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The Effect of a Health Educational Program on Sleep Related Health Outcomes

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Table of Contents

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Abstract

Sleep quality has effects on both physical and mental health. Because of this, sleep hygiene is an important health goal. Participation in health programs promoting healthy behaviors has helped people reach their health goals and elicited positive behavior change. Because of this, it was of interest to determine if participation in a virtual, multi-media health education program improved health and wellbeing outcomes of Arkansans. The main objective of this study was to determine the effect of a 20-week behavior and health educational program on the ability of participants to achieve their health goals and improve their health behaviors related to sleep quality. Other aspects of health such as emotional states (depression, anxiety, and stress) over time in the program were also measured. The study used data from surveys taken at 0 weeks, 10 weeks, and 20 weeks to determine changes in sleep quality and emotional states. Sixty-eight people in total participated in the study. Out of the 68 participants, only 17 completed the required survey at all three time points for sleep quality data. Out of 68 total participants, only 19, 18, and 17 participants finished the portions of the survey for depression, anxiety, and stress scores, respectively, at all three times. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), and emotional states were measured by the Depression, Anxiety and Stress Scale (DASS). A higher sleep quality score indicates poorer sleep quality. Although the mean sleep quality score decreased over the course of the program, the relationship between duration of participation in the program and sleep quality score was not found to be significant. The relationship between duration of participation in the program and emotional state was not found to be significant. Although there was no association found between participation in a health educational program and on sleep quality, more research is still needed with a larger sample size.

Introduction

Sleep quality has both short-term and long-term effects on health (Medic et al. 2017). Disruptions in sleep have short-term consequences on memory and cognitive deficits, emotional distress, mood disorders, body pains, increased stress responsibility, and an overall reduced quality of life (Medic et al. 2017). Along with these short-term consequences, there are long-term consequences associated with sleep disruptions such as weight related issues, hypertension, cardiovascular disease, type 2 diabetes, and metabolic syndrome (Medic et al. 2017). In a longitudinal sleep cohort study, it has been found that sleep deprivation leads to elevated levels of ghrelin and lower levels of leptin, two hormones important in appetite regulation (Taheri et al. 2004). These changes in levels of ghrelin and leptin contribute to increased appetite. In the study, people with decreased sleep had a higher BMI and had higher fluctuations of ghrelin and leptin hormones (Taheri et al. 2004). This suggests that chronic decreased sleep can potentially lead to obesity due to dysregulated appetite.

Metabolic syndrome refers to a variety of factors that can predict the risk of type 2 diabetes mellitus and cardiovascular disease (Jennings et al. 2007). Some of these factors include obesity, high blood pressure, high fasting serum concentrations of triglycerides, and low serum high-density lipoprotein cholesterol (Jennings et al. 2007). It was found that sleep quality measured by the Pittsburgh Sleep Quality Index related significantly to three measures of obesity which were body mass index, fat percentage, and waist circumference and three measures of insulin resistance which were fasting glucose concentration, fasting insulin concentration, and estimated insulin resistance. A poor PSQI score was significantly associated with metabolic syndrome (Jennings et al. 2007).

One study found a significant association between sleep quality and mental and physical health (Clement-Carbonell et al. 2021). Sleep quality was measured by the Pittsburgh Sleep

Quality Index. This particular study showed a stronger association between sleep quality and mental health than sleep quality and physical health (Clement-Carbonell et al. 2021). This suggests that poor sleep quality could negatively affect mental health.

For reasons stated above, good quality sleep is important for a healthy life. Setting goals to obtain good quality sleep may prove to be beneficial in the short term and in the long term. Behavioral change can be elicited from participation in programs that promote a healthy lifestyle. The Noom smartphone app is an example of this type of program. On the Noom smartphone app, users set a target weight as their goal. The users also input their current weight and daily food intake. Based on that data and recorded physical activity by the app, Noom provides reports on users' weight trends, nutritional summaries of their diet, and exercise recommendations for their weight loss related goals (Chin et al. 2016). It was found that usage of the app led to successful weight reduction. In a study, 77.9% of the participants who used the app observed weight loss (Chin et al. 2016). It was also found that a critical factor in determining successful weight loss was input frequencies of diet, weight, and exercise (Chin et al. 2016). Regular and increased participation is needed to attain health goals.

Behavioral lifestyle interventions can not only improve physical health but also mental health. In a systematic review of studies, it has been found that behavioral lifestyle interventions can help treat obesity. It was found that the more intensive and comprehensive a behavioral lifestyle intervention was, there was more success in weight loss for patients with moderate and severe obesity (Lv et al., 2017). In another study of obese older adults, weight loss interventions had a beneficial effect on physical quality of life and mental health (Payne et al. 2018). The researchers in this study believe that the psychological benefits from participation in the weight loss behavioral intervention program are likely due to social support, the effect of weight loss on

health, and improvement in physical function (Payne et al. 2018). Behavioral interventions can help people improve different aspects of their health.

Participation in health promotion activities can improve health behaviors. This has been found in a study where health care employees participated in health promotion activities. The health promotion activities included lectures by the hospital that promote healthy behaviors. Overall, it was found that increased participation in health promotion activities was associated with engagement in better health behaviors (in diet, exercise, etc.) (Chiou et al. 2014). This is an example of participation in a health program that leads to better health behaviors.

Another example of a health program improving aspects of health for participation was a five-week psycho-educative health promotion program. In one study, migrants participated in a five-week psycho-educative health promotion program led by community health workers (Wrede et al. 2021). The program promoted health literacy and participants learned more about how to adapt to the situation they were in (being immigrants in another country). This study suggests that health promotion programs have potential to improve mental health (Wrede et al. 2021). Participation in such programs can improve different aspects of health.

In addition, social support is one technique that helps promote health behavior change. Social support includes material resources, emotional care, and affirmative feedback (Jane et al. 2018). Social support can also simply be the feeling that help is there when it is needed. It has been found that interpersonal connections have a mediating effect on behavior change (Jane et al. 2018). Studies have found that social media is a source of social support for many people (Jane et al. 2018). There are many ways to offer social support to people. Participating in a program that offers social support in any way can help promote healthy behavior change. Social support can lead to physical and mental health benefits.

Evidence from the National Institute for Health and Clinical Excellence, UK (NICE) suggests that if physicians engage more with patients about smoking cessation, there will be reductions in smoking prevalence (Stead et al. 2009). Educating and engaging people about health can promote beneficial wellness behaviors. Promoting wellness behaviors can have an overall positive impact on health, including physically and mentally. Getting better sleep is a healthy behavior. Behavioral change can be elicited from participation in programs that promote a healthy lifestyle and offer social support.

Since it has been found that health educational programs also have a positive effect on many different aspects of health, this study analyzed the effect of the health educational program on sleep quality and emotional states.

The **objective** of this study was to determine the effect of a 20-week behavior and health educational program on the ability of participants to achieve their health goals and improve their health behaviors related to sleep quality. Other aspects of health such as emotional states (depression, anxiety, and stress) were also measured over the duration of the 20-week behavior and health educational program.

We **hypothesized** that attending the behavior and health program would improve the sleep quality of participants and that increased participation in the program would lead to greater success in attaining their goals related to sleep quality. A secondary hypothesis is that emotional state would improve over time during the attendance of the program.

Research Questions

The individual research questions in this study are listed below:

1)   Is participation in a health educational program associated with increased sleep quality?

- We hypothesized that attending the behavior and health program will improve the sleep quality of participants.

2) Is there an association between participation in a health educational program and improved emotional state?

- We hypothesized that emotional states will improve over time during the attendance of the program.

Materials and Methods

Study Design. Participants followed the DFEND (Diet, Food, Exercise, and Nutrition During social distancing) educational program for 20 weeks . The DFEND3 website has content and information about the program (For reference: https://aaes.uada.edu/centers-and-programs/nutrition/dfend-3/). The DFEND educational program consisted of weekly educational sessions which took place via Zoom. In addition to the weekly educational sessions, participants had the option to talk to personalized coaches in nutrition, physical activity, and behavior each week to ask specific questions pertaining to their health goals. They were also able to participate in a private Facebook group and view tutorials on the Arkansas Nutrition and Exercise YouTube channel. The data came from pre-, mid-, and post-surveys (0 weeks, 10 weeks, and 20 weeks) taken by participants. These surveys were self-reported online questionnaires. This data was collected from February 2021 to July 2022. This study was approved by the Institutional Review Board at the University of Arkansas.

Participants. The participants in the study lived throughout Arkansas and included members of the University of Arkansas System community including students, faculty, staff, and community members. Participants had to be 18 years or older and have access to email, internet, and Facebook to participate. There were no additional restrictions for participation in the study. At

the beginning, middle, and end of the study, participants were asked to complete the DFEND digital survey via Qualtrics. The DFEND survey assessed health behaviors, physical and mental health, and student/work-related outcomes. The data in this study came from these surveys.

Recruitment. Participants were recruited using advertisements through the University digital newspaper (Arkansas News), the Food Science Department and Center for Human Nutrition websites, and University of Arkansas System Division of Agriculture listservs. Social media, email, and word-of-mouth aided in recruitment as well.

Sleep. Sleep quality was assessed through the Pittsburgh Sleep Quality Index (PSQI). Participants completed the PSQI in the DFEND survey at 0 weeks (baseline), 10 weeks, and 20 weeks into the study. The PSQI is a self-rated questionnaire. It assesses sleep quality and disturbances over the duration of one month through a total computed score (Buysee et al. 1989). Seven component scores for subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction are calculated from nineteen individual items on the questionnaire. The sum of the component scores gives a global score (Buysee et al. 1989). The global score measures overall sleep quality. A global score of greater than five indicates poor sleep quality.

Emotional States. The Depression, Anxiety and Stress Scale (DASS -21) was used to measure the emotional states of depression, anxiety, and stress. Participants completed the DASS-21 in the DFEND survey at 0 weeks (baseline), 10 weeks, and 20 weeks into the study. It is a self-reported questionnaire where participants rate twenty-one items on how much it applies to them over the previous week, from 0 being "Did not apply to me at all" and 3 being "Applied to me

10

very much, or most of the time." (Wood et al. 2010). Participants get three scores for the subscales, depression, anxiety, and stress. Based on the subscale score, the severity for depression, anxiety, and stress emotion states are determined (Wood et al. 2010).

Other Measured Factors. Demographic data of the participants were collected including information on pre-existing health conditions. Before each weekly DFEND session, demographic information such as age, gender, location, and ethnicity/race were collected. Participation was measured by Zoom attendance and by views of the session on the YouTube channel. Visits and comments to the Facebook page were recorded in an excel file and stored in a secure file. Participants were asked to take the DFEND survey at the beginning of the program (0 weeks into the program), the middle (at 10 weeks), and at the end of the program (at 20 weeks). The DFEND survey assessed health behaviors, physical and mental health, and student/work-related outcomes. Cognitive performance of participants using questionnaires on presenteeism, absenteeism, and work satisfaction (using the Health and Work Questionnaire) were assessed. Participants also completed the IPAQ (International Physical Activity Questionnaire) long.

Data Collection and Management. The data was collected from the DFEND program participants using Qualtrics. The Pittsburgh Sleep Quality Index scores and DASS-21 survey scores at 0 weeks (baseline), 10 weeks, and 20 weeks into the were analyzed using GraphPad Prism Software. The demographic data of the participant population was collected at the beginning of the program. The total number of participants and percentage of participants belonging to a certain race, gender, ethnicity were determined. A gender ratio breakdown was also determined. The number of total participants who reported their age, mean age of total reported participants, and standard deviation of total participants were calculated. The total

number of participants surveyed for having a condition or related health problem and percentage of participants having the condition were determined.

To analyze PSQI and DASS-21 data, these tables were created: a table summarizing all participants who completed the pre-survey, a table summarizing all participants who completed the pre-survey and mid survey, and a table summarizing all participants who completed the pre-survey, mid-survey, and post-survey. For PSQI, total participants (n), mean score, standard deviation, and proportion of participants with a global PSQI score of greater than 5 were determined. For DASS-21, total participants (n), mean score, and standard deviation were determined.

Statistical Analysis.

Sleep

A one-factor analysis of variance (ANOVA) was used to determine if there were statistically significant differences between PSQI scores at different time points (0 weeks, 10 weeks, and 20 weeks). The change between PSQI scores at baseline (0 weeks) and at 20 weeks was calculated and was analyzed to find a statistically significant difference.

Emotional States

A one-factor ANOVA was used to determine if there were statistically significant differences between DASS-21 depression scores at different time points (0 weeks, 10 weeks, and 20 weeks). A one- factor ANOVA was used for anxiety and stress scores in the same method.

Results

<u>Participant Demographics</u>

In total, 68 people participated in the study. The participant demographics are outlined in Table 1. The participant demographics include gender, race, ethnicity, and age. The table shows the total number of participants from each gender, race, and ethnicity subcategory as well as the percentage of participants in each subcategory out of the total sample population. The gender ratio of female to male participants is 5.8:1. 66 out of 68 participants reported age. Table 1 shows the mean age and standard deviation of ages reported by participants.

Table 1. Participant Demographics. Demographic information of all participants in DFEND program are listed.

Population Demographics		
	Total (n)	Percent of Sample (%)
Gender		
Female	58	85.3
Male	10	14.7
Race		
White	51	75.0
Black	5	7.3
Asian/Pacific Islander	2	2.9
Indian/Alaskan	2	2.9
Other	8	11.8
Ethnicity		
Hispanic	4	5.9
Non-Hispanic	64	94.1
Age		
Total Reported (n)	Total Reported (Mean)	Total Reported (SD)
66	41.3	16.4

Table 2 outlines the total number of participants who responded about a pre-existing condition or related problem, the total number of participants having said pre-existing condition or related problem, the total number of participants not having said pre-existing condition or related problem, and the percentage of participants having the condition out of total participants who were surveyed for the condition.

Table 2. Pre-Existing Conditions. DFEND program participants' pre-existing conditions and related problems are listed.

Pre-Existing Conditions				
	Total Surveyed for Condition (n)	Total Reporting Not Having Condition or Related Problems (n)	Total Reporting Having Condition or Related Problems (n)	Percentage of Those Having Condition or Related Problems out of Total Surveyed (%)
Asthma	63	58	5	7.9
Hypertension	64	43	21	32.8
Bladder	63	59	4	6.4
CAD	62	60	2	3.2
Cholesterol	64	50	14	21.9
Epilepsy	63	62	1	1.6
Kidney	63	61	2	3.2
Headache	63	50	13	20.6
Anemia	63	52	11	17.5
Diabetes	64	61	3	4.7

Table 3 outlines the total number of participants who completed the PSQI and DASS-21 survey at 0 weeks, 10 weeks, and 20 weeks into the study, total mean score, and standard deviation for PSQI and DASS scores. Table 3 also shows the proportion of the population at each of the three times with a PSQI global score of greater than 5, indicating poor sleep quality.

A total of 17 participants out of 68 participants in the DFEND program completed all three PSQI surveys at 0 weeks, 10 weeks, and 20 weeks.

For the DASS-21 survey, 19 participants had depression subscale scores for all three survey time periods (0, 10, and 20 weeks). 18 participants had anxiety subscale scores at 0, 10, and 20 weeks. 17 participants had stress subscale scores at 0, 10, and 20 weeks. This discrepancy of participants may be due to skipped questions in a subscale in the DASS-21 survey.

Table 3. Survey Data. PSQI and DASS score information for 0, 10, and 20 weeks are listed.

	Total (n)	Total Score (Mean)	Total (SD)	Proportion of Population with Score >5 (Poor sleep)
PSQI 0 Weeks (Baseline)				
	17	5.76	3.15	0.59
PSQI 10 Weeks				
	17	5.00	2.35	0.53
PSQI 20 Weeks				
	17	4.29	3.25	0.18
	Total (n)	Total Score (Mean)	Total (SD)	
DASS-21 0 Weeks (Baseline)				
Depression	19	7.26	5.59	
Anxiety	18	5.33	4.28	
Stress	17	8.47	8.20	
DASS-21 10 Weeks				
Depression	19	6.11	5.44	
Anxiety	18	5.78	5.17	
Stress	17	8.24	6.12	
DASS-21 20 Weeks				
Depression	19	6.11	6.58	
Anxiety	18	3.11	2.59	
Stress	17	8.24	8.69	

<u>Sleep Quality</u>

      Figure 1 shows plot points of all the PSQI global scores of the participants as well as the mean score of all the participants at different time points (0 weeks, 10 weeks, and 20 weeks). It also shows the plot points of changes in PSQI scores for all the participants from baseline 0 weeks to 20 weeks and the mean change from baseline 0 weeks to 20 weeks. Figure 2 shows only the mean PSQI global scores of all the participants at different time points (0 weeks, 10 weeks, and 20 weeks).

      The one-factor ANOVA determined if there were statistically significant differences between PSQI scores at different time points (0 weeks, 10 weeks, and 20 weeks). The p-value was 0.3546. Since it was greater than 0.05, there was not a significant difference among the mean PSQI scores at different time points.

Figure 1. PSQI Global Scores. PSQI global scores for the three survey time points and PSQI score change (from 0 weeks to 20 weeks) of participants are represented by black dots. The mean score of participants for the three survey time points and mean score change of participants are represented by bars. Error bars represent the standard deviation of data.
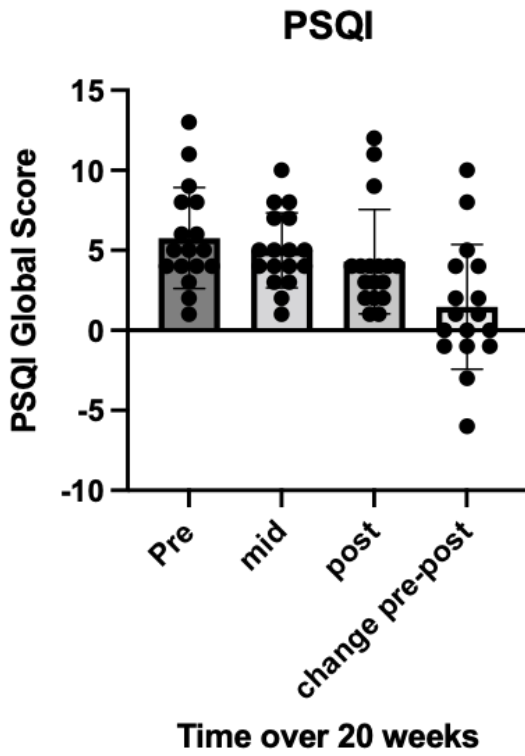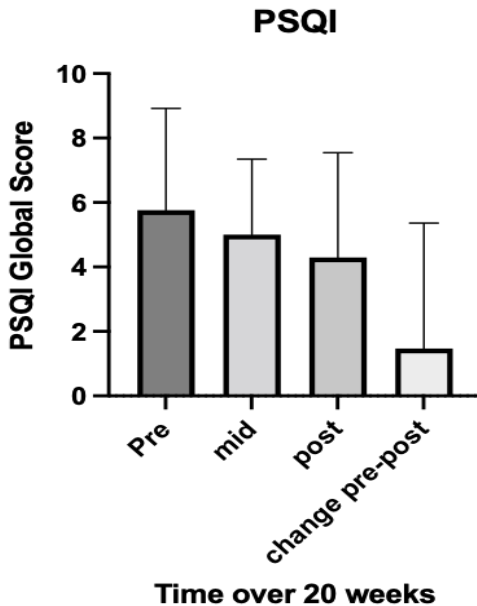
Figure 2. PSQI Global Scores Mean. The mean PSQI global score of participants for the three survey time points and the mean score change of participants are indicated by bars. Error bars represent the standard deviation of data.

Emotional States

Figure 3 shows plot points of all the DASS depression scores of the participants as well as the mean score of all the participants at different time points (0 weeks, 10 weeks, and 20 weeks). It also shows the plot points of changes in DASS depression scores for all the participants from baseline 0 weeks to 20 weeks and the mean change from baseline 0 weeks to 20 weeks. Figures 5 and 7 outline the same type of information as Figure 3 but for anxiety and stress data respectively.

Figure 4 shows only the mean DASS depression scores of all the participants at different time points (0 weeks, 10 weeks, and 20 weeks). Figures 6 and 8 outline the same type of information as Figure 4 but for anxiety and stress data respectively.

One-factor ANOVA was used for each subscale (depression, anxiety, and stress) to determine statistically significant differences between DASS scores at different time points (0

weeks, 10 weeks, and 20 weeks). For depression scores, the p-value was 0.8208, and therefore it was not statistically significant. For anxiety scores, the p-value was 0.1296, and therefore not statistically significant. For stress scores, the p-value was 0.9948, and not statistically significant.

Figure 3. DASS-21 Depression Scores. DASS depression scores for the three survey time points and PSQI score change (from 0 weeks to 20 weeks) of participants are represented by black dots. The mean score of participants for the three survey time points and mean score change of participants are represented by bars. Error bars represent the standard deviation of data.
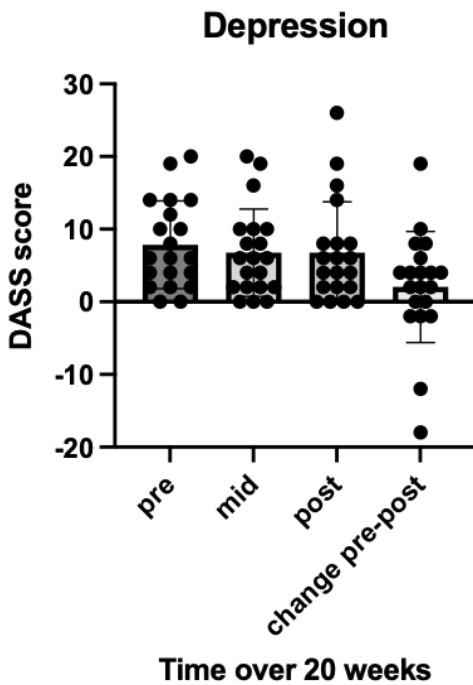
Figure 4. DASS-21 Depression Mean Scores. The mean DASS depression scores of participants for the three survey time points and mean score change of participants are represented by bars. Error bars represent the standard deviation of data.
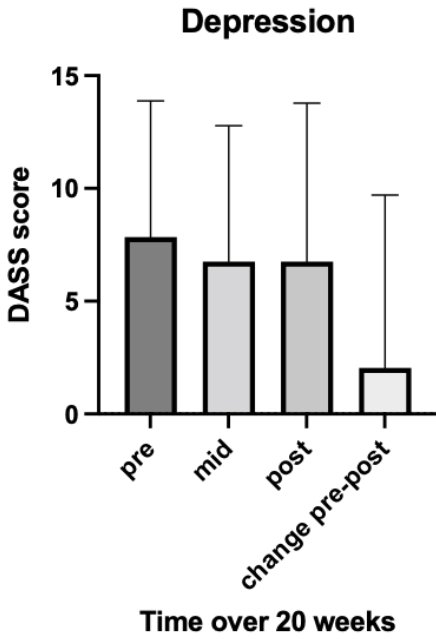
Figure 5. DASS-21 Anxiety Scores. DASS anxiety scores for the three survey time points and PSQI score change (from 0 weeks to 20 weeks) of participants are represented by black dots. The mean scores of participants for the three survey time points and mean score change of participants are represented by bars. Error bars represent the standard deviation of data.
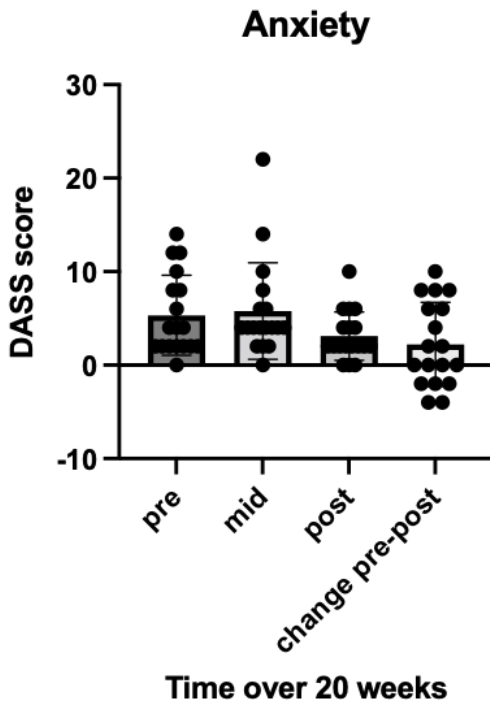
Figure 6. DASS-21 Anxiety Mean Scores. The mean DASS anxiety scores of participants for the three survey time points and mean score change of participants are represented by bars. Error bars represent the standard deviation of data.

Figure 7. DASS-21 Stress Scores. DASS stress scores for the three survey time points and PSQI score change (from 0 weeks to 20 weeks) of participants are represented by black dots. The mean scores of participants for the three survey time points and mean score change of participants are represented by bars. Error bars represent the standard deviation of data.
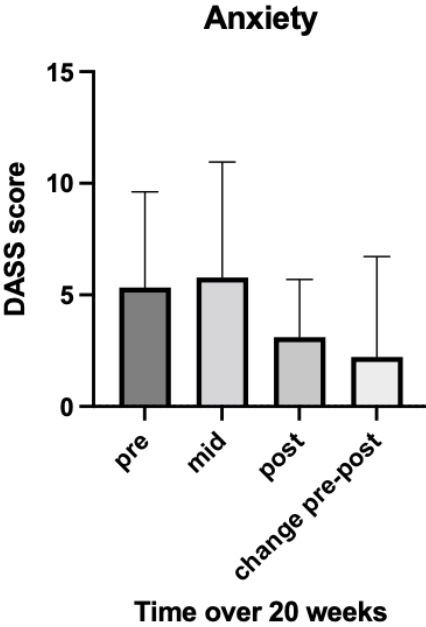
Figure 8. DASS-21 Stress Mean Scores. The mean DASS stress scores of participants for the three survey time points and mean score change of participants are represented by bars. Error bars represent the standard deviation of data.
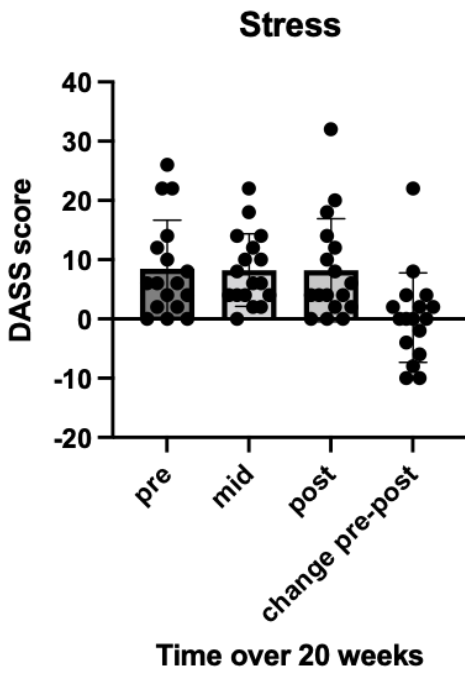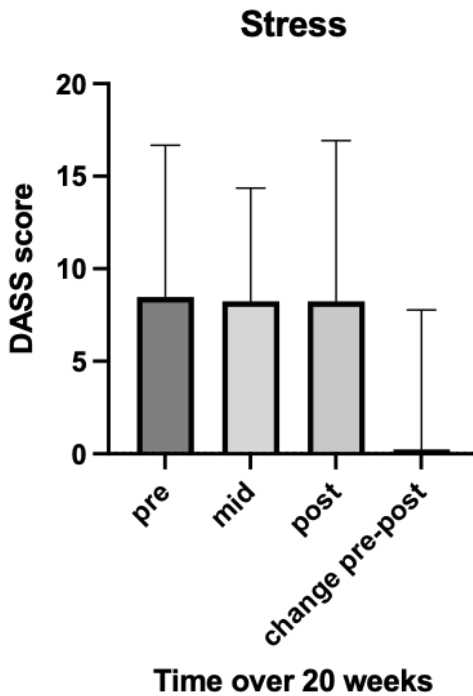

Discussion

Poor sleep quality can have adverse effects on physical and mental health with both short term and long-term consequences. Studies have found evidence that changes in sleep duration and sleep-disordered breathing can play a role in insulin resistance, type-2 diabetes, obesity, cardiovascular disease, and metabolic syndrome (Koren et al. 2016). In another study, poor sleep quality has been found to have a significant relationship with hypertension (Lo et al. 2018). Sleep quality negatively affects physical health in many ways, especially when related to metabolic syndrome related diseases.

Metabolic syndrome refers to a variety of factors (including but not limited to obesity, high blood pressure, and low serum HDL cholesterol) that can predict the risk of Type 2 diabetes mellitus and cardiovascular disease (Jennings et al. 2007). It has been found in a survey that

there was more than a 35% increase in metabolic syndrome prevalence from the years 1988-1994 to 2007-2012 among adults in the United States (Moore et al. 2017). The increase in prevalence in metabolic syndrome in the United States is a concern for many. Since sleep hygiene has an impact on metabolic syndrome, how one can improve sleep quality is a research topic of interest.

Sleep quality can also impact mental health. Results from a study of university students suggest that there is a significant relationship between sleep quality and depressive symptoms (Dinis and Bragança 2018). Another study found a strong association between sleep quality and mental health (Clement-Carbonell et al. 2021). Sleep quality has an association with mental health. This is why it was also of interest to look at mental health changes throughout the duration of the DFEND program.

The main objective of this study was to determine the effect of a 20-week behavior and health educational program on the ability of participants to achieve their health goals and improve their health behaviors related to sleep quality. The hypothesis was that attending the behavior and health program will improve the sleep quality of participants and that increased participation in the program will lead to greater success in attaining their goals related to sleep quality. Another hypothesis was that emotional state would improve over time during the attendance of the program. Over time, the mean global PSQI scores of participants decreased over time from 0 weeks, 10 weeks, and 20 weeks. However, the relationship between duration of participation in the program and PSQI score was not found to be significant. The mean DASS-21 depression and anxiety scores decreased from 0 weeks to 20 weeks. The mean DASS-21 stress score had a very slight change (less than one point) from 0 weeks to 20 weeks. However, none of the DASS-21 scores had a significant relationship with participation in the program.

Participation in health educational and similar programs promote positive health behaviors and reaching health goals. One reason why positive health behaviors could have been promoted is because of the presence of social support (Jane et al. 2018). The DFEND program offered social support. There were experts participants could talk to, and participants met with speakers and other participants every week. Social support was also found in the usage of social media. In addition to attending the weekly meetings, participants were able to participate in a Facebook group. These many avenues of social support could be a reason for improved health outcomes among participants in the DFEND program.

Even though the results from this research were not statistically significant, it is worth noting that mean scores for sleep quality decreased over time. The limitations of this study were the small sample size and the self-reported aspect of the surveys. Only 68 people participated in the study. Not every participant completed all the surveys. Out of the 68 participants, 17 completed all three survey portions for PSQI. 19 out of 68 participants had depression subscale scores for all three survey portions for DASS-21. 18 out of 68 participants had anxiety subscale scores, and 17 of 68 participants had stress subscale scores. This discrepancy of number of participants with depression, anxiety, and stress scores may be due to skipped questions in a subscale in the DASS-21 survey. If more people in the study participated in all of the surveys, it might have been possible to collect statistically significant data. It could also be possible to have statistically significant data if there were more total participants in the study. This could have been possible through better outreach. The surveys were self-reported online questionnaires which could mean that participants may not have accurately assessed and reported their behaviors. The gender ratio of the participants was imbalanced because there were more females. This could limit generalizability of the results.

More research could be done to see how health educational programs that promote healthy behaviors have an impact on sleep quality and participants trying to reach their sleep-related goals. It would also be interesting to see how health educational programs have an effect on other health goals, behaviors, and outcomes as well. This research is important because health educational programs can potentially improve a person's health and well-being.

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