Original Article

Progressive Muscle Relaxation and Stretching Interventions to Reduce Physical Fatigue and Injury Risk

Nadhifah Eka Cahyani[1], Tri Johan Agus Yuswanto [2]*
[1]Bachelor of Applied Nursing, Politeknik Kesehatan Kemenkes Malang, East Java, Indonesia
[2]Nursing Departement, Politeknik Kesehatan Kemenkes Malang, East Java, Indonesia
*Corresponding author denbagusjohan@yahoo.co.id

open access

ARTICLE INFO

ABSTRACT

Background: Physical fatigue is a major challenge frequently encountered by perioperative nurses due to high workload, long working hours, emotional pressure, and a demanding environment requiring continuous concentration and physical endurance. The purpose of this study was to analyze the effectiveness of progressive muscle relaxation and stretching methods used by perioperative nurses on fatigue levels and injury risk. **Methods**: This quasi-experimental study involved 120 perioperative nurses recruited by purposive sampling and assigned to two groups: an experimental group receiving progressive muscle relaxation (PMR) and a comparison group performing stretching exercises. Physical fatigue and injury risk were measured using the IFRC questionnaire and a researcher-developed injury risk questionnaire before and after intervention. Data were analyzed using the Mann-Whitney test with a significance level of $\alpha = 0.05$. **Results**: The primary outcomes showed a significant reduction in physical fatigue and injury risk in both groups after intervention ($p < 0.05$). The PMR group demonstrated a greater decrease in fatigue levels compared to the stretching group (effect size = [insert effect size]). Additionally, the risk of injury was significantly lower post-intervention in the PMR group. No significant changes were observed in the control or baseline measures. These findings indicate that both PMR and stretching are effective in reducing fatigue and injury risk, with PMR showing superior effectiveness. **Conclusion**: The study supports the implementation of progressive muscle relaxation and stretching exercises as practical, low-cost strategies to reduce physical fatigue and injury risk among perioperative nurses, contributing to improved occupational health and safety in hospital settings.

INTRODUCTION

Physical fatigue and injury risk are significant challenges for perioperative nurses in demanding environments such as operating rooms (Evander et al. 2019). These nurses often experience fatigue due to heavy workloads, extended shifts, and the need for continuous focus and specialized knowledge (Lubis et al. 2024). Fatigue presents as physical symptoms such as muscle soreness and reduced mobility,(Wiguna et al. 2023) and psychological symptoms such as difficulty concentrating and boredom(Harahap et al. 2021). The maximum workload must be achieved if high productivity is desired; however, if the workload is too low or too high, it can lead to low productivity (Amini et al. 2024).

Globally, over half of operating room nurses report work-related fatigue, and (Jun et al. 2021) approximately 67% experience fatigue after night shifts (Iskandar et al. 2024). In Indonesia, moderate and mild fatigue levels predominate among nurses (Prabowo, 2018). and fewer participants experienced severe fatigue (David H.T., 2022).

Fatigue and injury risk are influenced by individual factors such as age and health status (Rini et al. 2023). Non-pharmacological interventions, such as progressive muscle relaxation (PMR), have been shown to reduce musculoskeletal pain (Ma et al. 2023). Stretching exercises improve physical function and reduce pain (Thompson et al., 2021). However, few studies have compared the effectiveness of PMR with stretching in perioperative nurses. This study aimed to fill this gap by evaluating both interventions to guide occupational health strategies (Alqhtani et al. 2023).

METHODS

This study used a quasi-experimental design with three groups: progressive muscle relaxation and stretching, and a control group without intervention. This study aimed to compare the effectiveness of the two interventions in reducing physical fatigue and injury risk among perioperative nurses. The sample size calculation, recruitment process, and inclusion-exclusion criteria were clearly explained. The population in this study were nurses who met the inclusion criteria in the perioperative room (Preoperative, Intraoperative, and Postoperative Nurses), the sample was 120 perioperative nurses, the sampling method was purposive sampling, the research time was April 30 - June 9, 2025. The location was at IHC Lavalette Hospital, Malang City, Karsa Husada Batu Hospital and Kanjuruhan Malang Hospital.
The self-developed injury risk questionnaire was content-validated and pilot tested, although reliability measures, such as Cronbach's alpha, were not reported.

Data were analyzed using the Mann-Whitney U test, with a significance level of 0.05. The results showed that progressive muscle relaxation was more effective than stretching was. An intervention duration of seven days was chosen based on previous studies but requires further justification. Potential confounding factors, such as workload intensity, rest time, and individual health status were not controlled, representing a limitation that should be addressed in future research.

RESULTS

Data on respondent characteristics included age, sex, marital status, education, length of service, and nursing department. The data for respondent characteristics were obtained from an informed consent form.

Tabel 1 Distribution of Frequency of Respondent Characteristics Based on Age, Gender, Marital Status, Education, Length of Work, and Nursing Department

Variables	n	%
Age		
26-31	53	44.2
32-37	34	28.3
38-43	22	18.3
44-49	8	6.7
>55	3	2.5
Gender		
Man	55	45.8
Women	65	54.8
Married Status		
Marry	98	81.7
Not married yet	22	18.3
Education		
D3 Nursing	38	31.7
S1/D4 Nursing	82	68.3

Variables	n	%
Length of Work		
<5	63	52.5
5-10	40	33.3
>10	17	14.2
Nursing Section		
Surgical Nurse	60	50
Nurse Anesthetist	10	8.3
Room Nurse	50	41.7

Based on the frequency distribution of respondent characteristics by age, less than half of the respondents were in the age range of 26–31 years (44.2%). Less than half of the respondents were male (45.8%). The marital status of The majority of respondents were married (81.7). The last education of Less than half of the respondents had a D3 Nursing education (31.7%). Length of service Less than half of the respondents had a service period of five years or more, consisting of five to ten years (33.3%) and more than ten years (14.2%). Based on the Nursing Section Half of the respondents worked as surgical nurses (50%).

Tabel 2 Level of Physical Fatigue and Injury Risk Before Intervention and After Treatment Group ROP on Perioperative Nurses

Variables	Pre Rop		Post Rop	
	n	%	n	%
Physical Fatigue Level				
Low	0	0.0	40	100
Medium	35	87.5	0	0.0
High	5	12.5	0	0.0
Risk of Injury				
Low	0	0.0	40	100
Medium	40	100	0	0.0

Some results show implausible outcomes, such as the reported 100% improvement to "low fatigue" in the ROP treatment group, where fatigue levels reportedly shifted from moderate to high to low after the intervention. Similarly, the risk of injury has been reported to decrease by 100 % %from moderate to low. These findings raise concerns about potential measurement bias, overfitting, or issues with data validity; as such, complete improvements are uncommon in real-world settings and warrant cautious interpretation.

Tabel 3 Level of Physical Fatigue and Injury Risk Before Intervention and After Stretching Treatment Group on Perioperative Nurses

Variable	Pre P		Post P	
	(n)	(%)	(n)	(%)
Physical Fatigue Level				
Low	0	0.0	40	100
Medium	38	95	0	0.0
High	2	5	0	0.0
Risk of Injury				
Low	0	0.0	40	100
Medium	40	100	0	0.0

Some results show implausible outcomes, such as the reported 100% improvement to "low fatigue" in both intervention groups. For example, based on the table, the stretching treatment group reported a complete (100%) reduction in physical fatigue levels, shifting from moderate to high fatigue to low fatigue, and a similar 100% reduction in the risk of injury from moderate to low. These findings raise concerns about potential measurement bias, overfitting, or issues in data collection and analysis, as such perfect improvements are uncommon and may not

reflect real-world conditions.

Tabel 4 Level of Physical Fatigue and Injury Risk Before Intervention and After Control Group on Perioperative Nurses

Variable	Pre K		Post K	
	(n)	(%)	(n)	(%)
Physical Fatigue Level				
Low	20	50	24	60
Medium	20	50	16	40
Risk of Injury				
Low	20	50	30	75
Medium	20	50	10	25

The control group results reportedly show "significant change," which contradicts the study design assumption that no intervention would lead to stable fatigue and injury risk levels. However, based on the table, the control group showed no significant change in physical fatigue levels, with only a 10% change observed in four respondents, shifting from low to moderate fatigue. This suggests that physical fatigue levels remain relatively stable without specific interventions such as progressive muscle relaxation or stretching. The risk of injury in the control group increased by 25%, moving from low to moderate levels, which may indicate the influence of uncontrolled external factors or measurement variability. These findings highlight potential discrepancies in the reported significance and warrant cautious interpretation.

Tabel 5 Differences in Physical Fatigue Levels and Injury Risks Before and After Progressive Muscle Relaxation

Variables	Mean Ranks	Mann-Whitney U value	Sig. (2 tailed)
ROP Treatment Pre-Test			
Physical Fatigue Level	39.94	621.500	0.047
Risk of Injury	44.84		
ROP Treatment Pre-Test			
Physical Fatigue Level	36.50	607.500	0.028
Risk of Injury	45.64		

Based on the table of effectiveness of physical fatigue level and risk of injury before and after intervention in the treatment group, the level of physical fatigue and risk of injury pre-test had a significance value of 0.047 (p <0.05), indicating that before the intervention, there was a significant difference in the level of physical fatigue and risk of injury. After the 7-day intervention of ROP treatment, the post-test measurement was carried out again, with a significance value of 0.028 (p <0.05), indicating that after the ROP intervention, there was a statistically significant decrease in the level of physical fatigue and risk of injury.

Tabel 6 Of Differences in Physical Fatigue Levels and Injury Risks Before and After Stretching

Variables	Mean Ranks	Mann-Whitney U value	Sig. (2 tailed)
Pre-Test Treatment P			
Physical Fatigue Level	35.98	619.500	0.045
Risk of Injury	44.89		
Pre-Test Treatment P			
Physical Fatigue Level	43.94	602.500	0.038
Risk of Injury	36.07		

Based on the stretching treatment, the level of physical fatigue and risk of injury pre-test had a significance value of 0.045 (p <0.05), indicating that before the intervention, there was a significant difference in the level of physical fatigue and risk of injury between the stretching and comparison groups. After the 7-day intervention, the post-test re-measurement had a significance value of 0.038 (p <0.05), indicating that after the stretching intervention, there was a statistically significant decrease in physical fatigue.

Tabel 7 Of Differences in Physical Fatigue Levels and Injury Risks Before and After Control Group

Variables	Mean Ranks	Mann-Whitney U value	Sig. (2 tailed)
Physical Fatigue Level			
Pre-K Group	45.00	620.000	0.040
Post-K Group	36.00		
Risk of Injury			
Pre-K Group	45.50	600.000	0.022
Post-K Group	35.50		

Based on the Man-Whiteney test table from the control group, the p-value of the control group with a physical weakness level of 0.040 <0.05 and the control group with a risk of injury of 0.022 <0.05, which means there is a significant difference between the control group with a physical weakness level and the control group with a risk of injury. This shows a significant difference between the groups with a level of physical weakness and risk of injury both before and after control.

Tabel 8 Anova Test

Variables	F value	*p-value*
Physical Fatigue Level	27.363	0.001
Risk of Injury	31.366	0.001

Based on the table, an F value of 27,363 with a p-value <0.001 indicates a statistically significant difference in fatigue levels between groups or measurement times. Because the p-value was less than 0.05, the hypothesis was accepted. This means that the treatment/intervention significantly influenced changes in fatigue levels. Meanwhile, the F value of 31,366 with a p-value <0.001 also indicated a highly significant difference in injury risk between groups or measurement times. This means that the intervention had a significant impact on reducing or changing injury risk.

DISCUSSION

The results of this study indicate that both progressive muscle relaxation (PMR) and stretching interventions can significantly reduce the level of physical fatigue and risk of injury in perioperative nurses (Rahmayanti et al. 2021). Progressive Muscle Relaxation Training is a technique for training the relaxation of all muscles by tensing and relaxing several muscle groups and distinguishing the sensation of physical tension and relaxation, accompanied by mental relaxation, thus helping someone meet their sleep needs. Sleep quality is also influenced by several factors, including stress (Naim et al. 2023). This decrease was more evident in the intervention group than in the control group, which did not receive special treatment (anggela et al. 2023). Progressive muscle relaxation training is known to affect fatigue. With this awareness, nurses can take steps to prevent other types of fatigue, such as improving stress management skills, seeking social support, and maintaining work-life balance (Amini et al., 2024).

In the PMR group, a significant difference was found between the pre- and post-test scores, with a p-value <0.05. This indicates that PMR is effective in reducing physical fatigue and the risk of injury through mechanisms such as reducing muscle tension and stress, and improving physiological control of the body. Practicing progressive muscle relaxation can provide calm to

the body's muscles that are tense due to anxiety, thereby making emotions more stable (Mangundap et al. 2022). These results are consistent with previous research proving the effectiveness of PMR in reducing stress and improving physical well-being. Progressive muscle relaxation techniques in the 1920s can help patients overcome anxiety, relax muscles, and calm their mind (Imam et al. 2022). In addition, PMR is easy to practice independently, safe, and free from side effects, and can be applied in various nursing work situations. This implementation time refers to research (Oktavia et al. 2021) that states that morning and evening are effective times for achieving a relaxed state. Although these results support those of previous studies, it is possible that variations in intervention duration, workload intensity, or participants' psychological conditions could influence the effectiveness of PMR. These findings also align with the stress-recovery theory, which explains that relaxation activities help restore the balance of the autonomic nervous system, reduce sympathetic activation, and promote recovery from work-related strain.

Stretching has also been shown to be effective in reducing physical fatigue and injury risks. Interventions in the form of dynamic and static stretching performed for seven consecutive days showed a statistically significant impact (p < 0.05). The selection of this stretching technique was based on evidence that it improves muscle performance recovery and range of motion, supports balance and proprioception, and potentially reduces fatigue and the risk of injury at work(Daneshjoo et al. 2024). The main benefits of stretching include increased range of motion, acceleration of muscle recovery, support for balance and proprioception, and prevention of musculoskeletal injuries due to excessive workload. This is also supported by research Baharuddin et al. (2023) that found that stretching exercises have an effect on work-related pain in the musculoskeletal muscles. These findings are in line with previous research showing that stretching can reduce musculoskeletal disorders (MSDs) and help overcome work-related fatigue. These results are also supported by previous research showing similar results, (Ismayenti et al. 2021) where static stretching significantly reduced work fatigue (p-value = 0.046). Stretching significantly reduces musculoskeletal pain and physical fatigue after workloads, indicating the potential to reduce the risk of injury due to excessive workloads(Alqhtani et al. 2023). When comparing both interventions, PMR produced a greater reduction in fatigue and injury risk scores than stretching did, which may be attributed to its dual physical and psychological relaxation effects. However, stretching remains beneficial as it directly targets musculoskeletal tension and joint mobility, providing complementary benefits to PMR.

Although the control group also showed significant changes in physical fatigue levels and risk of injury, these improvements were likely due to external factors, such as workload adjustments, psychological adaptation, or the Hawthorne effect (You et al., 2023). The control group (without intervention) still showed small changes in fatigue levels due to time factors, work adaptation, or internal hospital policies but were not as effective as the group receiving structured interventions such as physical exercise or relaxation techniques. However, the decrease was not as large as that in the intervention group, so natural changes without structured strategies are considered insufficient to reduce fatigue and the risk of injury in the long term. The study findings regarding work period are in line with the theory that work period has a negative impact due to limited endurance in work processes, which results in fatigue and boredom in workers(Politon et al., 2021). If fatigue is allowed to continue, it will impact work performance and efficiency, which can lead to increased work errors and risk of work accidents (Surantri et al., 2022) (Purwandari et al. 2024). Despite these promising findings, this study had several limitations. The use of self-reported measures may introduce bias in assessing fatigue and injury risk, and the sample was limited to perioperative nurses in selected hospitals, which may restrict generalizability. Furthermore, the possibility of Hawthorne effect cannot be completely ruled out. Therefore, future studies should include larger and more diverse samples, employ objective physiological indicators, and evaluate the long-term sustainability of the PMR and stretching interventions.

CONCLUSION

Based on the results of the study on the effectiveness of relaxation and stretching techniques among perioperative nurses in Malang Raya Hospital, it can be concluded that progressive muscle relaxation (PMR) shows a greater tendency to reduce physical fatigue and the risk of injury than stretching exercises. However, this conclusion should be interpreted cautiously, as the claim of superiority is not supported by detailed comparative statistical analysis and the intervention period was relatively short, limiting external validity.

For nursing practice, it is recommended that relaxation or stretching sessions be incorporated regularly into nurses' work routines, ideally 10–15 minutes per session, two–three times per week, particularly after prolonged surgical procedures or during shift changes. Further research with a larger sample size and longer intervention duration is needed to confirm these findings and determine the optimal frequency and duration of such interventions in perioperative settings.

Author's Contribution Statement: Nadhifah Eka: Data curation, Writing –original draft preparation; **Tri Johan:** Supervision, Direction in article preparation.

BIBLIOGRAPHY

Alqhtani, R. S., Ahmed, H., Alshahrani, A., Khan, A. R., & Khan, A. (2023a). Effects of whole-body stretching exercise during lunch break for reducing musculoskeletal pain and physical exertion among healthcare professionals. *Medicina, 59*(5). https://doi.org/10.3390/medicina59050910

Alqhtani, R. S., Ahmed, H., Alshahrani, A., Khan, A. R., & Khan, A. (2023b). The effectiveness of deep breathing relaxation techniques on reducing pain scale in appendicitis patients at the emergency department of Otanaha Regional Hospital, Gorontalo City. *Journal of Health Science Research Innovation, 1*(2). https://doi.org/10.55606/detector.v1i2.1368

Amini, N. J., Fatimah, F., Setiyadi, N. A., & S. S. A. (2024). Analysis of factors affecting burnout rate in nurses working in adult nursing rooms at a hospital. *Poltekita: Journal of Health Sciences, 17*(4). https://doi.org/10.33860/jik.v17i4.3753

Anggela, A., Hosseini, E., Heshmati, S., Sahebozamani, M., & Behm, D. G. (2023). The implementation of progressive muscle relaxation on fatigue in children with kidney disease undergoing hemodialysis. *JONAH (Journal of Nursing and Homecare), 2*(1), 1–57. https://doi.org/10.36929/jonah.v2i1.713

Baharuddin, N., Baharuddin, A., & Masriadi. (2023). Factors associated with work fatigue among employees of PT FKS Multi Agro Tbk, Makassar. *Window of Public Health Journal, 4*(2), 333–346. https://doi.org/10.33096/woph.v4i2.763

Daneshjoo, A., Hosseini, E., Heshmati, S., Sahebozamani, M., & Behm, D. G. (2024). Effects of slow dynamic, fast dynamic, and static stretching on recovery of performance, range of motion, balance, and joint position sense in healthy adults. *BMC Sports Science, Medicine and Rehabilitation, 16*(1). https://doi.org/10.1186/s13102-024-00841-5

David, H. T. (2022). *Factors affecting work fatigue among nurses at Sundari General Hospital, Medan City, in 2022* (Skripsi). Institut Kesehatan Helvetia. https://repository.helvetia.ac.id/id/eprint/5518/

Evander Kondi, A., & Herlina. (2019). Factors associated with work fatigue among nurses at Awal Bross Hospital Bekasi. *Persada Husada Indonesia Journal, 6*(20), 1–9.

Harahap, P., & Rahma, D. (2021). The relationship between repetitive activities, work attitude, and length of work with muscle fatigue complaints among rubber latex workers. *Public Health and Safety International Journal, 1*(1). https://doi.org/10.55642/phasij.v1i01

Imam, N., Indrawan, A. B., Syahrizal, R., & Pranata, S. (2022). Intervention of progressive muscle relaxation on anxiety and sleep quality in COVID-19 patients: A systematic review. *Poltekita: Journal of Health Sciences, 16*(3), 402–408. https://doi.org/10.33860/jik.v16i3.1259

Iskandar, I., & Chandra, F. (2024). The influence of physical and mental workload and energy intake on the level of work fatigue among nurses. *Journal of Health Sciences, 2*.

Ismayenti, L., Suwandono, A., Denny, H. M., & Widjanarko, B. (2021). Reduction of fatigue and musculoskeletal complaints in garment sewing operators through a combination of stretching, brain gym®, and touch for health. *International Journal of Environmental Research and Public Health, 18*(17). https://doi.org/10.3390/ijerph18178931

Jun, J., Ojemeni, M. M., Kalamani, R., Tong, J., & Crecelius, M. L. (2021). Relationship between nurse burnout, patient and organizational outcomes: A systematic review. *International Journal of Nursing Studies*. https://doi.org/10.1016/j.ijnurstu.2021.103933

Lubis, S. A., Aini, N., & Yuniati, Y. (2024). Factors affecting fatigue levels of nurses at Mitra Medika General Hospital Amplas. *Vitamin: Journal of General Health Sciences, 2*(3), 134–156. https://doi.org/10.61132/vitamin.v2i3.482

Ma, L. Y., Chen, H. L., Gu, H. Y., Li, H., & Gao, X. M. (2023). Analysis of the clinical features and risk factors of device-related pressure injuries in the operating room. *International Wound Journal, 20*(3), 706–715. https://doi.org/10.1111/iwj.13912

Mangundap, S. A., Tampake, R., & Manggasa, D. D. (2022). Mental health education for people living with HIV/AIDS in facing the COVID-19 pandemic. *Poltekita: Journal of Community Engagement, 3*(3), 643–650. https://doi.org/10.33860/pjpm.v3i3.1228

Naim, R., Mariany, M., & Saputri, E. A. I. (2023). The effect of progressive muscle relaxation exercises on sleep quality of menopausal women. *Poltekita: Journal of Health Sciences, 17*(3), 682–686. https://doi.org/10.33860/jik.v17i3.3354

Oktavia, S., Rahmawati, R., & Uslianti, S. (2021). Measurement of physical workload and fatigue levels using CVL and IFRC methods. *Journal of Industrial Engineering, 18*(1), 1–12. https://doi.org/10.26418/jti.v18i1.51378

Purwandari, R., & Argiyanti, A. (2024). Tingkat kelelahan dan kecelakaan kerja perawat ruang rawat inap. *Jurnal Kesehatan, 13*(2). https://doi.org/10.37048/kesehatan.v13i2.436

Rahmayanti, A. D., Putra, K. R., & Yuliatun, L. (2021). Mind-body training and progressive muscle relaxation therapy on nurses with burnout syndrome. *Medisains, 19*(2), 46. https://doi.org/10.30595/medisains.v19i2.11011

Rini, W. N. E., Halim, R., & Sarah, U. (2023). Factors related to work fatigue among traffic police. *Poltekita: Journal of Health Sciences, 16*(4), 429–435. https://doi.org/10.33860/jik.v16i4.1740

Thompson, S., Wiebe, N., Arena, R., Rouleau, C., Aggarwal, S., Wilton, S. B., & James, M. T. (2021). Effectiveness and utilization of cardiac rehabilitation among people with CKD. *Kidney International Reports, 6*(6), 1537–1547. https://doi.org/10.1016/j.ekir.2021.03.889

Wiguna, A., Artana, I. W., & Dewi, S. P. A. P. (2023). Nurse burnout at Bali Mandara Hospital central surgery and anesthesia installation. *Jurnal Riset Keperawatan Nasional, 7*(1). https://doi.org/10.37294/jrkn.v7i1.468

You, Y., Huang, L., Peng, X., Liao, L., Zhang, F., Feng, M., & Liu, Y. (2023). An analysis of the influencing factors of depression in older adults under the home care model. *Frontiers in Public Health*. https://doi.org/10.3389/fpubh.2023.1191266