

## Physical Activity Moderating Pre-Sleep Arousal and Pain Intensity: The Role of Sex

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### Abstract

**Introduction:** Research has shown that physical activity can reduce chronic pain and improve

sleep. Additionally, poor sleep and higher pain have been shown to be associated. Further, women have an increased pain sensitivity, and have a higher prevalence of insomnia than men. However, research regarding the sex-specific interactive associations of different types of physical activity and sleep on pain is limited. This study aimed to determine whether physical and/or sedentary activity moderated associations between sleep characteristics and pain, and whether sex moderated these relationships.

**Methods:** Participants aged 50+ completed the Pre-sleep Arousal Scale (PSAS), Pittsburgh Sleep Quality Index (PSQI), International Physical Activity Questionnaire (IPAQ), and reported average pain intensity over the past month. Moderated regression analyses determined if minutes of physical or sedentary activity (total, vigorous, moderate, walking, sitting), sleep (cognitive,

somatic, total pre-sleep arousal, PSQI subscores), sex, or their interactions were associated with average pain intensity.

**Results:** Sex moderated the association between time spent sitting and somatic pre-sleep arousal ( $p=0.02$ ,  $R^2=0.02$ ) and total pre-sleep arousal ( $p=0.03$ ,  $R^2=0.02$ ) in their associations with pain. Specifically, higher somatic arousal was associated with worse pain at highest levels of sitting time in women ( $B=3.65$ ,  $SE=1.66$ ,  $p=0.03$ ), but not men ( $p=0.43$ ). Likewise, higher total pre-sleep arousal was associated with worse pain at highest levels of sitting time in women ( $B=2.05$ ,  $SE=0.89$ ,  $p=0.02$ ), but not men ( $p=0.87$ ). When examining if sex moderated the interaction between physical or sedentary activity and PSQI sub-scores in its association with pain intensity, the results were not significant ( $p>0.05$ ).

**Conclusion:** In middle-aged and older adults, sex moderates the interactive association of sitting time and pre-sleep arousal with pain intensity. In women, prolonged sitting and higher pre-bedtime physiological arousal may exacerbate pain. Future studies should investigate mechanisms underlying these sex-differences (e.g., cardiovascular autonomic regulation) to inform sex-specific recommendations and treatment efforts for chronic pain in mid-to-late life.