A Study Exploring the Relationship Between Racial Discrimination, Depression, Anxiety, and Stress on Sleep Quality

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by

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Abstract

Prior studies have shown that discrimination experiences have a positive association on adults' symptoms of depression, anxiety, and stress as well as on their sleep patterns. Symptoms of depression, anxiety, and stress appear to be associated with age, with younger adults experiencing higher levels of discrimination than older adults. The findings of this study may aid in evaluating the validity of prior literature and also exploring this further by studying the relationship between discrimination and symptoms of depression, stress, and anxiety with gender as a moderating variable. The present study is the first to examine COVID-19's effects on symptoms of depression, anxiety, stress, sleep patterns, and discrimination, which may have been caused by the pandemic. A total of 582 people between the ages of 18 and 79 participated in this study. In part 1 of the study, participants were asked to complete online questionnaires such as DASS for symptoms of depression, anxiety, and stress, PSQI for Pittsburgh Sleep Quality Index, DI for discriminatory index, and general questions about how their lives have been affected by COVID-19. After 48 hours, the participants take part in the second part of the experiment, during which they complete a questionnaire about stress coping strategies and a memory test for the images they've seen in the first part of the experiment. Three hierarchical regression analyses are performed to investigate whether adding variables such as DI, age and gender could significantly increase the variance accounted for in the outcome/criterion variables (i.e., PSQI and DASS). While there is a statistically significant relationship between DASS and PSQI, DI and DASS with age as a moderator, and DI and DASS with gender, the inclusion of the interaction terms for DI and gender or DI and age were not statistically significant indicating that there is no interaction effect which explains variance above and beyond the two independent variables separately. Future studies may modify parts of this study to observe race-related differences, such as increasing the sample size or changing the DI by adding race as a moderator variable.

Introduction

Depression, a common psychological disorder, is a serious public health concern and is estimated to severely affect the lives of 264 million people across the globe. In 2017, 17.3 million adults experienced at least one major depressive episode in the United States alone, and of those with a major depressive episode, 63.8% experienced at least one severe impairment in their daily lives [2]. Furthermore, several impairments resulting from depression can influence all areas of individuals' lives thus affecting professional and personal relationships, school/work performance, and even day-to-day leisure activities [2]. As stated by the WHO Department of Mental Health and Substance Abuse, Depression tends to be a common mental disorder that causes an individual to demonstrate a state of low mood, low energy levels, feelings of guilt, low self-worth, low self-esteem, disturbed sleep, disturbed appetite, poor concentration, loss of pleasure, and loss of interest in daily activities [3]. By developing a fundamental understanding of the mechanisms that link racial discrimination to poor sleep quality, this research aims to understand the significance of depressive symptomatology on an individual's emotional resilience.

Previous research studied the associations between mental health diagnoses and depression. Whitmyre et al. investigate the growing issue of mental health services received by adolescents not matching their diagnosis especially with irregular sleep patterns, and certain stress factors experienced in daily life [9]. For example, if a youth was diagnosed with anxiety, ADHD, or a substance abuse disorder, they were not likely to receive the correct treatment for their disorder. This discrepancy was driven more by adolescent reports than by parent reports. While those with higher socioeconomic status often received proper care, the standard community-based care was often shown to be inadequate for addressing ongoing disorders in many youths [9]. Episodic memory refers to the richly detailed memory for not only the events that people typically experience but also the associated details such as the contexts in which those specific events occur [4]. There is converging evidence that this form of memory is frequently hindered in depression. The relationship between episodic memory and depression indicates that a lack of episodic memories is correlated with depressive symptomatology [1]. Although previous studies have researched the effect of an individual's exposure to multiple experiences of racial discrimination, this study also describes the role of

socioeconomic positions and their relevance to racial discrimination and sleep disturbances within adults.

Furthermore, previous studies have only assessed that deficits in episodic memory are related to a cognitive feature of depression. To further observe the effect of primary life stressors on adult's depressive symptomatology, this research study will examine how the symptoms of depression, anxiety, and stress are related to people's sleep quality and experience with racial discrimination. In order to assess the effect of depression on cognitive performance, I'm studying the relationships between the various elements assessed in questionnaires such as the DASS for symptoms of depression, anxiety, and stress; and DI for discriminatory index. It is predicted that analysis will show higher scores for depressive symptomatology and lower scores for cognitive performance in individuals with low socioeconomic status and multiple experiences of racial discrimination. This research study requires participants to answer a series of questionnaires that cover topics related to health information, emotional regulation strategies, symptoms of depression, anxiety, stress, physical activity, sleep, and general questions about how their life may have been impacted by COVID-19. Therefore, by investigating the relationships between the components assessed by the various questionnaires, this research aims to also study the various side-effects and chronic health problems that are associated with sleep deficiencies in adults by studying the effect of racial and ethnic disparities on an adult's sleep cycle.

Literature Review

Public health is adversely impacted by depression, a commonly diagnosed mental disorder. According to the Centers for Disease Control and Prevention, 17.3 million adults in the United States experienced at least one major depressive episode in 2017 and of those, 63.8% had an impairment to their daily activities [2]. Today, depression is estimated to seriously affect the lives of 350 million people across the world. In addition, depression can cause impairment in all facets of an individual's life, affecting their work and school performance as well as their everyday lives [2]. The WHO Department of Mental Health and Substance Abuse describes depression as a common mental disorder that results in low mood, low energy, guilt, low self-esteem, disturbed sleep, disturbed appetite, poor concentration, and loss of interest in daily activities [3].

Episodic memory refers not only to what is usually remembered, but also to the details related to the specific events that take place [4]. There is converging evidence that this form of memory is frequently hindered in depression. The relationship between episodic memory and depression indicates that a lack of episodic memories is correlated with depressive symptomatology [1]. However, previous studies have only assessed that deficits in episodic memory are related to a cognitive feature of depression. In this current study, we investigate the effect of certain primary life stressors on increasing the symptoms of depression, anxiety and stress. Furthermore, previous studies also assessed the effect of internal biological processes in driving depression pathogenesis by analyzing the role of inflammation, somatic disorders, and other physical disease conditions in depression [1]. As reported by Slavich et al [10], regulatory SNP plays a significant role in modulating stress and depressive symptoms. Cytokines regulate depressive-like behaviors by typically communicating with the brain to monitor an individual’s mood, cognition, and behavior [1]. To further describe the role of inflammation in depression, much effort in recent decades has been devoted to research several inflammation-related disorders that co-occur with depression. Literature regarding the role of regulatory SNP in the human IL6 promoter revealed that levels of inflammatory activity are elevated in patients with depression [1]. In fact, inflammatory responses to the administration of bacterial endotoxins also revealed that endotoxins tend to increase depressive symptoms by changing the characteristics of depression-related neural systems [1].

Moreover, future research should also be conducted to determine and analyze the effects of anti-inflammatory agents in alleviating depressive symptoms in adults. As reported by Zahdone et al [8], it's important for a research survey to be available and accessible to a wide range of ages (28-85) and ethnicities in order to obtain relevant statistical data. Zahdone et. al designs the survey to study the effect of racial differences such as income and education in performing cognitive tasks. Zahdone's literature is relevant since the author places a strong emphasis on certain mediators such as socioeconomic, physical health, mental health, and psychosocial on a person's sleep cycle and lifestyle [8]. Furthermore, Zahdone's literature is also important to the current study because the statistics clearly illustrate the effect of income on episodic memory and executive functioning disparities among a wide range of groups.

As reported by Blashfield et al, the Diagnostic and Statistical Manual of Mental Disorders categorizes various sleep disorders associated with irregular sleep patterns [12]. The Annual Review of Clinical Psychology (ARCP) paper recounts the history of the Diagnostic and Statistical Manual of Mental Disorders, or DSM, and focuses on how measurement, input from clinicians, and the function of classification systems have all influenced the evolution of the manual [12]. Knowing the history of the DSM, one of the most important documents in the psychology world, will give me a valuable insight into how mental health, especially health-related to depression/stress has been viewed, treated, and interpreted over the years. The ARCP paper would work well since the paper clearly describes the history of mental health by particularly focusing on sleep disturbances and depression [12]. In the future, knowing more about the DSM specifically will help paint a broader picture of the complicated history of mental health and factors such as sleep, stress, and memory that impact a person's mental health.

In order to understand the associations between sleep and memory, Abel et al discuss brain plasticity and its relationship to sleep and memory processing [11]. As reported by Abel et al, sleep plays a prominent role at the cellular, molecular, and large level mechanisms of plasticity that assist with learning and memory consolidation [11]. For example, at the cellular level, sleep deprivation harms cellular excitability that is necessary. At the large scale level, firing patterns are replayed during sleep [11]. As shown, sleep is very important for all points related to memory and the levels to which the brain adapts to different situations. The literature from Abel et al. article provides significant information from a cellular, molecular, and

whole-brain level thus increasing the relevance of this research article regarding the relationship between sleep and memory [11]. Abel et al's literature is also relevant to the current study since we are planning to learn the various neurobiological mechanisms related to sleep disorders and long-term memory consolidation. In order to understand the association between memory and sleep, Ahuja et al. analyze the role of normal sleep versus sleep apnea played on human memory processing [7]. Sleep functions in a variety of functions related to memory and higher tasks such as spatial, navigational, emotional, declarative, procedural memories, probabilistic learning, transitive inference, and category learning [7]. Ahuja et al. indicate that a sleep disorder is obstructive sleep apnea that is characterized by intermittent hypoxia and sleep fragmentation [7]. When a disorder such as obstructive sleep apnea is brought into the picture, it is seen through multiple research articles that it plays a detrimental role in offline memory processing. However, the mechanism through which this could be accomplished still needs to be researched.

In order to understand the association between mental health diagnoses and depression, Whitmyre et al. research the growing issue of mental health services received by adolescents not matching their diagnosis especially with irregular sleep patterns, and certain stress factors experienced in daily life [9]. For example, if a youth was diagnosed with anxiety, ADHD, or a substance abuse disorder, they were not likely to receive the correct treatment for their disorder. This discrepancy was driven more by adolescent reports than by parent reports. While those with higher socioeconomic status often received proper care, the standard community-based care was often shown to be inadequate for addressing ongoing disorders in many youths [9]. As a result, there is an area of growth in the mental health community to enhance the quality of care for adolescents suffering from anxiety, ADHD, or a substance abuse disorder, specifically. Youths are one of the primary groups discussed in the conversation regarding mental health as a whole, so this insight on the lack of effective treatment for many members of this group can affect the perspective we as researchers have on the overall mental health crisis [9]. The literature from Whitmyre et al. study is relevant to the current study because it offers an insight into the way diagnosis and treatment can differ for those affected by physical/mental health disorders, leading to the ongoing mental health crisis especially due to stress and depression factors.

As reported by Insel, the public health approach combined with adequate digital technology can play an important role in monitoring mental health factors such as decreasing depressive symptoms and providing psychosocial support [10]. However, the clinical importance of smartphone applications in treating mental health problems associated with sleep and stress factors remains to be discovered from a public health management perspective. Insel provides a sufficient amount of statistical evidence to illustrate that smartphones have continuously led to a decrease in suicide rates by discussing the characteristics of smartphones. Insel's literature is also relevant to the current study because it provides new approaches to diagnose and cure mental health problems that are primarily causing due to depression, sleep, and stress factors [10].

By understanding the role of smartphones in a clinical environment, further research could be performed to study and investigate specific care management apps and health apps in smartphones that have improved a person's physical and mental health [10]. Moreover, the progression of various telemedicine apps and their role in providing emergency care for a patient with mental illness, especially during COVID-19, could also be studied to further understand the role of technology in treating mental illnesses. The statistical data from Insel's literature such as the various NAMI's infographics could be utilized to discuss developments in the field of digital technology and the role of digital technology in hospitals and other mental health centers to improve sleep quality and reduce sleep-related disorders.

To better understand the role of racial discrimination on an individual's sleep cycle, Paine et al. researched the effect of race on mental and physical health and emphasized that racial discrimination acts as a chronic stressor as it activates a series of physiological responses and psychological responses such as blood pressure, heart rate, cortisol secretion, stress, and negative emotional states respectively [5]. The various physiological responses and psychological responses are able to increase an individual's vulnerability to a range of illnesses, diseases, and even premature death [5].

In order to further understand the association between race and insomnia, Cheng et al. analyze the various mechanisms by which racial disparities in the severity of insomnia disorder may arise [6]. The literature from Cheng et al's article is relevant since the researchers include several minority groups in the research and the article also includes the statistics about the minority groups' educational backgrounds, discrimination, and sleep patterns from over 1,458

individuals indicating the relevance of bigger samples in conducting a cross-sectional study and testing the authors' respective hypothesis [6]. As stated by Cheng et al, minority groups are more likely to experience racial discrimination thus increasing their chances of experiencing insomnia and other sleep-related diseases [6]. Overall, previous research states that racial discrimination is an important mechanism that drives racial disparities in symptom severity in insomnia disorder, and provides relevant information regarding potential differences in the role of racial discrimination between racial minority groups [6]. However, future research should repeat and extend these results with a prospective study design using more comprehensive techniques such as evaluating racial discrimination along with additional predictors such as socio-economic, health, and stress factors in a sample that better represents the diverse racial groups. With a fundamental understanding of the mechanisms that link racial discrimination to poor sleep quality, we can also determine the effect of neural pathways such as the hypothalamic-pituitary-adrenal axis and the sympathetic nervous system on an adult's sleep stages, sleep patterns, and even response to environmental stress.

In our current study, we specifically analyze how racial discrimination and symptoms of depression, anxiety, and stress are related to people's sleep quality. In order to understand the association between sleep and age, we are also researching the various side effects and chronic health problems that are associated with sleep deficiencies in adults by studying the effect of racial and ethnic disparities on an adult's sleep cycle. Previous studies have researched an individual's exposure to multiple experiences of racial discrimination. In our current study, we are investigating the influence of racial discrimination on adult sleep cycle.

Methods

Measures:

Depression, Anxiety and Stress Scale (DASS-21):

The Depression, Anxiety and Stress Scale is a revised version based on the three-dimensional scale of depression, anxiety and stress (DASS) [15]. The DASS-21 consists of 21 questions and is scored on a scale of zero to three. On the DASS-21, participants rate how relatable each question has been over the past week, and the questions from the three separate dimensions are added together to measure depression, anxiety, and stress. By exploring and confirming the factor structure of the DASS, it was demonstrated that it had satisfactory psychometric properties. In the present study, the individual components for DASS are used as the independent variables for the first hierarchical regression model. Since DASS was used as a dependent variable in the second and third hierarchical regression models, each component was added to obtain total DASS scores. DASS-21 was chosen for its ability to be both clinically and research-relevant, providing both reliability and ease of administration.

Pittsburgh Sleep Quality Index (PSQI):

While sleep complaints are common among psychiatric patients, few sleep quality questionnaires such as PSQI have been developed specifically for clinical populations. The Pittsburgh Sleep Quality Index (PSQI) is a self-rated questionnaire designed to evaluate sleep quality and disturbances over a 1-month period [16]. There are 19 items in the PSQI, and each item is scored based on seven "components": subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. To form the above seven component scores, 19 self-rated items are added together, each of which ranges from 0 to 3. For all components, scores of "0" indicate low difficulty, while scores of "3" indicate extreme difficulty. One global score is determined by adding the scores of these seven components. The global scores range from 0-21 points with “0” indicating no difficulty and “21” indicating severe difficulties in all components. PSQI's clinical and clinimetric properties support its use in clinical practice as well as research [16]. Upon examining the PSQI, it was found that internal homogeneity, consistency (test-retest reliability),

and validity were acceptable. In order to retain a larger sample, question 9 of the PSQI is used as an index of the total PSQI score.

Discriminatory Index (DI):

Previous studies suggest racial discrimination affects health by causing biological dysregulation as a result of chronic psychosocial stress [17]. In the epidemiological literature, Discrimination is measured with the Everyday Discrimination Scale (EDS), which is one of the most common discrimination measures. The EDS was designed to be a measure of subjectively reported discriminatory experiences in everyday social situations [17]. The original version of the discriminatory index required people to answer if they experienced various forms of discrimination because of their race but our modified version of the discriminatory index included questions for other reasons people may face discrimination (e.g., gender identity, religion, disability) [24]. The questions for the Discriminatory Index were derived from the MIDUS study and the heightened vigilance scale w The seven questions for the Discriminatory Index were scored using several scales such as Racism Reaction Scale (RRS) [18], Perceived Racism Scale (PRS) [19], Index of Race-Related Stress (IRRS) [20], Racism and Life Experiences Scale (RLES) [21], Schedule of Racist Events (SRE) [22], Perceptions of Racism Scale (PoRS) [23].

Furthermore, previous research suggests that socioeconomic position and multiple experiences of racial discrimination may be major contributors to the ethnic inequality in sleep disturbances among minority populations [5]. Previous research used DASS, PSQI, and DI surveys because they provided strong, consistent, and divergent validity across various groups [25]. There has been evidence that the Depression Anxiety Stress Scale (DASS) is a valid and reliable measure of depression, anxiety, and stress separately, but also taps into a more general view of psychological distress [26]. Although previous studies have found poor sleep quality to be a common problem among pre-clinical medical students and to be associated with some psychological symptoms [27], the present study is the first to validate DASS as a measure of depression, anxiety and stress with age and gender as moderators. In school, work, and other circumstances, adults commonly deal with depression, anxiety, and stress [28]. Furthermore, previous studies have indicated that younger adults were significantly more likely than older

adults to report anxiety or depression [29]. However, the coronavirus has continued to spread across the country, and older adults are challenged to minimize the threat while protecting themselves from loneliness and isolation, which can negatively affect their psychological well-being [28]. Poor sleep quality and mental health problems are common in adults with high levels of DASS [30]. This study was also designed to measure the efficiency and applicability of DASS on PSQI in order to better understand if symptoms of DASS are correlated with age.

The present study involves three broader hypotheses. As for the first hypothesis, I predicted that younger adults are more likely to have higher DASS scores (depression, anxiety, and stress) than older adults because younger adults are more likely to come across stressful situations on a regular basis such as at work and in school [29]. Likewise, adults with low DASS scores are more likely to report good sleep quality since the PSQI global score was positively associated with scores for depression, anxiety, and stress on the DASS in previous studies [30]. As for the second hypothesis, I predicted that younger adults are more likely to experience discrimination than older adults since younger adults are more exposed to stigma, prejuidce and discrimination in work place settings. Previous studies have demonstrated a positive association between perceived racial discrimination and substance use among African Caribbean young adults [32]. This study is the first to study the association between Discriminatory index scores and DASS scores. Since previous studies used age as the potential moderator between discrimination and mental health [31], and demonstrated that young people are more likely to be discriminated against, this current study examines age as the potential moderator in the relation between discrimination and DASS scores. Lastly for the third hypothesis, I predicted that there will be higher DASS scores for individuals with multiple experiences of racial discrimination and that females are more likely to experience discrimination in work place settings than males. Previous literature has suggested that different aspects of social inequality, including both gender inequality and wealth inequality, have different effects on mental health [33]. Furthermore, previous studies have also reported that males and females differ in terms of the types of discrimination reported (e.g., racial vs. gender discrimination), and the association between these types of discrimination and substance abuse [34]. This current study examines gender as the potential moderator in the relation between discrimination and DASS scores in order to evaluate the validity of the previous studies.

Participants and Procedure:

In the present study, participants were recruited through Prolific, an online database. Prolific is an international platform for online research that allows adults to participate in a variety of studies for free. As per IRB consent, members must reside in the United States and be over 18 years of age in order to participate in this testing. Because of the substantial amount of written instructions throughout the study, the study was further restricted to individuals who designated English as their native/primary language. The survey questionnaires such as The Depression, Anxiety and Stress Scale (DASS), The Pittsburgh Sleep Quality Index (PSQI), and Discriminatory Index (DI) were managed as part of a longitudinal study. Apart from the surveys already discussed, participants were also required to provide their demographic information such as age, sex, race, and ethnicity. Additionally, this experiment was conducted in two parts. The participants' behavioral data was obtained on the first day of the study as participants were asked to complete a 10-minute online survey followed by a 30-minute emotional memory task. The succeeding day, the participants' demographic information was collected, and the emotional recall task was presented to the participants. The second portion of the study was conducted 48 hours after the completion of part one, and the quality of information/data from part 1 was carefully assessed prior to permitting participants to proceed with the second part of the study.

Each participant was compensated for participation in the experiment. Participants were either paid $15 per hour that they spent in the study. Altogether, 806 individuals were selected from Prolific to participate in the experiment. Of those, 94 participants failed to successfully complete the first part of the study and an additional 57 participants failed to return to finish the second part of the study. Moreover, another 58 individuals were unable to finish the experiment due to technical issues such as a weak internet connection. At last, 15 individuals were not invited to complete part two of the study due to low-quality responses in part one, including but not restricted to: the participant was unable to follow the task directions, participants also presented a significant amount of missing, repetitious or patterned data in which responses to all or approximately all stimuli during the emotional memory task were similar. Therefore, a total of 582 participants met all of the research measures to be included in further analysis. Of those, 175 participants were male and 239 were female with ages varying from 18 to 79 ($M = 40.8$, $SD = 14.9$). Of the 582 participants, 168 of them did not specify their gender.

Statistical Analysis:

In the present study, Excel was used to score the raw data for each survey and SPSS was used to complete all analyses of the raw data. Pearson's R correlations were used to identify relationships between independent variables (DI scores, age, gender) or dependent variables (PSQI and DASS). This was followed by hierarchical regressions used to establish relationships between independent and dependent variables. The first model assessed whether DASS predicted changes in PSQI with age as the moderator variable. For the PSQI, a bivariate correlation was performed between the overall PSQI score with question 9 of the PSQI score to retain a larger sample. The second hierarchical regression model looked at whether DI predicted changes in DASS with age as the moderator variable. Lastly, the third hierarchical regression model was performed to examine if DI predicted changes in DASS with gender as the moderator variable. For the second and third hierarchical regression models, an interaction between DI and age, and an interaction between DI and gender was also performed respectively.

Results

Hierarchical Regression 1:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	.909	.050		18.364	.000		
	DASS_D	.048	.011	.329	4.500	.000	.367	2.728
	DASS_A	-.055	.015	-.290	-3.723	.000	.324	3.090
	DASS_S	.063	.014	.362	4.394	.000	.290	3.451
2	(Constant)	.758	.119		6.367	.000		
	DASS_D	.049	.011	.337	4.599	.000	.364	2.744
	DASS_A	-.056	.015	-.295	-3.791	.000	.323	3.097
	DASS_S	.065	.014	.374	4.520	.000	.287	3.488
	Age	.003	.002	.063	1.391	.165	.946	1.057

a. Dependent Variable: PSQI_Q9

Table 1: Understanding the multicollinearity between the independent variables (DASS_D, DASS_A, DASS_S, and Age)

Correlations

		PSQI	PSQI_Q9
PSQI	Pearson Correlation	1	-.088*
	Sig. (2-tailed)		.034
	N	581	580
PSQI_Q9	Pearson Correlation	-.088*	1
	Sig. (2-tailed)	.034	
	N	580	580

*. Correlation is significant at the 0.05 level (2-tailed).

Table 1A: Bivariate correlation between Overall PSQI scores with Question 9 of the PSQI indicating a high significant correlation between the two variables

The appropriate assumptions of this statistical analysis were examined before performing a hierarchical multiple regression. In this study, a sample size of 582 was considered adequate as four independent variables were included in the analysis. The assumption of singularity was also confirmed as the independent variables (DASS_D, DASS_A, DASS_S, and Age) were not a combination of other independent variables in the study. Based on Table 1, a correlations test demonstrated that no independent variables were highly correlated, and the collinearity statistics

were all within acceptable limits indicating that the assumption of multicollinearity was satisfied. An analysis of the Mahalanobis distance scores revealed that the data doesn't consist of any multivariate outliers. Upon the analysis, the residual and scatter plots justified the assumptions of normality, linearity, and homoscedasticity. Participants must have complete data for each of these variables to be included in the final analysis. To retain a large sample, item 9 of the PSQI was used as the sleep quality measure of interest. This item asks, "During the past month, how would you rate your sleep quality overall?". Single item sleep measures have been validated in previous studies and show strong correspondence with the global PSQI scores [13]. As indicated by table 1A, In a subsample of participants, this measure was positively correlated with the global PSQI score ($r(582) = .034$, $p < .05$).

A four-stage hierarchical multiple regression was performed with PSQI as the dependent variable. DASS_D was entered at stage one of the regression. DASS_A was entered at stage two, DASS_S at stage three, and Age at stage four. The relationship variables were recorded in this order as it appeared chronologically plausible given testing for depression is followed by anxiety and stress consecutively, and stress levels are positively correlated with age. The intercorrelations between the various multiple regression variables were described in Table 1 and the regression statistics were demonstrated in Table 2.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.445[a]	.198	.192	.723	.198	33.609	3	408	.000
2	.449[b]	.202	.194	.722	.004	1.934	1	407	.165

a. Predictors: (Constant), DASS_S, DASS_D, DASS_A

b. Predictors: (Constant), DASS_S, DASS_D, DASS_A, Age

Table 2: Hierarchical regression between the independent variables (DASS_D, DASS_A, DASS_S, and Age) and dependent variable (PSQI_Q9)

Based on the model summary in table 2, the hierarchical regression revealed that at stage one, DASS_D contributed significantly to the regression model, $F(1,408) = 33.61$, $p < 0.05$) and accounted for 19.8% of the variation in PSQI scores. Introducing the Age in model 2 explained an additional 0.4% of the variation in PSQI and this change in R^2 was not significant, $F(1,407) = 1.934$, $p > .05$. Based on the above multiple hierarchical regression model, DASS_S, DASS_D

and DASS_A in model 1 uniquely explained 19.8% of the variation in PSQI compared to the addition of age in model 2. Therefore, the two independent variables together accounted for only 20.2% of the variance in PSQI scores.

Hierarchical Regression 2:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	8.437	.706		11.952	.000		
	Overall Discriminatory Index Scores	3.340	.312	.406	10.705	.000	1.000	1.000
2	(Constant)	7.439	.775		9.601	.000		
	Overall Discriminatory Index Scores	3.230	.312	.393	10.355	.000	.986	1.014
	Age	.004	.001	.115	3.027	.003	.986	1.014
3	(Constant)	7.410	.849		8.731	.000		
	Overall Discriminatory Index Scores	3.250	.395	.396	8.228	.000	.616	1.623
	Age	.004	.002	.118	2.227	.026	.507	1.973
	Interaction between Overall Discriminatory Index Scores and Age	-5.922E-5	.001	-.005	-.085	.933	.364	2.747

a. Dependent Variable: Total DASS

Table 3: Understanding the multicollinearity between the independent variables (Discriminatory index (DI) score, Age, and the interaction between overall DI scores/Age)

Like hierarchical regression 1, the appropriate assumptions of this second statistical analysis were examined before performing a hierarchical multiple regression. In this study, a sample size of 582 was considered adequate as two independent variables were included in the analysis. The assumption of singularity was also confirmed as the DI_Overall and Age were not a combination of other independent variables in the study. Based on Table 3, a correlations test demonstrated that no independent variables were highly correlated, and the collinearity statistics were all within acceptable limits indicating that the assumption of multicollinearity was satisfied. An analysis of the Mahalanobis distance scores revealed that the data doesn't consist of any multivariate outliers. Upon the analysis, the residual and scatter plots justified the assumptions of normality, linearity, and homoscedasticity.

A three-stage hierarchical multiple regression was performed with the total DASS as the dependent variable. Overall DI score was entered at stage one of the regression, age at stage 2, and the interaction between Overall DI scores and age at stage 3. The relationship variables were

recorded in this order as it appeared chronologically plausible given analyzing for the discriminatory index is associated with age. The intercorrelations between the three multiple regression variables were described in Table 3 and the regression statistics were demonstrated in Table 4.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.406[a]	.165	.164	12.67715	.165	114.591	1	579	.000
2	.422[b]	.178	.175	12.58872	.013	9.163	1	578	.003
3	.422[c]	.178	.174	12.59954	.000	.007	1	577	.933

a. Predictors: (Constant), Overall Discriminatory Index Scores

b. Predictors: (Constant), Overall Discriminatory Index Scores, Age

c. Predictors: (Constant), Overall Discriminatory Index Scores, Age, Interaction between Overall Discriminatory Index Scores and Age

Table 4: Hierarchical regression between the independent variables (Overall Discriminatory Index (DI) Scores, Age, and the interaction between overall DI scores/Age) and dependent variable (Total DASS).

Based on the model summary in table 4, the hierarchical regression revealed that at stage one, the overall Discriminatory Index (DI) score contributed significantly to the regression model, $F(1,579) = 114.591$, $p < 0.05$, and accounted for 16.5% of the variation in total DASS scores. Introducing the Age moderating variable in model 2 explained an additional 1.3% of the variation in DASS and this change in R^2 was also significant, $F(1,577) = 9.163$, $p < .05$. Finally, the addition of the interaction between Overall DI scores and Age to the regression model 3 did not explain any additional variation in DASS and this change in R^2 square was also not significant, $F(1,577) = 0.007$, $p > .05$. When all three independent variables were included in stage three of the multiple hierarchical regression model, both the DI and age were significant predictors of changes in DASS scores since the calculated p-value is smaller than the alpha value of 0.05. The most important predictor of DASS was the overall DI scores which uniquely explained 16.5% of the variation in total DASS. Therefore, the three independent variables together accounted for only 17.8% of the variance in DASS scores.

Hierarchical regression 3:

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	8.437	.706		11.952	.000		
	Overall Discriminatory Index Scores	3.340	.312	.406	10.705	.000	1.000	1.000
2	(Constant)	7.554	.755		10.012	.000		
	Overall Discriminatory Index Scores	3.224	.312	.392	10.339	.000	.986	1.014
	Gender	.004	.001	.120	3.151	.002	.986	1.014
3	(Constant)	7.527	.811		9.283	.000		
	Overall Discriminatory Index Scores	3.243	.378	.395	8.575	.000	.671	1.490
	Gender	.004	.002	.123	2.323	.021	.508	1.969
	Interaction between Overall Discriminatory Index Scores and Gender	-6.166E-5	.001	-.006	-.092	.927	.386	2.590

a. Dependent Variable: Total DASS

Table 5: Understanding the multicollinearity between the independent variables (Overall Discriminatory index (DI) Scores and Gender)

Like hierarchical regression 2, the appropriate assumptions of this second statistical analysis were examined before performing a hierarchical multiple regression. In this study, a sample size of 582 was considered adequate as two independent variables were included in the analysis. The assumption of singularity was also confirmed as the DI_Overall and Gender were not a combination of other independent variables in the study. Based on Table 3, a correlations test demonstrated that no independent variables were highly correlated, and the collinearity statistics were all within acceptable limits indicating that the assumption of multicollinearity was satisfied. An analysis of the Mahalanobis distance scores revealed that the data doesn't consist of any multivariate outliers. Upon the analysis, the residual and scatter plots justified the assumptions of normality, linearity, and homoscedasticity.

A three-stage hierarchical multiple regression was performed with the total DASS as the dependent variable. Overall DI score was entered at stage one of the regression and Gender at stage 2. Finally, the interaction between overall DI score and Gender was entered at stage 3 of the regression. The relationship variables were recorded in this order as it appeared chronologically plausible given analysis for the Discriminatory index is associated with gender. There is also an interaction between gender and DI. The intercorrelations between the three

multiple regression variables were described in Table 3 and the regression statistics were demonstrated in Table 4.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.406[a]	.165	.164	12.67715	.165	114.591	1	579	.000
2	.423[b]	.179	.176	12.58051	.014	9.929	1	578	.002
3	.423[c]	.179	.175	12.59131	.000	.008	1	577	.927

a. Predictors: (Constant), Overall Discriminatory Index Scores

b. Predictors: (Constant), Overall Discriminatory Index Scores, Gender

c. Predictors: (Constant), Overall Discriminatory Index Scores, Gender, Interaction between Overall Discriminatory Index Scores and Gender

Table 6: Hierarchical regression between the independent variables (Overall Discriminatory Index (DI) Scores, Gender and the interaction between overall DI scores/gender) and dependent variable (Total DASS)

Based on the model summary in table 6, the hierarchical regression revealed that at stage one, the overall Discriminatory Index (DI) score contributed significantly to the regression model, $F(1,579) = 114.591$, $p < 0.05$, and accounted for 16.5% of the variation in total DASS scores. Introducing the Gender moderating variable in model 2 explained an additional 1.4% of the variation in DASS and this change in R^2 was also significant, $F(1,577) = 9.929$, $p < .05$. Finally, the addition of the interaction between Overall DI scores and gender to the regression model 3 did not explain any additional variation in DASS and this change in R^2 square was also not significant, $F(1,577) = 0.008$, $p > .05$. When all three independent variables were included in stage three of the multiple hierarchical regression model, overall DI scores uniquely explained 16.5% of the variation in DASS compared to the interaction between other independent variables. Therefore, the three independent variables together accounted for only 17.9% of the variance in DASS scores.

Discussion

The present study investigated the relationship between the individuals' symptoms of depression, anxiety, and stress, as well as experiences with racial discrimination, and the quality of their sleep. Since this study was conducted online, we were able to recruit participants from all regions of the United States. The obtained scatter plots along with correlational analysis of the adult sample illustrated demographic diversity, including an equivalent distribution of young, middle-aged, and older adults who were from various racial backgrounds, sexual identification, cultures, and nationalities.

Since the males and females participating in the present study were not all of the same age, there was a possibility that age was a potentially confounding variable to the sleep quality. Previous studies have shown that aging is associated with a decrease in the amount of slow wave sleep and an increase in stage 1 and 2 non–rapid eye movement sleep, but it is unclear when this decline begins [14]. In order to explore this further, statistical analyses were performed in SPSS to examine the quality of sleep in both younger and older adult males and females. Overall, it was found that there was no significant difference in sleep quality when age was introduced as a moderating variable.

Based on the results for the first hierarchical regression, there is a significant correlation between the independent variables (Depression, Anxiety, Stress) and PSQI. The obtained p-value for the predictors is smaller than the alpha value of 0.05 indicating that there is a significant relationship between the independent and dependent variables. According to the second hierarchical regression, there is a significant difference between the independent variables (Overall Discriminatory Index Scores, Age) and Total DASS. Lastly, the third hierarchical regression revealed that there is a significant difference between the independent variables (Overall Discriminatory Index Scores, Gender) and Total DASS. However, there was no significant difference when an interaction between the Overall Discriminatory Index Scores and age, and overall Discriminatory Index Scores and gender was performed respectively. This suggests that interactions between independent variables were not influencing the changes in DASS scores among the participants. Although previous studies have evaluated that deficits in episodic memory are related to a cognitive feature of depression, this study is the first to investigate the effect of certain primary life stressors such as racial discrimination, symptoms of depression, anxiety, and stress on sleep quality.

The present study posed some limitations. Since the study was conducted during Covid-19, it is likely that the participants' responses were affected by the stressful circumstances faced during this pandemic. Financial stress and loss of jobs may have also affected the obtained results. Based on the statistical analysis, the correlations obtained from this experiment were consistent with previous literature. Since correlations were strongly correlated and because collinearity tests during regression analysis yielded significant collinearity between variables, DI, age and gender cannot be completely observed as unique variables. Furthermore, features of sleep such as slow oscillations, spindles, and REM sleep are very important for memory, especially certain ones, but how they all interact still needs to be looked at in future studies.

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Conclusion

In summary, statistical results indicated that symptoms of depression, anxiety, and stress were successful in significantly predicting changes in sleep quality. Three of the hypotheses pertaining to significant correlations between DASS and PSQI, DI and DASS with age as a moderator variable, and DI and DASS with gender as a moderator variable were all confirmed. Even though there is a significant association between DASS and PSQI, introducing age as a moderator variable in hierarchical regression 1 did not statistically predict variance in DASS indicating that age did not serve as a moderating variable. Similarly, the specific interaction terms (age × DI) , and (gender × DI) did not statistically predict DASS scores above and beyond the two variables separately indicating that interaction terms did not statistically significantly increase the amount of variance in DASS scores, which supports that a moderating effect is absent. Overall, the hierarchical regressions and the Pearson correlations also demonstrated that experiences with racial discrimination significantly predicted DASS. Furthermore, the study indicates a positive correlation between young adults and symptoms of depression, anxiety, and stress indicating that young adults are more likely to experience racial discrimination. Due to the COVID-19 pandemic, the present study was also limited by time constraints and limitations on procedures that had to be conducted online. There were also difficulties obtaining participant data due to the technical issues with Qualtrics and Prolific. This research presents preliminary support and guidance for universities to create and execute mindfulness projects and activities to help university students understand the importance of sleep quality and stress coping symptoms. Research on discrimination and symptoms of depression, anxiety, and stress is important because these symptoms occur on a daily basis, and understanding the potential factors, such as age or gender, that could influence coping mechanisms is essential.

Future Directions

While the present study has some limitations, future studies should evaluate the discriminatory index in terms of more diverse populations and different dimensions of stress, such as social, financial, emotional, etc. The participants' financial income could be studied to further understand the impact of financial burdens on stress and sleep quality. Additionally, future research may investigate whether resilience plays a greater role in managing situational stress and having an impact on sleep quality. Moreover, future studies can be conducted on stressors that are comparable across age groups in order to better understand the relationship between age, gender, stress response, and sleep quality. Similarly, future research should also explore how race and ethnicity affect coping with racial discrimination, DASS, and sleep quality.

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