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EFFECT OF KYPHOTIC ANGLE ON HAND GRIP STRENGTH AMONG THE STUDENTS OF THE UNIVERSITY OF FAISALABAD

Original Research

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ABSTRACT

Background: Hyper-kyphosis, an exaggerated curvature of the thoracic spine, is increasingly prevalent among university students due to sedentary lifestyles and poor ergonomic habits. This postural deviation can contribute to musculoskeletal imbalances, impaired function, and possibly reduced muscular strength. Evaluating the relationship between hyper-kyphosis and physical performance parameters such as hand grip strength is essential to understand its broader impact on student health and inform preventive strategies.

Objective: The primary objective of this study was to assess the relationship between age and hyper-kyphosis among university students. A secondary aim was to determine whether kyphotic curvature affects hand grip strength and daily physical performance.

Methods: This cross-sectional study included 264 male students aged 18–25 years from The University of Faisalabad, Amin Campus. Participants were selected based on specific inclusion and exclusion criteria. Kyphotic angles were measured using a Flexi curve ruler, with calculations based on the kyphosis index. Hand grip strength (HGS) was assessed using a hydraulic hand dynamometer, with the average of three attempts recorded for analysis. Descriptive statistics, mean comparisons, and Pearson correlation analysis were conducted using IBM SPSS version 27.

Results: A significant positive correlation was observed between age and kyphotic angle ($r = 0.952$, $p < 0.001$). Mean kyphotic angle increased from $43.06° \pm 0.55$ in the 18–19 age group to $52.34° \pm 1.40$ in the 24–25 age group. Similarly, students in senior semesters exhibited higher kyphotic angles ($49.52° \pm 3.63$) compared to junior semesters ($45.14° \pm 2.86$). However, the correlation between hyper-kyphotic angle and hand grip strength was weak and statistically insignificant ($r = 0.092$, $p = 0.136$).

Conclusion: This study concluded that kyphotic curvature significantly increases with age among students, yet does not show a meaningful impact on hand grip strength. Early postural assessment is essential to mitigate potential long-term musculoskeletal dysfunction.

Keywords: Age Factors, Grip Strength, Kyphosis, Musculoskeletal Health, Posture, Sedentary Lifestyle, Spine Curvatures.

POSTURAL KYPHOSIS AND GRIP STRENGTH IN STUDENTS

BACKGROUND

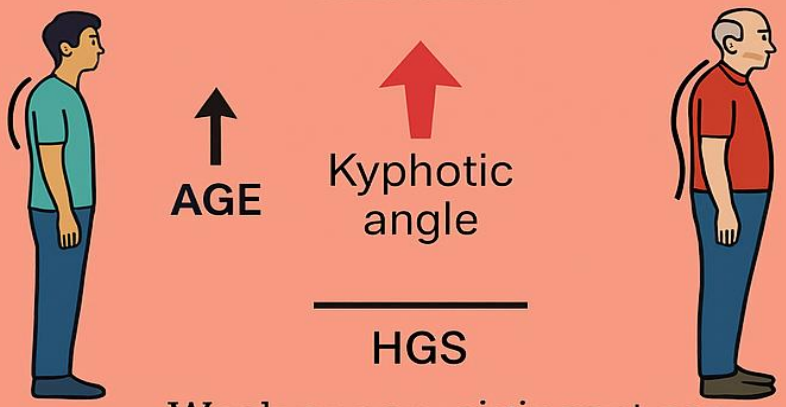
Hyper-kyphosis is an exaggerated forward curvature of the thoracic spine. Its relationship with hand grip strength in university students is not well understood.

METHODS

- 264 male students aged 18–25 years
- Kyphotic angle measured using a flexicurve ruler
- Hand grip strength (HGS) assessed using a dynamometer

Flexicurve ruler

RESULTS



Weak or non-sigincant cor.

CONCLUSION

Kyphotic curvature was positively associated with age, but not with hand grip strength.

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INTRODUCTION

Posture plays a fundamental role in maintaining balance, ensuring stability, and minimizing energy expenditure and structural stress during both static and dynamic activities. It is commonly described as the proper alignment of body segments—particularly the spine—in a manner that facilitates efficient movement while reducing the risk of injury (1). According to the American Academy of Orthopedic Surgeons, posture reflects the organized arrangement of skeletal components and muscular coordination, where ideal alignment promotes musculoskeletal harmony during routine tasks such as lifting and ambulating (1). Disruptions in this alignment, such as kyphotic posture, can result in discomfort within the lumbopelvic region, impaired spinal extensor function, and muscle activation anomalies due to altered scapular mechanics (2). The human postural control system is highly reliant on input from the vestibular and somatosensory systems, which work to reduce body sway and support muscular efficiency during static postures and movement (3). This coordination allows the neuromusculoskeletal system to operate mechanically efficiently, limiting fatigue and preserving organ function. However, prolonged misalignment, such as forward head posture—often associated with excessive screen time—leads to musculoskeletal imbalance, shortened muscles, and progressive structural deviation (4). Disorders like kyphosis, which involve an excessive curvature of the thoracic spine, may develop due to congenital, traumatic, or degenerative causes, often resulting in restricted mobility and heightened risk of falls as the condition progresses (5). In more severe instances, kyphosis can involve chronic discomfort in posterior chain muscles and even mimic cardiopulmonary conditions, as seen in straight back syndrome (6).

Persistent postural deviations contribute to muscle length alterations and functional decline, with muscle weakness both a cause and consequence of poor posture (7). Among specific populations, university students are particularly susceptible to posture-related complications due to extended sedentary behavior and reduced physical activity, which foster muscular imbalances and diminished fitness levels (8). In this context, hand grip strength (HGS) has emerged as a critical measure of overall musculoskeletal integrity, offering insights into both posture and general physical performance (9). HGS is influenced by factors such as age, sex, body size, and activity level, and is commonly assessed using hand dynamometers for clinical accuracy. Furthermore, it has established links to functional health markers, including sarcopenia and rehabilitation outcomes in hospitalized patients (9). The role of HGS extends beyond clinical assessment into functional and athletic performance. Individuals engaged in labor-intensive work typically demonstrate greater grip strength than sedentary workers, and right-handed individuals generally exhibit superior grip compared to their left-handed counterparts (10). Spinal pathologies—especially those involving the cervical discs at C5-C6 and C6-C7—can adversely affect grip by compromising neural pathways responsible for fine motor control (11). Collectively, posture and grip strength reflect a person's overall physical function and health status, underscoring the need to better understand their interconnected roles across clinical and non-clinical populations (12). Given this background, the present study aims to investigate the relationship between postural alignment and hand grip strength among university students. By identifying the association between these variables, this study seeks to inform early interventions and preventive strategies for maintaining optimal musculoskeletal health and function in sedentary young adults.

METHODS

A quantitative, observational cross-sectional study was conducted from April 12, 2024, to June 12, 2024, to evaluate the effect of kyphotic angle on hand grip strength among male university students. The study was carried out at The University of Faisalabad, Amin Campus, Faisalabad. The sample size of 264 participants was determined using Raosoft software with a 90% confidence interval (13). Only male students aged 18 to 25 years diagnosed with hyperkyphosis were included in the study population (14). Exclusion criteria comprised individuals with spinal disorders or systemic conditions likely to influence posture or muscular performance. Specifically, students with a history or diagnosis of lordosis, scoliosis, spinal trauma or surgery, neuromuscular diseases, cervical spondylosis, thoracic trauma, respiratory diseases, or females were excluded from the study to ensure homogeneity in sampling and reduce confounding variables. Before participation, written informed consent was obtained from each subject after a comprehensive explanation of the study protocol, benefits, and privacy policies. The consent clearly stated that the data would be utilized exclusively for research purposes, and confidentiality would be maintained throughout the study. Ethical approval and permission to conduct the study were obtained from the University of Faisalabad and the Head of the Department of Physical Therapy, following the principles outlined in the revised APTA Code of Ethics for Physical Therapists, adherence to ethical norms was maintained throughout the study process.

Data collection involved the use of two standardized tools: a hand dynamometer and a flexi curve ruler. The hand grip strength (HGS) was assessed using a hydraulic hand dynamometer, a reliable instrument for measuring isometric grip force (15). Each participant was instructed to exert maximum voluntary grip effort while seated, with the arm at right angles and the elbow beside the body. Measurements

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were recorded in kilograms, and the average of three trials was considered for final analysis. The kyphotic angle was measured using the Flexi curve ruler, a plastic-coated flexible metal strip designed to conform to the natural curvature of the spine. The ruler was positioned along the thoracic region of the spine and gently molded to replicate the curvature of each participant's back. The shape was then traced onto paper, allowing calculation of kyphotic index (E/L) and kyphotic angle (θ) based on geometric analysis involving perpendicular lines to fixed spinal points (16). All data were entered and analyzed using IBM SPSS version 27. Descriptive statistics were computed for demographic variables. The relationship between kyphotic angle and hand grip strength was assessed using appropriate statistical tests after checking data normality. A significance level ($p<0.05$) was considered statistically meaningful.

RESULTS

The analysis included 264 male university students with a mean age of 21.53 ± 2.37 years. The mean height was 162.39 ± 3.50 cm, mean weight was 60.95 ± 5.26 kg, and BMI averaged 23.16 ± 2.39 kg/m². The average academic semester was 5.49 ± 1.64. The mean hyper-kyphotic angle measured 47.22 ± 3.92°, and the mean hand grip strength was 35.99 ± 2.35 kg. The range for kyphotic angle extended from 41.0° to 58.0°, while hand grip strength ranged from 32.1 kg to 56.7 kg. When analyzed by academic level, junior semester students (n=139) exhibited a mean kyphotic angle of 45.14 ± 2.87°, whereas senior semester students (n=125) had a significantly higher mean angle of 49.53 ± 3.64°, indicating a progressive increase in spinal curvature with academic progression. The overall trend suggested increased hyper-kyphosis in students with more prolonged university exposure. Further breakdown by age groups revealed a clear trend: participants aged 18–19 years had a mean kyphotic angle of 43.06 ± 0.55°, those aged 20–23 years showed a higher mean of 46.35 ± 2.22°, and students aged 24–25 years recorded the highest mean angle of 52.35 ± 1.40°. This demonstrated a consistent age-related increase in thoracic spinal curvature. Correlation analysis between age and kyphotic angle revealed a strong positive relationship ($r = 0.952$, $p < 0.001$), indicating that advancing age was significantly associated with a higher degree of hyper-kyphosis. Conversely, the correlation between hyper-kyphotic angle and hand grip strength was weak and statistically non-significant ($r = 0.092$, $p = 0.136$), suggesting no meaningful association between spinal curvature severity and hand grip performance within this sample.

Table 1: Mean, Standard Deviation Minimum, Maximum and Percentage of Age, Height, Weight, BMI, Semester, Hyper Kyphotic Angle and Hand Grip

		Age	Height	Weight	BMI	Semester	Hyper-Kyphotic Angle	Hand Grip
Valid		264	264	264	264	264	264	264
Mean		21.527	162.39 cm	60.95 kg	23.1637	5.4886	47.218	35.993
Std. Deviation		2.3676	3.502	5.260	2.38855	1.64070	3.9184	2.3514
Minimum		18.0	150	50	18.21	3.00	41.0	32.1
Maximum		25.0	169	70	27.77	8.00	58.0	56.7
Percent-iles	100	25.000	169.00	70.00	27.7671	8.0000	58.000	56.700

Table 2: Comparison of Semester Type and Hyper-Kyphotic Angle:

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
Hyper-Kyphotic Angle * Semester Type	264	100.0%	0	0.0%	264	100.0%

Hyper-Kyphotic Angle						
Semester Type	Mean	N	Std. Deviation	Median	Minimum	Maximum
Junior Semesters	45.143	139	2.8680	44.500	41.0	55.0
Seniors Semesters	49.525	125	3.6361	51.000	43.0	58.0
Total	47.218	264	3.9184	45.900	41.0	58.0

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Table 3: Comparison of Age and Hyperkyphotic Angle

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
HyperKhyphotic Angle * Age Groups	262	99.2%	2	0.8%	264	100.0%

Hyper-Kyphotic Angle						
Age Groups	Mean	N	Std. Deviation	Median	Minimum	Maximum
18-19 years	43.063	70	.5543	43.000	41.0	44.0
20-23 years	46.351	117	2.2247	45.800	44.5	52.0
24-25 years	52.347	75	1.4000	52.000	51.0	58.0
Total	47.189	262	3.9194	45.900	41.0	58.0

Table 4: Correlation of Age and Hyper-Kyphotic Angle

Descriptive Statistics			
	Mean	Std. Deviation	N
Age	21.527	2.3676	264
Hyper-Kyphotic Angle	47.218	3.9184	264

Correlations			
		Age	Hyper-Kyphotic Angle
Age	Pearson Correlation	1	.952**
	Sig. (2-tailed)		.000
	N	264	264
Hyper-Kyphotic Angle	Pearson Correlation	.952**	1
	Sig. (2-tailed)	.000	
	N	264	264

Table 5: Correlation of Hyper-Kyphotic Angle and Hand Grip Strength

Descriptive Statistics			
	Mean	Std. Deviation	N
Hyper-Kyphotic Angle	47.218	3.9184	264
Hand Grip	35.993	2.3514	264

Correlations			
		Hyper-Kyphotic Angle	Hand Grip
Hyper-Kyphotic Angle	Pearson Correlation	1	.092
	Sig. (2-tailed)		.136
	N	264	264
Hand Grip	Pearson Correlation	.092	1
	Sig. (2-tailed)	.136	
	N	264	264

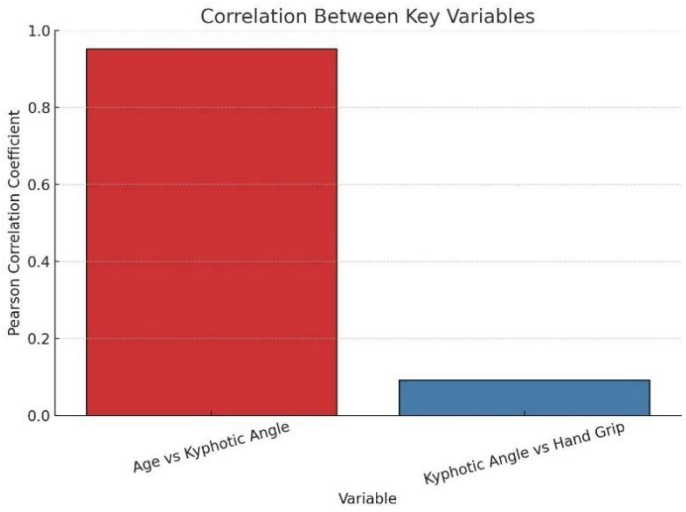

Figure 1 Correlation Between Key Variables

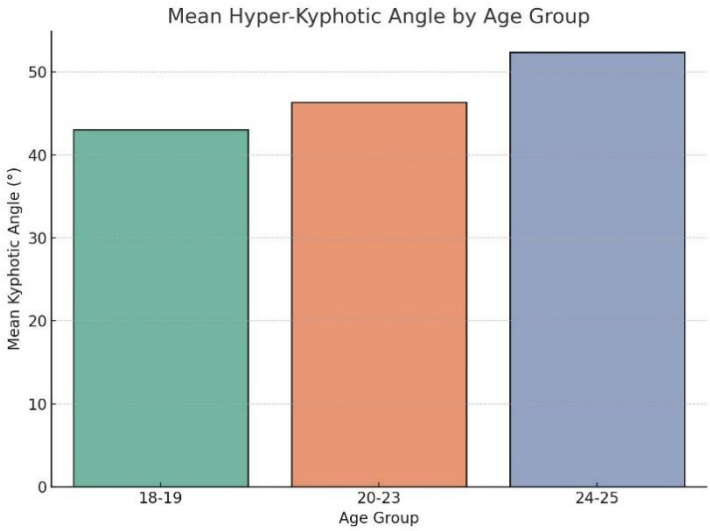

Figure 2 Mean Hyper-Kyphotic Angle by Age Group

DISCUSSION

The findings of this study align with and contribute to the existing literature emphasizing the musculoskeletal implications of postural deviations, particularly hyper-kyphosis, on upper limb strength. The observed trend of increasing kyphotic curvature with age among university students reinforces concerns over the cumulative effects of sedentary behavior and postural neglect in academic environments. Although the correlation between age and hyper-kyphotic angle was strong and statistically significant, the weak and non-significant association between kyphotic angle and hand grip strength suggests that the biomechanical impact of kyphosis may not directly impair grip strength in asymptomatic young males. Previous research supports the notion that postural abnormalities, especially kyphosis, can compromise muscular performance. A 2019 study reported reduced grip and pinch strength in females with hyper-kyphotic posture, echoing the broader understanding that spinal misalignment influences upper body strength (17). Similarly, findings from a study involving young males aged 20 to 22 highlighted the influence of anthropometric variables—such as height, wrist circumference, BMI, and body weight—on grip strength, and recommended the standardization of posture during strength assessments to avoid skewed measurements (18). These comparisons underscore the multifactorial nature of grip strength and the need for controlled assessment conditions. In contrast, another investigation demonstrated that the degree of kyphosis did not predict future athletic performance in healthy individuals, indicating that spinal curvature may not always translate to functional impairment (19). This highlights a critical distinction between anatomical deviations and actual performance capacity, which is especially relevant in young, physically able populations. Furthermore, evidence from a 2020 study on thoracic kyphosis showed that targeted upper body strength training not only improved grip strength but also enhanced gait parameters, suggesting that physical training can mitigate functional deficits associated with kyphosis (20). However, another study reported no significant correlation between hand grip strength and cranio-vertebral angle or forward head posture, indicating that not all postural variations exert measurable influence on muscular strength, particularly in asymptomatic individuals (21).

This study strengthens the understanding that while hyper-kyphosis correlates with age and academic progression, its impact on hand grip strength may be limited or influenced by confounding variables not directly accounted for in this sample. The strength of the study lies in its focused design, objective measurement tools, and a relatively large, homogenous sample of male students. The use of validated tools such as the hand dynamometer and Flexi curve ruler enhanced data accuracy and clinical relevance. However, several limitations must be acknowledged. The cross-sectional design limits causal inference, and the exclusion of female participants restricts generalizability. Additionally, potential confounders such as physical activity levels, nutritional status, or ergonomic practices were not controlled for, which could have influenced the results. Future research should aim to explore the relationship between posture and muscular strength in more diverse populations, including females and individuals from varying occupational and physical activity backgrounds. Longitudinal studies could better establish causality between postural changes and strength alterations over time.

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Moreover, assessing the effectiveness of postural correction programs or strength training interventions on both kyphotic curvature and hand grip strength may provide valuable insight into preventive and rehabilitative strategies. In conclusion, this study highlights the significant age-related progression of hyper-kyphosis among young males and provides cautious evidence regarding its association with grip strength. While posture is undoubtedly an important determinant of musculoskeletal health, its direct impact on grip strength in this demographic remains inconclusive, warranting further investigation through more nuanced and comprehensive research designs.

CONCLUSION

In conclusion, this study underscored the intricate relationship between hyper-kyphotic posture and musculoskeletal function, particularly highlighting how postural deviations may influence hand grip strength and overall physical performance. While the association between kyphotic angle and grip strength was not statistically significant, the progressive increase in kyphotic curvature with age and academic level emphasized the need for early identification and intervention. The findings advocate for individualized postural assessments in young adults to address emerging musculoskeletal imbalances before they compromise functionality. This research contributes meaningful insight into the preventative strategies and clinical considerations necessary for maintaining physical health in populations vulnerable to postural decline.

AUTHOR CONTRIBUTION

Author	Contribution
Muhammad Muneeb Jafar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Faizan Ahmed	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Jyesha Mustafa	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Maryam Farooq	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Kibsha Ghulam Hussain	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Rehman Akhter	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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