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The Effect of HIIT Zumba with Nusantara Music on Stress and Sleep Quality in Working Women: A Pre-Experimental Study

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ABSTRACT

Wanita pekerja rentan terhadap stress dan kualitas tidur buruk akibat gaya hidup sedentary dan tuntutan ganda. Kondisi ini meningkatkan risiko penyakit kronis dan menurunkan produktivitas kerja. Penelitian ini berfokus pada intervensi latihan fisik High Intensity Interval Training (HIIT):Zumba yang diiringi Musik Nusantara (Dangdut dan lagu daerah) dengan tempo 130-150 BPM sebagai solusi preventif. Tujuan dari penelitian ini adalah menguji pengaruh HIIT:Zumba terhadap kualitas tidur dan Tingkat stress pada Wanita pekerja di Banjarmasin, Kalimantan Selatan. Penelitian ini menggunakan desain pra-eksperimen one-group pretest-posttest design dengan pendekatan Preliminary Intervention Study. Sebanyak 30 wanita pekerja berusia produktif (15-64 tahun) dengan Tingkat stress sedang dan kualitas tidur buruk dipilih melalui purposive sampling. Intervensi berupa latihan HIIT: Zumba dilakukan selama 6 minggu. Kualitas tidur dan Tingkat stress diukur menggunakan kuesioner PSQI dan PSS Sebelum dan sesudah Intervensi. Data dianalisis dengan uji Wilcoxon Signed-Rank Test. Intervensi menunjukkan terdapat perbedaan yang signifikan pada kualitas tidur sebelum dan sesudah HIIT: Zumba dilakukan (p = 0.013) namun sebaliknya tidak ada perbedaan yang signifikan pada Tingkat stress sebelum dan sesudah intervensi (p = 0.166), kemungkinan karena beban eksternal yang kompleks (seperti tuntutan profesional dan domestik ganda) yang tidak sepenuhnya ditangani oleh intervensi fisik saja.

Working women are vulnerable to stress and poor sleep quality due to sedentary lifestyles and the burden of dual demands (professional and domestic). This condition increases the risk of chronic disease and reduces work productivity. This study focused on the physical exercise intervention of High Intensity Interval Training (HIIT): Zumba accompanied by Nusantara Music (Dangdut and region song) with a tempo of 130-150 BPM as a preventive solution. This research utilized a pre-experimental one-group pretest-posttest design and is presented as a Preliminary Intervention Study. A total of 30 working women of productive age (15-64 years) with moderate stress levels and poor sleep quality were selected through purposive sampling. The intervention, which involved HIIT Zumba Exercise was conducted for six weeks. Sleep quality and stress levels were measured using the PSQI and PSS. The data was analyzed by the Wilcoxon Signed-Rank Test. The intervention showed significant differences in sleep quality before and after HIIT: Zumba was performed (p = 0.013) however there was no significant difference in stress levels before and after the intervention (p = 0.166), likely due to complex external burdens (such as dual professional and domestic demands) that were not fully addressed by the physical intervention alone.

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Introduction

Health professionals consistently advocate for exercise and training as primary strategies for disease prevention and management. This foundational principle underscores the critical role of physical activity in maintaining optimal health. Specifically, physical activity serves as a vital preventative measure against a spectrum of chronic non-communicable diseases, including Diabetes Mellitus, Cancer, Obesity, Hypertension, Coronary Heart Disease, other cardiovascular diseases, and even psychological disorders like Depression (Avindharin, 2024).

In the contemporary environment, the prevalence of these chronic diseases is increasing, largely attributable to the rise of sedentary lifestyles among the working population, particularly working women. The occupational context often encourages behaviors characterized by minimal movement, prolonged sitting, accumulated fatigue, and irregular, nutritionally poor dietary habits (Avindharin, 2024). These behavioral patterns frequently manifest in early signs of lifestyle deterioration, namely stress and insomnia (Alnawwar et al., 2023).Evidence suggests a disproportionate health burden on female employees. A survey conducted by Cigna Indonesia revealed that working women in the country report higher stress levels (84%) compared to working men (76%). The dominant stressors for women include work pressure (29%), followed by personal financial concerns (13%), and family financial concerns (10%) (Sukmana & Jatmiko, 2019). Compounding this, a study by Fatima et al. (2016) demonstrated that women exhibit a significantly higher prevalence of poor sleep quality (65.1%) than men (49.8%) (Fatima et al., 2016).

Collectively, these findings indicate that working women face elevated risk factors for developing chronic diseases, specifically concerning elevated stress and compromised sleep quality (Fatima et al., 2016). Both sleep quality and stress levels are critical indicators of an individual's physical and psychological health. Furthermore, these two factors are inextricably linked to workplace concentration and overall work performance. Poor performance, in turn, perpetuates a detrimental, unending cycle of stress and sleep disturbance (Septian, 2024). Despite the compelling evidence of vulnerability, working women represent a highly under-investigated population. A review of the literature shows that research subjects are overwhelmingly focused on students, adolescents, or the elderly. This oversight is contrary to the preventive health philosophy of the Indonesian Ministry of Health, which prioritizes prevention over curative interventions (Rokom, 2023). This disparity highlights a significant opportunity to optimize the health of the productive working female population and mitigate their future risk of chronic disease development. Research investigating the effects of High-Intensity Interval Training (HIIT) on psychological issues manifested as stress, depression, and insomnia has been extensively conducted (Borrega-Mouquinho et al., 2021; Kusnanik et al., 2020). Specifically, prior studies have demonstrated the positive impact of exercise interventions relevant to the proposed format. For instance, Wahyuni (2018) found that a HIIT Zumba intervention significantly improved both the quality and duration of sleep in overweight and obese respondents (Wahyuni, 2018). Similarly, Herdianti (2018) reported the positive value of Zumba in reducing psychological stress among Medical Faculty students. The mechanism often attributed to these benefits is the ability of HIIT Zumba to increase the production of key neurotransmitters, including serotonin, dopamine, norepinephrine, and endorphins, thereby effectively regulating mood and stress levels (Herdianti, 2018).

HIIT generally shows favorable outcomes when applied over a sustained period, such as six weeks (6 days per week with a duration of 40 minutes per session). Moreover, numerous studies have confirmed the positive results of HIIT Zumba for cardiovascular fitness (Kusnanik et al., 2020). HIIT Zumba is characterized by its engaging, rapid-paced, and high-load nature, designed to maximize caloric expenditure and produce significant physiological and psychological effects on participants (8). It is hypothesized that this intervention can effectively reduce stress levels and improve sleep quality in individuals who participate regularly. However, despite the established benefits of HIIT and Zumba individually, references specifically affirming the effectiveness of HIIT Zumba on stress levels and sleep quality, particularly in the population of working women, remain scarce. This scarcity is critical because working women represent a highly vulnerable group for developing chronic diseases, often dealing with a double burden of professional demands in the workplace and domestic responsibilities at home. Furthermore, most previous research has tended to examine stress and sleep quality measurements separately.

This study utilizes a dual measurement approach to test the effectiveness of HIIT Zumba against both stress levels and sleep quality concurrently. Crucially, to enhance participant engagement and adherence, this intervention incorporates a unique cultural adaptation: the use of Nusantara Music (Dangdut and Indonesian regional songs) to accompany the sessions. This novel approach, which deviates from standard Western music used in typical Zumba classes, is a key strategy employed to potentially boost motivation and psychological outcomes within the local population.

The rhythmic structure and persistent "gendang" (drum) beats of modern Dangdut naturally align with the high-intensity requirements of HIIT, typically falling within the 130 to 150 Beats Per Minute (BPM) range. This specific beat serves as a natural metronome for high-impact cardio, helping participants maintain the vigorous exercise protocols necessary to stimulate physiological benefits such as neurotransmitter release and thermoregulation. This study is novel in integrating a culturally adapted HIIT Zumba program using Nusantara Music to simultaneously evaluate stress levels and sleep quality among working women, a population that has been underrepresented in previous intervention studies .

Based on the significant gaps and limitations identified in the existing literature, this research is not only expected to fill a critical void in the academic discourse but also to contribute a valuable innovation to preventive health approaches in the working environment, providing an evidence-based, enjoyable, and modern physical activity intervention for women. This study proposes the implementation of High-Intensity Interval Training (HIIT) in a Zumba format (HIIT Zumba) within the workplace setting. Given the existing research gap concerning the effectiveness of this specific intervention in this specific demographic, the following research questions are formally proposed: 1)Is there an effect of HIIT Zumba on the Sleep Quality of Working Women?, and 2)Is there an effect of HIIT Zumba on the Stress Level of Working Women?.

Methods

The study utilized a pre-experimental one-group pretest-posttest design to investigate the effect of HIIT Zumba on stress levels and sleep quality. This design involves measuring the dependent variables before (O1) and after (O2) the intervention (X) in a single group. The structure of the research design is represented as follow: O1 X O2. O1 represents the pretest measurement (sleep quality and stress level of working women) before the intervention. X represent the HIIT Zumba intervention. O2 represent the posttest measurement (sleep quality and stress level of working women) after the intervention. Recognizing the structural weakness inherent in this design (absence of a control group), which limits the ability to establish definitive causality and control for confounding factors, this research is presented as a Preliminary Intervention Study. This reframing acknowledges the limitations while emphasizing the valuable initial findings and feasibility of the intervention in this specific population.

A distinct feature of the planned intervention is the use of “Nusantara Music” combining Dangdut Modern and Indonesian regional songs modern, to accompany the HIIT Zumba sessions. This deviates from previous research, which typically uses modern western pop beat music, potentially enhancing participant engagement through culturally relevant music. To ensure the music maintained the required intensity for HIIT, all music used in the work intervals was adjusted or selected to have a tempo range of 130 to 150 Beats Per Minute (BPM), which falls within the typical range for high-impact cardio and vigorous exercise protocols (Marques et al., 2017).

The research was conducted at the Auditorium of STIKES Suaka Insan, Banjarmasin, from August to September 2025. The sample size for this pre-experimental design, was set at a minimum of 30 respondents. The sampling technique used will be purposive sampling, with the following criteria: 1) working women reporting moderate stress levels and poor sleep quality (determined by screening instruments); 2) Working women within the productive age range as defined by the Ministry of Health (15–64 years). Exclusion criteria included women who were pregnant, currently using sedative medications, or having pre-existing musculoskeletal injuries that would impede high-impact exercise. Ethical clearance was obtained from the Institutional Review Board (No:218/KEPK-SI/VII/2025), and all participants provided written informed consent prior to data collection.

The two primary instruments used to measure the outcome variables (stress and sleep quality) are the Perceived Stress Scale (PSS) and The Pittsburgh Sleep Quality Index (PSQI). The PSS is a widely utilized scale for measuring stress levels from a psychological perspective. The psychometric properties of the Indonesia version of the PSS were evaluated among employee participants (N=259). The results of the Confirmatory Factor Analysis (CFA) confirmed that the scale fits a two-factor model, consisting of perceived helplessness and perceived self-efficacy. For the employee group, the scale demonstrated robust convergent validity and internal consistency, with an overall Average Variance Extracted (AVE) of 0.58 and a Construct Reliability of 0.93. These results confirm the questionnaire's validity and reliability for assessing stress in working women in Indonesia. The PSS comprises 10 items with a Likert Scale response format and measures two dimensions of stress: positive and negative (Hakim et al., n.d.,2024).

The PSQI, developed by the University of Pittsburgh, is a standardized questionnaire for assessing sleep quality. The instrument contains 19 questions, consisting of 4 open-ended questions and 15 questions with ordinal scale answers. The psychometric properties of the Indonesian version of the PSQI were rigorously evaluated across clinical and healthy populations. The instrument demonstrated good internal consistency, with a cronbach's alpha coefficient of 0.79. Content validity was robust at 0.89, and construct validity was established through strong correlations between individual components and the global PSQI score. Futhermore, the indonesian PSQI showed significant known-group validity ($p<0.001$). Diagnostic accuracy analysis revealed a sensitivity of 1.00 and a specificity of 0.81 at a cut-off point of 5. These result confirm that the Indonesian PSQI is a valid and reliable instrument for assessing sleep quality in both clinical and general settings (Alim, I. Z.,2015).

Data analysis followed a sequence of steps including data checking, coding, entry, and computation of intervention effectiveness. The process begin with data checking to ensure the completeness of the filled PSS and PSQI questionnaires. Subsequently, coding is performed by assigning specific identifiers to each questionnaire. Data was then entered into the SPSS statistical software system. The analytical interpretation utilized statistical tests determined by the data distribution: 1) Normality Test: The Shapiro-Wilk test will be used to assess the normality of the data distribution, as the planned number of respondents is less than 50, 2) Data was not normally distributed, the Wilcoxon Signed-Rank Test was used as the non-parametric alternative to assess the intervention's effectiveness, 3) Descriptive Analysis: Univariate analysis using frequency distribution was employed to identify the characteristics of sleep quality and stress levels both before and after the intervention.

Result

The results of this study are based on data collected from 30 working women who participated in the HIIT Zumba intervention. The findings are presented beginning with the demographic characteristics to provide an overview of the study population. The specific distribution of respondents based on age groups and daily working hours is detailed in the following table 1.

Table 1. Demographic data of the respondents based on age group and working hour (n=30).

Variable		Frequency	Percentage (%)
Age group	24-36 Years	23	76.7
	36-45 Years	7	23.3
Working Hours	< 7 jam	2	6.7
	7-12 Hours	26	86.6
	> 12 Hours	2	6.7

The table shows that the study population was predominantly young adults, with the majority of respondents (76.7%) falling within the 24–36 year age group. Working women in the age range of 24–36 years are often in the early stages of career development and starting to build a family (having young children), which triggers the phenomenon of dual burden. This young age group tends to have different stressors than senior workers, such as high work pressure and difficulty dividing time between professional demands and domestic responsibilities.

Regarding working hours, the overwhelming majority of participants (86.6%) reported working a moderate range of 7 to 12 hours per day. Only a small fraction of the sample worked less than 7 hours (6.7%) or more than 12 hours (6.7%). The

7-12 hour work duration indicates that most respondents spend half of their waking time in a professional environment. Working women face a double burden, namely professional responsibilities in the office and domestic responsibilities at home. These long working hours, coupled with dual role conflicts, can be a major contributor to moderate stress levels and poor sleep quality.

Table 2. Comparison of Pre-Intervention and Post Intervention of HIIT:Zumba among working women towards stress level (N=30)

Stress Level	Pre-Intervention		Post-Intervention		P-Value
	f	%	f	%	
Low Stress Level	9	30	14	46.7	0.166
Moderate Stress Level	21	70	16	53.3	
High Stress Level	0	0	0	0	

Table 2 shows the quantitative results on pre-intervention and post-intervention stress levels. The results showed that the pre-intervention data from the majority of 30 participants were included in the category of moderate stress (70%). After the intervention, there was a decrease in the number of participants who experienced moderate stress from 70% to 53.3%. Descriptively there are indications that HIIT:Zumba interventions tend to reduce participants' stress levels, but from the results of statistical tests there is no significant effect. The P value is greater than the significance level ($\alpha = 0.05$) in the Wilcoxon Signed-Rank test results for the stress level which is $0.166 > 0.05$ so it can be concluded that there is no significant change. The small sample size (N = 30) made the test strength low, so the statistical results did not show a significant effect.

Table 3. Comparison of Pre-Intervention and Post Intervention of HIIT:Zumba among working women towards Quality of Sleep (N=30)

Quality of Sleep	Pre-Intervention		Post-Intervention		P-Value
	f	%	f	%	
Good Quality	3	10	12	40	0.013
Poor Quality	27	90	18	60	

Table 3 shows the results of comparing sleep quality before and after the intervention. There was a substantial increas the number of subjects who had good sleep quality, from only 10% (3 people) before the intervention to 40% (12 people) after the intervention. This is in accordance with the results of the Wilcoxon Signed-Rank test statistics, which is a P value of $0.013 < 0.05$ so that HIIT-Zumba interventions are significantly effective in improving sleep quality.

These changes highlight the positive impact of the HIIT Zumba program, reflecting a shift toward better sleep and reduced stress levels among participants. The data from both tables reinforce the conclusion that regular, time-efficient physical activity can significantly enhance both stress management and sleep quality in a population facing dual work and household responsibilities.

Discussion

Stress Levels and Sleep Quality Before High-Intensity Interval Training (HIIT) Zumba (Pre-Test)

The baseline data from the 30 working women before the HIIT Zumba intervention showed average stress and sleep quality scores of 1.70 and 1.10, respectively. The majority of respondents (70%) fell into the moderate stress category, while an overwhelming majority exhibited poor sleep quality (53.3%). Specifically, most respondents reported feeling easily irritable, often getting angry over unexpected events, and frequently experiencing anxiety and pressure. The prevalence of poor sleep quality was evidenced by respondents reporting feeling sleepy and fatigued during daytime activities, difficulty initiating sleep, and a latency period of 1 to 2 hours before falling asleep, with many unable to sustain sleep for 30 minutes after lying down.This vulnerable health profile is consistent with the theory that while women benefit from entering the workforce, they also face specific mental health challenges, such as stress, which can severely diminish their sleep and overall quality of life. Stress is more frequently reported by women than men, often as a consequence of the dual burden—balancing work hours with household responsibilities. This role conflict increases stress, which in turn exacerbates sleep quality problems and can lead to adverse mental health outcomes.

Poor mental health, particularly stress, negatively impacts sleep quality by affecting the autonomic nervous system, increasing sympathetic activity, and triggering cortisol release, leading to a state of prolonged arousal. This chronic state makes sleep initiation difficult, increases nighttime awakenings, and reduces sleep consolidation. The moderate stress levels observed pre-intervention may stem from various factors, including high workload, social pressure, demanding daily activities, and, critically, a lack of regular physical activity, relaxation, or healthy energy discharge. Stress in working women can manifest as increased absenteeism, aggression, decreased creativity, poor performance, interpersonal conflict, irritability, reduced frustration tolerance, and social isolation, all of which compromise sleep quality (Chandrasekaran et al., 2025).

Similarly, poor baseline sleep quality is influenced by factors like workload, the habit of using electronic devices before bed, and irregular physical activity patterns. Prior research has established that individuals with low physical activity levels face a higher risk of insomnia and sleep disturbances. Women who engage in physical activity for at least 60 minutes per day, three days a week, are less likely to experience sleep disturbances (Ricciardelli et al., 2024).

These findings affirm the strong link between stress and sleep disturbance, where both conditions mutually worsen without appropriate intervention. Given that time constraints are the main barrier to regular exercise, HIIT offers a metabolically effective and time-efficientalternative for busy adults. Therefore, the HIIT Zumba intervention was anticipated to be an effective strategy to improve both conditions in this sample.

Stress Levels and Sleep Quality After High-Intensity Interval Training (HIIT) Zumba (Post-Test)

The study found evidence of improvement in both stress and sleep quality following the HIIT Zumba intervention. The mean scores shifted to 1.53 for stress and 1.40 for sleep quality. The number of respondents with low stress increased to (14 respondents), and those with poor sleep quality decreased to (18 respondents), with now reporting good sleep quality.

Post-intervention results indicated that the majority of respondents achieved better sleep quality based on the Pittsburgh Sleep Quality Index (PSQI) criteria (a score of ≦ 5 indicates good sleep quality). This suggests that most respondents developed adequate and effective sleep patterns in terms of both duration and subjective quality, with many achieving the recommended 6–7 hours of sleep for adults. HIIT Zumba is effective in enhancing sleep efficiency and reducing sleep latency, resulting in deeper and longer sleep. Physical activity may also enhance sleep quality through the thermoregulation hypothesis. Exercise is a major thermal regulatory control method, and the subsequent drop in body temperature post-exercise aids in initiating sleep and regulating circadian rhythm via the suprachiasmatic nucleus (SCN) (Xu et al., 2025) .

The improvement is further supported by evidence that physical activity promotes better sleep quality by reducing sleep-related problems, lessening physical tension, and improving mood. Active women, who often favor non-pharmacological approaches to insomnia, have better sleep quality than their inactive counterparts. HIIT, specifically, promotes circadian rhythm regularity by increasing morning light sensitivity and regulating melatonin secretion, addressing the common sleep disturbances related to circadian misalignment in working women. Recent studies confirm that HIIT improves sleep continuity, increases deeper sleep phases, and reduces nighttime awakenings compared to moderate-intensity exercise (Kawinchotpaisan et al., 2025).

While the descriptive data showed a slight shift toward lower stress, (from 70% moderate stress to 53.3% post-intervention) the statistical analysis (Wilcoxon Signed-Rank Test) revealed no significant difference in stress levels after the intervention ($P = 0.166$). This outcome contrasts with the general understanding that high-intensity exercise, especially when combined with rhythmic music like Zumba, elevate neurotransmitters associated with positive mood (e.g., endorphins and dopamine) thereby reducing psychological tension. Group rhythmic activity also offers positive social effects (e.g., sense of community and support) that should contribute to stress reduction (Chandrasekaran et al., 2025).

An important finding in the study was a 100% retention rate, as all 30 participants completed the six-week protocol without a break. This remarkable adherence is significant given that time constraints are a major barrier

to exercising for busy professional women. This high level of compliance strongly suggests that Zumba's HIIT interventions are feasible and highly tolerable, despite their high-intensity nature. This success can largely be attributed to the cultural adaptation of the program through the use of "Musik Nusantara" (Dangdut and Indonesian regional songs).

The rhythmic structure and familiar melodies of Dangdut, which naturally align with the 130-150 BPM required for HIIT, provide a fun and exciting atmosphere. While perceived stress levels did not show a statistically significant reduction ($p = 0.166$), total adherence proved that music interventions successfully transformed demanding physical tasks into positive psychological and social experiences. For nursing practices and health promotion, this implies that integrating culturally relevant and fun elements is an important strategy to ensure the sustainability of non-pharmacological health interventions in the working population.

The lack of a statistically significant reduction in perceived stress may be linked to the time required for HPA axis adaptation. While the acute cortisol response to HIIT typically returns to baseline within 24 hours, the frequent, high-intensity nature of the six-week intervention (6 days per week) may have induced a chronic state of physiological stress accumulation, or hypercortisolemia. Consequently, this duration was likely insufficient for the participants to fully transition from the acute exercise stress phase to the desired chronic 'stress relief' adaptation, which requires a stable downregulation of resting cortisol levels (Montero et al., 2021).

The lack of significant stress reduction may also be attributed to the fact that the underlying sources of stress in working women—particularly the dual burden of professional and domestic responsibilities, time-splitting difficulties, and increased childcare demands—were not removed by the physical intervention alone. The conflict of dual roles has a positive correlation with stress, meaning higher role conflict equates to higher perceived stress (Thania et al., 2021). The statistical power of the analysis was likely compromised by the small sample size (N=30). As the Wilcoxon test is less powerful than its parametric counterpart, there is a distinct possibility of a Type II error, meaning the study may have been underpowered to detect a small-to-moderate effect on stress that may have actually occurred. Research suggests that achieving a significant reduction in stress or depression symptoms often requires the integration of physical exercise with psychosocial interventions, such as stress management programs or mindfulness (Serdar et al., 2021).

Furthermore, the frequency of the intervention conducted 6 days per week may have functioned as a "double-edged sword" regarding the study's outcomes. On one hand, such a high frequency is highly effective for rapid habit formation and physiological conditioning, which contributed significantly to the marked improvement in sleep quality. On the other hand, this intense schedule may have been physically taxing for women already navigating the "dual burden" of professional and domestic responsibilities.

The physical demands of almost daily high-intensity exercise may have maintained a high physiological arousal state, potentially triggering a chronic cortisol response or preventing the HPA axis from completely lowering over the duration of the study. This accumulation of physical stress likely counteracts the psychological benefits of the "happy hormone" of Zumba sessions, explaining why the perceived stress reduction does not reach statistical significance. Future nursing interventions should consider a balance of exercise frequency to allow adequate physiological recovery, especially in populations with high external stress.

Effect of HIIT Zumba on Stress Levels and Sleep Quality (Overall Summary)

The final analysis confirmed disparate results between the two variables: a statistically significant difference was found in sleep quality, but no statistically significant difference was found in stress levels. This indicates that HIIT Zumba is more effective in influencing sleep quality than perceived stress, likely due to its strong biological mechanisms (neurotransmitter release and circadian regulation) that directly affect sleep efficiency and quality. The positive impact on sleep quality aligns with prior studies that show HIIT effectively improves sleep quality and cardiorespiratory fitness in depressed patients, even when the reduction in depressive symptoms (and thus stress) is minor. In conclusion, the findings support HIIT Zumba as an efficient and enjoyable non-pharmacological physical activity alternative for working women to effectively enhance sleep quality, though future research must address the persistent, complex nature of their stress levels.

Study Limitations

The primary limitation is the use of a pre-experimental one-group pretest-posttest design without a control group. This structural weakness poses significant threats to the internal validity of the study. Specifically, it is impossible to definitively rule out the influence of confounding variables as alternative explanations for the observed significant improvement in sleep quality. Potential confounding factors include History (e.g., external events coinciding with the six-week intervention), Maturation (natural recovery or adaptation over time), and the Testing Effect (participants becoming sensitized to the questionnaires, influencing post-test scores). Consequently, the study can only claim an association between the HIIT Zumba intervention and improved sleep quality, not a definitive causal relationship. The small sample size (N=30) severely limits the generalizability (external validity) of these findings to the broader population of all working women.

The use of purposive sampling introduces the risk of selection bias. The women who volunteered to participate in an exercise-based program, even if identified as having poor sleep and moderate stress, may have already possessed a higher intrinsic motivation (self-efficacy) or positive predisposition toward physical activity. This self-selection process may have biased the results towards showing a positive outcome (especially on adherence and sleep quality improvement) and limits the generalizability of the findings to the broader population of working women who are physically inactive or resistant to starting an exercise regimen.

Furthermore, the small sample necessitated the use of the Wilcoxon Signed-Rank Test, a non-parametric test which is less powerful than parametric tests. This low statistical power increases the risk of a Type II error for the stress variable. The non-significant finding for stress (P=0.166) may thus reflect a failure to detect a true underlying effect, rather than a genuine absence of effect. The sample was heavily skewed toward a specific age group and, likely, health professions, further limiting the generalizability of these findings to the broader, heterogeneous population of working women. The study did not directly compare Nusantara music, such as Dangdut and regional songs, with Western pop music. Therefore, it is unclear how culturally relevant music affects psychological outcomes. However, the high retention rate suggests that such music might have helped keep participants motivated and committed. Instead of being a proven fact, using familiar music is considered a possible factor that improved the exercise experience for Indonesian working women.

This study is limited by the lack of biological markers, such as salivary or blood cortisol levels. The absence of these markers means the theory of chronic physiological stress accumulation (hypercortisolemia) could not be objectively verified, and results rely solely on self-reported psychological scales.

Conclusion

The HIIT Zumba intervention had a significant positive effect on improving the sleep quality of working women. However, the intervention did not result in a statistically significant change in the participants' perceived stress levels. This suggests that while the physical activity component successfully addressed physiological factors linked to sleep regulation, the psychological complexity of stress in this population was not significantly altered by this particular short-term physical intervention alone.

Future studies should incorporate a control group (Randomized Control Trial design) and consider a longer intervention period (e.g., >8 weeks) to observe potential changes in stress levels, allowing sufficient time for physiological adaptation of the HPA axis and HPA axis downregulation.

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Conflict of Interest

The authors declare that they have no competing interests.

Credit Author Statement

Fransiska Dwi Hapsari: Conceptualization, Project administration, Data Collection, Writing-Original Draft. **Maria Silvana Dhawo:** Methodology**,** Formal Analysis, Writing-Review. **Dyah Trifianingsih:** Data Collection, Writing-Review **Joan Chintya Putri Aholiab:** Data Collection, Documentation. **Ester Triayuni:** Data Collection, Documentation.

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