

ABSTRACT

Background: The postural consequences of habitual backpack use by Indian university students, especially in allied health sciences, are not well characterized. Existing literature indicates that loads over 10% of body weight, unilateral single-strap carrying, and prolonged daily use lead to shoulder and thoracic postural deviations. However, the applicability of these findings to an Indian university cohort has yet to be objectively assessed through multi-parameter evaluation.

Methods: An observational, cross-sectional study involving 100 healthy undergraduate students at Brainware University, Barasat, West Bengal, assessed thoracic kyphosis angle using a gravity-based inclinometer and evaluated forward shoulder posture and shoulder height asymmetry through photographic analysis. Variables measured included backpack weight (as a percentage of body weight), carrying style (single vs. double strap), and daily usage duration. Statistical analyses, including Pearson correlations, independent-samples t-tests, one-way ANOVA, and hierarchical multiple regression, were performed using SPSS v26.0 ($\alpha = 0.05$).

Results: A mean kyphosis angle of $22.52^\circ \pm 10.18^\circ$, with 5% of participants classified as hyper-kyphotic. The average backpack load was $7.69\% \pm 3.78\%$ of body weight (BW), where 21% of students exceeded the 10% BW threshold. Overloaded students showed increased kyphosis angles ($26.43^\circ \pm 10.45^\circ$ vs $21.46^\circ \pm 9.91^\circ$; $p = 0.047$) and greater forward shoulder displacement (5.82 ± 1.08 cm vs 4.48 ± 1.03 cm; $p < 0.001$). Single-strap users exhibited more shoulder asymmetry (0.535 ± 0.315 cm) compared to double-strap users (0.295 ± 0.283 cm; $p < 0.001$). Significant correlations were found between backpack load and kyphosis angle ($r = 0.251$; $p = 0.012$) as well as forward shoulder displacement ($r = 0.359$; $p < 0.001$). Daily carrying duration did not predict postural outcomes ($p = 0.826$). Multiple regression highlighted backpack load ($\beta = 0.31$; $p = 0.005$) and carrying style ($\beta = 0.28$; $p = 0.001$) as independent predictors of kyphosis angle (adjusted $R^2 = 0.18$; $p < 0.001$).

Conclusion: Backpack loads over 10% of body weight and unilateral carrying are linked to postural deviations in Indian university students. This highlights the need for ergonomic counselling and postural education in health services, with a call for future research on intervention programmes.

Keywords: *Backpack load; Thoracic kyphosis; Shoulder posture; Photographic postural analysis; Inclinometer; University students; Forward shoulder posture; Ergonomics*

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