

# Moderate-intensity aerobic exercise as an adjunct intervention to improve sleep quality among rotating shift nurses

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## Abstract

Nurses working rotating shifts (RS) are at risk of circadian rhythm disruption, which can affect sleep quality and can lead to emotional stress, anxiety, and depression. Aerobic exercise is a type of repetitive and structured physical activity that involves the metabolic system, which utilizes oxygen to produce energy and has been demonstrated to improve shift-workers' health and well-being. The main purpose of engaging in regular moderate-intensity aerobic exercise is to improve cardiopulmonary fitness and functional capacity. When engaging in moderate-intensity aerobic exercise, the increase in arterial pressure is accompanied by a simultaneous increase in heart rate, which significantly contributes to the rise in blood pressure, which is reversed after exercise due to an increase in parasympathetic activity and a decrease in sympathetic activity. Moderate-intensity aerobic exercise includes walking at a moderate pace, water aerobics, dancing, recreational swimming, gardening, table tennis, and stair climbing at a moderate pace and represents a cost-effective health promotion strategy for improving sleep quality and duration. Adherence to a moderate-intensity aerobic exercise program may increase both sleep quality and duration by improving melatonin concentrations, endocrine activities, heart rate and slow wave sleep among nurses working RS. Occupational medicine practitioners should consider creating a workplace health promotion program that incorporates moderate-intensity aerobic exercise for RS-nurses to minimize the impact of shift work on their sleep quality. *Clin Ter 2022; 173 (2):184-186 doi: 10.7417/CT.2022.2414*

**Key words:** *Insomnia, circadian rhythm, nurses, shift work, aerobic exercise, sleep quality*

## Introduction

One of the key roles of an occupational physician in a hospital is to design strategies to improve the sleep health of shift workers through monitoring individual circadian rhythms and sleep patterns of shift workers and their physical and mental health conditions. The physical and mental health of nurses working rotating shifts (RS) is a global concern because they are at a higher risk of job dissatisfaction and

adverse health effects (1). Poor sleep quality is a critical challenge for RS-nurses especially in this era of coronavirus disease. To enhance nurses' health and job performance during infectious disease outbreaks, appropriate interventions to improve physical and mental wellbeing, as well as sleep quality, are required. RS nurses work both day and night shifts on a rotational basis. To date, there are many different schedules of RS being used by various hospitals with different rotation (clockwise or counter-clockwise) and variable start and finishing time. Many nurses working RS suffer from poor sleep and sleepiness, and existing literature has shown a relationship between shift-work, including night-shift, and disruption of the circadian rhythm, resulting in sleep disorders due to the variations in working hours. As most RS nurses are unable to adjust their circadian rhythms to the atypical hours of sleep and wake, they appear susceptible to excessive sleepiness and/or insomnia (2). Moreover, older age, poor sleep conditions, gastrointestinal problems, and stress represent risk factors that contribute to inadequate sleep among RS-nurses (3). Physical activity (PA) is a cost-effective adjunct therapy in addition to the existing treatments for sleep disorders among RS-nurses. The length of slow-wave sleep, which is important for brain restoration and recovery during night-time sleep, is increased by PA (4). Aerobic exercise is a type of repetitive, structured PA that involves the metabolic system, which utilizes oxygen to produce energy. The main purpose of engaging in regular moderate-intensity aerobic exercise is to improve aerobic fitness and functional capacity. When engaging in moderate-intensity aerobic exercise, the increase in arterial pressure is accompanied by a simultaneous increase in heart rate, which significantly contributes to the rise in blood pressure, which is reversed after exercise due to an increase in parasympathetic activity and a decrease in sympathetic activity. If moderate-intensity aerobic exercises are performed regularly and long enough, they can improve cardiopulmonary fitness. Aerobic exercise has been described by some researchers as an adjunct therapy for the treatment of chronic insomnia (5). Participating in a moderate-intensity aerobic exercise

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program improved sleep quality and duration among female nurses (6). Furthermore, walking moderately at least for 30-minutes daily may reduce insomnia among nurses (7). A moderate-intensity aerobic exercise program designed for nurses and nursing aides working RS, which was planned by administering exercise sessions 2-6 days per week for a 4-month period at 60–70% of maximal heart rate, improved both sleep quality and duration (8). In particular, the mean sleep duration significantly improved after the evening shift compared to the control group (8).

**Possible physiological mechanisms through which moderate-intensity aerobic exercise improves sleep**

Exercise-induced skeletal muscle recruitment improves blood concentrations of myokine brain-derived neurotrophic factor, which has been found to improve sleep duration in animals (9). Moderate-intensity aerobic exercise significantly increased slow-wave activity among male subjects in the night and the following morning, signifying an improvement in sleep quality and duration (10). In one pre-post intervention study, the Pittsburgh sleep quality index decreased significantly from pre-intervention to post-intervention, with a corresponding increase in salivary melatonin concentrations among sedentary adult men who participated in a moderate-intensity aerobic exercise program, indicating a significant improvement in sleep quality (11). Therefore, these findings highlight that the longer the duration of a moderate-intensity aerobic exercise program, the more improvements in the quality of slow-wave sleep and slow-wave stability (11). Furthermore, a 6-month moderate-intensity aerobic exercise program yielded significant improvements in sleep health, quality of life, and mood among patients with chronic primary insomnia (12).

**Quantifying moderate-intensity aerobic exercise for nurse health promotion**

The Borg category-ratio 10 (CR-10) rating of perceived exertion scale can be used by RS-nurses to measure their effort and exertion, breathlessness, and fatigue and quantify intensity while engaging in moderate-intensity aerobic exercise at home (13). The American College of Sports Medicine recommends that every healthy adult should engage in moderate-intensity aerobic exercise for ≥30 minutes/day on ≥5 days/week for a total of ≥150 minutes/week (14). The types of moderate-intensity aerobic exercise that can be performed at home are walking at a moderate pace, water aerobics, dancing, recreational swimming, riding a stationary cycle ergometer at a gradual pace, gardening, table tennis, and stair climbing at a moderate pace (see Table 1). A moderate-intensity aerobic exercise session should be completed some hours before the main sleep time when working on a morning or day shift schedule. Furthermore, during the day of the night shift, exercise should be performed before an evening nap. The session can be tailored as persistent, rhythmic activities using large muscle groups (e.g., stair climbing at a moderate pace, riding a stationary bicycle

ergometer at moderate speed, and swimming), at least for 30 minutes/day at moderate intensity (3–6 on Borg CR-10 scale) for 3–7 days/week, with no more than 2 successive days without exercise. Setting up a home-based moderate-intensity aerobic exercise program for nurses working RS and compliance with the program could increase their sleep quality and duration by improving melatonin concentrations, endocrine activities, heart rate and slow wave sleep.

**Barriers to regular moderate-intensity aerobic exercise among rotating-shift nurses and their possible solutions**

Burnout, lack of time, lack of chance, and lack of motivation, are mostly the reasons why RS-nurses do not engage regularly in PA. High stress levels are one of the major barriers to PA and exercise adherence among nurses. Stress has a bidirectional relationship with exercise in which greater stress is associated with less exercise, and less exercise is associated with greater stress (15). One study revealed a high prevalence of stress, depression, and anxiety among hospital nurses, which may significantly reduce their PA levels (16). Hence, there is a need to emphasize the importance of setting up a workplace stress management program and mindfulness-based intervention for nurses working RS to mitigate factors that may affect their job performance, PA and cardiopulmonary fitness levels. Through collaboration with an exercise professional, hospital directors, nurse managers/administrators, and occupational medicine professionals may tailor a home-based moderate-intensity aerobic exercise

Table 1. Moderate-intensity aerobic exercise regimens

Item	Recommendation
Types	Stair climbing at a moderate pace, moderate running on a treadmill, riding a stationary cycle ergometer at moderate speed, golf, and brisk walking. These exercises can be performed separately or combined in a single regimen.
Frequency	3-7 days per week with no more than 2 consecutive days without training.
Time	30–60 minutes per day (150 minutes per week).
Volume	A simple pedometer counts of 7000-10,000 steps per day, which is equivalent to 5.33-7.62 km.
Metabolic equivalents task level	3.0–6.0
Heart rate reserve	50–70%
Borg category-ratio 10 rating of perceived exertion scale	3–6

program for RS-nurses working in the COVID-19 era to improve their sleep (17). There is a need to motivate nurses working RS regarding exercise compliance and practice to improve their adherence to the exercise routines.

## Conclusion

Occupational physicians should consider recommending moderate-intensity aerobic exercise to improve sleep among RS-nurses because engaging regularly in moderate-intensity aerobic exercise may improve sleep quality by increasing slow-wave activity and stability and reducing sleep latency. Moderate-intensity aerobic exercise-induced improvements in sleep quality and duration may depend on the frequency, intensity, mode, duration, and progression of training, and on an individual's health status and functional capacity. However, the physiological mechanisms by which moderate-intensity aerobic exercise improves sleep quality and duration depending on the time (day or night) an individual engages in it are not clear. Advanced experimental studies are required to compare the effectiveness of moderate-intensity aerobic exercise alone or combined with cognitive behavioral therapy and/or sleep-promoting medications, in the treatment of insomnia among nurses working RS.

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## Conflict of interest statement

We declare no conflict of interests.

These types of moderate-intensity aerobic exercise involve major muscle groups and are continuous and rhythmic. The frequency is the number of times per week that the exercise should be performed. The time refers to the duration an individual should spend exercising in a day or week. The volume is a measure of the total amount of physical activity that an individual performs. The metabolic equivalent of task level is the measure of the ratio of the rate at which an individual expends energy relative to the mass of that person while performing a specific exercise compared to a reference set by convention at 3.5 mL of oxygen per kilogram per minute which is equivalent to the energy expended when sitting at rest. The heart rate reserve is the difference between an individual's resting heart rate and the maximum heart rate. The Borg category-ratio 10 rating of perceived exertion scale is a tool which is widely used and a reliable indicator to monitor and guide exercise intensity. The scale allows individuals to subjectively rate their level of exertion during exercise. Using this scale, an individual's effort and exertion, musculoskeletal pain, breathlessness, and fatigue during physical activity can be determined. Moderate-intensity aerobic exercise is at the level of 3-6 on the 1-10 scale, while vigorous-intensity aerobic exercise is at the level of 7-9, and the level of 10 is extremely strong or maximal on the 1-10 scale.

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