

SLEEP QUALITY AND LIFE SATISFACTION IN SEVERELY DEPRESSED
INDIVIDUALS

By

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I. Abstract

Life satisfaction decreases as depression severity increases, but we wanted to explore how sleep quality factors into this relationship. Can higher sleep quality restore an individual's level of life satisfaction, especially in those who are severely depressed? To answer this question, we ran a regression of life satisfaction on sleep quality among individuals of minimal ($n=2178$), mild ($n=624$), moderate ($n=667$), and severe ($n=609$) depression, using data we collected during a 13-month online cross-sectional study on mental health (April 2020-April 2021). This yielded a separate regression analysis for each depression severity group, with the total score on the Satisfaction With Life Scale as the dependent variable, and responses to Item 6 on the Pittsburgh Sleep Quality Index (PSQI)—“During the past month, how would you rate your sleep quality overall?” ranging from “very bad” (coded as 1) to “very good” (coded as 4)—as the independent variable. Our findings showed a significant positive correlation between total SWLS score and PSQI sleep quality score in minimally, mildly, moderately, and severely depressed groups ($R_{\text{minimal}}=.187, p<.001$; $R_{\text{mild}}=.129, p=.001$; $R_{\text{moderate}}=.180, p<.001$; $R_{\text{severe}}=.438, p<.001$). However, the R square value was far larger in the severely depressed group than it was in all other groups ($R^2_{\text{adj/severe}}=.191$; versus $R^2_{\text{adj/minimal}}=.034$, $R^2_{\text{adj/mild}}=.015$, and $R^2_{\text{adj/moderate}}=.031$). These findings indicate that better sleep quality more strongly predicts higher life satisfaction in severely depressed individuals, compared to those who are not severely depressed. Thus, interventions that focus directly on improving sleep quality would likely be a meaningful approach to increase life satisfaction in severely depressed individuals.

II. Introduction

Life satisfaction benefits mental health and is linked to a range of life-enhancing behaviors. Regarding mental health, those who are more satisfied in life also demonstrate higher optimism (9, 24, 37), more positive affect (7, 21, 42), and experience lower levels of stress (20), loneliness, and aggression (6). Behaviorally, such individuals are more likely to seek social support and tackle their problems head-on by practicing problem-focused coping rather than avoiding their stressors entirely (16). Even from a functional perspective, life satisfaction is advantageous: in the workplace, those with greater life satisfaction report more fulfillment in their interactions with coworkers and also felt a greater commitment to their organization, and as a result, they were more likely to be innovative, committed to their work performance, and a team player (12). Taken altogether, these findings indicate that life satisfaction is an important contributor to mental health and interpersonal relations. Unfortunately, those with depression are less likely to experience it, as depression is associated with decreased life satisfaction. Prior studies have demonstrated negative correlation between the Satisfaction with Life Scale and the Beck Depression Inventory (35, 36).

Thus, it is critically important to explore ways to improve life satisfaction in those with depression. To address this need, we chose to analyze sleep quality as it affects life satisfaction. Getting high quality sleep can equip individuals with the physical and mental fortitude needed in their everyday lives and is thus correlated with higher life satisfaction (28, 31, 34, 40). However, while it is clear that sleep quality is associated with general satisfaction with life, it is not presently known whether the association is stronger in populations of various depression severities. Therefore, we examined the relationship between sleep quality and life satisfaction in individuals ranging from minimal to severe depression.

We hypothesized that sleep quality would exert a greater influence on life satisfaction among those with severe depression compared to those who are less severely or not depressed. And though severely depressed individuals often lack high quality sleep (1, 15, 33, 44, 46), we wanted to see whether sleep quality is an important contributor to life satisfaction in those with severe depression, which could serve as a foundation for future research on improving sleep quality in these individuals.

III. Methods

A. COVID-19 Mental Health Survey, Methods

As part of a larger project, we conducted a 13-month cross-sectional mental health study on the adult population in the United States, administered every month between April 2020 and April 2021. Our research was motivated by, but not limited to, the public's reaction to the COVID-19 pandemic and mental health during the lockdown months. The study consisted of a series of mental health batteries and assessments presented on the crowdsourcing platform Amazon Mechanical Turk (MTurk). All participants that were recruited on MTurk were compensated upon completion of the assessments. Our eligibility rules required the participants to be United States residents between the ages of 18 and 90 years old, with a required 6th grade or higher reading level. Reading comprehension was further confirmed by a reading proficiency test completed by participants prior to enrollment in the study. Upon passing eligibility requirements, a study description was provided to the participants, and they completed a written consent in order to be enrolled. This protocol ultimately created thirteen independent samples for our subsequent analysis.

This study was approved by the Institutional Review Board of the University of Arizona.

B. Participants

A total of 13,313 English-speaking adults participated in the study. All fifty states and the District of Columbia were represented in this sample, composed of 57.5% female participants and 42.1% male participants (0.4% declined to specify) with an average age of 37.19 years ($SD \pm 12.375$). Our sample demographics mirrored those of the general U.S. population at the time in

median income and race. The U.S. Census reported a median income of \$67,521 (41) in the year 2020, and the median income of our participants fell within our \$50,001-75,000 bracket. Our sample also closely approximated the 2020 racial composition of the general population (Figure 1) (38). Thus, our study reflected a representative sample.

We specifically analyzed participants from Month 1 ($n=1013$), Month 4 ($n=1043$), Month 7 ($n=1022$), and Month 10 ($n=1011$) of our 13-month cross-sectional study, as these were the months where we administered all of the three following assessments: the Beck Depression Inventory (BDI-II), the Pittsburgh Sleep Quality Index (PSQI), and the Satisfaction With Life Scale (SWLS). Participants who did not complete all three assessments during these months were excluded from the analysis ($n_{\text{excl}}=11$).

Race*	Census Percentages	Sample Percentages**
White	70.1	75.7
Black or African American	13.1	9.5
American Indian & Alaska Native	1.2	1.0
Asian	6.7	5.9
Native Hawaiian & Other Pacific Islander	0.2	0.3
Some Other Race	8.7	2.0
*The census data on "Race" includes responses for those identifying as one race alone		
**In our sample, ethnicity (hispanic/latino) was included in the "Race" identification, and accounts for 5.3% of the sample. 0.5% declined to specify.		

Table 1: Race Demographics, Census Data vs Sample Data

C. Measures for an Analysis of Depression, Sleep Quality, and Life Satisfaction

The Beck Depression Inventory (BDI-II) tests for depressive mood and is often used in the clinical setting to screen for depression (2) due to its high internal consistency and test-retest reliability (19, 48), and convergent- and discriminant-validity when measured against other psychometric batteries (23, 39). We administered the most up to date version, BDI-II, and analyzed the participants' total BDI scores. Higher total scores represent more severe levels of depression, with scores of 0-13 indicating minimal depression, 14-19 for mild, 20-28 moderate, and 29-63 severe.

The Satisfaction with Life Scale (SWLS) assesses whether one is content with the progression and current state of their life, with higher scores indicating greater life satisfaction. It has also been tested on a variety of populations for reliability and external validity (26, 27, 32), and it has also been shown to have convergent validity with other similar assessments (35).

The final material that concerns our present analysis of depression, sleep quality, and life satisfaction is the Pittsburgh Sleep Quality Index (PSQI). Several categories such as subjective sleep quality, sleep latency, and sleep duration (among others) comprise the PSQI, and the test is formatted such that higher scores indicate greater sleep dysfunction. The assessment is reliable

(3, 8), internally consistent when tested on a variety of populations (10, 30, 43), and demonstrates external validity in its correlations with real-world outcomes such as mental health and likelihood of substance abuse (25). For the current analysis, we specifically looked at Item 6 on PSQI, which asks the participant to rate their overall sleep quality during the past month as “Very bad,” “Fairly bad,” “Fairly good,” or “Very good.” Also, in isolating Item 6 for the analysis, we reverse-coded the question so that responses of poorer quality sleep received lower scores and higher quality sleep received higher scores.

D. Analysis of Depression, Sleep Quality, and Life Satisfaction

For our main data analysis, we ran a simple linear regression with life satisfaction as the dependent variable and sleep quality as the independent variable. Total scores on the SWLS represented life satisfaction, with higher scores corresponding to higher life satisfaction. Item 6 on the PSQI represented sleep quality, which asked the participant “During the past month, how would you rate your sleep quality overall?”. We coded this item by giving lower scores to poorer quality sleep (“very bad” and “bad” receiving scores of 1 and 2) and higher scores to better quality sleep (“good” and “very good” receiving scores of 3 and 4); thus, higher Item 6 scores corresponded to better sleep quality.

We ran this regression analysis on four different groups in our data—minimally, mildly, moderately, and severely depressed individuals—by dividing respondents according to the well-established score ranges for depression on the BDI (17). Scores of 0-13 classify those with minimal depression (n=2178); 14-19 for those with mild depression (n=624); 20-28 for moderate depression (n=667); and 29-63 for severe depression (n=609).

This yielded four separate regressions, allowing us to compare the relationship between life satisfaction and sleep quality according to depression level.

IV. Results

A. Depression Demographics

To provide a general outlook on our sample, we will briefly discuss depression rates. Of the total respondents, 53.4% were within the BDI score range for minimal depression; 15.3% for mild depression; 16.4% for moderate; and 14.9% for severe (Table 2 & Figure 1). It is worth noting that our rates of depression were slightly elevated relative to studies conducted in previous years (5), but this is likely due to the stressors brought on by the global pandemic, or potentially different characteristics of the population of MTurk workers relative to the general population.

Depression Severity	Frequency (n)	Percent (%)
Minimal	2179	53.4
Mild	625	15.3
Moderate	669	16.4
Severe	610	14.9

Table 2: Frequencies and Rates of Different Depression Levels

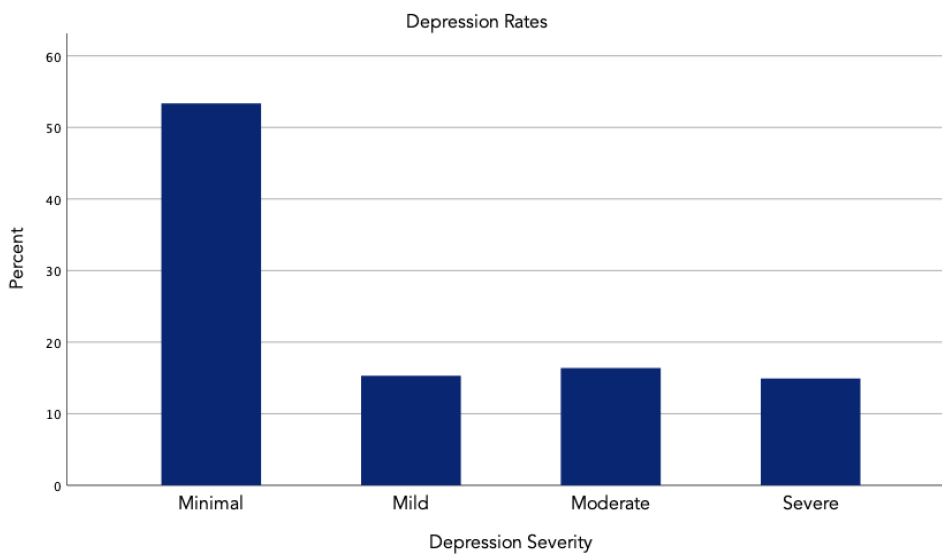


Figure 1: Depression Rates

B. Depression and Life Satisfaction

For a preliminary data analysis, we ran a simple linear regression between total BDI score and total score on the SWLS. A partial correlation demonstrated a significant negative relationship between depression and life satisfaction when controlled for age and sex ($r(1959) = -.457, p < .001$; Figure 2). This relationship reveals that as depression grows more severe, one's ability to find satisfaction in life decreases, or vice versa.

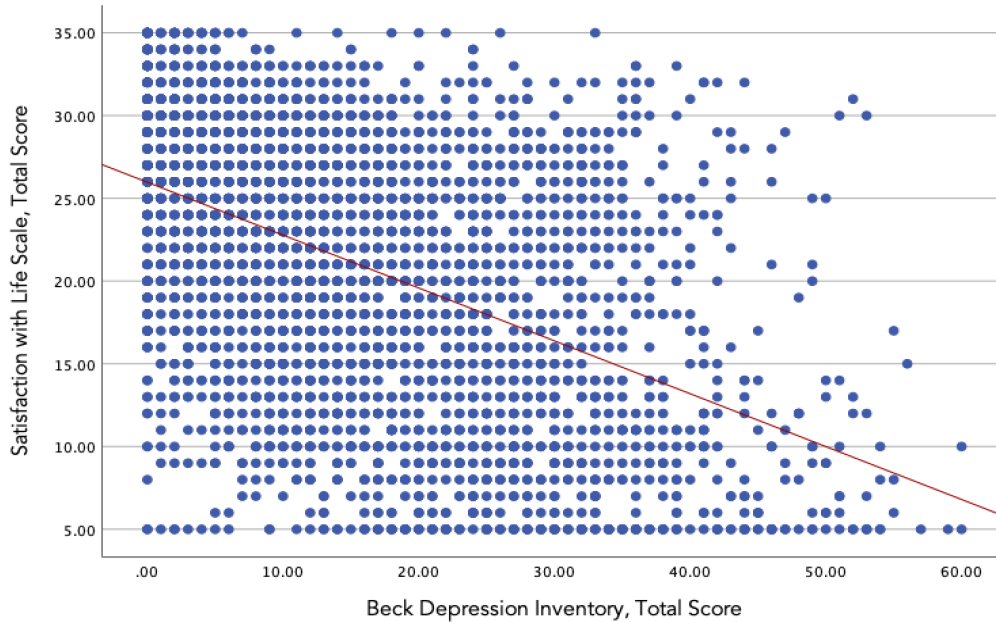


Figure 2: SWLS Total Score vs BDI Total Score

We confirmed the preceding linear relationship by performing a one-way ANOVA comparing the mean total scores on the SWLS among our samples of minimal, mild, moderate, and severe depression ($M_{\text{minimal}}=24.27$, $SD=6.52$; $M_{\text{mild}}=19.85$, $SD=7.19$; $M_{\text{moderate}}=17.59$, $SD=7.68$; $M_{\text{severe}}=15.39$, $SD=8.28$; Table 3). The ANOVA showed that these average SWLS scores differed significantly among all four depressive groups ($F(3,4079)=337.075$, $p<.001$; Table 4), and post hoc comparisons using the Bonferroni correction confirmed that the differences between each group were significant ($p<.001$ for each comparison; Table 5). This demonstrates that more severe levels of depression are associated with significant decreases in life satisfaction, which further exposes the problem that depressed individuals face in experiencing life satisfaction. Finally, to visualize this trend of decreasing scores, we created a box plot of depression severity and median scores on the SWLS (Figure 3).

Depression Severity	Mean	SD	N
Minimal	24.27	6.52	2179
Mild	19.85	7.19	625
Moderate	17.59	7.68	669
Severe	15.39	8.28	610

Table 3: Depression Severity and Mean Scores/Standard Deviations on SWLS

	Sum of Squares	df	F(3,4079)	η^2	Significance
Between Groups	51067.693	3	337.075	.199	<.001
Within Groups	205992.954	4079			

Table 4: One-Way Analysis of Variance in Total SWLS Score

Depression Severity	Minimal	Mild	Moderate	Severe
Minimal	0	4.424*	6.686*	8.887*
Mild		0	2.262*	4.463*
Moderate			0	2.201*
Severe				0

*Difference is significant at the .001 level

Table 5: Mean Differences in SWLS Score, & Posthoc Comparisons (Bonferroni Correction)

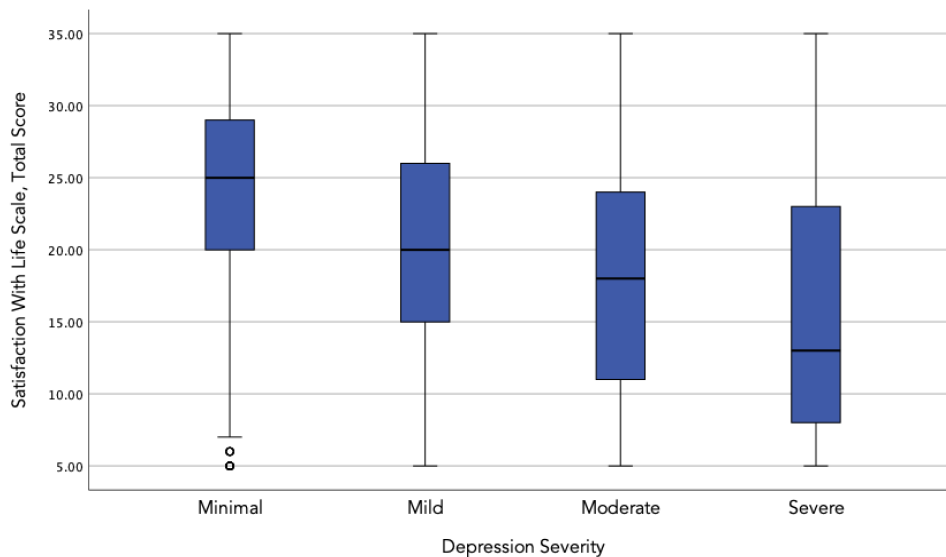


Figure 3: Box Plot of Depression Severity and Median Scores on SWLS

C. Sleep Quality and Life Satisfaction Across Differing Levels of Depression

There was a significant positive correlation between total SWLS score and PSQI sleep quality score in minimally, mildly, moderately, and severely depressed groups ($R_{\text{minimal}}=.187$, $p<.001$; $R_{\text{mild}}=.129$, $p=.001$; $R_{\text{moderate}}=.180$, $p<.001$; $R_{\text{severe}}=.438$, $p<.001$; Table 6).

Consistent with the aforementioned correlations, our results showed that a much greater amount of variance in life satisfaction is determined by the variance in sleep quality in the

severely depressed group ($R^2_{adj/severe}=.191$; versus $R^2_{adj/minimal}=.034$, $R^2_{adj/mild}=.015$, and $R^2_{adj/moderate}=.031$; Table 6). In line with these findings, the Pearson correlation between life satisfaction and sleep quality (cited above) was significantly larger in the severely depressed group than all other groups given their sample sizes; this difference between coefficients was significant at the $p<.001$ level for all three comparisons (minimal vs severe; mild vs severe; and moderate vs severe). Thus, sleep quality is a stronger predictor of life satisfaction in severely depressed individuals than it is in those with lower levels of depression.

Depression Severity*	Unstandardized Coefficients		Standardized Coefficients		R Square	Adj R Square	Significance
	B	Std. Error	Beta	t			
Minimal	1.743	0.197	.187	8.856	.035	.034	<.001
Mild	1.408	0.434	.129	3.246	.017	.015	.001
Moderate	1.861	0.393	.180	4.730	.033	.031	<.001
Severe	4.346	0.362	.438	12.017	.192	.191	<.001

Table 6: Regression of Life Satisfaction on Sleep Quality, by Depression Severity

*Sample sizes of the depression groups are as follows: $n_{minimal}=2178$, $n_{mild}=624$, $n_{moderate}=667$, $n_{severe}=609$. These were the data from participants who completed the BDI, the PSQI, and the SWLS.

Figure 4 shows the association between sleep quality and life satisfaction for each depression group. According to these predictive models, the slope is greatest for the severely depressed group. Moreover, the model suggests that life satisfaction in severely depressed individuals with high quality sleep slightly surpasses that of moderately and even mildly depressed individuals with high quality sleep.

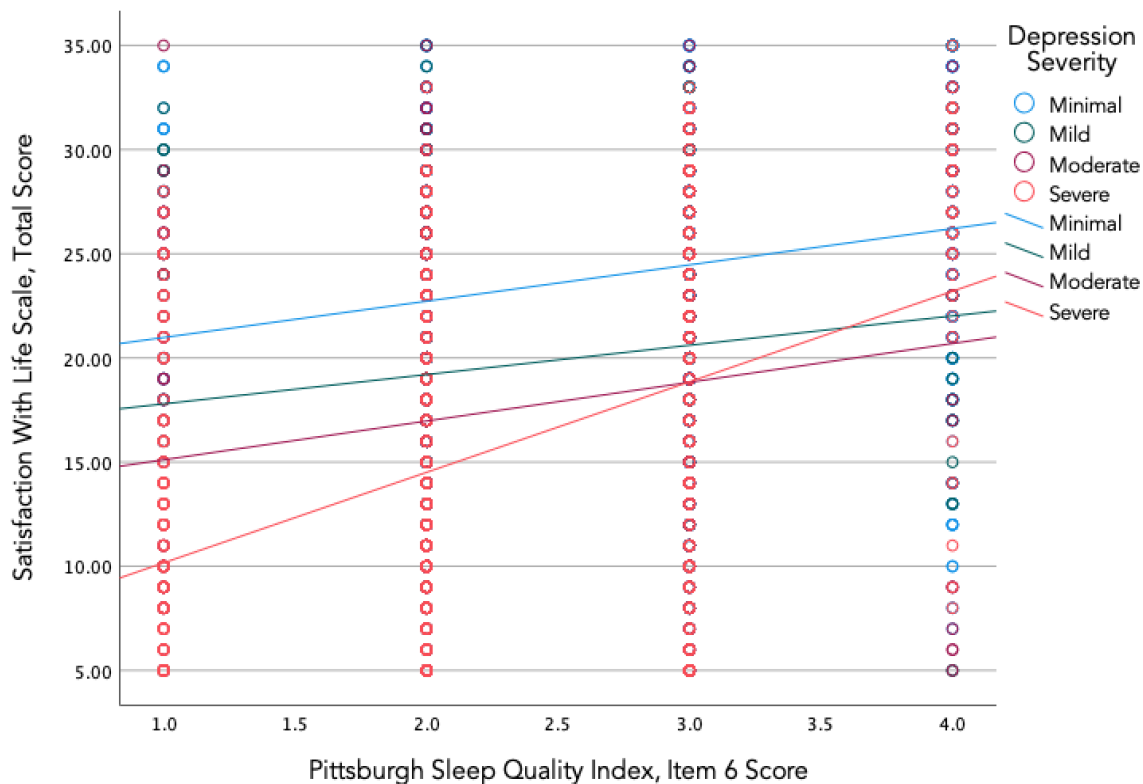


Figure 4: Regression of Life Satisfaction on Sleep Quality, by Depression Severity

To account for age and sex in this model—two factors that can also influence life satisfaction—we performed a hierarchical regression while keeping the total score on the SWLS as the dependent variable. While age did not significantly contribute to variations in life satisfaction at any depression severity ($p > .05$ in minimally, mildly, and severely depressed group; $p > .01$ in the moderately depressed group), sex had a significant effect on life satisfaction in groups of minimal, mild, and moderate depression ($R_{\text{minimal}(\text{sex})} = .120$, $p < .001$; $R_{\text{mild}(\text{sex})} = .140$, $p = .001$; $R_{\text{moderate}(\text{sex})} = .115$, $p = .003$). Minimally and mildly depressed groups also demonstrated an interaction effect between sex and sleep quality on life satisfaction ($R_{\text{minimal}(\text{sex}/\text{SQ})} = -.226$, $p = .013$; $R_{\text{mild}(\text{sex}/\text{SQ})} = -.523$, $p = .001$).

However, the severely depressed group once again differed from the other groups in that it did not have a significant relationship between sex and life satisfaction ($p > .05$); and while together sex and sleep quality had an interacting effect on life satisfaction, it still remained smaller than the effect of sleep quality alone on life satisfaction ($R_{\text{severe}(\text{sex}/\text{SQ})} = -.320$, $p = .003$; vs $R_{\text{severe}(\text{SQ alone})} = .560$, $p < .001$).

V. Discussion

In a large survey study, we found that there was a clear association between sleep quality and satisfaction with life, and that this association was stronger for those in the most severe range of depressive mood. These findings support our a priori hypotheses and suggest that sleep may be a particularly important contributor to satisfaction with life among severely depressed individuals. We discuss these findings in greater detail below.

Our first data analyses revealed that as depression increased, life satisfaction decreased. This was demonstrated through a simple linear regression between total scores on the BDI and total scores on the SWLS. Agreeing with this finding were the large and statistically significant differences in mean scores on the SWLS between different depression groups. Although these results were expected, it was beneficial to confirm the negative relationship between depression and life satisfaction to demonstrate the problem faced by those with depression in finding life satisfaction. Moreover, the benefits of life satisfaction are well known (7, 16, 21, 24), and evidence suggests that low satisfaction with life is indeed a problem—in a variety of domains in everyday life, such as emotional health and behavioral patterns (6, 20).

We then factored sleep quality into our analysis. We wanted to explore the association between sleep quality and life satisfaction in our samples of individuals with different depression severities. The results supported our hypothesis that sleep quality has a greater influence on life satisfaction for severely depressed individuals compared to those who are not severely depressed. Severely depressed respondents with high quality sleep—as indicated by Item 6 on the PSQI—scored much higher on the SWLS compared to severely depressed individuals who had lower quality sleep, whereas the sleep quality of individuals in other depression categories did not affect their satisfaction in life as greatly. This revealed differences between minimal, mild, moderate, and severely depressed individuals in their relationship between sleep quality and life satisfaction, wherein severely depressed individuals showed the strongest relationship between sleep quality and life satisfaction. Though all depression samples had significant relationships between sleep quality and life satisfaction, the severely depressed group had the strongest. Approximately 20% of the variability in life satisfaction in severely depressed individuals was accounted for by their sleep quality, compared to only the 1.5%-3.5% seen in other depression groups.

The aforementioned findings are intriguing and suggest that the relationship between sleep quality and life satisfaction is far stronger in those who are the most severely depressed, relative to less severe groups. This corresponds to the existing body of literature regarding the relationship between quality of sleep and satisfaction in life. Previous studies show that depression mediates this relationship (4, 49), which supports our own findings that depression is indeed involved in the relationship. Although we did not study whether depression was a partial or full mediator as the previous research did, our research implies a potential *moderating* effect of depression on the association between sleep quality and life satisfaction, since our regression models showed that as depression severity increases, so does the strength of the relationship

between sleep quality and life satisfaction. This field of research would benefit from future studies that explore whether depression is in fact a moderator in this relationship, which would further support the idea that depression severity partly determines the influence of good quality sleep (or lack thereof) on perceptions of satisfaction in life.

Taken altogether with these prior studies, our findings contribute a potentially important discovery towards therapeutic interventions for severely depressed individuals. Improving sleep quality to alleviate one of the detrimental effects of depression—namely, lower life satisfaction—is accessible to everyone, and is therefore a potential therapeutic route that could reach a greater proportion of the severely-depressed population. Many severely depressed individuals lack access to mental health care, or for a variety of reasons, choose not to seek such care (13, 14, 29, 45, 47), but getting a good night’s sleep is a form of self-care that does not require costly medical visits. However, it is important to note that while improving sleep quality is theoretically less costly and more accessible than antidepressants and other treatments, sleep interventions might prove difficult in severely depressed individuals as research shows a significant correlation between depression and sleep abnormalities (1, 15, 33, 44, 46). Thus, future research aimed toward enhancing quality of life among depressed individuals would benefit from addressing specific approaches directed toward the alleviation of sleep problems, including cognitive therapies, behavioral modification approaches, non-pharmacological interventions, and light interventions.

To finish our analysis, we examined the influence of age and sex on life satisfaction to determine whether sleep quality had a *greater* effect than these other factors at different depression levels. These additional regression analyses were motivated by prior research indicating that age can influence satisfaction with life—or rather, the life events associated with certain ages (11, 18)—and sex has an effect as well (22). Our data showed that age did not significantly contribute to variations in life satisfaction at any depression severity. However, our results for sex were more nuanced. Sex had a significant effect on life satisfaction in non-severely depressed samples, but this was not the case in the severely depressed sample. And while this sample demonstrated that sex *together* with sleep quality contributed some influence to self-perceptions of life satisfaction, it was still much smaller than the effect of sleep quality alone on life satisfaction.

Ultimately, this final analysis further confirmed our findings that sleep quality—rather than some other factor, like sex—is more reliably associated with levels of life satisfaction in severely depressed individuals. It is yet another differentiation between severely and non-severely depressed individuals concerning the kinds of factors that determine life satisfaction.

VI. Limitations

Life satisfaction is a complex, multifaceted domain, and is thus affected by a multitude of factors. Though age, sex, and sleep quality are some—and were studied in our current analysis—

there are many others that may have an effect such as genetics, upbringing, past and current social environments, and career fit. While an adjusted R square of .191 between sleep quality and life satisfaction in those with severe depression is considered to be medium to large effect size, it is still an incomplete picture of how life satisfaction is determined. Additionally, the measure we used to represent sleep quality in this relationship was an ordinal scale variable, which violates the assumptions of parametric analyses such as regressions; the difference between “very bad” and “bad” sleep quality, for example, cannot be precisely quantified. Thus, additional studies are needed to support our findings.

Our research was also unable to fully identify the mechanisms driving relationship differences between sleep quality and life satisfaction at various depression severities. Several questions remain. Is it because those who struggle with severe depression require higher quality sleep that they fail to consistently get, thus resulting in dissatisfaction? Or perhaps is it that these individuals are prone to define their life satisfaction by how well they are able to accomplish what they set out to do, like getting a good night’s sleep, and failure to do so results in dissatisfaction? Thus, interpersonal differences concerning the potential cause-and-effect relationship between sleep quality and life satisfaction remain unknown. Our sample was also limited to a specific population during a specific time period—namely, the U.S. population during the main months of COVID lockdown—and should therefore be validated in different groups to be more generalizable.

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