Association between Cervical Curvature and Sleep Factors among Chinese Adult Population

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ABSTRACT

Background: Cervical curvature plays a key role in supporting the head and enabling neck movements. Its alteration is linked to neck pain and musculoskeletal disorders. Sleep-related factors can influence cervical alignment, yet their effects remain underexplored. This study investigates the association of sleep factors with cervical curvature to inform preventive strategies and clinical guidance.

Objective: To assess the association between sleep factors like sleeping position, duration, and pillow height with cervical curvature among the adults undergoing cervical spine MRI.

Methods: This study was hospital based and cross-sectional. It was conducted among 610 adults. The participants were of 30-59 years age. They were attending a tertiary care Chinese hospital for cervical spine MRI. A validated literature based questionnaire was used to collect the data related to sleep factors, socio-demographic, ergonomic, and lifestyle variables. Cervical curvature was evaluated using MRI-based Cobb angle measurement from cervical spine C2-C7. Cervical spine curvature was classified based on the Cobb angle a 'lordotic' type if the angle was between >7° and <20°, as "normal", and a 'straight' type if it is between > -7° and <7°, and a 'kyphotic' type if it is -7° or less, both combined as "abnormal". Multivariable logistic regression was performed to estimate adjusted odds ratios (aORs) with 95% confidence intervals (CIs).

Results: Most of the participants exhibited normal curvature (62%). Female participants had significantly higher odds of abnormal cervical curvature compared to males (adjusted OR = 2.9, 95% CI: 2.0-4.2, $p < 0.001$), after adjusting for other covariates. Participants with abnormal sleep duration had higher odds of abnormal curvature compared to those with normal sleep (adjusted OR = 1.4, 95% CI: 0.9-1.9, $p = 0.05$) after adjusting.

Conclusion: Cervical curvature is independently associated with sleep duration but not sleep position and pillow height. Maintaining normal sleep duration may represent modifiable strategies to support long-term cervical spine health. Longitudinal studies are required to establish causality.

Keywords: Cervical curvature, Sleeping position, Pillow height, Sleep duration, Magnetic resonance imaging

INTRODUCTION

The vertebral column, or spine, is a segmented bony structure forming the sub-cranial portion of the axial skeleton and is divided into five regions: cervical, thoracic, lumbar, sacral, and coccygeal [1]. The cervical spine consists of 7 articulating vertebrae, the thoracic spine has 12 vertebrae, and the lumbar spine contains 5 vertebrae. Although these regions share a similar basic morphology, variations in flexibility, range of motion, and joint movements produce the characteristic S-shaped curvature of the spine. The cervical spine, extending

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from C1 to C7, comprises two major functional segments and plays a key role in supporting the cranium and enabling head and neck movements [2].

The intervertebral disc (IVD) is a fibro-cartilaginous structure that provides flexibility while transmitting compressive loads between adjacent vertebral bodies [3]. IVD-related disorders most commonly present as back pain, with a point prevalence ranging from 12% to 30%, and approximately 10% of affected individuals progressing to chronic back pain [4,5]. Globally, neck pain affects around 186 million adults aged 25 years and older [6]. Of these, an estimated 18.34 million people experience disability as measured by Disability-Adjusted Life Years (DALYs) [6-8].

In China, neck pain affects approximately 46.46 million adults aged 25 years and older, with about 4.61 million individuals living with disability as measured by DALYs. In the same age group, neck pain accounts for 3.3% of the total Years Lived with Disability (YLDs) in the country [6, 8].

Cervical curvature change is also associated with sleep factors by studies. Sleep is the basis for health and is very important in life [9, 10]. For adult, the duration of 7 hours or more sleep per night is recommended by various literature [11, 12]. The reported sleep positions in a study are lateral, supine, prone, upright and varied [13, 14]. The sleeping position in which the physiological cervical curvature is maintained is the best sleeping position [15]. Along with the quality of sleep, the sleeping position plays role on the condition like obstructive sleep apnea, back pain and gastroesophageal reflux [16]. The improper height of the pillow leads to malalignment of the cervical spine [17] leading to pain disturbing sleep thus reducing quality of sleep [18]. And the improvement in pain was associated with pillow height satisfaction [19].

Most existing studies primarily focus on lower back pain, with very few examining cervical curvature and cervical disc degeneration. Among the limited research on cervical spine, most studies have investigated associations with daytime physical activities, work conditions, screen time, and ergonomic factors. While the influence of daytime posture on spinal symptoms has been widely studied, the role of sleep posture, sleep duration, and pillow height in contributing to night-time or early morning spinal symptoms remains largely unexplored. To our knowledge, the few studies that have examined sleep quality and its relationship to neck and back pain report conflicting results-some recommend lateral-supported sleeping positions [18], while others suggest changing positions throughout the night [20]. These inconsistencies limit our understanding and hinder identification of sleep-related modifiable factors for cervical spine disorders.

Factors such as aging, genetics, smoking, biomechanical stress, and nutrition also contribute to disc degeneration [3, 21-26]. Although disc degeneration is often considered age-related, it does not occur uniformly within the same age group, indicating that individuals vary in vulnerability based on mechanical loading exposure [27]. Previous research has explored the effects of sleep posture on sleep quality [15], neck position on cervical alignment [28,29], pillow height on cervical alignment [17, 30], and sleep posture on overall spine alignment [31]. However, these studies either manipulate sleeping positions, introduce novel support systems, or evaluate isolated conditions, often assessing the spine only at a single point in time, which may not reflect long-term outcomes and also focusing on disc degeneration rather than curvature angle. Furthermore, only a few studies have examined preferred sleeping positions, chosen pillow heights, and adequate sleep duration in relation to cervical curvature and disc health. This leaves a gap in understanding how sleep-related factors-such as position, duration, and pillow height-affect cervical curvature and disc degeneration.

Thus, this study puts a limelight on the very essential and regularly practicing sleep factors which are usually overlooked in the day-to-day practice. Building up a deeper understanding on the association between sleep factors like sleep positions, duration and pillow height with cervical curvature and cervical disc degeneration helps the clinician to guide their patient with individualized advice. It is also a milestone to help in spreading awareness among the public to adopt preventive approach and maintain cervical curvature in normal physiological condition.

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METHODOLOGY

We used cross-sectional study design using quantitative research. The research was done at the First Affiliated Hospital of Jiamusi University, a tertiary care regional medical center of Heilongjiang Province. The hospital integrates medical treatment, teaching and scientific research, as well as it possesses advanced MRI machines [32]. We selected the participants purposively. The hospital attendees of 30-59 years age who visited the hospital for the cervical spine MRI scan were enlisted. We excluded the patients with already diagnosed neck / cervical spine related diseases, surgical history and disorders related to sleep. The study was conducted from March to December 2025.

We used the T2 weighted mid-sagittal digital magnetic resonance image to measure the cervical curvature. It was calculated by using Cobb's method. The second and seventh cervical vertebral level were used. The Cobb angle was measured between two perpendicular lines drawn from the inferior margin of C2 and the superior margin of C7. The angle was considered positive when the superior margin of C7 is rotated more clockwise relative to the inferior margin of C2. Cervical spine curvature was classified based on the Cobb angle as follows: a 'lordotic' type if the angle was between >7° and <20°, a 'straight' type if it is between > -7° and <7°, and a 'kyphotic' type if it is -7° or less [33].

Similarly, we developed the semi-structured questionnaire for socio-demographic characteristics [34], sleeping position [35-41], sleep duration [42-46], pillow height [47-52] and ergonomic [53-55]. We categorized the pillow height of 10-15 cm as "normal" and <10 cm and >15 cm as "abnormal" [30]. Likewise, we categorized the sleep duration of 7-9 hours as "normal duration" of sleep while <7 hours to >9 hours as "abnormal duration" [56].

We assessed the physical activity level using short version IPAQ [57-58]. We calculated the body mass index using the standard formula: BMI = Weight (kg)/ Height $(m)^2$. We used the electronic scale and stadiometer for measuring weight and height. The calculated BMI in the range 18.5-24.9 kg/m^2 was taken as normal BMI and those < 18.5 kg/m^2 and >24.9 kg/m^2 were taken as abnormal BMI [59]. We finalized the questionnaire with necessary modifications through appraisal and verification by the supervisor and suggestions from experts to enhance the content and face validity of the tool.

For fixing the sample size, rule of thumb for logistic regression, sample size (n) = $100 + 50i$ [60] was used where i is the number of independent variables. In this study the independent variables (i) were 9, including socio-demographic variables (age, sex, occupation), sleeping position, pillow height, sleep duration, physical activity level, type of work station, and body mass index. The calculated sample size (n) was 550. Addressing 10% margin of error and possible missing data, 610 participants were fixed as the total sample size (N).

We obtained the required permission from the Medical Ethics Review Committee of the First Affiliated Hospital of Jiamusi University (2023-500-44) as well as the hospital administration for collecting the data. Further, we took verbal consent from the radiology department of the hospital. We ensured voluntary participation through informed written consent from the participation. We distributed the self-administered questionnaires to the participants for independent variables, while the researcher himself measured the height and weight.

The imaging technologist conducted the MRI. MRI scanner generated digital data of images. These data of images were transferred and stored into Picture Archiving and Communication System (PACS). By using the Synapse software which was interlinked to Fabric application and PACS, the images were viewed. The Cobb's angles were measured by using Cobb method at C2 and C7 level. When the superior margin of C7 is more clockwise than the inferior margin of C2, the angle was considered to be positive [33].

The table 1 below represents the classification of Cobb's angle, which was followed in this study:

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Table 1: Cobb's angle classification for cervical curvature: [33]

Type of cervical curvature	Cobb's angle measurement
Lordotic curvature	>7° but <20°,
Straight curvature	>−7° but <7
Kyphotic Curvature	−7° or less

Because the kyphotic category included only a small number of participants (<5%), for statistical analysis, we merged the straight and kyphotic categories into a single "abnormal curvature" group. This resulted in a binary outcome for regression analysis: lordotic (normal) vs straight/kyphotic (abnormal)**.** This approach is consistent with previous studies where deviations from normal lordosis were considered abnormal.

The analysis was conducted on STATA 13. We computed the frequencies and percentages for categorical variables and mean and standard deviation for continuous variable. We used multi-variate logistic regression for inferential statistics. We entered all exposure variables and covariates simultaneously into the logistic regression model to estimate independent associations with cervical curvature type. Odds ratio, 95% confidence interval (CI) and p-value were reported.

RESULTS

Table 2 describes the independent variables of the participants. Nearly half of the participants were of age 50-59 years (52%). They were mostly female (58.2%). The majority of participants were involved in farming (27.4%). Tablet/mobile phones as primary work station was the most commonly reported (40%). More than half of the participants (55.08%) had higher level physical activity. Similarly, more than half of them had normal BMI (18.5-24.9 kg/m2), while nearly two-thirds of the participants preferred side-lying position while sleeping (61.8%). Likewise, more than half of them had normal sleeping duration of 7-9 hours (54.6%) whereas a large majority of them used pillow height of <10 cm and >15 cm (69.7%).

Table 2: Socio-demographic characteristics, sleeping position, sleep duration, and pillow height of the participants (N=610)

Characteristics		**Frequency (%)**
Age in years (Mean ± SD)		47.9± 7.8
Gender		
	Male	255 (41.8)
	Female	355 (58.2)
Occupation		
	Do not work	149 (24.4)
	Farming	167 (27.3)
	Office work	65 (10.6)
	Others*	229 (37.5)
Type of work station		
	Manual work (Non desk use)	223 (36.5)

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	Desktop/Laptop/Computer	143 (23.4)
	Tablet/Mobile phones	244 (40)
Activity Level		
	Low activity	48 (7.8)
	Moderate activity	226 (37.05)
	High activity	336 (55.08)
Body Mass Index (BMI)		
	Normal BMI	333 (54.6)
	Abnormal BMI	277 (45.4)
Sleeping position		
	Side lying	377 (61.8)
	Prone or Supine position	233 (38.2)
Sleep Duration		
	Normal sleep duration	331 (54.3)
	Abnormal sleep duration	279 (45.7)
Pillow height		
	Normal pillow height	185 (30.3)
	Abnormal pillow height	425 (69.7)

***Others (Occupation): Cattle-raising, Forestry, Industrial, Mining, Construction, Services, and Pensioned**

Figure 1 below depicts the types of cervical curvature as per Cobb's angle measurement. More than half of the participants had normal cervical curvature (62%).

Figure 1: Type of Cervical curvature as per Cobb's angle measurement

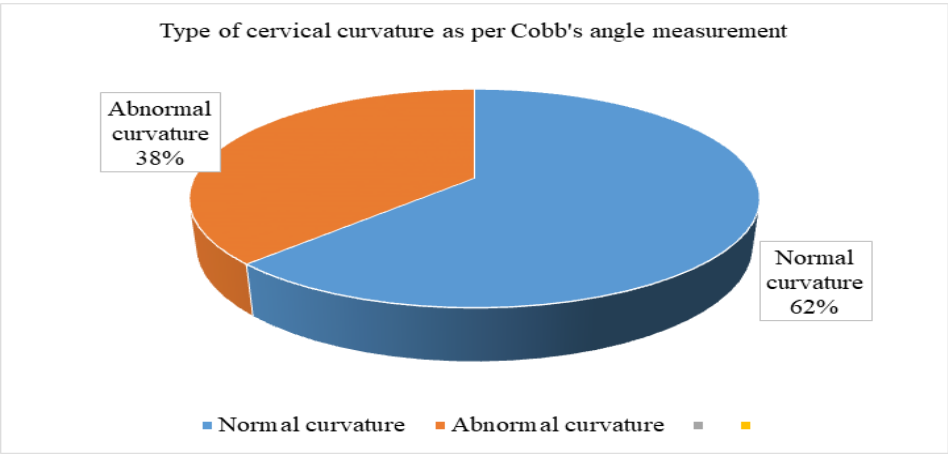

Fig. 1: Types of cervical curvature as per Cobb's angle measurement

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Table 3 below represents the association of socio-demographic characteristics, sleep factors, ergonomics, physical activity and BMI with cervical curvature. In this study, female participants had significantly higher odds of abnormal cervical curvature compared to males (adjusted OR = 2.9, 95% CI: 2.0-4.2, $p < 0.001$), after adjusting for other covariates. Age, occupation, physical activity level, type of workstation, and BMI were not significantly associated with cervical curvature (all $p > 0.05$).

Table 3: Association between socio-demographic characteristics, sleep factors, ergonomics, physical activity and BMI with cervical curvature (N=610)

		Crude OR			**Adjusted OR**		
Variables		**OR**	**95% CI**	**P-value**	**OR**	**95% CI**	**P-value**
Age in years		0.9	0.9, 1.01	0.3	0.9	0.9, 1.003	0.08
Gender							
	Male	Ref.			Ref.		
	Female	2.8	2.002, 4.07	**<0.001**	2.9	2, 4.2	**<0.001**
Occupation							
	Do not work	Ref.			Ref.		
	Farming	0.8	0.5, 1.2	0.3	1.02	0.6, 1.6	0.9
	Office works	0.7	0.4, 1.4	0.3	0.7	0.4, 1.8	0.7
	Others	0.9	0.6, 1.4	0.7	1..04	0.6, 1.7	0.8
Physical activity level							
	Low activity	Ref.			Ref.		
	Moderate activity	1.7	0.8, 3.4	0.1	1.7	0.9, 3.6	0.9
	High activity	1.6	0.8, 3.2	0.2	1.6	0.8, 3.3	0.8
Type of work station							
	None desk work	Ref.			Ref.		
	Desktop/laptop	0.9	0.6, 1.4	0.7	0.9	0.5, 1.6	0.9
	Tablet/Mobile phone	0.8	0.6, 1.3	0.5	0.9	0.6, 1.4	0.8
BMI							
	Normal BMI	Ref.			Ref.		
	Abnormal BMI	0.7	0.5, 1.07	0.1	0.8	0.6, 1.2	0.5

Bold p-values indicate significant at 5% level of significance

Table 4 shows the association between sleep factors: sleeping position, sleep duration and pillow height with cervical curvature. The sleeping position and pillow height were not significantly associated with cervical curvature in both crude and adjusted analysis. However, participants with abnormal sleep duration had slightly higher odds of abnormal curvature compared to those with normal sleep (adjusted OR = 1.4, 95% CI: 0.9-1.9,

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p = 0.05) after adjusting for covariates. This indicated that the sleep duration showed the strongest link to cervical curvature, while sleeping position and pillow height showed no significant effect.

Table 4: Association between sleep factors with cervical curvature (N=610)

		Crude OR			**Adjusted OR**		
Variables		**OR**	**95% CI**	**P-value**	**OR**	**95% CI**	**P-value**
Sleeping position							
	Sidy lying	Ref.			Ref.		
	Prone or Supine	1.2	0.8, 1.6	0.3	1.3	0.9, 1.9	0.1
Sleep duration							
	Normal sleep duration	Ref.			Ref.		
	Abnormal sleep duration	1.4	0.9, 1.9	**0.05**	1.4	0.9. 1.9	**0.05**
Pillow Height							
	Normal pillow height	Ref.			Ref.		
	Abnormal pillow height	0.9	0.6, 1.4	0.9	0.9	0.6, 1.3	0.7

Bold p-values indicate significant at 5% level of significance

Adjusted for Age, Gender, Occupation, Physical activity level, Type of work station and BMI

DISCUSSION

In this hospital-based cross-sectional study, female gender and abnormal sleep duration were the main factors associated with abnormal cervical curvature. Females were nearly three times more likely than males to exhibit straight or kyphotic cervical alignment, highlighting a potential sex-related susceptibility. Similarly, participants with inadequate sleep had higher odds of abnormal curvature, suggesting that sleep duration may play a role in maintaining normal cervical lordosis. Other demographic, lifestyle and ergonomic factors, including age, occupation, physical activity, workstation type, pillow height, and sleeping position, were not significantly associated with cervical curvature. These findings indicate that biological sex and sleep patterns may be key contributors to cervical spine alignment, while other commonly considered factors may have minimal influence.

This finding is parallel with a previous study reporting that cervical alignment and curvature patterns differ between males and females [61]. The study also highlighted that cervical curvature is related to both posture and gender in healthy adults. A more forward head posture was associated with a partly reversed cervical curvature, and gender differences were observed in curvature patterns.

Guo et al. (2018) performed a meta-analysis of asymptomatic adults to assess cervical lordosis using the C2-C7 Cobb angle and posterior tangent methods. They found that about two-thirds of adults had a lordotic cervical curve, with slightly greater angles in males and no significant relationship with age. [62] In a similar approach, our study evaluated cervical curvature on sagittal MR images and classified participants as lordotic, straight, or kyphotic. Despite focusing on young adults, we observed a comparable prevalence of lordosis and no significant associations with age or BMI. While Guo et al. combined data from studies using different measurement methods, our standardized imaging protocol improved internal consistency. Overall, agreement

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between the meta-analysis and our results suggests that cervical curvature patterns in younger populations are relatively stable and not strongly influenced by demographic factors.

Another observational study evaluated the relationship between cervical curvature and neck pain in adults over 45 years using standardized lateral radiographs and the posterior tangent method, classifying alignment as lordotic, straight, or kyphotic [63]. They found no meaningful differences in cervical curvature between individuals with and without neck pain, and no consistent link between sagittal profile and pain severity, suggesting that altered curvature is often incidental. Similarly, our study of adults using categorical measures found no significant associations between abnormal curvature and age, BMI, or neck posture in multivariate analyses. Although Grob et al. focused on an older clinical population and our study included a younger cohort with lifestyle factors such as sleep, both used established radiographic classifications and reached comparable conclusions. Together, these findings support the view that variations in cervical curvature are not reliably explained by pain status or basic demographic factors and may reflect individual anatomical variability and measurement differences.

Similarly, Singh et al. (2025) examined cervical lordosis in adults with chronic neck pain using C2-C7 Cobb and Jackson Physiological Stress angles on lateral radiographs across pain subtypes and demographic groups. They reported no significant associations between cervical lordosis and pain category, age, gender, or BMI, regardless of the measurement method [64]. In parallel, our study, conducted in a broader adult population, classified curvature using Cobb-based categories and similarly found no significant relationships between abnormal curvature and age or BMI. While Singh et al. focused on symptomatic patients, our study additionally considered lifestyle and sleep factors, identifying influences beyond structural alignment. Overall, both studies suggest that cervical alignment is largely independent of demographic characteristics and pain status, and that its clinical relevance is shaped by multiple contributing factors rather than curvature alone.

Gao et al. (2019) explored the association between cervical alignment and disc herniation in young adults with neck pain, classifying sagittal curvature on lateral radiographs as lordotic, straight, or kyphotic and relating these patterns to disc pathology and spinal compression [65]. They reported greater disc herniation severity in individuals with straight or kyphotic alignment, while restoration of lordosis over time was accompanied by reduced herniation and improved disc height. This approach is methodologically comparable to ours in its reliance on radiographic curvature categorization; however, Gao et al. examined a symptomatic clinical cohort with established structural disease, whereas we evaluated lifestyle and sleep factors as potential correlates of curvature.

In contrast to our study, a study by Tang et al. [66] reported increased C2-C7 Cobb angles with age, identifying significant differences in sagittal parameters among age, possibly because our sample primarily represented adults with limited variability in age compared with that broader radiographic dataset that included older age groups. Methodologically, Tang et al. included detailed sagittal balance parameters beyond Cobb angle, whereas our analysis was limited to categorical curvature outcomes derived from Cobb's measurement. Thus, while normative alignment may evolve across the lifespan, age effects may be less detectable in much younger populations like ours.

The pillow height influences neck muscle activity and comfort, highlighting physiological mechanisms by which sleep setup may affect cervical posture [67]. The differential electromyographic patterns across pillow heights suggest that optimal head and neck positioning may reduce muscular strain, although these investigations do not directly link pillow height to long-term radiographic curvature outcomes. The methodology in the pillow study was experimental with small sample sizes assessing muscle activity, while our approach was epidemiologic and focused on curvature categorization, a difference that may explain divergent findings.

A large, national study on self-reported pain outcomes had suggested short and long sleep durations associated with increased prevalence of chronic musculoskeletal pain (SMP) with 7 hours of sleep corresponding to the lowest risk. This result is further highlighted by our study comparing sleep duration with cervical curvature change rather than musculoskeletal pain [68]. Similarly, another cross-sectional study among female nurses in Taiwan also showed short sleep duration (<7 hours) as a major contributor to chronic neck and shoulder

discomfort, accounting for 8.8% neck discomfort cases [69]. While their study relied on self-reported musculoskeletal symptoms and focused on a single occupational group, our study used radiographically measured cervical curvature in a broader young adult population. Despite differences in methodology and outcome measures, both studies support the notion that inadequate sleep may negatively impact cervical spine health and postural integrity, highlighting the importance of sufficient sleep for musculoskeletal well-being.

A recent systematic review highlighted that cervical alignment measured in the sagittal plane varies significantly with body posture**,** with differences ranging from 1° to 16.6° depending on sitting versus standing positions and arm placement [70]. This underscores the notion that radiographic measurements are sensitive to positioning, which could partly explain variability in curvature outcomes across studies. Unlike that review, which focused on methodological variability in postural influence on radiographs, our study assessed categorical cervical curvature (lordotic, straight, kyphotic) in a cross-sectional sample and correlated these outcomes with demographic and sleep-related factors. While posture standardization is essential for precise quantitative comparisons, our inferential approach may be more robust to small positional differences, though it does not capture subtle degrees of curvature.

Furthermore, a cohort study in China claimed a decline in cervical lordosis over an eight-year period, which was conducted among females consistently exhibiting lower curvature and older adults showing reduced lordosis compared to younger participants [71]. This age-related findings contrast to our study as there was no significant association with curvature change in relation to age. However, our findings also identified female sex as a risk factor for abnormal curvature, suggesting that sex-related differences in cervical alignment may exist even in young, asymptomatic populations. Unlike their longitudinal and multi-method assessment using Cobb's, Harrison posterior tangent, and Borden's methods, our study used only Cobb angle measurements in a cross-sectional design. This methodological distinction may limit direct comparison of absolute angles but supports the concept that demographic factors can influence cervical curvature trends. Although these findings have not yet been peer-reviewed, they align with our observation that cervical curvature may differ by sex.

Karabag and Iplikcioglu (2022), study demonstrated that upright cervical alignment can be simulated in the supine position using a pillow [72]. While their study focused on adults undergoing imaging for surgical planning, our study examined cervical alignment in Chinese adults visiting a tertiary care center for MRI, providing normative values for lordosis, straight, and kyphotic curves. Both studies utilized the C2-C7 Cobb angle, but unlike their interventional approach, our study assessed natural cervical curvature without positional modifications. The strong correlations observed by Karabag et al. supports the validity of using imaging to evaluate cervical alignment, which complements our findings on the distribution and classification of cervical curvature. That study highlights clinical applications in surgical settings, whereas our study emphasizes diagnostic and descriptive relevance.

Another study by Morimoto et al. (2019) compared cervical alignment measurements obtained in different positions and focused that cervical alignment values can vary substantially between sitting and standing imaging, emphasizing the influence of body posture on sagittal parameters [73]. In contrast, our study describes the natural distribution and classification of cervical sagittal alignment (lordosis, straight, kyphosis), without positional variation in measurement. While Morimoto et al. focused on methodological differences across postures, emphasizing implications for clinical imaging and interpretation, our findings contribute normative data and prevalence estimates for cervical curvature types.

A major strength of this study lies in the application of MRI-based measurement of Cobb's angle for cervical curvature. The relatively large sample size and use of multivariable logistic regression further enhance internal validity. Nonetheless, the cross-sectional design precludes causal inference, and reliance on self-reported sleep behaviors introduces the possibility of recall and misclassification bias. However, in a hospital-based study, it is more practical to have self-reported sleep behaviors as a routine history taking, which can be incorporated for study purpose. Additionally, hospital-based recruitment may limit generalizability. We planned to assess the magnitude of the cervical curvature related problems within the hospital-based population. We suggest for community focused longitudinal studies including multiple factors that were excluded in our study like sleep quality, occupational posture, psychosocial stress, and prior neck conditions. We believe, further longitudinal studies would provide a more comprehensive understanding of determinants along with valuable insight into

the problem. While the Cobb angle is a fundamental measurement for spinal deformities, its categorization for cervical lordosis involves defining ranges that reflect normal physiological variations, mild deviations, and pathological conditions that necessitate intervention [74-77]. Various studies have reported normative values for cervical lordosis, though these can vary across populations due to differences in age, gender, and measurement techniques [62, 78]. We further suggest mixed method studies- including neck length and having patient's and care provider's perspectives on sleep quality, pillow height factors and sleeping positions' effect on cervical spine could provide clear vision for cervical health promotion.

CONCLUSION

After controlling for demographic, lifestyle, and ergonomic factors, this study shows that cervical curvature changes can be found in gender and independently correlated with sleeping duration, but not with pillow height and sleeping posture. The study expands current symptom-based evidence to objective structural results through the use of MRI-based, categorical Cobb's angle measurement. These results imply that improving sleep duration could be straightforward, adjustable goals for promoting cervical spine health. To establish causality and guide clinical recommendations, more long-term and interventional research is required.

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