



Evaluation of the Effect of an Integrative Eastern Medicine-Based Lifestyle Intervention on Stress, Sleep Quality, and Self-Reported Well-Being among Adults: A Prospective Observational Study

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ABSTRACT

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Background: Adults often experience stress, poor sleep quality and decreased psychological well-being, which can have a negative impact on their functioning and quality of life. Integrative lifestyle approaches of Eastern medicine are the combination of mind-body movement, breathing, meditation, relaxation and sleep hygiene, along with lifestyle modification, but findings on the combination of these in real-world settings are limited. The aim of this study was to assess the impact of a structured integrative lifestyle programme by using Eastern medicine on perceived stress, sleep quality and self-reported well-being in healthy individuals who suffer from insomnia. The objective of this study was to examine the effect of a structured integrative lifestyle intervention based on Eastern medicine on perceived stress, sleep quality and self-reported well-being among healthy individuals with insomnia. adults.

Methods: This prospective observational study was conducted at Government College University Faisalabad, Pakistan, over a period of six months. A total of 150 adults were enrolled and participated in a structured lifestyle intervention incorporating yoga-based movement, controlled breathing, mindfulness or meditation, relaxation practices, sleep-related behavioral modification, and general lifestyle guidance.

Results: Of the 150 enrolled participants, 138 completed the six-month follow-up, corresponding to a retention rate of 92.0%. Mean PSS-10 scores decreased from 24.6 ± 5.8 at baseline to 19.1 ± 5.5 at three months and 15.8 ± 5.2 at six months. Mean PSQI scores decreased from 10.3 ± 3.4 to 7.6 ± 3.2 and 5.9 ± 2.9 , respectively.

Conclusion: A six-month integrative Eastern medicine-based lifestyle intervention was associated with significant improvements in perceived stress, sleep quality, and self-reported well-being among adults.

Keywords: Eastern medicine; lifestyle intervention; perceived stress; sleep quality; well-being; mindfulness; yoga; prospective observational study.

INTRODUCTION

Stress, disturbed sleep, and reduced subjective well-being are increasingly recognized as interrelated concerns that can adversely influence physical health, psychological functioning, productivity, and overall quality of life. Stress is a normal adaptive process in response to environmental and internal demands, but chronic or poorly managed stress can lead to the prolonged activation of physiological stress pathways which can contribute to emotional exhaustion, decreased ability to concentrate, sleep disturbance, and lower quality of life. Meanwhile, lack of or poor quality sleep can exacerbate emotional reactivity and disrupt the capacity to deal with daily stressors effectively. Thus, interventions that target more than one symptom or outcome, such as stress regulation, sleep, and overall health, are likely to be more effective than those that target a single symptom or outcome.

Traditional and complementary medicine has always been based on the holistic interrelationship of physical activity, mental state, sleep, dietary behavior, daily routine and the environment. Traditional and complementary medicine has been recognised as an important and popular approach to health care and self-help, and there is need for evidence-based

development of evidence on the safe and appropriate use of traditional and complementary medicine in health care and self-help [1]. Eastern medicine-based methods can involve practices from various systems like yoga, Ayurveda, traditional Chinese health methods, meditation, breathing control, conscious movement, relaxation, sleep-wake cycle and personal daily habits. Many of them are not just about treating the disease, but also maintaining balance between the body and mind through routine life habits.

There is a close biologic and behavioral relationship between stress and sleep. Stress response systems such as the hypothalamic-pituitary-adrenal system can have effects on the sleep-wake cycle; sleep disturbances can have effects on the subsequent response to stress. Acute and chronic stress can thus have different impact on sleep depending on the duration, intensity and person-to-stressor response to the stressor [2]. This interaction gives a good rationale for the dual focus of interventions targeting physiological arousal and behavioural lifestyle patterns. Stress can be affected by mind-body interventions in a variety of ways, such as relaxation, breathing, attention, movement, and autonomic and neuroendocrine changes. In a meta-analysis, Pascoe et al. found a positive association of Yoga and MBSR with changes in various physiological parameters related to stress regulation [3]. Likewise, a systematic review of studies in healthy adults revealed that overall Yoga interventions were related to decreases in perceived stress, but there was variance in intervention type and methodology reported in the studies that is important to note [4].

Mind/body and Eastern medicine-related methods have also garnered a great deal of scientific interest, particularly with regard to sleep. Mindfulness Based Stress Reduction (MBSR) combines meditation, awareness of the here and now and non-judgemental observation of thoughts and sensations. Kim and colleagues conducted an updated systematic review and meta-analysis which found that mindfulness-based stress reduction may positively impact sleep-related outcomes in adults with sleep problems, but results differed by study design and comparison groups [5]. This finding indicates that cognitive and emotional arousal plays a role in subjective sleep experiences and that it is possible to improve these experiences by reducing cognitive and emotional arousal.

Similar potential has been found in traditional Chinese mind-body practices. Tai Chi uses slow and co-ordinated movements, controlling posture, breathing, relaxation and concentration. Tai Chi was shown to be moderately effective in improving subjective sleep quality in adults, in a systematic review and meta-analysis of randomized controlled trials [6]. Like other forms of movement, breathing, posture and meditative awareness, Qigong also has been studied for sleep-related outcomes. A meta-analysis and systematic review of 13 RCTs with 1,147 participants found positive impacts of Health Qigong on sleep quality, but with significant heterogeneity and issues with the control groups [7]. These results suggest that meditative movement can be a helpful non-pharmacological sleep support strategy.

One key factor in lifestyle interventions is that its effects can go beyond symptom reduction. Subjective well-being is the individual's subjective appraisal of the overall psychological function and satisfaction, emotional balance, and coping in daily life. There is a suggestion that mind body practices have a positive impact on these wider effects. Hendriks et al. conducted a systematic review of randomized controlled trials (RCTs) of yoga in healthy adults and found evidence of benefits for psychological health but noted a lack of methodological consistency in the majority of trials [8]. Previous studies on Tai Chi have also found links to decreased stress, anxiety, depressive symptoms and mood disturbance, as well as psychological well-being enhancements [9]. The following observations lead to the potential for integrated lifestyle programs to affect multiple interrelated aspects of health rather than just a single clinical measure.

This idea of complementary practices is important as people often use multiple approaches in their daily life. Some practice physical activity along with meditation, breathing exercise, diet, sleep habits or other traditional health measures, for instance. A randomized controlled trial of yoga and Ayurvedic intervention in adults with insomnia showed reductions in stress, sleep quality, and a few domains of quality of life, indicating the importance of traditional Indian interventions for these overlapping outcomes [10]. Evidence on integrated programs, however, is less robust than evidence for single programs, such as yoga, mindfulness, tai chi or qigong.

There has been much literature on the evaluation of single mind-body therapy in controlled settings and comparatively fewer studies have looked at multidimensional lifestyle programs based on Eastern medicine in routine or community settings. In addition, there is significant variation in the length, frequency, and characteristics of interventions, and in the type of participant, adherence, and measures of outcome. World Health Organization has therefore called for evidence-based approaches to be used when incorporating traditional and complementary medicine into health systems and lifestyle-related care [11]. Prospective observational studies may be used to complement controlled trials to assess for changes in patient-reported outcomes in real-world setting and to supplement data on acceptability, adherence, and response over time.

In this context, the purpose of the present prospective observational study was to assess the impact of an integrative lifestyle medicine program on perceived stress, sleep quality, and self-reported health in adults. The study will compare these interrelated outcomes in a prospective way to support the potential for a structured, holistic lifestyle approach to improve psychological well-being and sleep and decrease perceived stress among adults.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted at the Health Care Center, Government College University Faisalabad (GCUF), Faisalabad, Pakistan, over a period of six months. The study was designed to prospectively evaluate changes in

perceived stress, sleep quality, and self-reported well-being among adults participating in a structured integrative Eastern medicine-based lifestyle intervention. As the study was observational in nature, participants were not randomly allocated to intervention groups, and no separate control group was constituted. All eligible participants who voluntarily elected to participate in the lifestyle program were followed prospectively during the study period.

Study Population

The study population consisted of adult patients attending the study center during the six-month recruitment period. Participants were screened for eligibility by trained research personnel before enrollment. Individuals fulfilling the predefined inclusion criteria and providing written informed consent were consecutively recruited until the required sample size was achieved.

Sample Size

A total of 150 participants were enrolled in the study. The sample size was planned to provide sufficient statistical power for detecting clinically meaningful within-participant changes in the principal outcome measures between baseline and the end of follow-up. Assuming a small-to-moderate standardized within-participant effect size of approximately 0.25, a two-sided significance level of 5%, and statistical power of 80%, approximately 126 evaluable participants were required. The target sample was increased to 150 to compensate for an anticipated loss to follow-up of approximately 15% to 16%.

Sampling Technique

A consecutive sampling technique was used. All potentially eligible adult patients presenting during the recruitment period were screened sequentially and invited to participate until the predetermined sample size of 150 was reached. This approach was selected to minimize investigator-driven participant selection and to reflect the characteristics of individuals receiving the intervention under routine real-world conditions.

Inclusion Criteria

Participants were eligible for inclusion if they:

1. Were aged 18 years or older.
2. Were able to understand the study instructions and provide informed consent.
3. Were willing to participate in the integrative lifestyle intervention for the prescribed study period.
4. Were willing to complete the stress, sleep, and well-being assessments at baseline and follow-up.
5. Were clinically stable enough to participate in mild to moderate lifestyle and mind-body activities.
6. Had access to telephone or another feasible means of follow-up communication.

Exclusion Criteria

Participants were excluded if they:

1. Had an acute medical condition requiring immediate hospitalization or intensive treatment.
2. Had severe physical limitations that prevented participation in the prescribed movement or breathing practices.
3. Had a severe uncontrolled psychiatric or neurological disorder that could interfere with participation or completion of study questionnaires.
4. Were currently participating in another structured mind-body or lifestyle intervention likely to substantially influence the study outcomes.
5. Had initiated or substantially changed sedative, hypnotic, antidepressant, or other relevant psychotropic treatment immediately before enrollment.
6. Were unable or unwilling to comply with the follow-up schedule.
7. Withdrew consent at any stage of the study.

Integrative Eastern Medicine-Based Lifestyle Intervention

The intervention consisted of a structured multimodal lifestyle program incorporating principles and practices commonly used within Eastern mind-body and traditional lifestyle approaches. The program was designed to address physical activity, mental relaxation, sleep-related behavior, breathing regulation, and daily lifestyle practices simultaneously.

To improve reproducibility and minimize variation in intervention delivery, participants received standardized instructions covering four major components.

1. **Mind-body movement:** Participants were encouraged to perform gentle yoga-based stretching, mobility exercises, and meditative movements according to their physical ability. Practices were designed to promote relaxation, body awareness, flexibility, and controlled movement rather than vigorous physical exertion.
2. **Breathing and relaxation practices:** Participants were instructed in slow diaphragmatic breathing and controlled breathing exercises. Guided relaxation and brief mindfulness or meditation practices focusing on breath awareness, bodily sensations, and present-moment attention were incorporated into the daily routine.
3. **Sleep and daily-routine modification:** Participants received counseling regarding maintenance of regular sleeping and waking times, reduction of stimulating activities before bedtime, limitation of unnecessary screen exposure during the pre-sleep period, creation of a quiet sleep environment, and avoidance of irregular daytime sleeping. Participants were also encouraged to establish consistent daily patterns for meals, activity, relaxation, and sleep.

4. Lifestyle and dietary guidance: General guidance emphasized regular meals, adequate hydration, moderation in the intake of highly processed foods and stimulants, mindful eating, appropriate physical activity, and development of a balanced daily routine. Recommendations were individualized where required according to age, health status, and physical capacity.

The intervention emphasized non-pharmacological lifestyle practices. No participant was required to discontinue prescribed conventional medical treatment. Any ongoing medications were continued according to the recommendations of the participant's treating physician.

Participants were encouraged to undertake approximately 30 minutes of structured mind-body and relaxation practice on at least five days per week. Periodic reinforcement of the intervention was provided during follow-up contacts. Participants were encouraged to record their practice frequency using a simple adherence record.

Study Procedure

Following eligibility screening and informed consent, demographic and relevant clinical information was recorded using a standardized case-record form. Baseline information included age, sex, marital status, educational level, occupation, relevant medical history, medication use, smoking status, physical activity, usual sleep duration, and previous experience with meditation, yoga, or related lifestyle practices.

Outcome assessments were performed at three predefined time points:

- **Baseline:** before initiation of the structured lifestyle program.
- **Three months:** intermediate follow-up assessment.
- **Six months:** final study assessment.

The same standardized instruments and administration procedures were used at each assessment point.

Outcome Measures

The principal outcomes were perceived stress, sleep quality, and self-reported well-being.

Perceived Stress

The 10-item Perceived Stress Scale (PSS-10) was used to measure perceived stress. The instrument assesses how much situations in one's life in the previous month are felt as unpredictable, uncontrollable or overwhelming. Items are rated on a 5-point scale of response. The positively phrased items are scored on a reverse scale and then the item scores collected to arrive at the total score of 0-40. A higher score indicates higher perceived stress.

The change in total PSS-10 score from the baseline to 6 months was the primary stress outcome.

Sleep Quality

The Pittsburgh Sleep Quality Index (PSQI) was used to determine sleep quality. The PSQI explores a number of facets of sleep over the last month, including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The component scores are added together to give a total score of 0 to 21, with higher scores indicating poorer sleep.

Baseline to three months and baseline to six months change in score in the global PSQI was assessed. Where applicable, the percentage of subjects who improved clinically in sleep quality was also determined.

Self-Reported Well-Being

The World Health Organization Five Well-Being Index (WHO-5) was used to assess well-being. It comprises five positively worded items relating to mood, vitality, interest and overall psychological functioning in the last two weeks. Raw scores are transformed into a percentage scale (0–100), with higher scores indicating greater subjective well-being.

The primary outcome for well-being was the difference from baseline to six-month assessment in the WHO-5 score.

Intervention Adherence

Adherence was determined by self-report from participants and practice records. In follow-up participants were asked how often they completed recommended mind-body, breathing, relaxation and lifestyle practices. The rate of adherence was determined by the percentage of recommended sessions that were reported.

High adherence was defined as participants who finished at least 80% of the suggested intervention activities. Adherence was also analyzed as a continuous variable to explore potential dose-response relationships between adherence and changes in stress, sleep and well-being outcomes.

Safety Monitoring

The intervention included low-risk lifestyle, relaxation, breathing and gentle movement practices, but participants were encouraged to report any discomfort, dizziness, musculoskeletal pain, worsening in symptoms, and any other adverse events experienced during participation. Participants were asked to discontinue any activity that caused a significant level of discomfort and to go for medical evaluation as needed.

All adverse events occurring during the 6-month follow-up were recorded, along with their severity and possible association with the lifestyle intervention.

Data Quality and Bias Reduction

A series of measures were taken to enhance data quality. Eligible participants were recruited consecutively based on set criteria. Both baseline and follow-up were measured with the same standardized testing instruments. The questionnaires were administered to research personnel in a uniform manner and scored. Data collection forms were verified for completeness prior to input into data base.

When possible, data on outcomes were represented by participant identification codes instead of names. Prior to analysis, the statistical data was validated for missing, inconsistent, impossible and duplicate records.

The results were self-reported, so the participants were asked to answer the questionnaires in an unbiased way, away from any pressure of the study personnel. To ensure consistency, the same set of outcome instruments was used throughout assessments visits.

Statistical Analysis

An appropriate statistical software package was used to analyze the data (IBM SPSS Statistics 26.0 or an equivalent validated statistical software package). Means and standard deviations were used to summarize data from approximately normally distributed continuous variables, and medians and interquartile ranges were used to summarize data from skewed continuous variables. Categorical variables were presented in frequencies and percentage.

Distributional assumptions were tested graphically, by Q-Q plots and the Shapiro-Wilk test as appropriate.

The changes at baseline, 3 and 6 months in regard to PSS-10, PSQI and WHO-5 scores were first summarized descriptively. Linear mixed-effects models were used to primarily analyze the changes over time, with assessment time as a fixed effect and participant as a random effect. This approach enabled repeated observations within participants and enabled available data for participants with incomplete follow-up to be used under the missing-at-random assumption.

The baseline to mean outcome change were reported as 95% confidence intervals for each outcome. Age, sex, baseline score of the outcome, relevant comorbidities, medication usage and adherence were included where appropriate as covariate to determine if observed changes were independent of these potential confounding factors.

Pairwise comparisons of baseline and 6-month scores were conducted using the paired-samples t test for normally distributed differences, or Wilcoxon signed-rank test if the assumptions of normality were not met, for supportive analyses.

Chi-square test or Fisher's exact test, as appropriate, was used to compare categorical outcomes. Pearson or Spearman correlation coefficients and multivariable regression analysis were used to explore relationships between adherence to intervention and changes in outcome scores.

Standardized effect sizes were also calculated to supplement statistical significance and to estimate the size of the observed changes. Both tests were performed on both sides. A p value <0.05 was regarded as statistically significant and effect estimates were expressed as 95% confidence intervals.

RESULTS

During the six months of the study, a total of 168 adults were screened for eligibility. 18 people did not meet the eligibility criteria or refused to take part. So, 150 participants were recruited and completed the baseline assessment. The 143 participants were available at the three month follow up, with a 95.3% retention rate. The overall study retention rate was 92.0% at 6 months. The 12 participants who failed to complete the 6-month assessment were not reached by telephone (n = 7), did not complete the assessment due to personal or scheduling limitations (n = 3), or chose not to agree to participate in the assessment (n = 2). None of the participants withdrew due to a serious AE associated with the intervention.

Table 1. Baseline demographic and clinical characteristics of the study participants

Characteristic	n (%) or Mean $\pm$ SD
Total participants	150
Age, years	36.8 $\pm$ 11.2
Age group	
18–29 years	45 (30.0)
30–39 years	40 (26.7)
40–49 years	35 (23.3)
$\geq$ 50 years	30 (20.0)
Sex	
Male	62 (41.3)
Female	88 (58.7)
Marital status	

Married	93 (62.0)
Unmarried/other	57 (38.0)
Educational status	
Up to secondary education	28 (18.7)
Higher secondary/intermediate	36 (24.0)
Graduate	56 (37.3)
Postgraduate or above	30 (20.0)
Employment status	
Employed	86 (57.3)
Student	31 (20.7)
Homemaker	18 (12.0)
Other/unemployed	15 (10.0)
Current smoker	20 (13.3)
Regular physical activity ≥ 3 days/week	48 (32.0)
Previous yoga/meditation experience	36 (24.0)
At least one chronic comorbidity	46 (30.7)
Usual sleep duration, hours/night	6.1 $\pm$ 1.2
Baseline PSS-10 score	24.6 $\pm$ 5.8
Baseline PSQI score	10.3 $\pm$ 3.4
Baseline WHO-5 score	43.2 $\pm$ 15.1

The participants had a mean age of 36.8 ± 11.2 years, with 58.7% being female. About one-third of the participants said they had at least one chronic medical problem. Twenty four percent (24.0%) said they had previously practiced yoga, meditation or other mind-body practices. On the baseline assessment, participants had a relatively high mean perceived stress score (PSS-10 = 24.6 ± 5.8) and poor subjective sleep quality score (PSQI = 10.3 ± 3.4).

Table 2. Changes in perceived stress, sleep quality, and well-being during the six-month follow-up

Outcome	Baseline (n=150)	3 months (n=143)	6 months (n=138)	P value for time trend
PSS-10 score	24.6 $\pm$ 5.8	19.1 $\pm$ 5.5	15.8 $\pm$ 5.2	<0.001
PSQI global score	10.3 $\pm$ 3.4	7.6 $\pm$ 3.2	5.9 $\pm$ 2.9	<0.001
WHO-5 well-being score	43.2 $\pm$ 15.1	57.4 $\pm$ 14.7	67.1 $\pm$ 14.2	<0.001
Average sleep duration, hours/night	6.1 $\pm$ 1.2	6.7 $\pm$ 1.1	7.0 $\pm$ 1.0	<0.001

All three principal patient-reported outcomes improved progressively during follow-up. Mean PSS-10 scores decreased from 24.6 ± 5.8 at baseline to 19.1 ± 5.5 at three months and 15.8 ± 5.2 at six months. Similarly, mean PSQI scores decreased from 10.3 ± 3.4 to 5.9 ± 2.9 during the study period, indicating improved subjective sleep quality. In contrast, WHO-5 scores increased from 43.2 ± 15.1 to 67.1 ± 14.2 , indicating improvement in self-reported well-being. The overall time effect was statistically significant for all outcomes ($P < 0.001$).

Table 3. Estimated longitudinal changes in primary outcome measures using mixed-effects analysis

Outcome comparison	Estimated mean change	95% CI	P value
PSS-10			
Baseline to 3 months	-5.4	-6.1 to -4.7	<0.001
Baseline to 6 months	-8.6	-9.4 to -7.8	<0.001
3 months to 6 months	-3.2	-3.9 to -2.5	<0.001
PSQI			
Baseline to 3 months	-2.6	-3.0 to -2.2	<0.001
Baseline to 6 months	-4.3	-4.8 to -3.8	<0.001
3 months to 6 months	-1.7	-2.1 to -1.3	<0.001
WHO-5			
Baseline to 3 months	+14.0	+11.9 to +16.1	<0.001
Baseline to 6 months	+23.5	+21.0 to +26.0	<0.001
3 months to 6 months	+9.5	+7.3 to +11.7	<0.001

Mixed-effects analysis confirmed significant longitudinal improvement in each primary outcome. At six months, the adjusted mean PSS-10 score was 8.6 points lower than baseline (95% CI -9.4 to -7.8; $P < 0.001$). The corresponding

reduction in PSQI was 4.3 points (95% CI −4.8 to −3.8; $P<0.001$). Mean WHO-5 scores increased by 23.5 points (95% CI 21.0 to 26.0; $P<0.001$). Significant improvement was also observed between the three-month and six-month assessments, suggesting that changes continued beyond the initial intervention period.

Table 4. Clinically relevant improvement in stress, sleep quality, and well-being among six-month completers

Clinical outcome	Baseline n (%)	6 months n (%)	P value
Good sleep quality, PSQI ≤ 5	10 (7.2)	71 (51.4)	<0.001
WHO-5 score ≥ 50	52 (37.7)	112 (81.2)	<0.001
$\geq 30\%$ reduction in PSS-10 score	—	91 (65.9)	—
$\geq 30\%$ reduction in PSQI score	—	84 (60.9)	—
≥ 20 -point improvement in WHO-5	—	79 (57.2)	—

The proportion of participants classified as having good subjective sleep quality increased substantially during follow-up, from 7.2% at baseline to 51.4% at six months ($P<0.001$). Similarly, the proportion with a WHO-5 score of at least 50 increased from 37.7% to 81.2% ($P<0.001$). At the six-month assessment, 65.9% of participants demonstrated at least a 30% reduction in perceived stress, while 60.9% achieved a reduction of at least 30% in PSQI score.

Table 5. Association between adherence to the lifestyle intervention and changes in study outcomes

Outcome	High adherence $\geq 80\%$ (n=84)	Lower adherence $<80\%$ (n=54)	P value
Mean adherence, %	90.1 $\pm$ 6.1	63.8 $\pm$ 10.7	<0.001
Change in PSS-10	−10.0 $\pm$ 5.1	−6.7 $\pm$ 4.8	<0.001
Change in PSQI	−5.1 $\pm$ 3.0	−3.2 $\pm$ 2.7	<0.001
Change in WHO-5	+27.4 $\pm$ 15.0	+17.6 $\pm$ 14.2	<0.001
Increase in sleep duration, hours	+1.1 $\pm$ 1.0	+0.6 $\pm$ 0.9	0.004

Among the 138 participants completing the six-month assessment, 84 (60.9%) achieved adherence of at least 80% to the recommended lifestyle activities. Participants with high adherence demonstrated significantly greater improvement in all principal outcomes. Mean PSS-10 scores decreased by 10.0 $\pm$ 5.1 points among highly adherent participants compared with 6.7 $\pm$ 4.8 points among those with lower adherence ($P<0.001$). Similar adherence-related differences were observed for sleep quality and well-being.

Table 6. Multivariable analysis of factors associated with six-month improvement in primary outcomes

Predictor	PSS-10 change β (95% CI)	P value	PSQI change β (95% CI)	P value	WHO-5 change β (95% CI)	P value
Adherence, per 10% increase	−1.05 (−1.52 to −0.58)	<0.001	−0.58 (−0.86 to −0.30)	<0.001	+2.83 (1.45 to 4.21)	<0.001
Age, per 10-year increase	−0.31 (−0.92 to 0.30)	0.318	−0.15 (−0.48 to 0.18)	0.369	+0.64 (−1.14 to 2.42)	0.478
Female sex	−0.72 (−2.03 to 0.59)	0.279	−0.26 (−0.96 to 0.44)	0.464	+1.91 (−1.54 to 5.36)	0.275
Presence of comorbidity	+0.54 (−0.91 to 1.99)	0.464	+0.37 (−0.41 to 1.15)	0.350	−1.62 (−5.41 to 2.17)	0.399
Previous mind-body experience	−0.88 (−2.38 to 0.62)	0.248	−0.41 (−1.20 to 0.38)	0.307	+2.05 (−1.78 to 5.88)	0.292

After adjustment for age, sex, comorbidity, previous mind-body experience, and baseline outcome severity, intervention adherence remained independently associated with improvement in all three principal outcomes. Each 10% increase in adherence was associated with an additional 1.05-point reduction in PSS-10, a 0.58-point reduction in PSQI, and a 2.83-point increase in WHO-5 score. Age, sex, and pre-existing comorbidity were not independently associated with the magnitude of improvement.

The lifestyle intervention was generally well tolerated. Fifteen participants (10.0%) reported at least one mild, transient complaint during the intervention period. These included temporary musculoskeletal discomfort following movement exercises, mild fatigue, and occasional transient dizziness during breathing practices. Symptoms resolved spontaneously or following modification of the activity. No serious adverse event, hospitalization, or clinically significant deterioration was considered related to participation in the lifestyle intervention.

Over six months of prospective follow-up, participation in the integrative Eastern medicine-based lifestyle program was associated with significant reductions in perceived stress and sleep disturbance and a simultaneous increase in self-reported well-being. Improvements were already apparent after three months and became more pronounced at six months. Higher adherence to the prescribed lifestyle practices was consistently associated with greater improvement, and this relationship remained significant after adjustment for relevant participant characteristics.

Figure 1. Participant flow through the prospective observational study

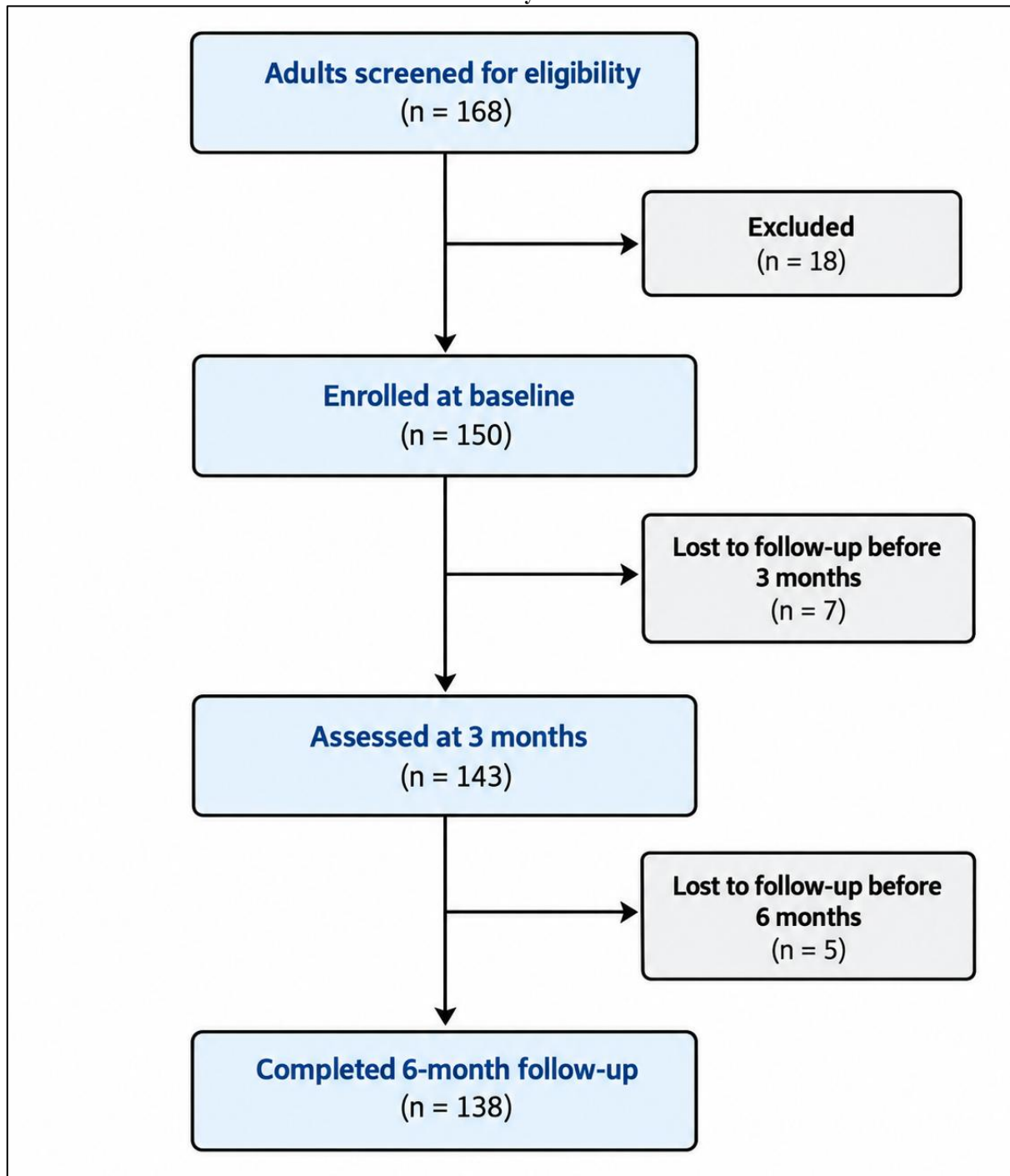


Figure 1 illustrates participant recruitment and retention throughout the study. A total of 168 adults were screened for eligibility, of whom 18 were excluded. The remaining 150 participants were enrolled at baseline. At the three-month follow-up, 143 participants were assessed after seven were lost to follow-up. By the six-month assessment, a further five participants were lost to follow-up, resulting in 138 participants completing the study. The overall six-month retention rate was 92.0%.

Figure 2. Change in mean perceived stress scores during the six-month integrative Eastern medicine-based lifestyle intervention

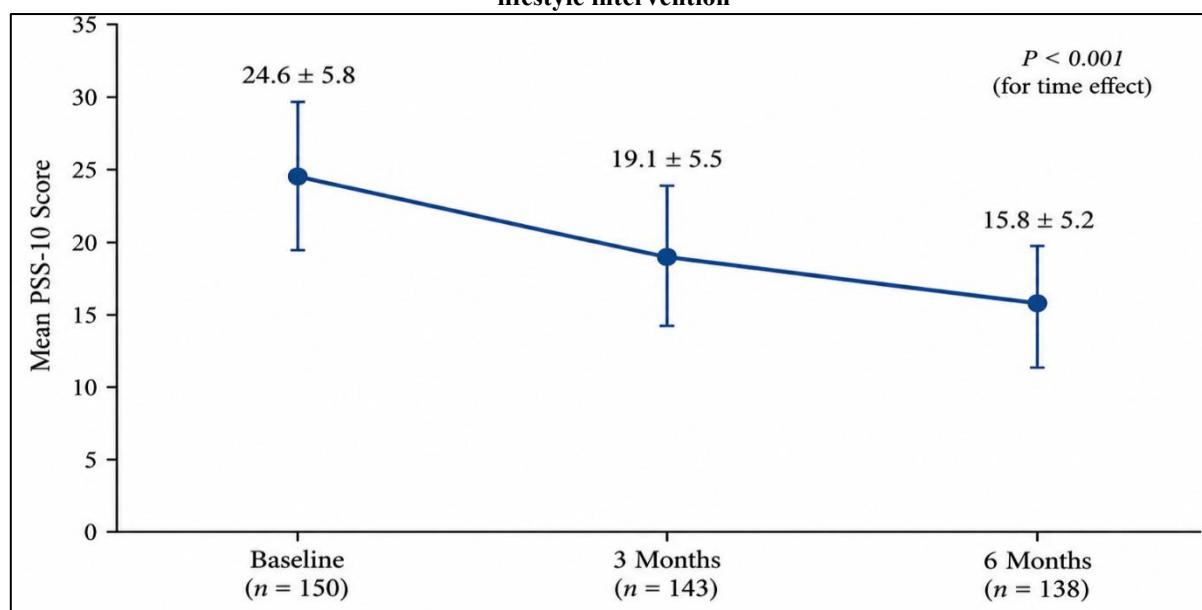


Figure 2 Mean PSS-10 scores decreased progressively from 24.6 ± 5.8 at baseline to 19.1 ± 5.5 at three months and 15.8 ± 5.2 at six months ($P < 0.001$ for time effect).

Figure 3. Change in global Pittsburgh Sleep Quality Index scores during six months of follow-up

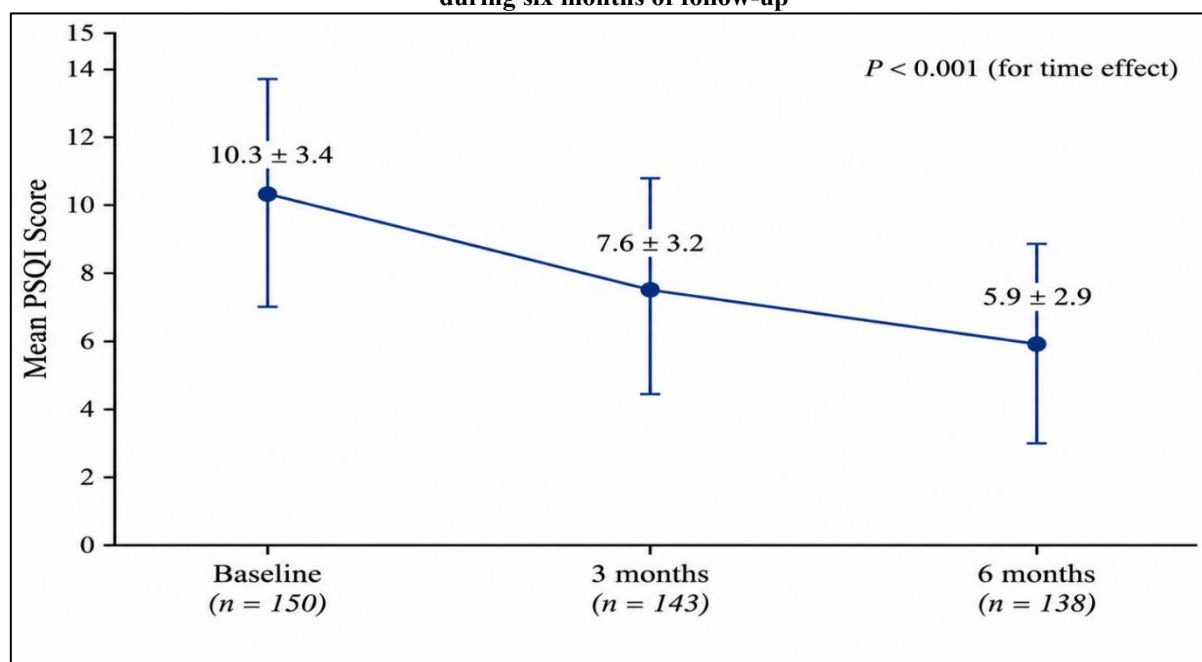


Figure 3 Mean PSQI scores decreased from 10.3 ± 3.4 at baseline to 7.6 ± 3.2 at three months and 5.9 ± 2.9 at six months, indicating progressive improvement in subjective sleep quality ($P < 0.001$).

DISCUSSION

The present prospective observational study evaluated changes in perceived stress, sleep quality, and self-reported well-being among adults participating in a six-month integrative Eastern medicine-based lifestyle intervention. The principal findings demonstrated progressive improvement across all three outcome domains. Perceived stress decreased substantially, sleep quality improved, and self-reported psychological well-being increased between baseline and six months. Importantly, improvement was already evident at the three-month assessment and continued through six months. Participants with greater adherence to the prescribed lifestyle practices experienced significantly larger improvements, while the intervention was generally well tolerated with no serious intervention-related adverse events. Taken together, these findings suggest that a structured multimodal lifestyle approach incorporating mind-body movement, breathing,

relaxation, meditation, sleep hygiene, and lifestyle modification may be useful for supporting stress management, sleep, and subjective well-being in adults.

A substantial reduction in perceived stress was observed during follow-up. Mean PSS-10 scores decreased from 24.6 at baseline to 19.1 at three months and 15.8 at six months, while mixed-effects analysis estimated an adjusted reduction of 8.6 points from baseline to six months. These findings are consistent with previous research examining yoga-based and integrative mind-body interventions. Parajuli et al. evaluated a four-week integrated yoga program among nursing professionals and observed a significant 27.01% reduction in perceived stress following the intervention [12]. Similarly, Fang and Li demonstrated that regular yoga practice over six months resulted in significantly lower work-related stress among nurses compared with a non-yoga control group [13]. More recently, Phansikar et al. conducted a randomized controlled trial among working adults with symptoms of stress and reported significantly lower stress following an eight-week moderate-intensity yoga intervention [14]. These findings support the direction of change identified in the present study and suggest that regular mind-body practice may provide a practical non-pharmacological strategy for stress management.

The reduction in perceived stress may reflect the combined effects of several components of the present intervention rather than the effect of a single activity. Slow movement, controlled breathing, meditation, relaxation, and increased awareness of bodily and emotional states may reduce psychological arousal and improve individuals' ability to respond to daily stressors. Consistent with this interpretation, there is evidence from other Eastern mind-body practices. In a randomized controlled trial (RCT) of 12 weeks of Tai Chi, Zheng et al. found that it reduced perceived stress, anxiety, mental health and vitalities in adults who were stressed, yet otherwise healthy [15]. These findings are significant as tai chi, yoga, breathing and meditation share many commonalities such as conscious movement, attention control, relaxation and breathing integration. It is thus possible that the multi-modal character of the present intervention could have had different multiple complementary behavioral and psychophysiological effects on levels of stress.

Other improvements observed during the study included notable improvements in sleep quality. There was a mean reduction in the PSQI score from baseline to 3 months (10.3 to 7.6) and 6 months (10.3 to 5.9), with an estimated adjusted reduction of 4.3 points at the final assessment. Moreover, the percentage of those who ended up with a PSQI score of 5 or less increased significantly over time. These results are clinically significant since the improvement did not just occur with the questionnaire score, but also with the average sleep time reported of 6.1 hours to 7.0 hours per night. The sleep improvement that was noted is similar to that previously found in yoga and mindfulness-based sleep interventions. In four weeks, the study by Parajuli et al., demonstrated that integrated yoga achieved a 38.68% improvement in sleep quality [12]. Six months of yoga training was also reported to be associated with significantly improved sleep quality [13] by Fang and Li.

Research studies using meditation also indicate a positive mind-body connection with subjective sleep. Rusch et al. performed a systematic review and meta-analysis of 18 RCTs with a total of 1,654 patients that yielded promising evidence for the efficacy of mindfulness meditation interventions to enhance sleep quality compared to nonspecific active controls [16]. Weber et al. also examined meditative movement practices such as Yoga, Tai Chi and Qigong and reported evidence of positive changes in sleep quality and other psychological outcomes in older adults [17]. The current intervention included some of these components at the same time: mindfulness, breathing regulation, gentle movement, relaxation, and sleep-wake routine modification. The progressive decrease in PSQI scores over 6 months could be interpreted as a decrease in psychological activity as well as an improvement in behavioral factors that impact sleep.

Concurrently, these two outcomes improved, which may be understood in the context of the relationship between stress and sleep. People who are under chronic psychological stress typically complain of sleep initiation, sleep maintenance or sleep disturbance. On the other hand, poor sleep can lead to dysregulation of emotions and sensitivity to daily stressors. An intervention that would take steps to decrease pre-sleep arousal, promote regular sleep-wake schedules, increase daytime physical activity, and facilitate relaxation might therefore affect both outcomes simultaneously. This is consistent with the parallel trajectories found in both PSS-10 and PSQI scores in the current study. Due to the observational nature of the study and the lack of formal mediation testing, it is not possible to conclude whether or not reduced stress resulted in better sleep, improved sleep resulted in reduced perceived stress, or both were directly influenced at the same time.

Another important finding was the substantial increase in self-reported well-being. Mean WHO-5 scores increased from 43.2 at baseline to 57.4 at three months and 67.1 at six months, corresponding to an adjusted estimated improvement of 23.5 points. The proportion of participants with a WHO-5 score of at least 50 also increased from 37.7% to 81.2%. This suggests that potential benefits of the lifestyle program were not limited to reducing negative symptoms but extended to positive perceptions of psychological functioning and quality of life. A large systematic review and meta-analysis by Galante et al. found that mindfulness-based programs can improve psychological distress and mental well-being among adults in nonclinical settings, although effects varied across populations and intervention settings [18]. Similarly, Kelley and Kelley reviewed meta-analyses of meditative movement therapies, including yoga, Tai Chi, and Qigong, and found that the majority of analyzed effects favored improvement in health-related quality of life [19]. These findings are broadly consistent with the improvement in WHO-5 scores observed in the present study.

Multiple interacting factors may be responsible for the improvement in well-being. Improved sleep could lead to increased daytime energy, concentration and mood, and decreased perceived stress may help people feel better able to interact

positively with work, family and social activities. With regular physical and meditative activities, participants also may experience greater self-efficacy and have strategies for mitigating daily psychological stressors. Consequently, the concurrent improvement in PSS-10, PSQI, and WHO-5 scores reinforces the need for an integrative (lifestyle) approach to treatment over a symptom specific approach.

One of the key findings of the current study was the relationship between adherence and outcomes. The changes were significantly more for those who adhered to at least 80% of the recommended activities. The high-adherence group showed a 10.0-point decrease in PSS-10 scores compared to the lower-adherence group with a score of 6.7. Corresponding improvements were also greater for PSQI and WHO-5. Moreover, age, sex, comorbidity, previous mind-body experience and baseline severity of the outcomes were controlled, and adherence was still independently associated with all three primary outcomes. For every 10% improvement in adherence, there was a corresponding reduction in PSS-10 (-1.05 points) and PSQI (-0.58 points) and an improvement in WHO-5 (+2.83 points).

This adherence-response relationship is supported by previous evidence. Parsons et al. systematically reviewed home practice within mindfulness-based stress reduction and mindfulness-based cognitive therapy programs and found a small but statistically significant association between the amount of formal home practice and intervention outcomes [20]. Similarly, Forseth et al. reported good adherence to an eight-week yoga program in a university setting alongside reductions in stress and depressive symptoms [21]. These observations are important because Eastern mind-body practices generally depend on repeated participation and continued practice rather than a single therapeutic exposure. The current findings therefore suggest that strategies designed to improve engagement and long-term adherence may be important when implementing similar lifestyle programs.

The intervention also demonstrated a favorable safety profile. Although 10.0% of participants reported mild and transient symptoms such as musculoskeletal discomfort, fatigue, or occasional dizziness, no serious adverse event was attributed to participation. This is consistent with the systematic review and meta-analysis by Cramer et al., which examined safety reporting across randomized yoga trials and found that yoga was generally as safe as usual care and exercise, although non-serious adverse events may occur and appropriate monitoring remains necessary [22]. The use of gentle movements adapted to individual ability, together with instructions to stop activities producing significant discomfort, may have contributed to the favorable safety findings observed in the present study.

Several strengths of this study should be acknowledged. First, participants were followed prospectively for six months, providing a longer observation period than many short-duration lifestyle intervention studies. Second, outcomes were measured at baseline, three months, and six months, allowing evaluation of the trajectory of change rather than relying on a single post-intervention measurement. Third, internationally recognized instruments were used to assess three complementary domains: perceived stress, sleep quality, and subjective well-being. Fourth, adherence was specifically evaluated, permitting examination of the relationship between intervention exposure and outcome improvement. Finally, the relatively high six-month retention rate of 92.0% suggests that the program was feasible and acceptable to most participants.

Nevertheless, the findings should be interpreted in the context of several limitations. Most importantly, this was a single-center prospective observational study without a randomized control group. Consequently, the observed improvements cannot be attributed exclusively to the intervention. Natural changes over time, regression to the mean, expectations of benefit, increased attention from study personnel, changes in medication or other lifestyle behaviors, and unmeasured confounding factors may have contributed to the observed changes. Self-selection may also have occurred because individuals willing to participate in a six-month lifestyle program may have been more motivated to modify their health behaviors.

Second, PSS-10, PSQI, adherence, and WHO-5 outcomes relied primarily on self-report. Although validated instruments improve measurement consistency, subjective reporting can be influenced by recall and social desirability. Objective or physiological measurements, such as actigraphy, sleep diaries, heart-rate variability or cortisol or other measures of stress when possible, should be included in future studies. Third, adherence was partially based on participant-reported practice, which could overestimate adherence. In future studies, adherence measurement might be improved through the use of digital practice records or objectively monitored attendance. Fourth, the study sample was selected from 1 setting in Faisalabad, Pakistan, which could restrict the generalizability of the findings to other populations with different cultural, demographic, socioeconomic, and healthcare backgrounds.

Future studies should assess this integrative intervention with an adequate sample size and randomized controlled design with an appropriate comparison group. Future studies need to identify which specific aspects of the intervention help most and whether there are any clear benefits to using multiple interventions compared to using yoga, meditation, sleep-hygiene education, or physical activity alone. It would be useful to have more follow-up after completion of the structured intervention to assess whether any improvements are maintained and whether ongoing intervention is required for this to occur.

CONCLUSION

The results of this six-month, prospective, observational study suggest that these lifestyle changes, which include the use of Eastern medicine, led to a progressive decrease in perceived stress, sleep disturbance and significant improvements in

self-reported well-being for adults. There were improvements by 3 months and greater at 6 months. The levels of adherence were associated with better outcomes at all times, which may be an important relationship between regular adherence and benefit. There were no serious adverse events related to the intervention, it was generally well tolerated. However, due to the observational design and lack of a control group, it is not possible to make causal inferences. The results indicate the need for additional research with well-designed RCTs and objective outcomes to further explore structured integrative lifestyle programs with longer follow-up.

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