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SLEEP POSTURE AS A MODIFIABLE FACTOR ASSOCIATED WITH SPINAL PAIN IN ADULTS

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Abstract: Sleeping posture has been recognized as playing an important role in spinal welfare due to its relation to spinal orientation. Sleeping in a neutral spinal orientation may result in decreased pain levels due to enhanced spinal comfort. The relationship of sleeping posture to spinal pain may reveal both the contributing aspects of spinal health as well as its significant predictors. This investigation proposes researching the relationship of sleeping posture to spinal pain in Canadians and Pakistanis. The online survey collected data from 100 participants comprising 50 Canadians and 50 Pakistanis. The participants were asked about the sleeping positions they practiced regularly, the levels of spinal pain as scored on a visual analog scale of 0-10 points, and overall spinal health. The levels of pain in different sleeping positions were analyzed through the application of the Wallis tests. Back sleepers experienced less pain (Median: 3.0; IQR: 2.0-4.0), in comparison to persons sleeping in the prone and combination positions (Median pain levels of 6.0 and 5.5). Side sleepers had an intermediate level of pain. In the regression analysis, sleep position, as well as sleep health, were found to be significant predictors of the intensity of pain, with a value of $p < 0.05$, and were not significant for the other factors: countries, gender, and bed time. Persons sleeping in a prone position or in a side-lying position with support experienced less spinal discomfort and better sleep health in comparison with stomach sleepers or those Personnel, who frequently change positions.

Key words: sleep posture, Spinal Pain. Physical Therapy

INTRODUCTION

Among all the human necessities in life, sleeping is one of the most important. Sleeping forms part of the five major bases of excellent health in human life because it almost affects every function in human life. During sleeping, the body is subjected to several prolonged positions merely because of sleeping. This affects the distribution of the loads of the spine. The spinal load distribution theory may provide an explanation in this context because it asserts that the body is capable of developing mechanical stress during sleeping due to the prolonged positions taken during sleeping. This results in strains in the body due to waking up after sleeping. Looking at it from the ergonomic perspective, sleeping positions are greatly affected by the support component like height and mattress firmness: a quality which can either maintain or jeopardize spinal alignment. Poor spinal alignment during sleep can exacerbate regional discomfort-particularly in the neck and lower spine. Mattress hardness and comfort are more recently emphasized as equally important factors in morning spinal curvature, suggesting the role of additional support in conjunction with spinal strain in the degree to which posture contributes to sleep (Hyung *et al*., 2015; Chen and Cai, 2012; Bolton *et al*., 2022). These same biomechanical changes have the potential to act as stimulants for spinal pain during wakefulness and also impede the process of sleep itself. This therefore suggests a mutually influencing relationship between spinal strain and sleep. It has been considered that the pathophysiological processes for spinal pain manifested during wakefulness relate to poor sleep posture leading to prolonged spinal mechanical loading. Evidence from trials conducted on young active military participants shows that 33% of participants reported their worst spinal pain at the time of sleep or woke up with spinal pain, and 50% of participants experienced disrupted sleep patterns due to pain (Cary *et al*., 2021). “Sleep postures or environments inducing spinal discomfort can posteriorly alter overall wake time and sleep architecture, resulting in decreased overall sleep efficiency.” Poor spinal posture at night can effectively predict the development of spinal pain in people of all ages. “Sleep disruptions owing to pain can unleash a self-reinforcing process in which pain contributes to disturbed sleep, while disturbed sleep can heighten pain perceptions and decrease pain thresholds.” This process can ultimately lead to enduring spinal pain, fatigue, and reduced overall life quality in the long run (Finan *et al*., 2013;

Riemann *et al*., 2023).There has been increasing literature evidence for the existence of a link between habitual body posture in sleep and spinal alignment, load distribution, and musculoskeletal outcomes. Various body postures result in variations in the force direction and force magnitude on the spinal column. This contributes to detrimental spinal loading effects associated with long sleep periods in various body postures, and habitual preference for such body postures has recently been linked to detrimental spinal effects in healthy and pathological subjects (Buckley *et al*., 2025). Furthermore, epidemiological research has emphasized spinal pain distribution in relation to lifestyle and ergonomic aspects of life, including sleep practices, and thus preventive approaches (Buke *et al.*, 2025). Nevertheless, most of this past work has mainly focused on pathological and immobilized patients, and hence there has been a knowledge gap in the effects of habitual body posture in healthy adults. Hence, sleep posture constitutes a modifiable behavioural factor with implications for spinal pain. The present study aimed to investigate the associations of habitual sleep postures with spinal outcomes in order to elucidate the role that posture plays in musculoskeletal health. Understanding these relationships is essential to underpin ergonomic recommendations and preventative strategies with the aim of reducing spinal pain in everyday populations.

MATERIALS AND METHODS

Study Design

The current research used a cross-sectional design where participants completed questionnaires online. The main focus of this study was to investigate the relationship between sleeping posture and spinal pain in adults. The cross-sectional design helped to ascertain whether certain sleeping postures were related to differing levels of spinal pain.

Study Setting and Population

Participants ranged in age from 18-60 years and came from the South and Central districts of Karachi, Pakistan, or the Greater Toronto Area (GTA), Canada. These sites ensured a degree of cultural diversity concerning their overall patterns of sleep. In all, 100 participants took part (50 per country; 50 males, 50 females), sampled using convenience sampling.

Inclusion and Exclusion Criteria

Participants for this study were considered eligible if they were between 18 and 60 years of age, had resided for at least n= six months within the selected regions, and could independently fill out this online study. Participants will not qualify for this study if they are, or could be, pregnant or if they ever had any kind of spinal deformities or injuries, or any kind of neurological or neuromuscular problems. Partial or inconsistent responses were excluded from the analysis. Informed consent was obtained electronically prior to participation.

Data Collection

Data collection was done through an anonymous self-administered online questionnaire designed using Google Forms. The variables captured in this survey were as follows:

- Age, sex, occupation, and location of the patient is living in
- Primary sleep posture (back, side, stomach, or mixed)
- Sleep duration
- Self-reported intensity of spine pain on a 0-10 scale
- Basic ergonomic preferences: mattress firmness and pillow type

The participants went through an informed consent statement before submitting the survey. All responses were recorded and stored automatically and securely.

Data Analysis

Data analysis was done using the SPSS software version 29. Descriptive statistics involved the use of demographics, sleep postures, and levels of pain. Inferential tests involved analyzing the differences in postures. The Kruskal-Wallis test was applied in comparing pain levels in the sleep postures because the data was not normal. Spearman's correlation test determined the correlation between the variables of posture and the levels of pain. Multiple linear regressions analyzed the potential predictive values of the variables of posture in spinal pain. Only relevant test statistics to the study of sleep posture and pain were kept in the study for relevance to the study objectives.

All assumptions necessary for the statistics conducted were tested for, and these include normality (Shapiro and Wilk), homogeneity of variance (Levene's Test), and multicollinearity (VIF < 2.5), while effect sizes (η^2, ε^2) were reported where appropriate.

Ethical Considerations

Ethical scrutiny and oversight were conducted by Dr Shah Ali Ul Qader, University of Karachi. The information sought was voluntary, anonymized, and based upon ethical considerations set forth in Declaration of Helsinki (2013). The information collected is only to be used in academia.

RESULTS

Table 01: Association Between Habitual Sleep Posture, Spinal Pain Intensity, and Sleep Health Scores

Characteristic	n (%)	Pain Intensity (0–10)	Sleep Health Score
Country		Mean ± SD	Mean ± SD
Canada	50 (50%)	4.9 ± 2.2	3.1 ± 0.7
Pakistan	50 (50%)	5.5 ± 2.3	2.9 ± 0.8
Gender			
Male	50 (50%)	4.8 ± 2.3	3.0 ± 0.8
Female	50 (50%)	5.4 ± 2.1	3.0 ± 0.7
Habitual Sleep Posture		Median (IQR)	Mean ± SD
Back	5 (5%)	3.0 (2.0–4.0)	3.5 ± 0.6
Right side	38 (38%)	5.0 (3.0–6.5)	2.9 ± 0.8
Left side	10 (10%)	4.5 (2.5–6.0)	3.0 ± 0.7
Mixed / changing	38 (38%)	5.5 (3.0–7.0)	2.4 ± 0.7
Stomach	5 (5%)	6.0 (4.5–7.5)	2.2 ± 0.9
Overall	100 (100%)	5.2 ± 2.2	3.0 ± 0.7

The intensity of the pain tends to vary based on the sleep position. Those who sleep on their backs have the lowest scores in terms of pain levels (Median = 3.0, IQR = 2.0-4.0) but the highest scores in terms of sleep health (Mean ± SD = 3.5 ± 0.6), while those who sleep on their stomachs in addition to those who switch positions have the highest levels of pain (Median = 6.0 & 5.5), respectively. Those who sleep on their sides had intermediate results.

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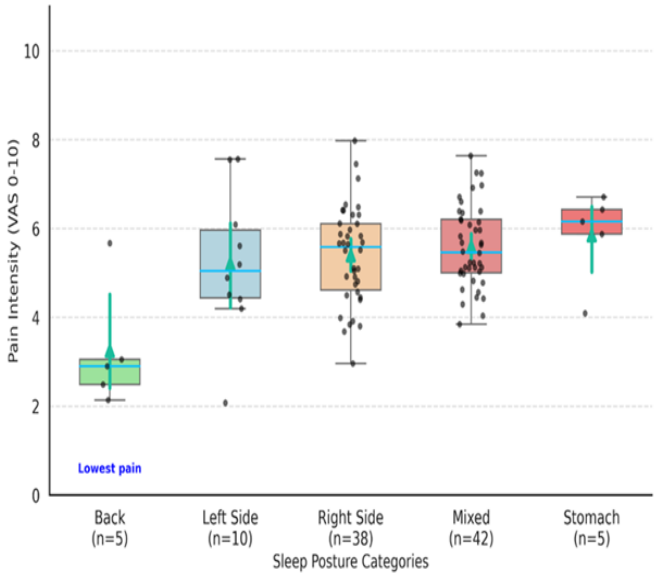

Fig. 1: Distribution of Spinal Pain Intensity by Habitual Sleep Posture

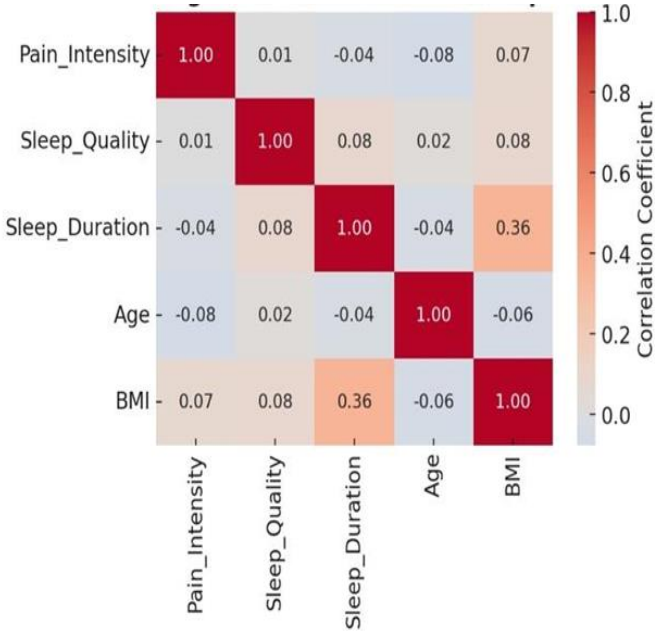

Fig. 2: Correlations Between Spinal Pain Intensity, Sleep Health, and Participant Characteristics

Figure 2 presented the correlation of spinal pain with sleep health and other variables. Moderate negative correlation was found between intensity of spinal pain and sleep health, suggesting that as pain increases, sleep health worsens. Weak correlations were found with other variables.

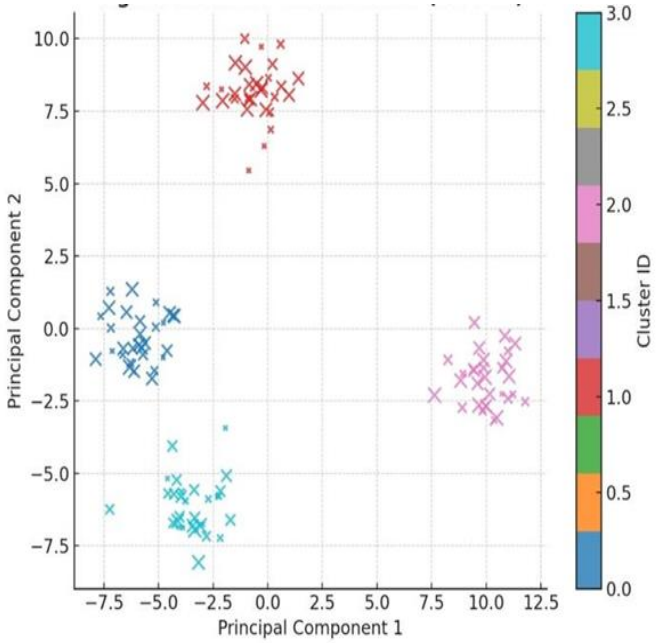

Fig. 3: Cluster analysis of Sleep Posture, Spinal Pain Intensity, and Sleep Health

Figure 3 showed four clusters based on sleep posture, pain intensity, and sleep health. Back and supported side-lying postures were associated with lower pain and better sleep health, while mixed and stomach sleeping postures showed higher pain and poorer sleep.

DISCUSSION

The aim of the current research was to explore the relationship between sleep posture preference and spinal pain, as well as sleep quality in a sample of Canadian and Pakistani adults. The results showed that the preference for a particular sleep posture impacts spinal pain and overall perceptions of sleep performance more so than a purely ergonomically driven preference. For the total sample of 100 adult respondents surveyed for the research, a preference for a predominantly supine/side-lying sleep posture correlated with a preference for a reduced level of spinal pain along with enhanced levels of overall sleep health compared to those respondents who favored a predominantly stomach-lying sleep position, as well as those who tended to switch between multiple sleep postures throughout the night. Although a relationship between the specific sleep position and the amount of spinal pain did approach but not quite reach significance (p = .063), there is a clear underlying implication that spinal load on the basis of preference for a certain sleep

position does correlate well with musculoskeletal levels of comfort.

The promotion of neutral spinal orientation in sleeping positions may help function as a protective mechanism against spinal pain symptoms and insomnia. This is because previous literature has identified side-lying without support and prone sleeping positions to be significant predictors of spinal pain in the mornings (Cary et al., 2021). Conversely, sleeping supine or in side-lying positions with support has been identified as critical in facilitating favorable spinal orientation (Cary *et al*., 2021). Biomechanical analyses also validate this assertion in showing that neutral cervical spines are significant in reducing loading on spinal structures when one is stationary in rest positions (Chen *et al*., 2021). A small cross-cultural difference was found in the current research, where Pakistani respondents showed slightly higher levels of pain compared to Canadian respondents; although insignificant, the difference was statistically notable. This indicates that even though cultures may choose to engage in different activities that can affect their sleep behaviors and levels of comfort, the fact that one is sleeping in a certain position definitely impacts spinal pain.

Correlation analysis showed a moderate negative correlation between sleeping health and the intensity of pains ($r = -0.43$), indicating that a decrease in sleeping health increases intensities of spine pains. The idea can be supported by the bi-directional relationship between sleeping and pains where difficulties sleeping and / or a lack of restorative sleeping can sensitizing pains and pains can also affect sleeping to ensure that one gets refreshing sleeping. These results are supported by previous works acknowledging that a bi-directional relationship between sleeping disturbances and pains amplifications (Finan *et al*., 2013).

Cluster analysis revealed additional findings on posture-related data about sleep and pain. There were four identified clusters of posture-related sleep and pain data: (1) the low pain back sleepers who had relatively little pain and the best sleep health outcomes, (2) the mixed high pain sleepers who had much positional change and the worst sleep health outcomes, (3) the side sleepers who had moderate pain and moderately good sleep health, and (4) the stomach sleepers who had the highest level of pain and the lowest sleep health. Sleeping position has long been noted in the literature to affect post-sleep cervical pain and rigidity in the mornings in people who sleep in various positions (Gordon *et al*., 2002), while the standard view focuses on the posture-related need for neutral spinal positioning for reduced pain and avoidance of reinjure (Gracovetsky, 1987).

Some of the possible limitations that should be taken into consideration in the light of the above observations are as follows: The study had used convenience sampling as the sampling method. This may have affected the external validity of the study to a certain extent. Further, the possibility of recall bias cannot be denied as the study used self-reporting for the pain and sleep variables. The study may have been affected by some unmeasured variables.

In sum, the results support the conclusion that sleep position is a modifiable behavior with nontrivial potential to impact spinal comfort and sleep function. The education of individuals to use supine positioning or supported side-lying positioning may be considered a simple, low-cost intervention to improve spinal pain risk-safety and sleep function outcomes.

CONCLUSIONS

This paper reported that adults who habitually sleep in a back or well-supported side-lying position experience lower spinal pain and better sleep health compared with stomach sleepers or individuals who frequently change position. Maintaining neutral spinal alignment during sleep may be an important factor in spinal comfort. While some associations failed to reach statistical significance, the overall pattern observed in this sample supported this trend.

Overall, findings support the view that sleep posture represents a modifiable behavioral factor associated with spinal pain. A focus on sleep posture and spinal alignment during rest may inform simple strategies toward enhancing spinal comfort and improving sleep quality. Larger samples, along with objective measures, are needed to confirm such associations and further elucidate their clinical implications..

Conflict of interest

Authors declare no conflict of interest.

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