

# Effects of Ergonomic Interventions and Assistive Devices in Nursing Practice: A Systematic Review

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**Abstract:** *Objective:* To systematically evaluate the effects of ergonomic interventions and assistive devices on work-related musculoskeletal disorders (WMSDs), physical workload, and nursing safety during nursing procedures. *Methods:* This systematic review was conducted in accordance with the PRISMA 2020 statement. Eleven electronic databases were searched from inception to November 2025. Randomized controlled trials (RCTs) and quasi-experimental studies were included. The PICO framework was used to establish the research question. Study quality was assessed using the Cochrane Risk of Bias Tool and JBI Critical Appraisal Tool. *Results:* A total of 67 studies were included (32 RCTs and 35 quasi-experiments). Engineering control interventions (e.g., transfer equipment, height-adjustable hospital beds) significantly reduced lumbar load and the incidence of WMSDs. Comprehensive interventions combining equipment, training, and workflow optimization achieved the most stable and sustained effects. Single training interventions showed limited effectiveness. Although some devices slightly prolonged operation time, they reduced long-term injury risks. *Conclusions:* Assistive devices based on engineering controls are core strategies for preventing occupational musculoskeletal injuries among nurses. Wider implementation is limited by compliance and organizational barriers. Future research should strengthen intelligent equipment applications and implementation science to improve sustainability and clinical adaptability.

**Keywords:** Ergonomics; Nursing procedures; Work-related musculoskeletal disorders; Low back pain; Assistive devices; Occupational safety

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## 1. Introduction

It has been fully recognized that nursing work carries occupational health risks. When nurses perform tasks, they need to keep their bodies in mandatory positions for a long time. The back lumbar region, neck, shoulders and limbs are the main affected parts<sup>[1]</sup>. But this scope review highlights a problem: there is a lack of research evidence to support specific preventive interventions. The issue of absenteeism and employee retention proves one thing, the human and economic costs associated with back injuries have worsened

nursing work, threatened the sustainability of the health care system, and the development of effective interventions has become an urgent matter. In all kinds of research designs, low compliance and the loss of follow-up action are great, which brings an inherent challenge to the table: it is difficult to formulate interventions that nurses are willing to incorporate into the daily routine.

Meta analysis shows that the prevalence of musculoskeletal diseases in clinical nurses in China has reached 85.5%, the annual prevalence is 81.0%, and the weekly prevalence is 65.0% [2]. To sum up, medium and high-level musculoskeletal risks are common in nursing work, and it is urgent to be dealt with through systematic ergonomic intervention. From objective risk assessment to the development and application of various assistive devices, there is evidence that multi-level intervention strategies can improve the working posture of medical staff, reduce the body load, and ultimately improve their health level and patient safety. However, how to select and optimize these interventions according to different clinical scenarios, job roles and individual differences requires more high-quality research to integrate evidence and clarify best practices, so as to lay a solid scientific foundation for building a more resilient medical working environment.

## **2. Methods**

### **2.1. Literature search**

The computer retrieves Web of Science, PubMed, Cochrane Library, Embase, ScienceDirect, CINAHL, SinoMed, China Knowledge Network, Wanfang Database, the full-text database of the Chinese Medical Association and the VIP database, and search for the relevant literature on ergonomic intervention and auxiliary methods in nursing operations published from November 2025. Use the combination of “thematic word + free word” to construct search words. The Chinese search words are “nursing operation/comfortable nursing”, “ergonomics/ergonomic principles/ergonomics intervention”, “nursing aids/auxiliaries configuration/auxiliaries/medical device design/medical equipment ease of use/operation efficiency/safety”, etc. Use Boolean logic characters (AND/OR) to match the search words, and supplement the missing literature with manual retrieval and literature traceability.

### **2.2. Study selection**

Guide all the retrieved entries into the NoteExpress literature management software. The first step is to eliminate duplicate documents. After this operation is completed, two researchers will read the topics and abstracts respectively, complete the initial screening independently, and eliminate those documents that do not meet the standards at first glance. After the initial screening, the literature left may meet the inclusion requirements. Next, the full text should be read carefully to complete the second screening. In this process, if there is a difference of opinion between the two researchers, they can discuss it first. If the discussion is fruitless, they should find a third-party researcher for arbitration to reach an agreement.

#### **2.2.1. Inclusion criteria**

- (1) Research subjects  
Active registered nurses or nursing staff with corresponding qualifications.
- (2) Intervention measures  
Nursing operation methods designed according to the principle of ergonomics, such as the optimization of nursing postures, the use of ergonomic tools, and some auxiliary equipment that can improve nursing

efficiency and patient comfort, such as rehabilitation nursing utensils, displacement equipment, etc., and ergonomic training courses to prevent musculoskeletal diseases in nurses.

(3) Results

It can reflect the efficiency of nursing operations, the comfort of patients, and the changes of some related indicators of nurses' low back pain after the use of ergonomic intervention or assistive.

(4) Publication

Published in peer-reviewed journals.

### 2.2.2. Exclusion criteria

(1) Literature review

(2) Conference summary

(3) Intervention program formulation research and gray literature

### 2.3. Data extraction

Two researchers independently participated in this data extraction work, using a standardized Excel data extraction table designed in advance. The extraction content will cover the first author, the year of publication, the country or region where the research institute is located, the purpose of the research, the type of research design, the intervention measures and implementation duration, the sample size, as well as the outcome indicators and the main research results. After the extraction work is completed, the two people will do a cross-check and reach an agreement through discussion.

### 2.4. Quality assessment

In order to evaluate the quality of the included papers, this study used the Cochrane risk bias assessment tool for randomized controlled trials to evaluate the bias risk; for experimental studies and experimental studies, the evaluation tool of the JBI evidence-based health care center was used for evaluation.

## 3. Results

### 3.1. Basic characteristics of included studies

There are 67 articles finally included in the literature. In terms of research types, there are 32 randomized controlled trials (RCT) articles and 35 experimental studies. The two are basically the same in quantity. The publication year has been from establishment to 2024. Among them, 61 articles have been published since 2011, suggesting that this field has been a research hotspot for more than ten years.

The research covers 16 countries. China has the most research, 41 articles, the United States and Denmark have 4 articles each, and the remaining 18 articles are scattered in other countries. The research sites are mainly concentrated in hospitals, and high-intensive departments such as ICUs, operating rooms and neurosurgery are the most common. Only one study was placed in community nursing institutions, and the other four were completed in elderly nursing institutions.

The research subjects are clinical nurses (n=48), and the rest of the studies include nursing staff, medical assistants, nursing interns and other nursing-related practitioners. The sample range is large, and the sample size of a single group is 10~594 cases.

## **3.2. Study quality**

Among the 32 randomized controlled experiments included, only 3 scores were below 6 (out of 10)<sup>[3-5]</sup>. Most of the studies used random sequence grouping, and the lack of blindness and distribution has become the most common quality problem.

## **3.3. Classification of ergonomic interventions**

### **3.3.1. Engineering controls**

In the primary prevention strategy system, engineering control is regarded as the most effective measure to prevent musculoskeletal diseases. Its core logic is to directly eliminate exposure to hazards in the workplace with the help of technology, or to control it at an acceptable level when it cannot be eliminated. In terms of the medical environment, such measures are usually implemented as the redesign or modification of work equipment and workstations and to make fundamental adjustments at the level of physical conditions to achieve the most direct reduction in biomechanical load. Engineering control has an outstanding advantage, that is, the protection effect does not depend on the continuous compliance of employees, and reliability and durability can be guaranteed. Specifically at the operational level, the procurement of patient handling auxiliary equipment, adjusting the height of the workbench, optimizing the layout of the workstation and other measures can reduce the biomechanical load caused by manual lifting and handling activities from the source.

### **3.3.2. Administrative controls**

When engineering control cannot completely eliminate the hazards, administrative control will intervene as a secondary strategy to reduce the degree of risk exposure and its consequences through management and organizational means. Such measures do not change the harm itself, but adjust the contact mode between personnel and hazards. In routine nursing work, administrative control covers the formulation and implementation of safe patient handling policies, regular ergonomics training (such as correct body mechanics education, risk assessment training), and optimizing work scheduling to avoid excessive fatigue of employees. The effect of administrative control largely depends on management execution and employee compliance, which generally requires continuous supervision and resource investment, and the protection effectiveness is eventually weaker than engineering control.

### **3.3.3. Behavioral controls**

The idea of behavior control intervention is to change the behavior, habits and cognition of individual workers in order to enhance their ability to cope with residual risks. Specifically, nurses will be educated and trained to master the correct body mechanics and posture, such as teaching them to use their legs instead of leaning on their waists when carrying patients; at the same time, they will encourage or require them to wear personal protective equipment such as suitable support belts; regular inter-work lumbar and back muscle exercises will also be promoted to enhance the strength and endurance of the core muscle group. After the introduction of cognitive behavior training, nurses can learn to identify the work pressure or thinking patterns that bring bad postures, and master a set of coping strategies. Teamwork methods such as the “three-person handling method” are also included in behavior control, which standardizes the team operation process and reduces the burden of individuals. However, the effect of behavior control largely depends on whether the individual’s compliance can be sustained, and it is always a supplement to engineering control and

administrative control, not a substitute.

### **3.4. Types and applications of assistive devices**

#### **3.4.1. Patient transfer and handling equipment**

Patient transfer and transportation is one of the most physical loads in nursing work, and it is also the most likely to cause musculoskeletal damage. With the help of mechanical assistance, all kinds of transfer equipment can move patients from one place to another smoothly and safely, which greatly reduces the physical burden of nursing staff. The ceiling lift operates through a track system fixed on the ceiling. With it, patients can be transferred without barriers between the whole room and even adjacent rooms. It is especially suitable for scenes with limited space but frequent and long-distance movement, such as intensive care units or home care environments for long-term bedridden patients. Floor-standing hydraulic or electric lifts are more flexible. The base generally has pulleys, which can be pushed between different rooms. It is suitable for places such as hospital wards and rehabilitation centers that require multi-point transfer. The transfer skateboard or shifter mainly responds to the short-distance translation between the bed and the chair. It relies on low-friction materials to reduce the movement resistance, which is easy and fast to operate. The systematic use of these devices can significantly reduce the risk of lumbar and back injuries for nursing staff. The rational configuration and use of patient transfer equipment has become a core strategy to prevent occupational musculoskeletal diseases in nursing staff.

#### **3.4.2. Positioning equipment**

Position management involves a comfortable and therapeutic lying position, and regular turning over for patients to prevent pressure sores. These tasks have high requirements for the physical strength and skills of nursing staff. Take the adjustable electric bed as an example, the height and angle of its backboard and leg plate can be easily adjusted through the electric controller. The nursing staff can maintain a good working posture when doing oral care, changing sheets or helping the patient sit up. The bending and excessive stretching are reduced, and the patient's autonomy and comfort are also improved. For special groups such as newborns, there is a modified neonatal bed, which integrates the operation height more ergonomically, and the side panel is also designed to be easier to approach, so that the neck and waist strain caused by long-term bending operation of medical staff can be alleviated. Turn-over aids are also a way, such as turn-over cloths with handles or suspenders, and self-made handle-type turn-over cotton pads. They can allow nurses to use the lever principle and team cooperation to safely turn over the patient with relatively small force, which avoids the huge shear force and lumbar torque generated by moving the patient's torso with bare hands. There is also a decompression mattress. Take the alternating inflatable mattress as an example, which can automatically and continuously change the pressure of the body contact point, which can not only effectively prevent pressure sores in patients, but also reduce the frequency and intensity of manual turning over by medical staff, which is equivalent to reducing the risk of fatigue from the source. These devices work together, turning the original high-intensity and high-risk manual work into a safer and more labor-saving process. While ensuring the safety and comfort of patients, it has also become a kind of tool to protect nursing staff and reduce them from repetitive fatigue and acute and chronic musculoskeletal diseases.

#### **3.4.3. Other assistive tools**

In addition to large-scale transfer and body position equipment, many auxiliary tools for specific daily

operations can also effectively prevent micro-injuries and repetitive fatigue. For example, when standing for a long time, such as surgery or long-term infusion monitoring, wearing a pair of unstable shoes or laying an anti-fatigue mat can mobilize the micro-regulation of the calf muscles, improve the blood circulation of the lower limbs, and relieve the static load. Wearing improved stretchable card sleeves for pediatric patients reduces the number of times nurses bend over when checking, and also saves the trouble of frequent loss and replacement. When doing fine operations such as venipuncture, use a small table that can be folded and height-adjustably to support the patient's arm, which can keep the operator's elbows close to the body and the wrists naturally neutral, and the static muscle load of the shoulder, neck and wrist is reduced. The ergonomic nursing cart has an easy-to-grasp pusher, a flexible steering wheel and a reasonable layered space for placing items. The resistance is less when pushing, and there is less unnecessary body twisting. These tools look inconspicuous, but they target repeated movements in nursing work, such as bending over, reaching out, twisting and maintaining a static posture for a long time. After optimizing the tool design and working environment, the daily accumulated work ergonomics exposure can be systematically reduced, which is exactly necessary to build a comprehensive musculoskeletal injury prevention system.

### **3.5. Effects of ergonomic interventions**

#### **3.5.1. Ergonomic training and posture intervention**

According to some studies, the ergonomics training will take human mechanics, the concept of no lifting, labor-saving handling, the theory of knowledge-faith-action, and the theory of protection motivation as the core content. Through theoretical propaganda, operation demonstration, practical drills and individualized guidance, it will correct the bad working posture of nurses and reduce the physical load. The Back School systematic chemical chemistry training done by Jaromi et al. has lowered the VAS score of chronic low back pain nurses, and the body posture has also improved<sup>[6]</sup>. Tang Linqi and others engaged in position management training based on the concept of “no lifting”, and the subjective fatigue level and pain visual simulation score of the nursing staff were significantly reduced<sup>[3]</sup>. Wang Jingjing and others introduced the British manual handling method training, the theoretical level of nurses and operation standardization improved, and the error rate in practice also decreased<sup>[7]</sup>. An Mengying and Liu Li used the principle of labor-saving mechanics to the placement of the surgical body position, which reduced the physical consumption of nurses when moving and lifting, and the risk of lumbar muscle strain was also reduced<sup>[8]</sup>. In addition, that kind of diversified training, taking human mechanics knowledge, back pain prevention and control, position management, and handling skills as the core content, can play a role in reducing the incidence of back pain and musculoskeletal diseases in nurses. The scores of pains and dysfunction such as VAS and RMDQ will go down, and high-risk physical exposure will also be reduced<sup>[1,2,8]</sup>.

#### **3.5.2. Application of assistive devices**

Assistive devices are the core means of engineering control. They can directly reduce the biomechanical load on the spine. The protective effect of this intervention is the most stable, and the consistency of relevant evidence is also the highest. The friction reduction devices such as sliding cloth, turning over sheet, sliding pad, and effort-saving sheet can significantly reduce the frequency of lifting, bending and twisting the waist. The medium and heavy labor intensity has been reduced by more than 50%, and the time required for body position placement has also been shortened. The VAS/NRS pain score has been reduced by 30–50%, and the physical function and quality of life (SF-36) have also been improved<sup>[9–12]</sup>. In terms of lifting and shifting

devices, such as Binder, Eagle, and Maxi Air, can reduce the electromyoelectric activity (EMG) of the lumbar and back muscles by 34% to 47%, and the subjective physical consumption will also be reduced. However, some devices will slightly extend the operation time<sup>[13]</sup>. This is the case with adjustable height beds, but it can reduce the load on the waist muscles, lower the risk score of REBA posture, and play a role in optimizing the working posture. Belt protection and lumbosacral support devices can relieve low back pain in the short term, and the JOA function score has also been improved<sup>[14]</sup>. However, long-term continuous use may lead to lumbar muscle atrophy and decreased lumbar mobility, so it should be treated with caution<sup>[15]</sup>.

### **3.5.3. Workflow and environmental optimization**

Process optimization is adjusted through these four aspects, how to match personnel, how to do the work, whether the equipment is suitable, and whether the environment can be changed. The purpose is to reduce the exposure of bad posture and improve the operation efficiency and safety. Some studies combined the elastic scheduling and the double-bridge movement rollover method, and found that the patient's NRS pain score and RMDQ dysfunction score were down<sup>[16]</sup>. Another study on the improved bed sheet handling method showed that there were five or six people to move a patient. After the change, two to four people were enough, and the probability of catheter falling off was also reduced, and the efficiency of team cooperation was significantly improved<sup>[17]</sup>. For example, the foldable small table was used in the scene of venous puncture, and the time of the nurse's bending operation was directly cut by 55.1%. On the other hand, the proportion of completing the operation without bending was increased by 23.0%; with the modification of the newborn bed, the incidence of nurses' low back pain and the fatigue symptoms of the night shift were alleviated<sup>[18,19]</sup>. There are also some studies that have been verified from other perspectives, such as the Bobath handshake turning method, the improved mobile patient technology, and the sliding board and the electric patient transfer equipment. They are really effective in improving the safety of nursing and making the operation more convenient, providing a basis for the continuous improvement of the workflow<sup>[20-22]</sup>.

### **3.5.4. Physical exercise and cognitive behavioral intervention**

Methods such as lumbar and back muscle exercise, core training, stretching training and cognitive behavioral intervention can improve pain and function from both physiological and psychological ways. Tian Suzhai et al. designed a set of graded lumbar and back muscle exercises using the action research method<sup>[23]</sup>. As a result, it was found that this set of exercises reduced the Oswestry dysfunction index (ODI) and VAS scores of ICU nurses, improved the exercise compliance, and the pain relief rate was also improved. Zhang Zhao et al. built an exercise plan based on the theory of protection motivation, which can reduce nurses' fear-avoidance (FABQ-CHI) score and improve chronic low back pain; physical training such as Tai Chi, yoga, and four-section stretching system can also relieve muscle fatigue, improve lumbar function and physical tolerance<sup>[16,24-27]</sup>.

### **3.5.5. Multidisciplinary comprehensive intervention**

The idea of multidisciplinary comprehensive intervention packages the strategies of ethic adjustment, physical training, cognitive behavioral therapy, aids, process optimization and health education together, which is in line with the biological-psychological-social medicine model. In the long run, this packaged approach has a more stable and lasting protective effect than only a single measure. Fang Yuxia et al. did a study to confirm that participatory engineering, physical training, coupled with cognitive behavioral

intervention, can shorten the duration of musculoskeletal diseases, reduce the intensity of pain, and reduce the cost of diagnosis and treatment <sup>[27]</sup>. The research of Rasmussen et al. also shows that after comprehensive intervention, low back pain can be reduced by 0.8 days per month, and the pain intensity can be reduced by 0.4 points <sup>[28]</sup>. Traditional Chinese medicine physiotherapy, flexible scheduling, environmental transformation, and the promotion of healthy lifestyle can also be included in the comprehensive intervention. In the long-term follow-up, it can be seen that its protective effectiveness is maintained quite stable and lasting.

## **4. Discussion**

This systematic review evaluates the improvement of ergonomic interventions and assistive devices on the occupational health of nursing staff and the safety of patients. The discussion is held from the aspects of major findings, evidence quality, practical significance and research prospects.

### **4.1. Key findings and comparison with existing knowledge**

This review has a very consistent finding that the most direct way to reduce the lower back load and injury risk of nursing staff is to introduce and correctly use patient transfer and position management equipment, such as lifts and electric hospital beds. This just confirms the concept of prioritizing “engineering control” in the hierarchical control model, that is, eliminating harm from the source is much more useful than relying on personal behavior changes. Research also shows that it is not enough to have equipment alone. It is not possible to guarantee that it will be used. It requires mandatory use policies, training to embed the workflow, and enough manpower. Only by combining these three things can obstacles such as time pressure and habit resistance be overcome, so that the engineering control measures can really continue. This truth is in line with the implementation science that “intervention measures need to be embedded in the existing system”. As with the existing understanding, this review finds that it is difficult to maintain the effect for a long time by taking physical mechanics training alone for intervention, which also exposes the fact that in a complex working environment, only changing individual knowledge without changing the physical attributes and organizational support of the task is very limited.

In addition, this review also reveals the outcome of the dual benefit of the patient of an ergonomic intervention. While protecting nursing staff, assistive devices have been associated with the decline in the incidence of patient falls and pressure sores with a more stable and safer operation process, and patient satisfaction has also increased. Some economic assessment results show that although the initial investment is considerable, the cost of work-related injuries has been compressed, the number of sick leave days has been reduced in sync with the loss of personnel, and the long-term return on investment is more likely to turn positive.

### **4.2. Barriers to clinical implementation**

The large-scale application of assistive devices in medical scenarios has long been subject to multiple structural obstacles. Economic constraints come first, and the high initial procurement cost constitutes a dominant barrier. For small and medium-sized medical institutions under budget pressure, the practical feasibility of introducing advanced auxiliary equipment on a large scale is limited. Spatial conditions constitute the second major limitation. This problem is particularly prominent in the hospital area where the

construction date is relatively old and the functional zoning has been solidified. Some auxiliary equipment is large in size or need to be matched with special operation units, and it is difficult to delimit suitable placement points and reserve compliant operation space in the existing building layout. The problem of insufficient training is also profound, and forms a direct hedge with the high load of clinical work. In the saturated work arrangement, the time and resources that can be allocated to the systematic operation training of new equipment are significantly compressed. This gap is transmitted to the practical level, that is, after the equipment configuration is in place, the standardized utilization rate and overall acceptance are at a low level for a long time. The deeper obstacle is rooted in cultural inertia. The empirical judgment of “manual operation is faster and more direct” precipitated in long-term clinical practice has a considerable basis for behavioral inertia. Especially in high-pressure and fast-paced disposal situations, operators tend to prioritize the activation of their most skilled physical response mode, and have an instinctive tendency to avoid the time delay that may be brought about by the introduction of equipment. There are still continuous weaknesses in the maintenance and guarantee link. If daily calibration, fault repair and technical response cannot be followed up in time, once the user’s trust in the reliability of the equipment is loosened, idleness tends to become an irreversible destination. The above obstacles are not isolated from each other in actual operation. They form a mutually reinforced nested structure, pointing to the “last kilometer” dilemma of assistive devices from the completion of procurement to embedding in the daily clinical path.

### **4.3. Facilitating factors for successful implementation**

It relies on a set of systematic promotion strategies to smoothly integrate assistive devices into the workflow and overcome various obstacles in the implementation link. Strong leadership support and institutional commitment form the basis of the work. The management must raise employee safety and ergonomics to a strategic level while completing the allocation of necessary resources. The collaborative participation of multidisciplinary teams is equally critical. Members should include direct users (such as nurses and technicians), physiotherapists who provide ergonomic guidance, engineers or biomedical technicians responsible for equipment selection, maintenance and customized transformation, and safety specialists. With the help of user-centered design and selection process, the equipment can more accurately meet the needs and limitations of the actual work scenario, and the acceptance is improved. Continuous and interactive education and training should not be limited to the operation of the equipment itself, but also extend to the correct application of human mechanics, the ability to identify risks, and the specific methods of integrating the use of equipment into the standardized operation process. Overall, organizations need to deeply embed ergonomic principles in safety culture, making them the core values arranged in parallel with infection control and fire safety. This means that risk assessment should be carried out regularly, employees should be encouraged to take the initiative to report physical discomfort or potential hidden dangers, and safety practices should be integrated into the performance appraisal system, so as to create a working environment that actively prevents musculoskeletal injuries and actively accepts auxiliary technologies.

### **4.4. Limitations of the review**

Among the 32 RCT experiments included in this study, most of them have methodological defects, such as the lack of blindness and insufficient distribution and concealment, which is relatively common, and the gray literature is not retrieved, which will cause the source of evidence to be lacking. Most of the people included

in the research are nurses, and other nursing-related personnel (such as nurses) with the same suffering from low back pain are not included. The advantage of this is to ensure the homogeneity of the study, and on the other hand, the scope of use of the research results is limited.

## 5. Conclusion

This systematic review examines the effect of ergonomic intervention and auxiliary application in nursing operations. Judging from the existing evidence, the introduction of auxiliary equipment (skids, elevators, etc.), the implementation of esthetic training (covering position management, handling skills, etc.), and the promotion of multi-dimensional comprehensive intervention (integrated environment optimization, physical training and cognitive behavioral therapy), the three paths have achieved significant results in reducing the incidence of nurses' low back pain, the risk of musculoskeletal diseases and labor intensity, and the long-term effects are more prominent. The compensatory effect of assistive equipment is mainly reflected in the reduction of spinal load, and the multi-dimensional comprehensive intervention scheme shows a more lasting protective effect in long-term follow-up, which has obvious advantages over single measures. On the other hand, the role of single means such as relying solely on theoretical training is limited. In addition, there are methodological limitations such as insufficient blind implementation and large sample heterogeneity in existing studies, and the quality of evidence is uneven. Subsequent research needs to further refine the intervention plan, integrate standardized risk assessment tools, and carry out a hierarchical analysis of the target population, such as examining the differentiated responses of new nurses and senior nurses respectively. The deep integration of technical assistance and clinical practice is also a direction worth exploring, so as to improve the directionality and effectiveness of intervention and provide a more reliable evidence-based basis for the occupational health management of nurses.

## Disclosure statement

The authors declare no conflict of interest.

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