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Review article

A systematic review of physical activity-based interventions in shift workers☆

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ABSTRACT

Shift workers are at increased risk of a range of chronic diseases and there is evidence to suggest that these risks can be ameliorated by physical activity. Little is known however about the efficacy of physical activity interventions in shift workers. The aim was therefore to critically review the literature to improve understanding of the efficacy of physical activity promotion initiatives for this occupational group.

A systematic review of randomized controlled trials of physical activity in shift workers was conducted in 2016–2017 following the Preferred Reported Items for Systematic Review and Meta-Analysis (PRISMA) guidelines. Only seven studies were found.

None of the studies measured changes in physical activity behaviour or reported on the timing or setting of the intervention protocols. Instead, most focused on health-related outcomes including body composition, fitness and sleep. Almost all provided physical activity 'prescriptions' with walking or 'aerobic activity' as the primary intervention mode and most reported significant improvements in one of the outcome measures.

Although the findings suggest that physical activity may mitigate intermediate risk factors associated with non-communicable diseases (NCD) in shift workers, the studies offer little insight into physical activity behaviour change in this occupational group. Future research should assess actual changes in physical activity behaviour, and its determinants, as well as the reach and uptake of intervention strategies in this challenging population group.

1. Introduction

Shift work is characterized as work outside the normal 9:00 am–5:00 pm period (Atkinson et al., 2008). Schedules vary due to organizational factors, such as the number of consecutive working days and the frequency and direction of the shift rotation (Brum et al., 2015). The length of each shift can differ (6–12 h) (Harrington, 2001) as can the number of rest days between shifts. The variability of shift work causes disruptions in homeostasis leading to adverse health outcomes. Common repercussions associated with shift work include inadequate sleep (Åkerstedt and Wright Jr, 2009), poor diet (Antunes et al., 2010) and insufficient physical activity (Atkinson et al., 2008). These intermediate consequences cause elevations in biological risk factors, which contribute to the development of many non-communicable diseases. Shift workers are at increased risk of developing metabolic syndrome (Canuto et al., 2013) and diabetes (Knutsson and Kempe, 2014) and are at 48% and 40% greater risk of developing breast cancer (Megdal et al., 2005) and cardiovascular diseases (CVD) (Boggild and Knutsson, 1999) respectively. The risk of CVD morbidity (17%) and mortality (20%) is higher for shift workers than non-shift workers and after five years of shift work, the risk increases by 7.1% (Torquati et al., 2017). As one-fifth of the global work force is now involved in shift work (Pati et al., 2001), it is important to include these workers in health promotion and disease prevention initiatives.

Physical activity has been associated with a number of health benefits including improved cardiovascular fitness, musculoskeletal functioning and body composition (Warburton et al., 2006). To achieve these health benefits, current global guidelines recommend a minimum of 150 min of moderate intensity physical activity each week (World Health Organization, 2010). This amount of activity has significant protective effects on the development of CVD, diabetes and some cancers, and reduces the risk of all-cause mortality (Arem et al., 2015; Lee et al., 2012).

Despite these well-documented health benefits, many shift workers fail to achieve the recommended physical activity guidelines and consequently, the majority of shift workers are insufficiently active. In a

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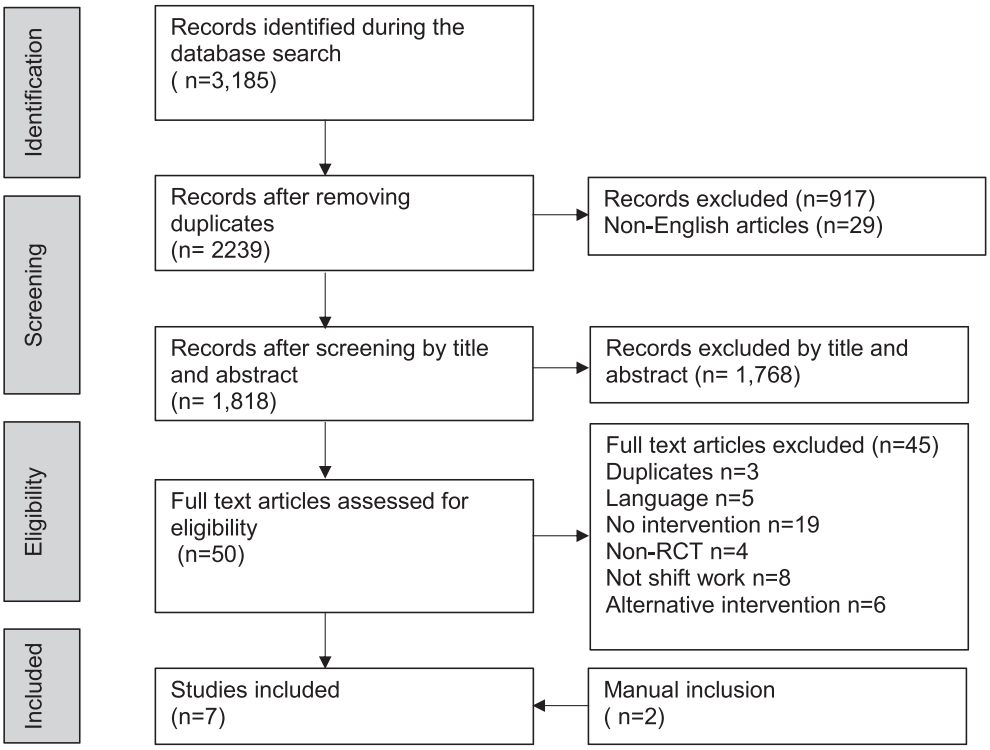

Fig. 1. Flow diagram of study results.

cross sectional survey of 1206 production line workers in Brazil, 64% reported that they were not engaging in 150 min of activity per week (Garcez et al., 2015). In another cross-sectional study of 551 English nurses, 49% reported that they did not meet the recommended guidelines (Malik et al., 2011). Moreover, low levels of physical activity have been reported in samples of shift workers in the U.S.A. (Chin et al., 2016), Canada (Neil-Sztramko et al., 2016), India (Ram et al., 2014) and Iceland (Škrbina and Zurc, 2016), suggesting that inactivity among shift workers may be of global concern. However, a recent study has shown that objectively measured leisure time and occupational physical activity levels are similar in Dutch hospital workers (Loef et al., 2016). Notwithstanding, it is generally agreed that demanding work schedules, reduced access to facilities and circadian rhythm disruption (Atkinson and Davenne, 2007) may explain the observation that shift workers are less physically active than their non-shift working counterparts (Puttonen et al., 2009; Vandelanotte et al., 2015).

Worksite physical activity interventions have been shown to positively influence many aspects of workers' health including: physical activity behaviours, stress levels and musculoskeletal functioning (Conn et al., 2009; Proper et al., 2003; To et al., 2013). Moreover, worksite physical activity interventions can increase employee productivity and reduce health care costs (Van Dongen et al., 2011). Growth in this field of health promotion research is illustrated by the fact that a 2007 meta-analysis identified 206 worksite physical activity interventions, compared with only 26 interventions in a 1998 review. Although the latter review reported that the effectiveness of such interventions was largely unrealized (Dishman et al., 1998), Conn et al. (2009) found significant positive effects on physical activity behaviours, anthropometric measures, cardiovascular fitness, work attendance and job stress. However, neither review provided details of shift schedules or working hours of the employees. Therefore, despite the potential reach and benefits of worksite physical activity interventions, their utility for shift workers remains unclear.

Considering that many shift workers have high levels of inactivity, and are therefore at increased risk of poor health, the overall aim of this study was to synthesize and critically review the available literature on physical activity-based interventions in shift workers.

2. Methods

2.1. Design

A systematic review of physical activity interventions for shift workers was conducted following the Preferred Reported Items for Systematic Review and Meta-Analysis (PRISMA) guidelines (Moher, 2010).

2.2. Search strategy

Four electronic databases were searched for articles published from 1988 to 2017: PubMed, EMBASE, Scopus, CINAHL. Key search terms relating to target population (e.g. 'shift work', 'night shift') exercise (e.g. 'exercise', 'physical activity') and intervention (e.g. 'workplace intervention', 'worksite physical activity program') were considered. A full list of the search terms is provided in the supporting documentation (see Appendix A).

2.3. Inclusion criteria

The following inclusion criteria were applied: (a) randomized control trials (RCT) or RCT protocols; (b) with shift workers as the target population; and (c) physical activity as the *primary* intervention component. (Studies in which the main focus was weight loss, with physical activity as one intervention component were excluded.) Only peer reviewed journal articles written in English language were considered for selection.

2.4. Screening/selection

Articles were screened for inclusion by two independent reviewers (HF, TKA) using a three-stage process. In stage one, both reviewers excluded articles by title. In stage two, abstracts were screened and