported emotional experience and objective measures of physiological arousal).

Furthermore, ESM studies have inherent limitations due to the required brevity of measures used. Although this is a fundamental part of ESM design, and our single-item measures were found to be reliable, single-item measures of constructs are susceptible to the effects of misinterpretation. Moreover, the compassion items in this study were triple-barrelled, in that the client had to endorse all three adjectives or none when answering the item. This may have influenced the accuracy of the items in measuring their respective constructs. While the single-item measures of self-compassion and other-compassion used in this study were designed to capture the essence of these constructs, they may not fully reflect all facets of compassion, such as common humanity or mindfulness. Future research could benefit from using multi-item scales to provide a more comprehensive assessment of these constructs, particularly in studies where participant burden is less of a concern. Finally, the ESM items were not validated against established measures of compassion, mood, or sleep, and it cannot be assumed that the single items captured their respective constructs validly.

In summary, the results of the present study suggested bidirectional associations between compassion and subjective sleep quality indicators on within-person and between-person levels. This supported the soothing capacity of compassion and provided further evidence for sleep as being linked with fundamental psychological processes. Furthermore, this study lent support for the value of an ESM approach for psychological intervention research on sleep quality. By mapping out the heterogeneity in

compassion-sleep quality associations, we hope to encourage future research that explores why different patients respond differently to compassion, and which individuals will benefit from compassion the most. These questions may be addressed with similar longitudinal, within-person research that focuses on change at the level of the individual (Hayes et al., 2020).

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Author Contribution MIF responsible for conceptualization, investigation, methodology, project administration, resources, supervisor, and writing. ACE responsible for conceptualization, methodology, and writing. DA responsible for conceptualization and methodology. JC and BS responsible for conceptualization, formal analysis, investigation, methodology, supervision, validation, and writing. ATG responsible for data curation, investigation, resources, and writing.

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Data Availability De-identified data available upon reasonable request.

Declarations

Ethics Approval This study used an existing dataset collected as part of the larger Choose Change study (Gloster et al., 2023; Villanueva et al., 2019). The Choose Change study was registered with the ISRCTN (ISRCTN11209732) and approved by the Ethics Committee of northwestern and central Switzerland (Ethikkommission Nordwest- und Zentralschweiz; EKNZ: Project 165/13).

Informed Consent All participants provided informed consent.

Use of Artificial Intelligence AI was not used in this study nor manuscript.

Conflict of Interest The authors declare no competing interests.

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