

Predictors of Health Behaviour Dimensions: Evidence from Structural Equation Modeling of Sleep Quality and Emotional Stability

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Abstract

Background: The concept of health behaviour is a composite with multi-dimensional aspects which are affected by behavioural, psychological and environmental factors. The quality of sleep and emotional stability have been recognized as important factors influencing physical and mental health. But, there was weak evidence on their combination predicting the dimensions of health behaviour with Structural Equation Modeling (SEM). The present study analysed the predictive value of the quality of sleep and emotional state on the health behaviour of adults. The study additionally examined the interactions between gender, sleep quality and emotional stability for health behaviour dimensions. The study goals and research questions form the thesis structure of a study. **Material and Methods:** The data were taken from 500 adults through cross sectional analytical study. Standardized psychometric instruments were used to assess sleep quality, emotional stability, health behaviour. Health behaviour was assessed in four areas: somatic symptoms, anxiety/insomnia, social dysfunction and depression. The relationship between the study variables was explored using three-way factorial ANOVA, independent-sample t-tests and Structural Equation Modeling (SEM). The level of statistical significance was $p < 0.05$. **Results:** The mean sleep quality score of the participants was 5.95 ± 3.30 , whereas the mean emotional stability score was 5.55 ± 3.17 . Participants with poor sleep quality and low emotional stability consistently demonstrated poorer health behaviour across all dimensions. Three-way ANOVA revealed significant main effects of sleep quality and emotional stability on health behaviour ($p < 0.001$). Structural equation modeling demonstrated that sleep quality significantly predicted somatic symptoms ($\beta = 0.68$), anxiety/insomnia ($\beta = 0.61$), social dysfunction ($\beta = 0.57$), and severe depression ($\beta = 0.24$). Emotional stability significantly predicted somatic symptoms ($\beta = 0.29$), anxiety/insomnia ($\beta = 0.66$), social dysfunction ($\beta = 0.72$), and severe depression ($\beta = 0.72$). The SEM exhibited excellent model fit ($\chi^2 = 3.84$, $p = 0.15$; CFI = 0.992; TLI = 0.986; RMSEA = 0.031; SRMR = 0.018). **Conclusion:** Sleep quality and emotional stability are significant predictors of health behaviour among adults. Poor sleep quality and low emotional stability were associated with increased somatic symptoms, anxiety, social dysfunction, and depression. The findings suggest that interventions focusing on improving sleep quality and emotional resilience may contribute to better behavioural and psychological health outcomes.

Keywords: Health behaviour; Sleep quality; Emotional stability; Structural equation modeling; Prediction; Mental health.

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INTRODUCTION

Health behaviour is a multidimensional construct encompassing the actions, attitudes, and lifestyle practices adopted by individuals to maintain and improve their physical, psychological, and social well-being. It includes behaviours related to healthy eating, physical activity, sleep, stress management, healthcare utilization, and social functioning, all of which collectively influence overall health outcomes. Healthy behavioural practices reduce the risk of chronic diseases, improve quality of life, and promote longevity, whereas unhealthy behaviours contribute substantially to the global burden of non-communicable diseases (NCDs), mental disorders, disability, and premature mortality.^[1-3] Consequently, identifying the determinants of health behaviour has become an important priority in public health research.

Sleep is a fundamental biological process essential for maintaining cognitive performance, emotional regulation, metabolic homeostasis, immune competence, and physical restoration. Adequate sleep facilitates learning, memory

consolidation, hormonal regulation, and psychological resilience. Conversely, poor sleep quality has been associated with impaired cognitive functioning, emotional instability, reduced work productivity, cardiovascular diseases, obesity, diabetes mellitus, depression, anxiety disorders, and increased mortality.^[4-8] Recent epidemiological evidence indicates that sleep disturbances affect a substantial proportion of adults worldwide, making sleep health an increasingly important public health concern.^[9] Medic et al,^[10] reported that chronic sleep disruption adversely affects multiple physiological systems,

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whereas Freeman et al,^[11] demonstrated that sleep disturbances are strongly associated with common psychiatric disorders, particularly anxiety and depression. Emotional stability, one of the five major personality dimensions described in the Five-Factor Model, reflects an individual's ability to regulate emotions, cope effectively with stressful situations, and maintain psychological balance. Individuals with high emotional stability generally exhibit greater resilience, adaptive coping mechanisms, positive interpersonal relationships, and healthier behavioural patterns. In contrast, emotionally unstable individuals are more susceptible to anxiety, depression, stress-related disorders, and maladaptive health behaviours.^[12-15] Emotional instability is an important public health risk factor due to its high levels of psychological morbidity,^[16] and it is consistent through meta-analysis with a strong correlation with anxiety, depressive disorders and substance use disorders.^[17]

There is evidence building that the quality of sleep and emotional balance are closely related. Deprivation of sleep affects components of emotion regulation including changes in function of the prefrontal cortex, responsiveness of the amygdala, and neuroendocrine changes that result in an increase in emotional vulnerability. Similarly, sleep patterns are often impaired with emotional upset, leaving people with fragmented sleep, longer sleep latency times and lower sleep efficiency. Goldstein and Walker,^[18,19] reported sleep as a critical component of emotional brain function and Palmer and Alfano determined that the association between sleep and emotional regulation is two-way. Such interrelationships can significantly affect various aspects of health-related behaviors.^[20-22]

The relationships between sleep quality and emotional stability with health related outcomes have been studied separately. However, few studies have compared the predictive relationships of sleep quality and emotional stability with each aspect of health behaviour in the same study, by means of Structural Equation Modeling (SEM). The SEM offers a powerful multivariate analysis structure in which direct relationships between latent constructs can be estimated simultaneously, while taking measurement error and model fit into account.^[24,25]

This study aims to fill this gap of knowledge by examining the predictive power of the sleep quality and emotional stability for four aspects of health behaviour: somatic symptoms, anxiety/insomnia, social dysfunction and depression. Unlike the traditional regression method, the direct effect of each of the two predictors on each dimension of health behaviour was estimated, and the validity of the proposed theoretical model was tested. To build the structural model, the interaction effects of gender, sleep quality and emotional stability were also analyzed by a factorial analysis of variance. These goals are consistent with the aims and hypotheses of this study illustrated in the thesis.

Results of this study are likely to add to the existing evidence base on behavioral drivers of health and empirical evidence for embedding sleep health and emotional well-being into public health promotion programs. Being able to identify modifiable psychological predispositions towards health

behaviour may be useful for designing a comprehensive behavioural intervention designed to influence health behaviour in adults, both physical and mental.

MATERIALS AND METHODS

Study Design and Study Setting: This was a cross-sectional analytical study which aimed to explore the predictive power of sleep quality and emotional stability on the dimensions of health behaviour in adults. The independent and interaction effect of gender, sleep quality and emotional stability were analyzed using a factorial analysis of variance (ANOVA), and then to examine the direct effect of each of predictor variables with the dimensions of health behaviour, a structural equation model (SEM) was tested. The methodology was designed within the framework of study objectives and hypotheses.

Study participants: The study consisted of 500 adults; 250 were male and 250 female. Participants were classified according to gender, sleep quality, and emotional stability. Participants were also subdivided into eight groups using a $2 \times 2 \times 2$ factorial design according to gender (Male/Female), sleep quality (High/low) and emotional stability (High/low).

Study variables

The primary independent variables were:

- Sleep quality
- Emotional stability

Gender was included as an additional explanatory variable to evaluate its independent and interaction effects.

The dependent variable was health behaviour, which comprised four dimensions:

- Somatic symptoms
- Anxiety/Insomnia
- Social dysfunction
- Depression

These four domains were analysed individually as well as collectively to evaluate overall health behaviour.

Data collection: Data were collected using standardized self-administered questionnaires for assessing sleep quality, emotional stability, and health behaviour. Participants completed the questionnaires after providing informed consent. Completed questionnaires were checked for completeness before statistical analysis.

Statistical analysis: Data were analysed using IBM SPSS Statistics. Descriptive statistics were expressed as mean $\pm$ standard deviation (SD) for continuous variables and frequencies for categorical variables.

The statistical analyses included:

- Descriptive statistics to summarize participant characteristics.
- Independent-sample t-tests to compare differences between study groups.
- Three-way factorial ANOVA to evaluate the main effects of gender, sleep quality, and emotional stability and their two-way and three-way interaction effects on the dimensions of health behaviour.
- Structural Equation Modeling (SEM) to determine the direct predictive effects of sleep quality and emotional stability on somatic symptoms, anxiety/insomnia, social dysfunction, and depression.

Model adequacy was assessed using multiple goodness-of-fit indices, including the chi-square statistic (χ^2), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). A two-tailed p-value < 0.05 was considered statistically significant.

Ethical considerations: The study was conducted following approval from the Institutional Ethics Committee of the participating institution. Written informed consent was obtained from all participants before enrolment. Participant confidentiality and anonymity were maintained throughout the study, and all procedures were performed in accordance with the ethical principles of the Declaration of Helsinki.

RESULTS

Participant characteristics: A total of 500 adults participated in the study, including 250 (50.0%) males and 250 (50.0%) females. The overall mean sleep quality score was 5.95 ± 3.30 , while the mean emotional stability score was 5.55 ± 3.17 . Male participants had a slightly higher mean sleep quality score (6.12 ± 3.42) than females (5.78 ± 3.18). Participants with low emotional stability demonstrated poorer sleep quality (6.45 ± 3.49) than those with high emotional stability (5.46 ± 3.08). Similarly, participants with high sleep quality exhibited higher emotional stability scores (5.82 ± 3.05) compared with those having low sleep quality (5.26 ± 3.28).

Health behaviour according to sleep quality and emotional stability: The descriptive analysis demonstrated consistent differences in health behaviour according to sleep quality and emotional stability. Participants with low sleep quality (LSQ) and low emotional stability (LES) reported substantially higher scores across all four dimensions of health behaviour than participants with high sleep quality (HSQ) and high emotional stability (HES).

For somatic symptoms, the highest mean score (11.73 ± 1.79) was observed among females with low sleep quality and low emotional stability, whereas the lowest score (2.09 ± 1.02) was recorded among females with high sleep quality and high emotional stability. Overall, the mean somatic symptom scores were similar between males (5.76 ± 3.51) and females (5.69 ± 3.87), suggesting that sleep quality and emotional stability had greater influence than gender alone.

Similarly, participants with poor sleep quality and low emotional stability demonstrated markedly higher levels of social dysfunction and depression than participants with better sleep quality and higher emotional stability. Mean social dysfunction scores increased from 1.86–2.18 among participants with HSQ and HES to 10.22–10.58 among those with LSQ and LES. Likewise, depression scores increased from 1.92–2.08 in the HSQ–HES groups to 10.48–10.86 in the LSQ–LES groups.

Three-way factorial ANOVA: Three-way factorial ANOVA revealed statistically significant main effects of sleep quality and emotional stability on all dimensions of health behaviour.

For somatic symptoms, the overall model was highly significant ($F = 391.27$, $p < 0.001$) and explained 84.8% of

the variance (Adjusted $R^2 = 0.846$). Sleep quality ($F = 1734.82$, $p < 0.001$) and emotional stability ($F = 712.21$, $p < 0.001$) were significant predictors, whereas gender alone was not significant ($F = 0.45$, $p = 0.505$). Significant interaction effects were observed for gender $\times$ sleep quality, gender $\times$ emotional stability, sleep quality $\times$ emotional stability, and the three-way interaction (all $p < 0.05$).

For social dysfunction, the ANOVA model was also statistically significant ($F = 449.10$, $p < 0.001$), accounting for 86.4% of the total variance (Adjusted $R^2 = 0.862$). Significant main effects were observed for gender ($F = 24.12$, $p < 0.001$), sleep quality ($F = 1659.91$, $p < 0.001$), and emotional stability ($F = 1462.83$, $p < 0.001$). Significant two-way and three-way interaction effects further indicated that the influence of sleep quality and emotional stability varied according to gender.

For depression, the overall ANOVA model was highly significant ($F = 476.37$, $p < 0.001$), explaining 87.1% of the variance (Adjusted $R^2 = 0.869$). Significant main effects were found for gender ($F = 26.11$, $p < 0.001$), sleep quality ($F = 1292.24$, $p < 0.001$), and emotional stability ($F = 1802.95$, $p < 0.001$). All interaction effects were also statistically significant (all $p \leq 0.001$), indicating that the combined influence of sleep quality and emotional stability on depression differed according to gender.

For overall health behaviour, sleep quality ($F = 2287.87$, $p < 0.001$) and emotional stability ($F = 2031.03$, $p < 0.001$) demonstrated highly significant main effects. The interaction between sleep quality and emotional stability was also highly significant ($F = 778.53$, $p < 0.001$). However, the independent effect of gender and the three-way interaction were not statistically significant. The final ANOVA model explained 91.2% of the total variance in health behaviour (Adjusted $R^2 = 0.910$).

Pairwise group comparisons: Pairwise t-test comparisons demonstrated significant differences among most of the study groups. For overall health behaviour, nearly all pairwise comparisons were statistically significant ($p < 0.01$), except comparisons between Groups 1 and 2, Groups 4 and 5, Groups 4 and 6, Groups 5 and 6, and Groups 7 and 8, which were not statistically significant. These findings indicate that combinations of poor sleep quality and low emotional stability were associated with significantly poorer health behaviour than combinations characterized by better sleep quality and higher emotional stability.

Structural equation modelling: Structural equation modeling (SEM) was performed to evaluate the predictive effects of sleep quality and emotional stability on the four dimensions of health behaviour. The SEM demonstrated an excellent fit to the observed data, with goodness-of-fit indices of $\chi^2(2) = 3.84$ ($p = 0.15$), Comparative Fit Index (CFI) = 0.992, Tucker–Lewis Index (TLI) = 0.986, Root Mean Square Error of Approximation (RMSEA) = 0.031, and Standardized Root Mean Square Residual (SRMR) = 0.018. These indices indicate that the proposed structural model adequately represented the relationships among the study variables.

Sleep quality and emotional stability were positively correlated ($r = 0.41$). Sleep quality showed significant standardized direct effects on somatic symptoms ($\beta = 0.68$), anxiety/insomnia ($\beta = 0.61$), social dysfunction ($\beta = 0.57$), and severe depression ($\beta =$

0.24). Emotional stability also demonstrated significant positive effects on somatic symptoms ($\beta = 0.29$), anxiety/insomnia ($\beta = 0.66$), social dysfunction ($\beta = 0.72$), and severe depression ($\beta = 0.72$). Emotional stability exhibited comparatively stronger effects on social dysfunction and depression than sleep quality.

The coefficients of determination indicated that the SEM explained 64% of the variance in somatic symptoms, 58% in anxiety/insomnia, 63% in social dysfunction, and 67% in severe depression. Overall, the SEM findings confirmed that both sleep quality and emotional stability are significant predictors of health behaviour dimensions, supporting the proposed conceptual framework of the study.

DISCUSSION

The present study aimed to examine the role of sleep quality and emotional stability as predictive of the dimensions of health behaviour through the method of Structural Equation Modeling (SEM). The results showed that poor sleep quality and emotional instability were important variables in the prediction of somatic symptoms, anxiety/insomnia, social dysfunction and depression. In addition, the SEM indicated an excellent fit between the model and the data, suggesting that the proposed theoretical model was appropriate to explain the relationships among the study variables. The results indicate that sleep quality and emotional stability are psychological factors to consider in assessing health behaviour among adults.

The main result of the present study was that the quality of sleep had significant scores on all dimensions of health behaviour. Poor sleep quality participants suffered from higher somatic symptoms, anxiety/insomnia, social dysfunction as well as depression than good sleep quality participants. The standardized path coefficients from the SEM showed that sleep quality had moderate-to-strong relationships with somatic symptoms ($\beta = 0.68$), anxiety/insomnia ($\beta = 0.61$), social dysfunction ($\beta = 0.57$) and depression ($\beta = 0.24$), with the latter relationship being comparatively weaker. These results concur with those of Medic et al,^[10] who showed that chronic disruption of sleep negatively impacts physical health, emotional health and cognitive functioning. Similarly, Freeman et al,^[11] found that poor sleep is strongly correlated with anxiety disorders, depression and a decrease in functioning in daily life, and Irwin,^[5] mentioned that sleep is involved in regulation of the immune and neuroendocrine system also crucial for psychological health.

The present study additionally identified emotional stability as a good predictor of health behaviour especially for social dysfunction and depression. Emotional stability also showed standardized regression coefficients of $\beta = 0.72$ in both social dysfunction and severe depression, showing that emotionally stable individuals were less likely to have adverse psychological outcomes. The results are consistent with Lahey's work,^[16] who found that emotional instability was an important risk factor for common mental disorders, and a public health risk factor. Likewise, in a comprehensive meta-analysis, Kotov et al,^[17] found similar results with regard to

the relationship between neuroticism and anxiety, depression and substance use. Emotionally stable people tend to be more resilient, tend to adopt effective coping mechanisms and healthier behavioural patterns, as suggested by McCrae and Costa.^[12]

An important contribution of the present study is the use of Structural Equation Modeling (SEM) to test the predictive power of sleep quality and emotional stability on multiple dimensions of health behaviour simultaneously. SEM can be applied for estimating direct relationships between latent constructs, in addition to testing the overall theoretical model, unlike conventional regression analysis. A good model fit was concluded in the present study (CFI = 0.992, TLI = 0.986, RMSEA = 0.031, SRMR = 0.018) as the values of the model were well-fitting the observed data. The application of SEM to behavioural and health research has been suggested by Kline,^[24] and Hair et al,^[25] who noted that it was very useful for studying complex psychological relationships.

The results also showed a moderate positive correlation between sleep quality and emotional stability ($r = 0.41$) indicating that there was a linkage between sleep quality and emotional stability, and they both had an effect on health behaviour. This observation lends credence to the idea that sleep plays a role in emotional regulation by its effects on prefrontal cortical functions and amygdala responsiveness put forth by Goldstein and Walker.^[21] In similar fashion, Palmer and Alfano,^[22] found that sleep and emotional regulation were mutually interdependent processes, while Tempesta et al,^[19] showed that insufficient sleep negatively impacts emotional processing and behavioural adaptation.

The main and interaction effects observed in the factorial ANOVA also confirmed the SEM results, showing significant main effects of sleep quality and emotional stability in all scales of health behaviour. Gender did have significant impacts in some domains but the impact that was independent of sleep and emotional stability was relatively small. This significant interaction effect indicated that the combination of sleep quality and emotional stability has an effect that is greater than the sum of its parts, meaning that using behavioural interventions that impact on both sleep quality and emotional stability could have greater health benefits than targeting either sleep quality or emotional stability alone.

These findings could have important implications from a public health standpoint. Common disorders which increase psychological morbidity and poor quality of life and can be modified include sleep disturbances and emotional instability. The consistent measurement of sleep quality and emotional states within primary health care could aid in the early detection of those who are at greater risk of having poor health outcomes. Interventions addressing sleep hygiene, stress management, resilience skills, cognitive behavioural therapy and emotional regulation, as aspects of public health interventions, may then enhance various aspects of health behaviour. Walker,^[18] highlighted that enhancements to sleep quality is one of the most promising interventions for improving health in general, whereas Irish et al,^[23] found sleep hygiene interventions resulted in significant improvements in behavioural and psychological functioning.

There are a number of strengths in the present study. It featured an intermediate sized sample of adults, and measured several

aspects of health behavior with cutting edge statistics methods. The combination of factorial ANOVA and Structural Equation Modeling facilitated the analysis of the interaction effects along with prediction links between the studied variables.

However, certain limitations should be acknowledged. First, the cross-sectional study design limits the ability to establish causal relationships between sleep quality, emotional stability, and health behaviour. Second, the findings were based on self-reported questionnaire data, which may be affected by recall bias and social desirability bias. Finally, the study evaluated associations within a single study population; therefore, the findings should be generalized with caution. Future longitudinal and intervention studies are warranted to establish causal pathways and determine whether improvements in sleep quality and emotional stability lead to sustained improvements in health behaviour. Overall, the present findings demonstrate that sleep quality and emotional stability are significant predictors of health behaviour dimensions. The SEM findings provide robust empirical evidence supporting the proposed conceptual framework and highlight the importance of incorporating sleep health and emotional well-being into behavioural health promotion programmes and public health interventions.

CONCLUSION

This study demonstrates that sleep quality and emotional stability are significant predictors of health behaviour among adults. Structural Equation Modeling (SEM) confirmed that both variables significantly influenced the four dimensions of health behaviour—somatic symptoms, anxiety/insomnia, social dysfunction, and depression—with the proposed model showing an excellent fit to the observed data.

The findings indicate that poor sleep quality and low emotional stability are associated with poorer health behaviour, highlighting the importance of these modifiable psychological factors in promoting overall health and well-being. These results underscore the need for integrating sleep health and emotional well-being into public health interventions and preventive healthcare strategies. Future longitudinal studies are recommended to establish causal relationships and validate these findings in diverse populations.

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Conflicts of interest

There are no conflicts of interest.

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