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Review Article

A survey of the relationship between sarcopenia and sleep

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Abstract

Sarcopenia, characterized by the progressive loss of muscle mass and function, represents a significant global health concern, not only among older adults but also in younger populations due to modern lifestyle changes. Emerging evidence highlights sleep as a crucial lifestyle factor influencing sarcopenia. Both insufficient sleep duration (fewer than 6 hours) and excessive sleep (exceeding 8 hours) have been linked to an elevated risk of sarcopenia. The underlying mechanisms encompass hormonal dysregulation, chronic inflammatory processes, oxidative stress, and insulin resistance, all of which contribute to progressive muscle deterioration. Additionally, prolonged sleep has been linked to reductions in muscle mass, poor physical performance, and exacerbation of sarcopenia severity. This review provides a comprehensive survey of the relationship between sarcopenia and sleep, assessing both duration and quality. It explores the intricate physiological pathways linking sleep disturbances to muscle degeneration, emphasizing the U-shaped association between sleep duration and sarcopenia risk. Furthermore, we discuss the potential for optimizing sleep habits as a cost-effective, nonpharmacological strategy to prevent and manage sarcopenia in contemporary society. Addressing this relationship as a growing public health challenge, we advocate for global initiatives and future research to unravel the underlying mechanisms and develop targeted prevention strategies.

Keywords: Sarcopenia, sleep, sleep duration, sleep quality.

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INTRODUCTION

Sarcopenia was first described by Rosenberg in 1989. The word sarcopenia originates from sarx, meaning meat, and penia, meaning loss (1). The European Working Group on Sarcopenia in Older People in 2010 recommended three diagnostic criteria for sarcopenia based on low muscle mass, low muscle strength, and low physical performance (2). It has been shown that the size and number of type II muscle fibres and satellite cell fibres decrease, and intramuscular and intermuscular fat infiltration occurs in sarcopenic muscles (3). Oxidative stress, inflammation, and insulin resistance also contribute to muscle damage (4).

Sarcopenia is a global public health problem. Muscles provide the body with the necessary mechanical support to maintain posture, balance, and walking stability. Sarcopenia is a progressive loss of muscle mass and functionality (5). This situation confronts the person with an increased risk of functional decline, frailty, falls, and increased mortality rates (6,7). Furthermore, reduced physical abilities and functional decline can lead to higher levels of dependence and disability, resulting in a reduced quality of life (8,9). This study focuses on the relationship between sleep and sarcopenia.

BACKGROUNDS

Epidemiology of sarcopenia

The prevalence of sarcopenia has been reported to be around 29-50% in older adults (4). In today's changing modern world, this condition cannot be considered only as an older adult problem. Although sarcopenia is currently recognized as an older adult problem, it is an important public health problem with increasing prevalence in young adults due to changing modern lifestyles, increasing sedentary behavior, and rising incidence of obesity (10,11). Future studies should focus on clarifying causality, and effective health policies should be developed to prevent sarcopenia (12).

Several studies have suggested that women are at higher risk of developing sarcopenia and especially sarcopenic obesity due to increased fat and lower muscle mass (13). In contrast, although the gender-specific prevalence of sarcopenia varies from country to country, a higher prevalence of sarcopenia has been reported in men, especially in studies conducted for the Korean population. Metabolic differences between males and females may influence the sarcopenic phenotype and the onset of physical and metabolic dysfunction (14). The prevalence of sarcopenia is not only associated with age (15) and gender (16), but also with various factors. Other influential factors include genetic conditions (17), diet, physical activity, comorbid chronic diseases, and hormonal changes (18). In addition, many studies have confirmed that sarcopenia is significantly related to cardiometabolic diseases such as insulin resistance, diabetes mellitus, and cardiovascular disease (19,20).

Sarcopenia and sleep

Lifestyle is an influential factor for sarcopenia (21). Sleep represents a crucial component of lifestyle, encompassing a substantial portion of the day and influencing numerous metabolic parameters within the body (22). To better clarify the relationship between sarcopenia and sleep, the issue should be considered in two dimensions, sleep duration and sleep quality.

Some correlational studies have shown that shorter sleep duration leads to loss of muscle mass (23). People with inadequate sleep have a higher prevalence of sarcopenia than those who report adequate sleep (24). Previous studies have shown that insomnia is significantly associated with sarcopenia and carries a 1.67 times greater risk than normal sleepers (25). In a longitudinal study involving 994 participants followed for a four-year period, short sleep duration was identified as a potential risk factor for the development of sarcopenia. (26). A plausible explanation for these findings is the dysregulation of the hypothalamo-pituitary-adrenal axis and the occurrence of endocrine changes associated with circadian rhythm changes in participants with insufficient sleep (27,28). As a result, differences in hormonal regulation (anabolic and catabolic balance) may occur, resulting in elevated cortisol levels. IGF-1, an anabolic hormone that plays a crucial role in protein synthesis and thereby in the maintenance of muscle mass, is down-regulated by sleep insufficiency. This leads to skeletal muscle fibre type shift, loss of mitochondrial function, and loss of muscle function, resulting in increased muscle damage and

sarcopenia (27,29-31). In addition, another link between sleep duration and sarcopenia may be chronic inflammation (32). During regular sleep, body damage is gradually repaired and rejuvenated through processes such as protein synthesis and hormone production. Nevertheless, when the circadian rhythm is disrupted, the body maintains a chronic inflammatory state (33). Increased cortisol levels cause low-level inflammation. The released inflammatory mediators increase oxidative stress and activate proteolytic pathways, which leads to sarcopenia (34-37). Furthermore, decreased sleep duration can trigger insulin resistance, damage muscle elasticity, and accelerate muscle deterioration, thus promoting sarcopenia (38). In addition, it has been reported that the increased risk of sarcopenia caused by insufficient sleep can be reduced by short midday napping however, this practice has been associated with increased cardiovascular events and elevated all-cause mortality (39,40). As a consequence of modern life, the duration and quality of sleep in young adults are decreasing significantly. This situation increases the risk of sarcopenia in young and middle-aged adults (41). Therefore, the relationship between sleep and sarcopenia should be addressed as a growing global public health problem not only in older people but also in adults of all ages. Comprehensive studies should be conducted to understand better the relationship, and health policies should be focused on developed for prevention. (12,23,24). Improving sleep duration should be considered as a target in early preventive and health strategies against the development of sarcopenia (26).

Remarkably, when this subject was analyzed extensively, it was found that the relationship between sleep duration and sarcopenia risk was not linear but U-shaped (35,42). Previous studies have demonstrated an association between shorter sleep durations of less than 6 hours or longer durations exceeding 8 hours and an increased risk of sarcopenia (43,44). Furthermore, prolonged sleep duration has been shown to be associated with a reduction in muscle mass, as well as reduced muscle mass and poor physical performance (25,45-48). Studies, especially in Asian populations, have suggested that long sleep is associated with an increased risk of sarcopenia (49). Additionally, prolonged sleep duration has also been reported to exacerbate the severity of sarcopenia (50).

The precise mechanism of the association between long sleep duration and sarcopenia remains unclear, and there are some possible explanations. Sleep is a lifestyle in its own right, and lifestyle factors can influence sleep duration. Physical inactivity, sedentary lifestyle, and low socioeconomic status are closely associated with sleep duration (49,51,52). Some studies have suggested that this may be related to insulin resistance (19). Pyykkonen et al. also reported that long sleep duration (≥ 9 hours) is closely associated with increased insulin resistance (53). Brocato et al. suggested that long sleepers are more likely to have components of metabolic syndrome (54). In addition, longer sleep duration increases the risk of obesity even in the absence of decreased physical activity and may lead to sarcopenic obesity with low muscle mass and reduced muscle strength (55,56). It has also been suggested as a possible mechanism that when sleep duration is prolonged, inflammatory changes in the muscles may lead to functional impairment in the muscles (57). Patel et al. demonstrated that IL-6 levels increased linearly with longer sleep duration (32). In light of these findings, it appears that not only short sleep duration, but also long sleep duration is associated with sarcopenia. Further studies are required to shed light on the underlying mechanisms (58). Sleep quality also affects sarcopenia. Previous studies have shown that sleep quality is associated with sarcopenia (24,59).

Currently, there are no specific drugs approved for the treatment of sarcopenia. In the non-pharmacological treatment of sarcopenia, some dietary approaches such as adequate nutrition, adequate protein intake, vitamin D, long-chain polyunsaturated fatty acid intake, resistance exercise, and leisure time activities have been shown to have positive effects against sarcopenia (60-63). In recent studies, sleep disorders have also been reported to be associated with sarcopenia. It has been demonstrated that providing optimal sleep duration and quality increases muscle mass and reduces the risk of sarcopenia through anti-inflammatory effects, although the mechanism has not been clearly established (64-66). In contrast to most studies on this topic, in a study conducted by Monterrosa-Castro Á et al. on postmenopausal women, no association was found between sleep disorders and sarcopenia (67). Comprehensive studies should be carried out to clarify this issue more clearly. The best treatment for sarcopenia as a public

health issue is to prevent sarcopenia before it occurs, to recognize it early, and to support preventive measures. When all findings are analyzed together, optimizing and improving sleep quality in the treatment of sarcopenia offers an opportunity for early diagnosis of risk and cost-effective prevention of sarcopenia (68,69).

CONCLUSION

With all this knowledge, it is obvious that sarcopenia is a global concern that can cause loss of workforce, affect quality of life, and result in high disability and costs for not only older adults but also for adults of all ages nowadays. It appears that short or long sleep duration is an influential factor in the occurrence of sarcopenia, and that maintaining optimal sleep habits is an important factor for preventing the development of sarcopenia at low cost. We recommend that global initiatives aiming to improve not only the duration but also the quality of sleep should be supported, and comprehensive studies should be conducted to clarify the mechanism of the relationship between sleep and sarcopenia.

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