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Ergonomic Risk Identification and Occupational Safety and Health (OSH) Based on Ergonomic Intervention: A Pilot Study

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Abstract

Background: Banking employees are commonly exposed to hidden ergonomic hazards resulting from prolonged sitting, repetitive movements, and extensive computer use. These exposures contribute to musculoskeletal disorders (MSDs) and visual fatigue, posing risks to occupational health and productivity.

Methods: A community-based intervention was conducted on 4 October 2025 at Bank in Makassar City, involving 20 participants. An andragogical training model was implemented through lectures, discussions, risk identification sessions, and hands-on demonstrations on workstation adjustment and micro-break techniques. Ergonomic complaints were qualitatively identified, and risk factors were mapped based on established ergonomic frameworks. Participants reported prevalent ergonomic-related symptoms, especially low back pain, neck–shoulder discomfort, and visual fatigue. Identified risk factors included static sitting postures, repetitive hand wrist movements, and suboptimal workstation design. The training improved participants' understanding of ergonomic risk factors and introduced practical OSH-based strategies, including workstation redesign, micro-break application, and posture correction.

Result: These results align with global evidence on high MSDs prevalence among office and banking workers. Banking employees are at considerable risk of MSDs and visual strain due to prolonged computer use and poor workstation ergonomics.

Conclusion: OSH-based ergonomic interventions, particularly engineering and administrative controls, are essential for reducing exposure and protecting worker health. Strengthened management commitment and ongoing ergonomic training are key to sustaining safe, productive banking environments.

Keywords:

Occupational Safety and Health, Musculoskeletal Disorders, Workstation Design

BACKGROUND

Occupational Safety and Health (OHS) is a fundamental element in protecting workers in various industrial sectors, including the banking sector. Globally, occupational health issues have shifted from a predominantly physical and mechanical focus to an increasing emphasis on latent and cumulative ergonomic risks, particularly in office-based work (1). The digital transformation and increasingly intensive computer use have resulted in workers spending a significant portion of their working time in static sitting positions, performing repetitive movements, and interacting with visual display terminals (VDTs) for extended periods (2). This situation has given rise to work-related musculoskeletal disorders (WMSDs), visual fatigue, and postural strain, which are now recognized as significant causes of reduced productivity and a high burden of occupational diseases in the service sector (3). Globally, the prevalence of WMSDs in office workers is reported to reach 50–70%, with the most common complaints being lower back, neck, shoulder, and wrist pain. A study of banking workers in India found a 71% prevalence of MSDs, associated with sitting for more than 6 hours per day and unergonomic working postures (4). Research in the journal Applied Ergonomics showed that administrative workers are at significant risk of neck-shoulder pain due to monitor misalignment and visual strain during intensive computer use (5). Meanwhile, the report's research found that a combination of static postures, repetitive movements, and time pressure (work demand) is the primary determinant of WMSDs among service-sector workers (6).

These global findings indicate that while the banking sector is not at high risk for accidents, the ergonomic risks experienced are more complex and long-term. This situation aligns with what is observed in Indonesia. Domestic studies confirm the high prevalence of musculoskeletal complaints in tellers and customer service staff due to unergonomic sitting postures, repetitive work, and long hours of computer use (7,8). Furthermore, lighting issues and the use of substandard computer screens have led to high rates of Computer Vision Syndrome (CVS), as evidenced in banking employees in Batam who experienced significant eye fatigue due to inadequate light intensity (9). Indonesia already has regulations regarding office OHS through Minister of Health Regulation No. 48 of 2016, which emphasizes that ergonomic risk control is mandatory to create a safe and healthy workplace (10). However, implementing this regulation in the banking sector still faces challenges, including limited ergonomic facilities, a lack of ergonomics education for workers, and the lack of ergonomics integration into the banking OHS Management System (SMK3). Internal studies by several large banks, such as (11) and (12), show that, despite OSH policies at the management level, ergonomics implementation at the executive level remains suboptimal, particularly in risk assessment and workstation design.

From an academic perspective, there is a clear research gap. Most ergonomics research in the banking sector focuses on surveys of MSD complaints or risk analysis using Rapid Office Strain Assessment (ROSA), Rapid Upper Limb Assessment (RULA), and Nordic Body Map (NBM) methods (13). However, ergonomic interventions based on OSH training specifically designed for bank workers, particularly through community-based intervention or andragogical training approaches, remain very limited, especially in Indonesia. This is despite international literature showing that ergonomics training has a significant impact on reducing the risk of WMSDs. For example, a study by Musa demonstrated that a combination of ergonomics education and changes in work behavior can reduce musculoskeletal complaints by up to 35%. Similarly, a study by Patra on computer workers in Australia found that ergonomics education directly reduced visual fatigue. Based on these findings, research is needed that not only maps ergonomic risks but also provides practical interventions grounded in ergonomics-based OSH applicable to employees. Ergonomics training activities such as community engagement are a relevant approach because they allow for direct knowledge transfer, discussion of real-world problems, and demonstration of ergonomic solutions that bank employees can immediately implement. Therefore, this study was conducted to assess and implement an OHS-based ergonomics training intervention for

employees at the Bank Mega Makassar Panakkukang Branch. This study is expected to provide a comprehensive overview of ergonomic complaints, their underlying risk factors, and the effectiveness of training in improving workers' ergonomic awareness and behavior (15). Furthermore, the results of this study are expected to contribute to the body of banking ergonomics literature in Indonesia and serve as a reference for banks in formulating more systematic, structured, and evidence-based ergonomic policies.

METHODS

Study Design and Setting

This is a quantitative study, using a one-group pretest–posttest pre-experimental design. The study used a pre–post design without a control group to evaluate preliminary changes in ergonomic knowledge, workstation risk level, and self-reported work behavior following an OSH-based ergonomic intervention.

Population and Sampling

The participants were 20 bank employees (tellers, customer service officers, and administrative staff) from the Bank Mega Makassar Panakkukang Branch, Indonesia. Participants were recruited voluntarily during an internal occupational health activity conducted on 4 October 2025.

Instrument

Musculoskeletal complaints were assessed using a structured MSD symptom questionnaire adapted from commonly used occupational health screening tools. Ergonomic risk was evaluated using the Rapid Office Strain Assessment (ROSA) method. Ergonomic knowledge was measured using a 20-item questionnaire administered before and after the intervention.

Protocol Intervention

The intervention consisted of four structured stages:an educational lecture on ergonomic hazards and OSH principles; Participatory ergonomic risk identification and discussion; Hands-on workstation adjustment and posture demonstration; and a reinforcement session focusing on micro-breaks and stretching techniques. The overall structure of the ergonomic intervention is illustrated in Figure 1.

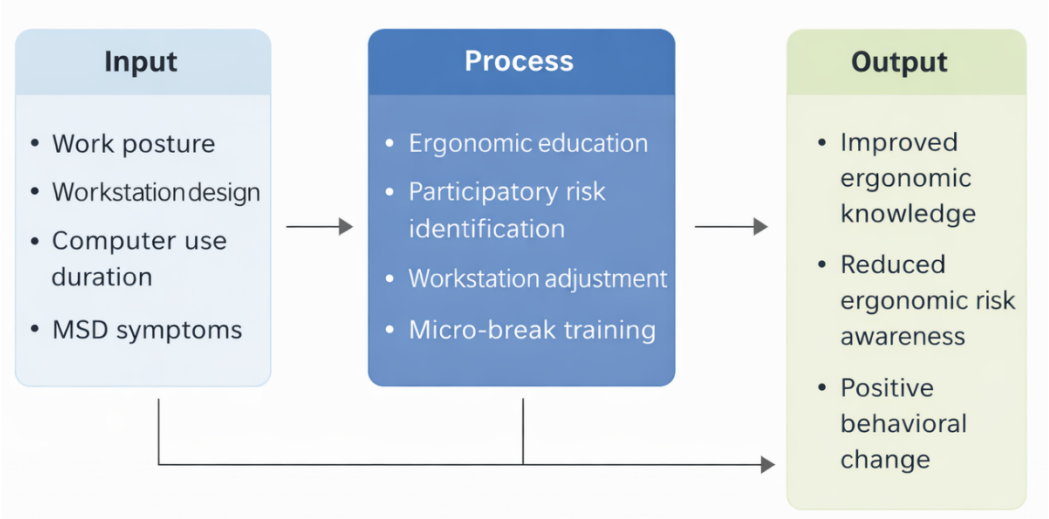

Figure 1. OSH-Based Ergonomic Intervention Framework for Bank Employees

Figure 1 presents the OSH-based ergonomic intervention framework implemented in this study. The framework was designed to operationalize the intervention procedures and ensure methodological clarity and reproducibility. It consists of three interrelated components: input, process, and output. The input component represents baseline ergonomic risk factors among bank employees, including work posture, workstation design, duration of computer use, and self-reported musculoskeletal disorder (MSD) symptoms. These inputs informed the intervention's focus and content.

The process component describes the structured intervention activities conducted during the program, comprising ergonomic education, participatory ergonomic risk identification, hands-on workstation adjustment, and micro-break training. An andragogical learning approach was applied to encourage active participation and the acquisition of practical skills. The output component illustrates the expected short-term outcomes of the intervention: improvements in ergonomic knowledge, increased awareness of ergonomic risks, and positive changes in work-related ergonomic behavior. This framework clarifies that the study represents a pilot OSH-based ergonomic intervention framework, rather than a fully validated predictive or causal model.

Data Collection and Analysis

Practical demonstrations were conducted to teach correct sitting posture, workstation adjustment, and safe body mechanics, after which participants engaged in guided practice to apply ergonomic corrections. A reinforcement session with an educational presentation concluded the intervention, emphasizing key ergonomic strategies, including implementing micro-breaks, stretching routines, and maintaining posture. Participants completed a follow-up behavioral questionnaire one week later.Data were analyzed descriptively. Pre-and post-intervention ergonomic knowledge scores were compared to assess changes following the intervention. Given the pilot nature and limited sample size, findings were interpreted cautiously.

Ethical approval

This study was conducted in accordance with ethical standards for occupational health research. Ethical approval was obtained through institutional ethical review procedures (Approval No. 003/K3/UNF/IX/2025). All participants were fully informed about the study objectives, procedures, potential benefits, and their right to withdraw from the study at any time without any consequences. Participation was entirely voluntary, and written informed consent was obtained prior to data collection. No personal identifying information was recorded, and confidentiality and anonymity were strictly maintained throughout the study. All data were used solely for research purposes and handled in accordance with ethical principles to ensure the protection of participants.

RESULT AND DISCUSSION

Demographic Characteristics

Table 1. Demographic Characteristics (n =20)

Variables	Category	Number (n)	Percentage (%)
Gender	Man	7	35%
	Woman	13	65%
Age	21–30 years	6	30%
	31–40 years	9	45%
	> 40 years	5	25%
Years of service	< 3 years	4	20%

Variables	Category	Number (n)	Percentage (%)
	3–10 years	10	50%
	> 10 years	6	30%
Job Position	Teller	8	40%
	Customer Service	6	30%
	Administration	6	30%

Note: n =total; %=precentage

Reported Musculoskeletal Disorders (MSDs) Complaints

Based on the FAST-MSDs questionnaire, the results of reported musculoskeletal complaints are presented in Table 2.

Table 2. Distribution of MSDs Complaints Among Bank Employees

Type of Complaint	Number (n)	Percentage (%)
Low Back Pain (LBP)	14	70%
Neck Pain	12	60%
Shoulder Pain	10	50%
Wrist Pain	6	30%
Fatigue / Computer Vision Syndrome	16	80%

Note: n =total; %=precentage

Based on Table 2, eye fatigue was the most frequently reported complaint (80%), likely associated with intensive computer use. Low back pain (70%) and neck pain (60%) were the most common musculoskeletal complaints, primarily related to prolonged static postures. In addition, tellers reported a higher prevalence of wrist pain, with 50% reporting hand and wrist discomfort.

Evaluation Risk Ergonomics Using the ROSA Method

Evaluation of workstation posture was conducted on 20 employees using the Rapid Office Strain Assessment (ROSA) approach.

Table 3. ROSA Scores of Bank Employees

ROSA Score	Category Risk	Number(n)	Percentage (%)
1–2	Low Risk	2	10%
3–4	Moderate Risk	6	30%
5–7	High Risk	12	60%

Note: Low Risk= 1-2; Moderate=3-4; high=5-7

Based on Table 3, 60% of the participants were classified as having a high ergonomic risk, indicating the need for immediate ergonomic intervention. The dominant contributing factors included inappropriate chair height, improper monitor positioning, and repetitive mouse use.

Ergonomic Knowledge Before and After Intervention

Ergonomic knowledge was assessed using pre-test and post-test scores (score 0–100).

Table 4. Ergonomic Knowledge Scores Before and After the Intervention

Measurement	Mean Score	SD
Pre-test	56.4	± 8.2
Post-test	83.7	± 6.5

Note: SD= Standard Deviation; MS=Mean score

Based on Table 4, an increase of 27.3 points (48.4%) in ergonomic knowledge was observed after the intervention. This finding suggests that the andragogy-based training was associated with improved participants' ergonomic knowledge, particularly regarding workstation setup, correct sitting posture, the importance of micro-breaks, and strategies for preventing musculoskeletal disorders (MSDs).

Changes in Work Habits After the Intervention

A total of 20 employees were asked about changes in their work behavior one week after the training.

Table 5. Changes in Work Behavior After Training

Behavior Change	Number (n)	Percentage
Started implementing micro-breaks	17	85%
Rearranged chair and monitor position	15	75%
Performed light stretching	14	70%
Applied the ergonomic sitting posture	16	80%
No changes	3	15%

Note: n =total; %=precentage

Table 5 illustrates that the majority of employees apply the ergonomics technique studied, suggesting the potential effectiveness of the educational intervention.

DISCUSSION

Based on the training outcomes, several occupational health complaints related to ergonomic risks were identified among employees. The most frequently reported complaint was low back pain (LBP), which is commonly associated with poor sitting posture and inadequate lumbar support. These findings are consistent with previous studies demonstrating a significant association between sitting posture, prolonged sitting duration, length of employment, and the occurrence of LBP (16). In addition, some employees reported neck and shoulder discomfort, which may be attributed to sustained neck flexion and forward head posture during monitor use. This observation is consistent with the findings of Weale (17), who reported a high prevalence of musculoskeletal complaints among office workers. Furthermore, a number of employees experienced visual fatigue, in line with the study by Syafiqah et al. (9), which identified light intensity, prolonged computer use, and task characteristics as key factors associated with visual complaints. Overall, these findings indicate that ergonomic risk factors represent a significant occupational health issue that requires systematic management through ergonomics-based occupational safety and health (K3) implementation.

Identification Risk Ergonomics Specific to Bank Employees

An identification of ergonomic risks among bank employees shows that each position has distinct characteristics and associated dangers based on its daily tasks. As this study represents a pilot intervention with a limited sample size, the findings should be interpreted as preliminary evidence rather than definitive causal conclusions. In teller positions, ergonomic risks primarily arise from repetitive hand and wrist movements associated with cash handling, data entry, and continuous customer service

at the counter. These repetitive and static work patterns place excessive load on the musculoskeletal system, particularly affecting the lower back, hips, neck, shoulders, and wrists, and may contribute to musculoskeletal disorders such as low back pain and repetitive strain injuries. Consistent with these findings, Demissie et al. (18) reported that tellers represent one of the most vulnerable occupational groups for MSD complaints due to highly repetitive tasks and non-neutral working postures. Furthermore, Geto et al. (19) highlighted that prolonged work duration and sustained postural demands are significantly associated with the occurrence of musculoskeletal complaints among banking employees, particularly those in front-line service roles such as tellers.

Among customer service (CS) and administrative staff, ergonomic risks primarily stem from prolonged static sitting and extended periods of computer use. Intensive use of keyboards and mouse devices may lead to increased musculoskeletal strain in the wrists, hands, arms, lower back, shoulders, and neck, particularly when workstation and monitor placement do not comply with ergonomic standards (20). Improper monitor positioning, such as monitors placed too low, too high, or too far from the user, can promote sustained neck flexion and the development of a forward head posture, thereby increasing the risk of neck, shoulder, and upper back discomfort. These findings are consistent with the study by Putri et al. (21), which reported a high prevalence of musculoskeletal complaints and Computer Vision Syndrome (CVS) among office workers due to prolonged computer use and inadequate lighting conditions. In addition to musculoskeletal disorders, CS and administrative workers are also susceptible to visual fatigue, eye irritation, blurred vision, and headaches, which are commonly reported symptoms of CVS associated with prolonged computer-based work.

Health Impacts Due to Risk Ergonomics

Continuous exposure to ergonomic risk factors among bank employees may lead to various adverse health outcomes, particularly MSDs These disorders arise from a mismatch between physical job demands and workers' physiological capacity, especially when non-neutral postures, repetitive movements, and prolonged static loading are present. One of the most commonly reported conditions is low back pain (LBP), which is associated with poor sitting posture, inadequate lumbar support, and prolonged static sitting. Musa et al. (14) reported a high prevalence of LBP among bank employees, particularly front-line workers, attributable to repetitive work patterns and limited awareness of appropriate working postures. These findings are further supported by Hardianto et al. (8), who demonstrated significant associations between length of employment, sitting posture, workload, and the occurrence of LBP among banking workers. In addition to LBP, carpal tunnel syndrome (CTS) is another important ergonomic-related health risk, particularly among employees who use keyboards and mice intensively. Repetitive compression of the median nerve at the wrist may result in pain, tingling, and numbness in the fingers, as described by Ajid (22), highlighting repetitive occupational activities as a major contributing factor to CTS.

Beyond musculoskeletal disorders, bank employees are also susceptible to neck, shoulder, and visual complaints associated with prolonged computer use (23). Neck and shoulder discomfort frequently results from sustained forward head posture caused by improper monitor height, leading to chronic tension in the cervical and trapezius muscles (21). Furthermore, prolonged exposure to computer screens under suboptimal lighting conditions may induce Computer Vision Syndrome (CVS), characterized by eye fatigue, blurred vision, dry eyes, and headaches. Syafiqah et al. (9) identified inadequate lighting intensity, prolonged computer use, and task characteristics as significant contributors to visual fatigue among banking employees. Collectively, these conditions not only reduce work comfort but also impair concentration, increase the likelihood of errors, and negatively affect overall employee productivity.

Implications and limitations

The implementation of occupational safety and health (K3) strategies to prevent ergonomic risks should be carried out progressively, following the hierarchy of controls, with priority given to engineering controls as the most effective preventive measures. Engineering controls are considered effective because they directly reduce hazards at the source by modifying the work environment (5). One key example is the provision of ergonomically designed workstations, including chairs with adequate lumbar support, adjustable backrests and armrests, five-point bases, and adjustable seat height to accommodate individual worker needs. Boadi-Kusi et al. (24) demonstrated that appropriate chair and desk configurations, which allow an elbow angle of approximately 90° during typing, significantly reduce musculoskeletal load.

Monitor placement also plays a critical role in ergonomics. According to International Labour Organization (ILO) recommendations, computer monitors should be positioned at or slightly below eye level and at a viewing distance of approximately one arm's length to minimize neck flexion and reduce the risk of neck pain. Additional engineering interventions include ergonomic work tools, such as separate keyboards, vertical mice, and document holders, which have been shown to reduce muscle tension in the hands and neck (25,26). Adequate workplace lighting is equally important to prevent glare and visual strain; Syafiqah (9) reported that poor lighting conditions may increase the risk of Computer Vision Syndrome (CVS) among computer-based workers by more than 40%.

Beyond engineering controls, preventive strategies should also incorporate administrative controls to modify work patterns, job organization, and ergonomic practices to reduce exposure to risk factors. Practical measures include implementing micro-breaks, defined as short rest periods of 2–5 minutes every hour while standing, walking, or performing light stretching. To further reduce visual fatigue, the 20-20-20 rule is recommended: workers should look at an object approximately 20 feet away for 20 seconds every 20 minutes of computer use. Job rotation may also be applied to distribute physical workload more evenly and reduce repetitive strain on specific body regions.

In addition, regular ergonomics training is essential to enhance workers' knowledge and awareness regarding proper workstation setup, optimal working posture, and stretching techniques. Guduru et al. (5) demonstrated that ergonomics education can significantly improve worker awareness and reduce the incidence of MSDs over the long term. The use of personal protective equipment (PPE), such as wrist supports, should be considered only as a supplementary measure and not as a substitute for appropriate ergonomic design, and should be applied selectively for tasks requiring additional wrist stabilization. By integrating engineering and administrative controls, K3 programs can effectively promote a safe, healthy, and productive working environment for bank employees.

Table 6. Roles of Management and Workers in the Implementation of the Ergonomics Program

Role	Description of Tasks
Management	Allocate a budget for ergonomic facilities and equipment. Conduct periodic ergonomic risk assessments in the workplace. Facilitate and support ergonomics training programs for all employees.
Workers	Consistently apply ergonomic principles in daily work activities. Actively adjust workstations in accordance with ergonomic guidelines. Promptly report early symptoms of musculoskeletal discomfort to supervisors or the K3 (OSH) team.

The implementation of an ergonomics program relies heavily on collaboration between management that provides the facility, policy supporters, and workers who implement the principles of ergonomics in their Work every day. When both parties perform their roles consistently, with minimal risk of disturbance, musculoskeletal pressure, and productivity issues, Work increases significantly. This study has several limitations that should be considered when interpreting its results. First, the

sample size was relatively small and limited to a single bank branch, making the results difficult to generalize to the entire banking sector or other office work environments with varying characteristics. Second, the study design employed a short-term intervention approach without long-term follow-up, meaning the sustained impact of ergonomic behavior changes on reducing musculoskeletal disorders (MSDs) and visual fatigue cannot be comprehensively evaluated. Third, some of the data used were self-reported, both for measuring MSDs and changes in work behavior, potentially introducing bias and subjectivity into the respondents' perceptions. Furthermore, this study did not explore other organizational factors, such as workload, target pressure, and management support, in depth, which may influence ergonomic risks and the effectiveness of interventions. Therefore, further research is recommended to involve larger samples, longitudinal designs, and more comprehensive organizational factor analyses to strengthen the evidence for the effectiveness of OSH-based ergonomic interventions in the banking sector.

Relevance for Practice

This research has significant practical relevance for the implementation of occupational safety and health (OHS) in the banking sector, particularly in efforts to prevent ergonomic risks in computer-based office work. The research findings indicate a high prevalence of musculoskeletal disorders (MSDs) such as low back pain, neck and shoulder pain, wrist pain, and Computer Vision Syndrome (CVS) complaints due to static work postures, repetitive movements, and non-ergonomic workstation designs. This condition confirms that ergonomic risks for bank workers are latent and cumulative, with long-term impacts on employee health, comfort, and productivity. The OHS-based intervention model implemented through ergonomics training with an andragogical approach, participatory risk identification, and live demonstrations of workstation adjustments and micro-break techniques has been shown to increase ergonomic knowledge and encourage changes in more ergonomic work behavior. Practically, the results of this study can be used as a guideline for banking management to develop more systematic ergonomic policies, including the provision of ergonomic work facilities, the integration of ergonomic risk evaluation into the Occupational Health and Safety Management System (SMK3), the implementation of regular ergonomic training, and the strengthening of a safe and healthy work culture. Thus, this study makes a real contribution to bridging the gap between OHS regulations and the implementation of ergonomics in the banking workplace.

CONCLUSION

This study concludes that bank workers are at high ergonomic risk, particularly for musculoskeletal disorders and visual fatigue, due to long sitting periods, intensive computer use, repetitive work movements, and workstation design and layout that do not meet ergonomic principles. The results of the risk evaluation using the ROSA method indicate that most workers are in the moderate-to-high risk category, necessitating immediate and ongoing ergonomic interventions. Occupational health and safety-based ergonomic interventions combined with educational and hands-on approaches have proven effective in increasing ergonomic knowledge, improving work attitudes and habits, and encouraging the adoption of ergonomic behaviors such as adjusting work positions, implementing micro-breaks, and light stretching during work hours. Therefore, the implementation of engineering and administrative controls supported by management commitment, active worker participation, and regular ergonomic evaluations is key to preventing ergonomic risks in the banking sector. Integrating ergonomics into OHS policies and management systems not only plays a role in protecting worker health but also contributes to improving productivity, service quality, and the overall sustainability of the organization.

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AUTHOR'S CONTRIBUTION STATEMENT

The author was responsible for the conceptualization, study design, data collection, data analysis, interpretation of results, and manuscript preparation. The author reviewed and approved the final version of the manuscript. ANEP: conceptualization, Draf, Review &Editing. NMHA: conceptualization, Methods, Review. ME: Supervision. ANEP: Formal Analysis, Original Draft, Review. NMHA & ME: Validationi, Review.

CONFLICT OF INTEREST

The authors declare no conflict of interest

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

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