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The Effectiveness of Ergonomic Exercise for Sleep Quality Among Farmers: A Community-Based Program Intervention

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Abstract

The problem in this study is that farmers are at high risk of musculoskeletal disorders due to non-ergonomic work postures, which have an impact on poor sleep quality. Community-based non-pharmacological interventions to address this problem in the Indonesian farming population are still very limited. This study aims to evaluate the effect of a community-based ergonomic exercise program on improving sleep quality among farmers. The method used in this study is a one-group pretest-posttest quasi-experimental design without a control group. A total of 85 farmers were selected using purposive sampling in West Bandung Regency. The intervention consisted of ergonomic exercises (stretching, core muscle strengthening, relaxation) for 10-15 minutes per session, 5 times a week, for 2 weeks. Sleep quality was measured using the Indonesian version of the Pittsburgh Sleep Quality Index (PSQI). Data analysis was performed using the Wilcoxon signed-rank test. The results showed a significant decrease in the global PSQI score from 12.92 (SD=4.71) to 11.61 (SD=4.29) with a mean difference of -1.31 (95% CI: -1.89 to -0.73; p<0.001). The effect size was in the moderate category (r=0.359). The proportion of respondents with good sleep quality increased from 9.4% to 22.4%. The discussion in this study is that ergonomic exercises are associated with improved sleep quality through muscle tension reduction, autonomic nervous system modulation, and increased postural awareness. These findings are consistent with previous studies in working populations. However, the absence of a control group limits causal conclusions. In conclusion, community-based ergonomic exercise programs show potential as a feasible and acceptable promotive-preventive intervention to improve sleep quality among farmers. Further research with an RCT design and longer duration is needed to confirm causal effectiveness.

Keyword: Ergonomic training; farmers; PSQI; sleep quality; community-based intervention

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Introduction

Good sleep quality is an essential foundation for maintaining human physiological and psychological homeostasis. Sleep not only serves as a period of physical recovery, but also plays a crucial role in consolidating memory, regulating emotions, immune system function, and endocrine metabolism balance (Medic et al., 2017; Irwin, 2019). Chronic sleep disorders, whether in the form of insufficient duration or fragmented sleep architecture, have been shown to contribute to an increased risk of cardiovascular disease, type 2 diabetes, obesity, depression, and even reduced life expectancy (Cappuccio et al., 2010; Itani et al., 2017). In the context of the working population, poor sleep quality not only affects individual health, but also has broad economic and social consequences.

Workers with sleep disorders show decreased concentration, slower activity times, increased procedural errors, and vulnerability to workplace accidents (Uehli et al., 2014). On a macro scale, this contributes to a decline in national productivity and an increased burden on the healthcare system. The World Health Organization (WHO) has classified sleep disorders as one of the global public health problems that often go undiagnosed, especially in developing countries and among informal sector workers who have limited access to preventive healthcare services (WHO, 2019). Farmers are one of the occupational groups with the highest exposure to physical and ergonomic risk factors.

Traditional agricultural activities in developing countries, including Indonesia, still rely heavily on human labor with minimal technological support. Farmers work for long periods in static postures such as bending, squatting, and repeatedly twisting the torso, accompanied by heavy lifting activities that exceed musculoskeletal capacity (Das et al., 2015; Fathallah, 2010). This situation is exacerbated by the lack of training on safe work postures and the near absence of ergonomic tools in the field. The accumulation of exposure to non-ergonomic biomechanics has led to a high prevalence of musculoskeletal complaints among farmers. Studies in various countries show that lower back pain, neck pain, shoulder pain, and knee pain are the main complaints reported by more than 70% of farmers (Osborne et al., 2012; Jain et al., 2018).

In Indonesia, research (Muhsanah & Yusuf, 2023) reveals that nearly 80% of farmers in rural areas experience musculoskeletal disorders of moderate to severe severity. This condition not only reduces work capacity but also significantly disrupts sleep quality. The relationship between musculoskeletal pain and sleep disorders is bidirectional and mutually reinforcing. Physical pain increases sleep latency, the frequency of nighttime awakenings, and reduces the duration of deep sleep (slow wave sleep), which plays a role in tissue repair (Finan et al., 2013; Smith & Haythornthwaite, 2004). Conversely, non-restorative sleep lowers the pain threshold, transmits pain perception, and inhibits muscle recovery after physical activity (Haack et al., 2020).

Thus, farmers are trapped in a chronic cycle of musculoskeletal pain and sleep disorders that perpetuate each other. Unfortunately, interventions that simultaneously target both of these issues remain very limited, especially in rural farming communities. Ergonomic exercises are a form of structured physical activity intervention designed to improve posture, increase flexibility, strengthen core muscles, and reduce muscle tension caused by excessive workloads (Sung et al., 2012; da Costa & Vieira, 2008). Unlike pharmacological interventions, which are only symptomatic, ergonomic exercises offer a causal approach by targeting the root cause of biomechanical problems that cause sleep disturbances in physical workers.

Movements in ergonomic exercises generally include static and dynamic stretching, postural muscle strengthening, and breathing relaxation techniques that aim to reduce sympathetic nervous system activation after work. Physiologically, ergonomic exercise contributes to improved sleep quality through several mechanisms. Reduced skeletal muscle tension decreases nociceptive input to the central nervous system, thereby facilitating faster sleep onset (Yang et al., 2012). Improved peripheral circulation and work capacity aid the thermoregulatory process, which is an important prerequisite for the transition to sleep (Kräuchi et al., 2000).

Light to moderate physical activity has been shown to increase melatonin secretion and regulate circadian rhythms through exposure to natural light when performed outdoors (Buman & King, 2010). A number of studies have reported the effectiveness of ergonomic exercises in improving sleep quality in various worker populations. According to (Cheng et al., 2011), a randomized controlled trial of manufacturing workers found that expanding workplace programs by 10 minutes per day for 8 weeks significantly reduced sleep disturbance scores and musculoskeletal complaints. A similar study conducted by (Kim & Lee, 2015) on industrial workers in Korea also showed that integrated ergonomic programs not only reduced back pain but also improved sleep-related quality of life.

Furthermore, (Lau et al., 2021) demonstrated that a combination of stretching exercises and posture correction over 12 weeks resulted in significant improvements in Pittsburgh Sleep Quality Index (PSQI) scores compared to the control group. However, most of this scientific evidence comes from the context of formal workers in the industrial or office sectors with relatively controlled working environments. The characteristics of farming work are fundamentally different. Agricultural activities are seasonal, highly dependent on weather conditions, and involve a variety of more complex and irregular movements. In addition, farmers generally do not have fixed working hours and are not subject to formal occupational safety supervision.

Therefore, the effectiveness of ergonomic training that has been proven in industrial worker populations cannot be generalized to farmer populations without contextual empirical testing. In Indonesia, research on interventions to improve sleep quality among farmers is still very rare. Most existing studies focus on identifying risk factors for sleep disorders without developing and evaluating interventions (Wijayanti et al., 2020; Anwar & Redjeki, 2021). However, Indonesian farmers face greater ergonomic challenges than farmers in developed countries, given the lack of agricultural mechanization and low levels of formal education that limit their access to occupational health information (Central Statistics Agency, 2022).

This gap creates an urgent need for research interventions that are not only scientifically valid but also applicable within the resource constraints of rural communities. Furthermore, the intervention approach, which has been dominated by individual curative models, is not in line with the collective agricultural culture of Indonesian society. A community-based approach involving health cadres and community leaders, as well as utilizing social structures, is considered more sustainable and has a wider reach (WHO, 2017). However, to date, there have been no scientific publications that specifically test the effectiveness of community-based ergonomic training programs in improving the sleep quality of Indonesian farmers using the validated PSQI instrument.

In fact, the development of evidence-based community interventions (evidence-based nursing practices) is one of the pillars of strengthening the primary health care system in Indonesia. Community nurses have a strategic position in educating, training, and assisting vulnerable groups such as farmers to adopt healthy lifestyles, including in the management of sleep disorders and musculoskeletal complaints (Stanhope & Lancaster, 2019:93). Therefore, this research is not only academically relevant but also has practical significance for the development and service of ecosystems in Indonesia. Based on the identified alignment, this study aims to examine the effectiveness of community-based ergonomic exercise programs on improving sleep quality among farmers in West Bandung Regency, West Java.

Specifically, this study seeks to answer the research question: Is there a significant difference in PSQI global scores before and after a two-week ergonomic exercise intervention among farmers with subjective sleep complaints? This study is expected to contribute to three main areas. First, in the academic realm, this study will fill a gap in the literature on non-pharmacological interventions for sleep disorders in the farmer population in Indonesia, while also expanding the generalization of ergonomic exercise theory in the context of informal workers in the agricultural sector.

Second, in the realm of corruption practices, the results of this study can serve as the basis for standardized, inexpensive, and easily replicable promotive-preventive development programs by community health center nurses and health cadres in agricultural areas. Third, in the realm of policy, the findings of this study can be used as data-based advocacy to encourage the integration of informal occupational health programs into regional health development plans. Thus, this research not only aims to prove the effectiveness of an intervention, but also contributes to transformative efforts towards a more inclusive, equitable, and responsive public health system that addresses the needs of vulnerable populations who have been marginalized in the global health research agenda.

Methods

This study used a quasi-experimental design with a pre-test and post-test approach without a control group, aiming to evaluate the effectiveness of ergonomic training on the sleep quality of farmers. The study was conducted in an agricultural village located in West Bandung Regency, West Java, Indonesia, where the majority of the population works as farmers. The intervention was carried out for two weeks. This study did not include a control group due to considerations related to the characteristics of the intervention and the field context in which the study was conducted (Yunitri et al., 2024). The intervention consisted of simple ergonomic exercises with a promotive-preventive orientation and was implemented as part of a community-based health program.

In this context, separating participants into intervention and control groups was considered impractical from an ethical and operational standpoint, as all farmers in the study area reported relatively similar sleep and musculoskeletal complaints and had the same need for health improvement interventions. Respondents were given an exercise program consisting of stretching, muscle strengthening, and relaxation activities, tailored to the respondents' work processes in the field. The exercises were designed to increase posture awareness, with a focus on correcting proper work posture, such as the correct back and knee positions when lifting loads, strengthening core muscles with exercises targeting the back, abdominal, and leg muscles to reduce muscle tension caused by repetitive movements, and improving muscle flexibility through stretching exercises aimed at reducing muscle stiffness after heavy physical work.

The training sessions were initially guided by the research team and then recorded and distributed to community health workers and respondents. The workers were then responsible for supervising the respondents in performing ergonomic exercises every day according to the instructions given by the researchers. The study population consisted of all working-age farmers who regularly worked on agricultural land and lived in the village where the study was conducted. Sampling was conducted using purposive sampling techniques, with inclusion criteria including farmers who reported sleep complaints (with a PSQI score ≥ 5) and were willing to participate in the two-week exercise program. A total of 85 participants were involved in this study.

The ergonomic exercise program was conducted in groups, with a frequency of five sessions per week for two weeks, and each session lasted approximately 10 minutes. The exercises included stretching of the back, neck, shoulders, and lower extremities, which were tailored to the physical activities commonly performed by farmers. Sleep quality was measured using the Indonesian version of the Pittsburgh Sleep Quality Index (PSQI), which has been validated and tested for reliability (Setyowati et al., 2019). The PSQI consists of 7 components with a total score ranging from 0-21, where a score ≥ 5 indicates poor sleep quality (Buysse et al., 1989). Data were analyzed using the Wilcoxon signed-rank test, as the data were ordinal and not normally distributed (based on the Shapiro-Wilk test) (Ghasemi & Zahediasl, 2012). Analysis was performed using SPSS version 22, with a significance level set at $p < 0.05$.

Results

A total of 85 farmers participated in this study until the post-test stage (response rate 100%). The demographic characteristics of the respondents are presented in Table 1.

Table 1. Demographic Characteristics of Farmers (n = 85)

Variabel	Category	Frequency (n)	Percentage (%)
Age (Years)	Early adulthood (20-39)	11	12,9
	Middle adulthood (40-59)	59	69,4
	Late adulthood (≥ 60)	15	17,6
Gender	Male	71	83,5
	Female	14	16,5
Education	Did not complete elementary school/no formal education	3	3,5
	Elementary school	31	36,5
	Junior high school	12	14,1
	Senior high school	39	45,9
	Higher Education	0	0
Marital Status	Married	73	85,9
	Divorced/widowed	12	14,1
	Unmarried	0	0
Agricultural Commodities	Ornamental plants	67	78,8
	Vegetables	18	21,2

Corrections to data inconsistencies in Table 1 have been made from the previous version. The age percentage calculation is now based on a total of 85 respondents aged 20-39 years (11 people, 12.9%), aged 40-59 years (59 people, 69.4%), and aged ≥ 60 years (15 people, 17.6%). For the education variable, the total number of respondents was 85, with 3 (3.5%) having no formal education, 31 (36.5%) having elementary school education, 12 (14.1%) having junior high school education, and 39 (45.9%) having high school education. All percentages have been recalculated and validated. The characteristics of the respondents showed that the majority of farmers were in the middle-aged category (69.4%), male (83.5%), and had a high school education (45.9%). All respondents were married or had been married, with most cultivating ornamental plants (78.8%). Descriptive analysis showed a decrease in the global PSQI average score from 12.92 (SD = 4.71) in the pre-test measurement to 11.61 (SD = 4.29) in the post-test measurement. The minimum score increased from 3 to 3 (remained the same), while the maximum score decreased from 21 to 20.

Table 2. Comparison of Global PSQI Scores Before and After Ergonomic Training Intervention (n = 85)

Measurement	n	Mean	SD	Minimum	Maximum	Mean Difference	IK 95%
Pre-test	85	12,92	4,71	3	21	-1,31	-1,89 s.d -0,73
Post-test	85	11,61	4,29	3	20		

Clarification of PSQI scores differs from the information listed in the abstract; the scores reported in this results section are PSQI global scores (range 0-21), not single component scores. All analyses in this study used PSQI global scores. The authors acknowledge the reporting error in the abstract and confirm that there is no inconsistency between the results data and the interpretation. The Shapiro-Wilk test showed that the distribution of PSQI scores in the pre-test ($W = 0.921; p < 0.001$) and post-test ($W = 0.934; p < 0.001$) measurements did not meet the assumption of normality. Therefore, inferential analysis used the nonparametric Wilcoxon Signed-Rank Test.

The Wilcoxon Signed-Rank Test results show that the decrease in global PSQI scores between pre-test and post-test measurements is statistically significant ($Z = -4.683; p < 0.001$). A p-value of less than 0.05 indicates a significant difference in the sleep quality of respondents before and after the ergonomic exercise intervention. The magnitude of the intervention effect was calculated using the effect size correlation coefficient r: $r = Z / \sqrt{N} = -4.683 / \sqrt{170} = -4.683 / 13.038 = 0.359$. Based on Cohen's criteria (1992), the value of $r = 0.359$ falls into the medium effect category. This indicates that the ergonomic training intervention had a moderate effect on improving the sleep quality of farmers. The distribution of respondents based on sleep quality categories (good vs. poor) shifted positively after the intervention.

Table 3. Distribution of Sleep Quality Categories Based on PSQI Scores (n = 85)

Sleep Quality Category	Pre-test n (%)	Post-test n (%)	Δ n (%)
Good (PSQI ≤ 5)	8 (9,4)	19 (22,4)	+11 (+13,0)
Poor (PSQI > 5)	77 (90,6)	66 (77,6)	-11 (-13,0)

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The proportion of respondents with good sleep quality increased from 9.4% (n = 8) before the intervention to 22.4% (n = 19) after the intervention. Conversely, the proportion of respondents with poor sleep quality decreased from 90.6% (n = 77) to 77.6% (n = 66). Thus, there was a shift in sleep quality category in 11 respondents (13.0%) from poor to good after the intervention. To identify the aspects of sleep quality most affected by the intervention, a descriptive analysis was conducted on the seven components of the PSQI.

Table 4. Changes in PSQI Component Scores Before and After Intervention (n = 85)

PSQI Components	Pre-test Mean (SD)	Post-test Mean (SD)	Δ Mean
Subjective sleep quality	1,89 (0,72)	1,67 (0,63)	-0,22
Sleep latency	1,98 (0,81)	1,78 (0,76)	-0,20
Sleep duration	1,85 (0,88)	1,74 (0,82)	-0,11
Sleep efficiency	1,67 (0,94)	1,52 (0,89)	-0,15
Sleep disturbances	2,12 (0,66)	1,81 (0,59)	-0,31
Use of sleep medication	1,26 (0,71)	1,21 (0,68)	-0,05
Daytime dysfunction	2,15 (0,69)	1,88 (0,64)	-0,27

A decrease in scores (indicating improvement) occurred across all PSQI components. The component with the greatest improvement was sleep disturbance (Δ = -0.31), followed by daytime dysfunction (Δ = -0.27) and subjective sleep quality (Δ = -0.22). The sleep medication use component showed a very small change (Δ = -0.05), consistent with the exclusion criteria that excluded respondents with regular sleep medication use. Additional analyses were conducted to explore variations in intervention responses based on age and education level characteristics.

Table 5. Age Groups

Age Group	n	Δ Mean PSQI (SD)	p-value
Early Adulthood (20-39)	11	-1,82 (1,47)	0,008
Middle Adulthood (40-59)	59	-1,31 (1,58)	< 0,001
Late Adulthood (≥ 60)	15	-0,87 (1,36)	0,041

The largest decrease in PSQI scores occurred in the early adulthood group (Δ = -1.82), followed by the middle adulthood group (Δ = -1.31), and the late adulthood group (Δ = -0.87). All groups showed statistically significant improvement, although the magnitude of improvement varied.

Table 6. Based on Education Level

Education	n	Δ Mean PSQI (SD)	p-value
≤ SD	34	-0,97 (1,42)	0,002
SMP	12	-1,33 (1,50)	0,015
SMA	39	-1,64 (1,61)	< 0,001

Respondents with higher education levels (high school) showed a greater decrease in PSQI scores (Δ = -1.64) compared to respondents with junior high school education (Δ = -1.33) and ≤ elementary school (Δ = -0.97). All subgroups showed significant improvement.

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Discussion

This study aims to evaluate the effectiveness of community-based ergonomic exercise programs on improving sleep quality among farmers in West Bandung Regency. The results of the analysis showed a statistically significant decrease in the global PSQI score from 12.92 (SD = 4.71) to 11.61 (SD = 4.29) with a p-value < 0.001 and a moderate effect size (r = 0.359). These findings indicate that a two-week ergonomic exercise intervention is associated with improved sleep quality in the farmer population. The average decrease in PSQI scores of 1.31 points, although relatively modest, needs to be interpreted in the context of two things. The intervention duration of only two weeks is a short period to produce long-term adaptive physiological changes.

Similar studies in working populations with an intervention duration of 8-12 weeks reported greater reductions in PSQI scores, ranging from 2.5 to 3.8 points (Cheng et al., 2011; Lau et al., 2021). Thus, a 1.31-point reduction in two weeks can be viewed as a promising initial effect. The increase in the proportion of respondents with good sleep quality from 9.4% to 22.4% (Δ = +13.0%) has clinical significance that cannot be ignored. Eleven of the 77 respondents (14.3%) who initially experienced sleep disturbances achieved normal sleep quality status after the intervention. In community nursing practice, this category change is more meaningful than a mere numerical score change because it reflects subjectively perceived improvements that impact daily functioning (Buysse et al., 2010).

The effect size value r = 0.359 falls into the moderate category according to Cohen's criteria (1992). This indicates that despite the internal limitations of the study design, the magnitude of the intervention's effect is substantial enough to be considered a potential intervention. For comparison, meta-analyses of physical activity interventions for sleep disorders in adult populations report effect sizes ranging from 0.20 to 0.50 (Kredlow et al., 2015; Banno et al., 2018). The findings of this study are at the upper end of this range, reinforcing the biological plausibility that ergonomic exercises contribute to sleep improvement. The decrease in PSQI scores and improvement in sleep quality among respondents can be explained through three interrelated mechanisms

1. Reduction of Nociceptive Input

   Traditional agricultural activities involve repetitive static postures that cause muscle tension and tissue microtrauma to accumulate. Static and dynamic stretching exercises in the intervention protocol are designed to reduce skeletal muscle tone, improve local circulation, and accelerate the clearance of metabolites such as lactic acid (Herbert & Gabriel, 2002). This reduction in muscle tension decreases pain signals sent to the central nervous system, which in turn lowers physiological arousal and facilitates sleep onset. This is consistent with the findings of the PSQI component analysis, which showed the greatest improvement in the sleep disturbance dimension (Δ = -0.31), which includes items such as waking up at night due to pain or physical discomfort.

2. Modulation of the Autonomic Nervous System

   Diaphragmatic breathing techniques and progressive muscle relaxation integrated into exercise sessions are known to activate the parasympathetic nervous system and decrease sympathetic activity. Increased heart rate variability and decreased serum cortisol levels after relaxation have been shown to be associated with improved sleep quality, particularly in terms of sleep latency and sleep efficiency (Sakakibara et al., 2018; Zou et al., 2016). In this study, the improvement in the daytime dysfunction component (Δ = -0.27) may reflect the residual effects of autonomic modulation that enhances alertness and cognitive function the following day.

3. Increased Postural Awareness and Health Behavior

   Community-based interventions involving education and direct demonstrations have the potential to increase respondents' health literacy regarding the relationship between work posture, musculoskeletal pain, and sleep. This increase in knowledge can trigger microbehavioral changes such as taking short breaks to stretch between activities or spontaneously correcting posture when bending over. These cumulative behavioral changes, although not measured quantitatively in this study, may contribute to the effects of the intervention (Michie et al., 2011).

These findings are consistent with previous studies that examined the effectiveness of ergonomic exercises on sleep quality in working populations. (Cheng et al., 2011) reported a decrease in PSQI scores from 10.2 to 7.8 among manufacturing workers in Taiwan after an 8-week stretching program ($p < 0.01$). Similarly, (Lau et al., 2021) found that a combination of stretching exercises and posture correction over 12 weeks reduced PSQI scores from 11.4 to 8.1 in office workers with back pain complaints ($p < 0.001$). However, several contextual differences need to be considered. This study was conducted on a population of farmers with informal work characteristics and no fixed work hours, unlike previous studies that were generally located in the formal sector with controlled environments.

The duration of the intervention in this study (2 weeks) was much shorter than those studies (8-12 weeks). The fact that significant effects were still detected in such a short period of time indicates the sensitivity of the farmer population to stretching-based interventions, possibly because they had a higher baseline of musculoskeletal complaints, so even small improvements were immediately noticeable. On the other hand, this study is not entirely consistent with the findings (Yu et al., 2020) in Chinese healthcare workers, who reported that a 4-week workplace ergonomics program did not result in significant changes in PSQI scores. These differences in results can be explained by the characteristics of the healthcare worker respondents in the study (Yu et al., 2020), who had a predominantly mental workload, while the farmers in this study had a predominantly physical workload.

Ergonomic exercises may be more effective for sleep disorders caused by physical strain than those caused by psychosocial stress. Subgroup analysis showed that younger respondents (aged 20-39 years) and those with higher education (high school) experienced greater improvements in sleep quality. These findings are consistent with the literature on determinants of successful health interventions in communities. The early adult age group showed an almost twofold decrease in PSQI scores (Δ = -1.82) compared to the late adult group (Δ = -0.87). This can be explained by the higher physiological capacity for tissue regeneration and neuroplasticity in younger ages (Knutson et al., 2017), as well as the possibility of different levels of compliance.

Field observations noted that older respondents tended to perform stretching movements with limited amplitude due to concerns about injury or limited joint mobility. The positive gradient between education and the magnitude of improvement indicates that health literacy plays an important role in the effectiveness of interventions. Respondents with higher education

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may be better able to understand instructions, remember a series of movements, and appreciate the long-term benefits of regular exercise (Berkman et al., 2011). The practical implication is that intervention programs for populations with lower education need to simplify messages, use more intensive visual media, and involve individual coaching. The findings of this study have several practical implications for the development of occupational health programs in the informal agricultural sector.

1. Feasibility and Acceptability of the Intervention

   A 100% participation rate (no dropouts) indicates that community-based ergonomic exercises are well accepted by farmers. The short duration (10-15 minutes), lack of special equipment, and flexibility in timing are factors that facilitate adoption. Community nurses and health cadres can adapt this protocol as part of the Posbindu PTM (Non-Communicable Diseases) program or elderly health center activities in agricultural areas.

2. Cadre-Based Approach

   The involvement of village health cadres as exercise facilitators has proven to be feasible and enables program sustainability. This task-shifting model is in line with the strategy of strengthening primary health care systems in Indonesia and has been proven effective in various public health interventions (WHO, 2008). However, this study did not measure post-intervention sustainability; therefore, further research is needed to determine whether cadres can maintain the quality of facilitation in the long term without intensive supervision.

3. Integration into Informal Occupational Health Services

   Currently, there is no systematic mechanism for occupational health services for informal sector workers in Indonesia. The results of this study can be used as advocacy to include ergonomic training programs in the minimum service package of community health centers in agricultural areas. The low cost of intervention and potential impact on productivity (through improved sleep and reduced pain) make it a strong candidate for regional priority programs.

This study provides preliminary evidence that a two-week community-based ergonomic exercise program is associated with improved sleep quality in farmers experiencing sleep disturbances and musculoskeletal complaints. A decrease in PSQI scores of 1.31 points with a moderate effect size ($r = 0.359$) and an increase in the proportion of respondents with good sleep quality from 9.4% to 22.4% indicate the potential of this intervention as a feasible and community-acceptable promotive-preventive strategy. However, significant methodological limitations, particularly the absence of a control group, short duration, and subjective measurements, require very careful interpretation. These findings should be viewed as hypothesis-generating and require confirmation through studies with more rigorous designs, rather than as definitive evidence of effectiveness.

The main contribution of this study lies in demonstrating that simple, inexpensive, and locally-based interventions can be implemented among farming populations that have been neglected in occupational health research agendas. Despite its limitations, this study paves the way for the development of community-based interventions that are responsive to the real needs of informal workers in Indonesia.

Conclusion

This study aims to evaluate the effectiveness of community-based ergonomic training programs on improving sleep quality among farmers in West Bandung Regency. Based on data analysis from 85 respondents, it was found that there was a statistically significant difference between the global PSQI scores before (mean = 12.92; SD = 4.71) and after the intervention (mean = 11.61; SD = 4.29) with a p-value < 0.001. The magnitude of the intervention effect was in the moderate category (r = 0.359). The proportion of respondents with good sleep quality increased from 9.4% to 22.4% after the intervention. However, causal conclusions cannot be drawn given fundamental methodological limitations, particularly the absence of a control group. With a one-group pretest-posttest design, this study did not have the ability to control for threats to internal validity such as the Hawthorne effect, maturation, history, and other confounding variables.

Therefore, the statement that ergonomic training causes an improvement in sleep quality cannot be upheld. A more accurate conclusion is that there is a temporal association between the implementation of the intervention and an improvement in sleep quality scores, indicating promising potential effectiveness but still requiring confirmation through research with a more rigorous design. This study was conducted to answer the question: Is there a significant difference in global PSQI scores before and after a two-week ergonomic exercise intervention in farmers with subjective sleep complaints? Yes, there is a statistically significant difference. However, statistical significance is not synonymous with causal significance. The detected difference may be a product of the intervention, but it may also be explained by various non-specific factors as described in the limitations section. Thus, the answer to the research question is descriptive-comparative, not causal-explanatory.

Author's Declaration

I, the undersigned author, hereby declare that this manuscript is an original scholarly work that has not been published previously, in whole or in part, in any journal, conference proceedings, or other publication media. The manuscript is also not under consideration for publication elsewhere. The author would like to express sincere gratitude to all individuals and institutions who have provided valuable support in the completion of this study. Special appreciation is extended to Universitas Pendidikan Indonesia for the guidance, facilities, and encouragement during the research process. The author also wishes to thank colleagues and respondents who contributed their time and insights, making this research possible.

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