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THE EFFECTS OF AN INTENSIVE LIFESTYLE MODIFICATION PROGRAM ON SLEEP AND STRESS DISORDERS

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Abstract: Background. To determine if a lifestyle change program can modify behavior to reduce sleep and stress disorders. Methods. Analyses are based on 2,624 individuals aged 30 to 80 years from the Rockford, Illinois metropolitan area who completed a lifestyle evaluation at baseline and again after four weeks, following participation in a 40-hour educational course given over a four-week period. Participants receive instruction on the importance of making better lifestyle choices related to making long-term improvements in nutrition and physical activity and they learn ways to improve sleep and reduce stress in their lives. Results. Significant percent decreases were observed in the number experiencing selected sleep or stress disorders from baseline to four weeks later for "sleeps restlessly" (-59%), "suffers from insomnia" (-64%), "feels under pressure" (-37%), "easily emotionally upset" (-52%), and "feels fearful or depressed" (-61%). Experiencing a selected sleep or stress disorder after four weeks among those who had the disorder at baseline was significantly more likely in those not physically active and/or not having lowered their BMI after four weeks. Changes in alcohol consumption and smoking did not significantly contribute to changes in the disorders. Those who failed to lower their coffee/tea use after four weeks were significantly more likely to have a sleep disorder and be easily emotionally upset. Conclusions. Changes in lifestyle behaviors after attending an educational program significantly reduced sleep and stress disorders in as little as four weeks, primarily explained by decreasing BMI and/or increasing exercise.

Key words: Alcohol, BMI, coffee/tea, exercise, lifestyle intervention program, mental illness, prevention.

Introduction

Depression and other types of mental illness represent a major public health problem in the United States (1). During 2001 and 2002, 6.6% of adult Americans reported a major depressive disorder in the past year and 16.2% indicated a major depressive event in their lifetime (2). Among those, 78.5% and 72.1%, respectively, also experienced other mental health disorders, such as anxiety. In addition, several studies have associated mental illness with substance abuse (3-5). Mental health disorders resulting in poor quality of life and daily functioning problems equal or exceed chronic health problems, such as heart disease, diabetes, arthritis, and gastrointestinal complications (6). Depression and depressive symptoms have been previously associated with a host of health problems, including diabetes, chronic pain, migraine headaches, gastrointestinal problems, Alzheimer-type dementia, cancer, acquired immunodeficiency syndrome, and neurological conditions such as stroke and Parkinson's disease (7).

The widespread use of antidepressant medication in the US illustrates the magnitude of mental health disorders. The percentage of adults in the US who reported using antidepressant medication increased from 3% (3% in women and 2% in men) in 1988-94 to 7% (10% in women and 4% in men) in 1999-2000 (1). The increase in antidepressant use doubled or tripled in each of the age groups 18-44, 45-65, and 65 years and older. Based on data from the National Ambulatory Medical Care Survey and the National Hospital Medical Care Survey, antidepressant visit rates increased from 17% of adults in 1995-96 to 28% of adults in 2001-02 (1). The rate of antidepressant visit rates increased for both men and women, although the increase for women was twice that for men. The rate of antidepressant visits was observed for adults in each age group.

There is evidence that mental health disorders, in part, are influenced by diet, weight, and exercise. Deficiencies in the B complex of vitamins have been associated with depressive disorders (8, 9), and excessive alcohol intake has been linked with deficiencies in these vitamins (10). In addition, alcohol as a depressant can worsen existing depression (11). On the other hand, caffeine may increase energy levels in depressed people, but can prevent deep, restful sleep, which is necessary for well-being, and raise anxiety levels (12). Studies have also shown that weight loss can result in improved mood state, psychosocial functioning and mental well-being, as well as decrease depression and anxiety (13-16). Finally, several review articles have summarized the positive effects of exercise on mood, anxiety, and depression (17-21). In a study of older patients with major depressive disorders, exercise was observed to be a reasonable alternative to antidepressant medication (22).

The Coronary Health Improvement Project (CHIP) was created with the goal of reducing diseases and improving the overall health of the public by providing a lifestyle enhancing

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program to both community and workplace (23-26). CHIP, an educationally-centered program highlights in 40 hours of exposure time the importance of making better lifestyle choices in hopes of preventing, arresting, and reversing physical and mental health problems. The program teaches participants how to make changes in diet, physical activity, and smoking habits. A recent randomized clinical trial assessing the efficacy of the program found that significant lifestyle improvements were recorded at the end of the four-week intervention. The improvements were seen in health knowledge, nutrition and physical activity behavior, and in many chronic disease risk factors, such as total cholesterol, low-density lipoprotein cholesterol, blood glucose levels, systolic and diastolic blood pressure, and resting heart rate (26).

Between April 1999 and May 2001, the CHIP program was administered five times in the Rockford, Illinois metropolitan area. Participants in the program completed a lifestyle evaluation prior to the beginning of the program and again after four weeks. The questionnaire included questions on sleep and stress disorders. The purpose of the current study is to determine whether modifying diet, weight, and exercise through the CHIP program resulted in fewer selected sleep and stress disorders.

Materials and Methods

Participants voluntarily enrolled in the program classes through the SwedishAmerican Center for Complimentary Medicine (SACCM). SACCM targeted adults in the greater Rockford, Illinois metropolitan area through advertising, marketing through the Centers of Excellence, CHIP alumni groups, corporate client sites, and the SwedishAmerican Medical Group. Participants were highly encouraged to participate with a spouse or significant other. The study was approved by the Institutional Review Board of the SwedishAmerican Health System, January 2003.

The intervention consisted of both live and video version of the CHIP (23). Approximately 75%-80% participated in the live version. Participants met for two hours, four times a week for four week to received instruction. The curriculum topics cover modern medicine and health myths, atherosclerosis, coronary risk factors, obesity, smoking, dietary fiber, dietary fat, diabetes, hypertension, cholesterol, exercise, osteoporosis, cancer, lifestyle and health, the Optimal Diet, behavioral change, and self-worth. Instruction on improving sleep and reducing stress was subliminally inserted; that is, it was discussed that no coffee and exercise promoted better sleep and oxygen utilization.

Along with the program lectures, participants received a textbook and workbooks. These products closely follow the discussion topics and contain assignments with learning objectives for every topic. The purpose of the assignments is to help participants better understand and integrate the concepts and information presented in the class. Participants had access to scheduled grocery shopping tours and cooking demonstrations given to further support program objectives. Additionally, medical professionals and community health advocates were invited to speak, providing nutritional, health fitness, and medical information.

At each of the classes a lecturer presided to answer questions regarding the presentations, workbook assignments, and the program, with assistance from program staff. Participants are guided and motivated to set progressive dietary and exercise goals. The dietary goals include adopting a more plant-food centered diet with an emphasis on unrefined complex carbohydrate foods (65–70% of total calories), such as grains, legumes, vegetables, and fresh fruits. The diet is low in fat (less than 20% of energy), animal protein, sugar, and salt, very low in cholesterol, and high in fiber and micronutrients.

Program participants progressively work toward walking at least 30 minutes a day. Participants maintained daily exercise logs and recorded miles walked. Upon completion of the intensive four-week instructional program, participants are encouraged to enroll in the CHIP alumni association. CHIP alumni receive a monthly newsletter, have socials, dinners, and special events designed to help them maintain their new behaviors.

The lifestyle evaluation completed by participants before and after the four-week program, provided information on demographics, health history, dietary behavior, sleep and stress disorders, smoking and exercise status. Data on weight and height is collected, facilitating the calculation of the Body Mass Index (BMI). Demographic information includes gender, age at baseline, and marital status. Dietary information included the weekly intake of alcohol and coffee/tea. Sleep data were gathered using the Pittsburgh Sleep Quality Index (27, 28). Stress measures were gathered using questions from the State-Trait Anxiety Inventory (29, 30). Three stress variables ("feel under pressure," "easily emotionally upset," and "feel fearful or depressed") were used in the final analysis. Participants indicated "yes" to whether they were experiencing these sleep or stress disorders. The smoking variable used was their current smoking status. The exercise variable had four levels: "none," "mild 2-3 days/week," "moderate 3-5 days/week," and "vigorous 4-6 days/week." Trained program staff measured weight and height using standard medical weight and height scales regularly calibrated by the Biometrics Department of the SwedishAmerican Hospital. BMI is determined using the formula: weight (kg)/height (m^2).

The Mantel-Haenszel chi-square test was used to evaluate change in trend (31). The t-test was used for assessing differences in means (32). Repeated measurements on proportions were assessed using the McNemar Test (33). Risk ratios of experiencing a sleep or stress disorder after four weeks among those who experienced the disorder at baseline are estimated according to the levels of selected variables. Analyses were performed using SAS version 9.0 (SAS Institute Inc., Cary, NC, USA, 2003). Procedure statements used in SAS

for assessing the data were PROC UNIVARIATE, PROC FREQ, and PROC TTEST. Statistical significance and confidence intervals are based on the 0.05 level.

Results

Of 2,717 participants in the program, 96.6% (2,624) completed the lifestyle evaluation at both baseline and after four weeks. Analyses were based on this group of individuals. Participants ranged in age from 30 to 80 (M = 54.2, SD = 10.6). Some 65.6% were female, 34.4% males. Approximately 79.2% of the participants were married. The distribution of the consumption of alcohol and coffee/tea, BMI, smoking, and exercise at baseline and after four weeks is shown in Table 1. A significant movement occurred toward lower use of alcohol and coffee/tea, improved BMI, less smoking, and more exercise.

The number of alcohol drinkers who stopped drinking after four weeks fell by 45.6% (from 1,068 to 581). The number of coffee/tea drinkers who stopped after four weeks fell by 22.8% (from 2,136 to 1,649). BMI decreased in 92.6% (2,415 of 2,607) of the participants. Among smokers, 35.6% (41) quit smoking after four weeks. There were 193 (7.6%) who remained physically inactive, 86 (3.7%) who decreased their vigorous physical activity, but still remained moderately physically active, 956 (37.5%) who maintained their baseline level of physical activity, and 1,311 (51.5%) who increased their physical activity.

The hypothesis that the proportion of participants experiencing a selected sleep or stress disorder remained constant after four weeks is rejected for each of the disorders (Table 2). The largest decrease occurred in those feeling fearful or depressed. The smallest decrease occurred in those feeling under pressure.

Participants experienced between zero and six of the conditions listed in Table 2. A significant decrease in the number of conditions from baseline to after four weeks is shown in Figure 1 [Chi-square(5) = 404.32, $p < .0001$]. For example, at baseline there were 1,025 participants who indicated they experienced no disorders. After four weeks this number increased to 1,669.

The risk of a selected sleep or stress disorder after four weeks among those with the disorder at baseline is presented according to selected demographic and health lifestyle variables (Table 3). The percentage of those who slept restlessly after four weeks among those who slept restlessly at baseline was 22% higher for females than males (marginally insignificant),

Table 1
Comparison of the distribution of BMI, smoking, alcohol and coffee/tea use, and exercise at baseline and after four weeks

	Baseline		After Four Weeks		
	No.	**%**	**No.**	**%**	**Chi-square(trend) P Value†**
Alcohol (average)					
None	1511	57.7	2020	77.1	< .0001
Weekly	894	34.1	538	20.5	
One or more per day	214	8.2	61	2.3	
Coffee/tea (average)					
None	479	18.3	964	36.8	< .0001
Weekly	574	21.9	690	26.4	
About one per day	743	28.4	637	24.3	
Two or more per day	823	31.4	328	12.5	
BMI (Kg/m^2)					
Underweight (< 18.5)	15	0.6	16	0.6	< .0001
Normal (18.5-24.9)	441	16.8	591	22.7	
Overweight (25.0-29.9)	834	31.9	847	32.5	
Obese (≥ 30.0)	1327	50.7	1154	44.2	
Smoker					
No	2509	95.6	2550	97.2	< .0001
Yes	115	4.4	74	2.8	
Exercise					
None	944	36.4	227	8.8	< .0001
Mild	901	34.8	891	34.6	
Moderate	638	24.6	1170	45.4	
Vigorous	108	4.2	287	11.2	

†Mantel-Haenszel chi-square test

Table 2
Comparison in the proportion of those selected sleep or stress disorders at baseline and after four weeks

	Baseline		After four Weeks			
	No.	**%**	**No.**	**%**	**% Change**	**McNemar Test P value**
Sleep restlessly	912	34.8	373	14.2	-59.1	< .0001
Suffer insomnia	262	10.0	94	3.6	-64.1	< .0001
Feel under pressure	893	34.0	562	21.4	-37.1	< .0001
Easily emotionally upset	581	22.1	280	10.7	-51.8	< .0001
Feel fearful or depressed	481	18.3	187	7.1	-61.1	< .0001

Figure 1
Number of sleep and stress disorders at baseline and after four weeks

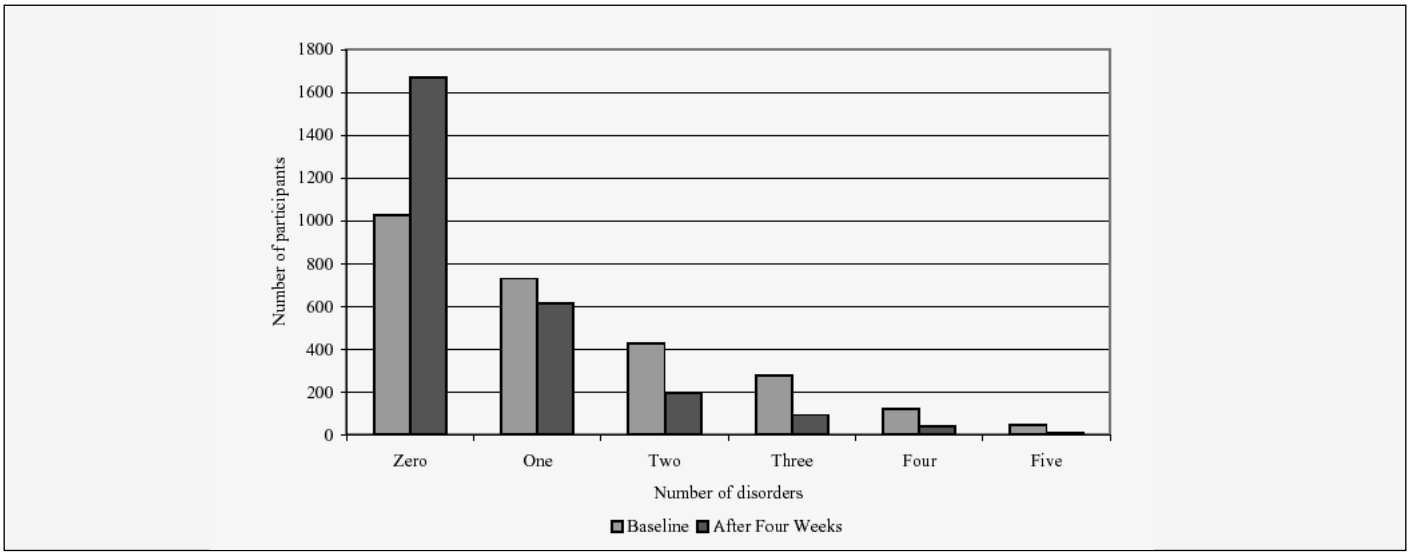
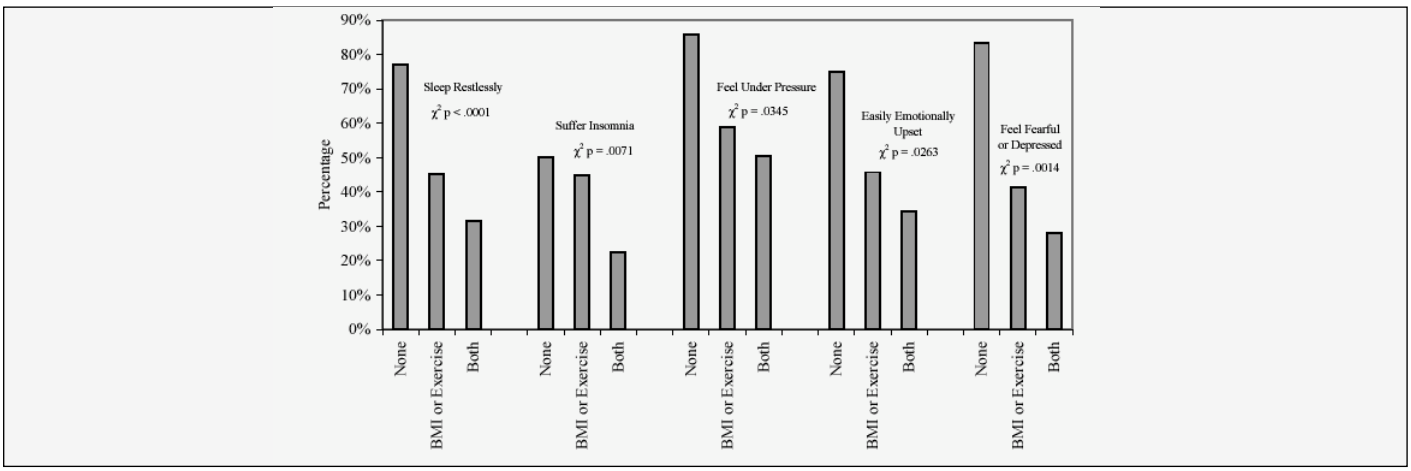


Figure 2
Percentage experiencing a sleep or stress disorder after four weeks among those who had the disorder at baseline according to exercise and BMI



None: Not physically active at least four weeks and no decrease in BMI. BMI or Exercise: Physically active at least four weeks only or decrease in BMI only. Both: Physically active at least four weeks and showed a decrease in BMI.

Table 3

Risk ratio of experiencing the disorder after four weeks among those who had the disorder at baseline according to selected demographic and health lifestyle risks

	Risk 1 %	Risk 2 %	Risk Ratio	95% Confidence Interval
Sleep restlessly				
(Risk 1 vs Risk 2)				
Females vs. Males	35.8	29.4	1.22	0.99, 1.50
Ages 54 and older vs. ages less than 54	34.5	32.8	1.05	0.88, 1.26
Not married vs. Married	35.8	32.9	1.09	0.88, 1.35
Alcohol use did not decrease vs. otherwise	38.1	35.8	1.06	0.75, 1.50
Coffee/tea use did not decrease vs. otherwise	37.8	30.5	1.24	0.99, 1.56
BMI did not decrease vs. otherwise	49.2	32.6	1.51	1.16, 2.00
Smoked after four weeks vs. otherwise	30.8	33.8	0.91	0.51, 1.63
Physically inactive after four weeks vs. otherwise	51.0	32.2	1.59	1.27, 1.98
Suffer insomnia				
(Risk 1 vs Risk 2)				
Females vs. Males	25.4	26.5	0.96	0.57, 1.61
Ages 54 and older vs. ages less than 54	26.9	25.0	1.08	0.72, 1.62
Not married vs. Married	27.6	24.9	1.11	0.71, 1.73
Alcohol use did not decrease vs. otherwise	27.3	20.0	1.36	0.61, 3.05
Coffee/tea use did not decrease vs. otherwise	26.3	22.0	1.20	0.65, 2.19
BMI did not decrease vs. otherwise	65.0	22.9	2.84	1.91, 4.22
Smoked after four weeks vs. otherwise	---	---	---	---
Physically inactive after four weeks vs. otherwise	32.1	25.8	1.25	0.70, 2.23
Feel under pressure				
(Risk 1 vs Risk 2)				
Females vs. Males	53.6	49.6	1.08	0.94, 1.24
Ages 54 and older vs. ages less than 54	53.3	51.2	1.04	0.92, 1.19
Not married vs. Married	57.4	50.3	1.14	0.99, 1.32
Alcohol use did not decrease vs. otherwise	54.8	51.0	1.07	0.84, 1.36
Coffee/tea use did not decrease vs. otherwise	53.8	52.5	1.02	0.87, 1.21
BMI did not decrease vs. otherwise	56.1	51.9	1.08	0.86, 1.35
Smoked after four weeks vs. otherwise	46.4	52.1	0.89	0.60, 1.33
Physically inactive after four weeks vs. otherwise	64.4	50.6	1.27	1.08, 1.49
Easily emotionally upset				
(Risk 1 vs Risk 2)				
Females vs. Males	37.4	33.8	1.11	0.85, 1.44
Ages 54 and older vs. ages less than 54	39.5	34.2	1.16	0.93, 1.43
Not married vs. Married	37.2	35.6	1.04	0.81, 1.35
Alcohol use did not decrease vs. otherwise	33.3	33.3	1.00	0.60, 1.66
Coffee/tea use did not decrease vs. otherwise	43.7	31.8	1.38	1.05, 1.80
BMI did not decrease vs. otherwise	51.0	35.4	1.44	1.07, 1.94
Smoked after four weeks vs. otherwise	40.0	36.4	1.10	0.58, 2.06
Physically inactive after four weeks vs. otherwise	46.2	35.6	1.30	0.97, 1.73
Feel fearful or depressed				
(Risk 1 vs Risk 2)				
Females vs. Males	30.9	31.0	1.00	0.73, 1.36
Ages 54 and older vs. ages less than 54	27.8	32.6	0.85	0.64, 1.13
Not married vs. Married	37.4	27.7	1.35	1.02, 1.78
Alcohol use did not decrease vs. otherwise	21.7	31.3	0.69	0.31, 1.56
Coffee/tea use did not decrease vs. otherwise	29.1	28.7	1.01	0.69, 1.49
BMI did not decrease vs. otherwise	47.1	29.6	1.59	1.08, 2.33
Smoked after four weeks vs. otherwise	44.4	30.0	1.48	0.87, 2.53
Physically inactive after four weeks vs. otherwise	46.6	28.7	1.62	1.18, 2.22

51% higher for those who did not lower their BMI, and 59% higher for those not physically active after four weeks. The percentage of those who suffered insomnia after four weeks among those who suffered insomnia at baseline was 184% higher for those who did not lower their BMI. The percentage of those who felt under pressure after four weeks among those who felt under pressure at baseline was 14% higher for non-married (marginally insignificant), and 27% higher for those physically inactive. The percentage of those who were easily emotionally upset after four weeks among those who were

easily emotionally upset at baseline was 44% higher for those who did not lower their BMI, 38% higher for those who did not lower their coffee/tea drinking, and 30% higher for those who where not physically active after four weeks (marginally insignificant). The percentage of those who felt fearful or depressed after four weeks among those who felt fearful or depressed at baseline was 35% higher for non-married, 59% higher for those who did not lower their BMI, and 62% higher for those not physically active after four weeks.

The percentage of those experiencing the selected sleep or stress disorder after four weeks among those who had the disorder at baseline is presented by a new variable representing the combinations of physical activity after four weeks (yes vs. no) and whether a decrease in BMI occurred (yes vs. no) (Figure 2). Percentage of those experiencing the selected disorders were highest for those neither physically active after four weeks nor experiencing a decrease in BMI. Percentages of those experiencing the selected disorders were lowest for those both physically active after four weeks and who experienced a decrease in BMI. Intermediate percentages occurred in those who were either physically active after four weeks only or who experienced a decrease in BMI only.

Discussion

Over the four-week period, participants exposed to the lifestyle intervention program experienced significant decreases in selected sleep and stress disorders. They also experienced a significant decrease in the number of disorders. With more than 80% of the participants being either overweight or obese, some of these favorable changes are largely explained by lowered BMI and/or improved exercise levels. The combination of both of these behaviors occurring together had the largest beneficial influence on mental health. Alcohol consumption was not significantly associated with either the sleep or stress disorders. Coffee/tea drinking had a marginally insignificant influence on sleeping restlessly and being easily emotionally upset. Coffee/tea use had a significant influence on being easily emotionally upset. The results with respect to weight loss and increased exercise are consistent with the literature.

While many studies have shown that mental health disorders can promote weight gain, little has been written on the possible effect of weight loss on mental health disorders. A study involving 100 obese women attending a hospital obesity clinic identified improved mood state following weight loss (13). Another study showed significant mood improvement in obese adults with depressive symptoms who lost at least 5% of their baseline weight (15). In a large-scale study of obese individuals, psychosocial functioning and mental well-being improved with weight loss (16). In a multidisciplinary weight loss intervention conducted among obese patients, 61% were successful at losing a targeted 5% or more of their body weight (14). Of these successful patients, mean Beck Depression Inventory scores improved by 57% and mean State-Trait Anxiety Inventory test scores improved by 29%. No biologic mechanism has been identified for why lowering body weight might result in better mental health. Nevertheless, improved mental health associated with weight loss is likely explained, at least in part, by a heightened sense of self-efficacy and self-value.

On the other hand, improvements in anxiety, depression and mood states after exercise have been associated with changes in endorphin and monoamines from exercise, from increased body temperature, blood circulation in the brain, as well as from improvement of self-efficacy, distraction and cognitive dissonance (34-36).

Among those with selected sleep or stress disorder at baseline, a lower risk of experiencing the respective disorder was observed after four weeks, even among those who did not improve their physical fitness or their BMI values. This may be partly explained by lifestyle recommendations provided to participants, based on their health history at baseline, and a combination of other factors not considered or not reaching statistical significance in the current study. Some patients were recommended to increase their rest and relaxation and/or pursue stress management. Other aspects of program participants may have enhanced mental health: social interactions, cognitive learning, and structure. Program participants are encouraged to attend the lecture and interact with others. They are encouraged to eat three meals per day and to engage in walking/exercise. Feeling accepted and developing hope through learning and accomplishment may contribute to better mental health, regardless of weight loss and increased exercise. Nevertheless, the additional benefit of exercise and lower BMI, separate and, especially when occurred together, had a large effect on lowering the risk of a mental health disorder.

Despite the fact that alcohol is a known depressant that can worsen existing depression (11), decreased alcohol consumption showed no significant influence on reducing sleep or stress disorders.

Caffeine intake through coffee/tea drinking and other substances has been shown to increase energy levels in depressed people by increasing the amount of the hormone adrenaline in the body, but heavy caffeine intake has also been associated with anxiety and sleep disruption (12, 37). Decrease in coffee/tea drinking was associated with improved sleep and lower risk of being easily emotionally upset in the current study. Furthermore, BMI improvements were modestly associated with reduction in the use of coffee/tea (Spearman's Correlation = .112, $p < .0001$). Even smaller risk differences were observed after adjusting for BMI (data not shown). A stronger association between coffee/tea consumption and the sleep and anxiety measures may have been found had the participants consumed higher levels of caffeine. Indeed, the percentage consuming two or more servings of coffee/tea, on average, was only 31.4% at baseline and 12.5% after four weeks.

Marriage has been previously associated with lower risk of depressive disorders (38, 39). Marriage (yes vs. no) was not significantly associated with whether or not the participants exercised after four weeks (Chi-square(1) = 1.29, p = .2565). However, marriage was associated with mean reduction in BMI through four weeks (-1.06 for nonmarried and -1.19 for married, t = 2.79, p = .0053). Adjusting the results in Table 3 for marriage did not change the significant associations observed between change in BMI and the selected sleep and stress disorders.

The lifestyle intervention program significantly improves health knowledge, nutrition, weight, and physical activity behavior (26). These, in turn, can markedly improve clinical risk factors in coronary heart disease, such as serum cholesterol, fasting blood sugar in diabetics, blood pressure in hypertensive individuals, and so on. The current study shows that an intensive lifestyle education program may also be efficacious in improving sleep and stress disorders, most likely mediated through weight loss and exercise enhancement. Despite these strengths, shortcomings of the study warrant discussion. This is an archival review study. Further prospective study should consider using stronger and more specific assessment instruments, such as the Beck Depression Inventory. Long-term follow-up will also allow us to identify whether continued mental health benefits persist from the lifestyle program. In addition, diet, sleep and stress disorders, exercise, and medication data were self-reported. These indicators need to be more clinically assessed.

Conclusion

The lifestyle intervention program significantly reduces sleep and stress disorders, in as little as four weeks. Although some of the improvement may be attributed to recommendations to increase rest and relaxation and/or pursue stress management techniques, according to baseline evaluation, decreasing BMI and/or increasing exercise had a significant impact on improving the disorders. Long-term mental health benefits from a lifestyle program will likely be associated with whether weight and exercise changes from the intervention can be maintained.

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