



ORIGINAL RESEARCH PAPER

Community Physiotherapy

DEVELOPMENT OF RAPID POSTURE ASSESSMENT TOOL (RPAT) FOR PRIMARY GRADE STUDENTS

KEY WORDS: Posture Assessment, Primary School Children, Face Validity, Ergonomics

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ABSTRACT

Background: Primary-school children sit for long periods in class, and growth, prolonged sitting and child-furniture mismatch may contribute to faulty posture. A simple observational tool could support early school-based screening. **Aim:** To develop the Rapid Posture Assessment Tool (RPAT) and establish its face validity for sitting posture in primary-grade students. **Methodology:** A descriptive, cross-sectional study in two phases. In Phase I, a 10-component observational tool was developed from biomechanical and ergonomic principles, each component scoring 1 (ideal) or 0 (faulty). In Phase II, four experts rated clarity and comprehension on a 4-point scale, and item-level and scale-level face validity indices (I-FVI, S-FVI/Ave) were calculated. **Result:** I-FVI ranged from 0.50 to 1.00; S-FVI/Ave was 0.80 (80%) for both clarity and comprehension. **Conclusion:** RPAT is a structured, visually observable screening tool with initial face validity; reliability and other forms of validity remain to be established.

INTRODUCTION

Primary-grade children spend much of the school day sitting to read and write, during a period of rapid musculoskeletal growth.^{1,2} Back, neck and spinal pain are common among school children, including in India,³⁻⁹ and mismatch between desk-chair dimensions and children's anthropometry may increase neck and trunk flexion during schoolwork.¹⁰⁻¹³ Sitting also alters spinal curvature.^{14,15} Existing posture assessments often need trained personnel, instruments or considerable time, limiting routine school screening where physiotherapists and equipment are scarce.

Need: If undetected, faulty sitting habits may progress to persistent musculoskeletal problems. A rapid, inexpensive and easy-to-use tool designed for primary-school children is therefore needed so that teachers, physiotherapists and school-health programmes can identify faulty sitting posture and modifiable ergonomic factors early. Early identification can guide posture education, ergonomic modification and preventive physiotherapy in schools.

Aim: To develop and validate the Rapid Posture Assessment Tool (RPAT) for primary-grade students.

Objectives: (1) To design and develop a rapid assessment tool for postural deviations in the sitting position in primary-grade students, and (2) to establish the validity of the tool using the Face Validity Index (FVI).

Methodology

A descriptive, cross-sectional instrument-development study, in two phases (tool development and expert face validation), was carried out after approval from the Institutional Ethics Committee of TMV's Lokmanya Tilak College of Physiotherapy, Kharghar, Navi Mumbai.

The tool is intended for primary elementary school settings.

In Phase I, RPAT was designed as a rapid observational screen for sitting and writing posture. Components were selected on biomechanical, kinesiological and ergonomic principles and were chosen to be observable during routine classroom sitting, with standard illustrations of correct ergonomic sitting posture used as references. The tool has 10 components: neck, back, hip, shoulder, elbow, knee, foot, eye level, desk-chair distance and desk/table height (Figure 1). Each is a side-view line drawing of a seated child, with the ideal posture drawn in yellow, deviations marked by red dotted lines and 90° angles indicated at the hip and knee. Each component is scored 1 for ideal posture and 0 for faulty posture, giving a total of 0-10,

where a higher score indicates better postural alignment. The tool is applied during natural classroom seating.

In Phase II, a panel of 5-7 experts was planned. Ergonomists and musculoskeletal and community physiotherapists with about 10-12 years' experience were included, and those who did not cooperate or consent were excluded; four expert raters took part. Each expert received a request letter describing the study, the RPAT and a face-validity rating form, and gave consent. Experts reviewed each posture illustration and its description independently and rated every component for clarity and comprehension on a 4-point scale (1 = not clear/comprehensible, 2 = somewhat, 3 = clear/comprehensible, 4 = very clear/comprehensible). Remarks were recorded ("N/A" if none). Ratings of 3 or 4 were scored as agreement and ratings of 1 or 2 as non-agreement. The item-level FVI (I-FVI) was the number of raters giving 3 or 4 divided by the total number of raters, and the scale-level FVI by the average method (S-FVI/Ave) was the mean I-FVI across components.¹⁶ A value of 0.80 or above was acceptable (some authors use 0.83), and 80-90% indicated substantial agreement. Expert feedback was reviewed during finalisation of the tool.

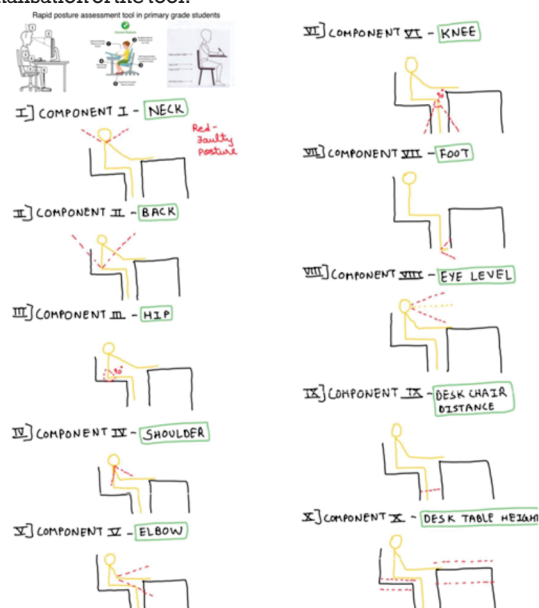


Figure 1. Rapid Posture Assessment Tool (RPAT): Ten Components of Sitting Posture (Faulty Posture in Red).

RESULTS

Four experts rated the 10 components. I-FVI ranged from 0.50 to 1.00 for both clarity and comprehension (Table 1). Back, elbow, eye level and desk/table height (components 2, 5, 8, 10) reached 1.00; neck, hip, foot and desk–chair distance (1, 3, 7, 9) reached 0.75; and shoulder and knee (4, 6) reached 0.50. S-FVI/Ave was 0.80 (80%) for clarity and for comprehension, indicating substantial agreement.

Table 1. Face Validity Indices of RPAT

Component	Clarity I-FVI	Comprehension I-FVI
1 Neck	0.75	0.75
2 Back	1.00	1.00
3 Hip	0.75	0.75
4 Shoulder	0.50	0.50
5 Elbow	1.00	1.00
6 Knee	0.50	0.50
7 Foot	0.75	0.75
8 Eye level	1.00	1.00
9 Desk–chair distance	0.75	0.75
10 Desk/table height	1.00	1.00
S-FVI/Ave	0.80	0.80

DISCUSSION

RPAT treats sitting as a whole-body process: the head, shoulders and arms interact with the desk and visual target, the trunk is influenced by the pelvis, the lower limbs form the base of support, and furniture affects several relationships at once.^{10–12,17} Neck and shoulder were considered together as the upper quarter works as one unit. Forward head position raises the gravitational flexion moment, so the cervical extensors (splenius capitis, semispinalis capitis, upper trapezius, suboccipitals) work harder, while altered shoulder position loads the upper trapezius, levator scapulae, rhomboids and serratus anterior. A high desk encourages shoulder elevation and a low desk trunk flexion and protraction; unsuitable furniture has been linked to prolonged neck and trunk flexion.^{12,17}

The elbow, eye level and desk/table height components reflect how desk height and visual orientation shape upper-limb and cervical posture. An appropriate desk height supports the elbows and forearms without shoulder elevation, reducing demand on the deltoid, biceps, triceps, forearm muscles and scapular stabilisers, whereas a low desk or low visual target promotes trunk and neck flexion; furniture–anthropometry mismatch is widely reported.^{18,19} The back component represents trunk alignment and lumbar curve: erector spinae, multifidus, transversospinalis and abdominals resist the gravitational flexion moment, and slouching-increases thoracic flexion, reduces lumbar lordosis and alters spinal loading.¹⁴ Thoracic kyphosis rises and lordosis falls during desk work.¹⁸

The hip component addresses the pelvis, the base of the trunk. Posterior pelvic rotation reduces lordosis and increases trunk flexion, whereas anterior rotation may increase lordosis; gluteus maximus, iliopsoas, hamstrings, rectus femoris and the hip abductors and adductors control the pelvis while body weight is met by chair reaction forces. At the knee and foot, the quadriceps, hamstrings, gastrocnemius and soleus position the lower limb and floor contact gives a ground reaction force that stabilises the pelvis and trunk; dangling feet provoke pelvic or trunk compensation, and foot support influences seated trunk and pelvic angles in children.²⁰ Adequate desk–chair distance lets the child position the chair comfortably, whereas too little causes sliding forward, pushing the chair back or trunk flexion; seat–desk mismatch has been linked to back pain.²¹

The S-FVI/Ave of 0.80 meets the minimum acceptable criterion but is below the stricter 0.83 used by some authors. Shoulder and knee had the lowest agreement, possibly because shoulder asymmetry and knee angle are subtle

visually; their illustrations need refinement. By identifying faulty sitting patterns and modifiable ergonomic factors, RPAT may guide posture education and ergonomic advice,^{22–24} but cannot replace clinical assessment.

In conclusion, RPAT is a simple, structured, visually observable screening tool for sitting posture in primary-grade students, with an S-FVI/Ave of 80% indicating initial face validity. Limitations are the small panel (four raters), face validity only, subjective observational scoring with lower precision than photographic or three-dimensional analysis, sitting posture only, and posture variation with age, growth, anthropometry, fatigue and furniture. Future studies should establish inter-rater and intra-rater reliability²⁵ and criterion validity, test larger, more diverse samples and age groups, relate scores to furniture, sitting duration and musculoskeletal discomfort, develop a digital version, and use longitudinal designs to assess whether early intervention reduces later problems.

REFERENCES

- Lafond D, Descarreaux M, Normand MC, et al. Postural development in school children: a cross-sectional study. *Chiropr Osteopat*. 2007;15:1.
- Syazwan A, Azhar MM, Anita A, et al. Poor sitting posture and a heavy schoolbag as contributors to musculoskeletal pain in children: an ergonomic school education intervention program. *J Pain Res*. 2011;4:287-96.
- Iyer SR. An ergonomic study of chronic musculoskeletal pain in school-children. *Indian J Pediatr*. 2001;68(10):937-41.
- Jones CT, Macfarlane GJ. Epidemiology of low back pain in children and adolescents. *Arch Dis Child*. 2005;90(3):312-6.
- Noll M, Candotti CT, Rosa BN, et al. Back pain prevalence and associated factors in children and adolescents: an epidemiological population study. *Rev Saude Publica*. 2016;50:31.
- Ben Ayed H, Yaich S, Trigui M, et al. Prevalence, risk factors and outcomes of neck, shoulders and low-back pain in secondary-school children. *J Res HealthSci*. 2019;19(1):e00440.
- Choudhary Y, Bhatia P, Kumar M, et al. Prevalence and determinants of musculoskeletal pain among school-going children carrying schoolbags: a cross-sectional study from Central India. *J Family Med Prim Care*. 2022;11(6):3045-50.
- Atia DT, Elsayed NI, Abdelmonem AF, et al. Prevalence of musculoskeletal disorders among general and technical secondary school students in Egypt. *Int J Environ Res Public Health*. 2023;20(2):1465.
- Fazaa A, Cherif I, Miladi S, et al. Prevalence of spine pain among Tunisian children and adolescents and related factors. *Pediatr Rheumatol Online J*. 2024;22(1):84.
- Panagiotopoulou G, Christoulas K, Papanikolaou A, et al. Classroom furniture dimensions and anthropometric measures in primary school. *Appl Ergon*. 2004;35(2):121-8.
- Gouvali MK, Boudolos K. Match between school furniture dimensions and children's anthropometry. *Appl Ergon*. 2008;37(6):765-73.
- Saarni L, Nygård CH, Kaukianen A, et al. Are the desks and chairs at school appropriate? *Ergonomics*. 2007;50(10):1561-70.
- Podrekar Loredan N, Kastelic K, Burnard MD, et al. Ergonomic evaluation of school furniture in Slovenia: from primary school to university. *Work*. 2022;73(1):229-45.
- Drazil-Grabiec J, Snela S, Rykala J, et al. Effects of the sitting position on the body posture of children aged 11 to 13 years. *Work*. 2015;51(4):855-62.
- Li C, Zhao Y, Yu Z, et al. Sagittal imbalance of the spine is associated with poor sitting posture among primary and secondary school students in China: a cross-sectional study. *BMC Musculoskelet Disord*. 2022;23(1):98.
- Yusoff MSB. ABC of response process validation and face validity index calculation. *Educ Med J*. 2019;11(3):55-61.
- Marschall M, Harrington AC, Steele JR. Effect of work station design on sitting posture in young children. *Ergonomics*. 1995;38(9):1932-40.
- Satr B, Erdogan FC. Comparison of classroom furniture to anthropometric measures of Turkish middle school students. *Work*. 2021;70(2):493-508.
- Fidelis OP, Ogunlade B. Anthropometric perspective to classroom furniture ergonomics and the need for standards in Nigerian schools. *Work*. 2022;72(1):279-89.
- Radika S, Zayac J, Goldberg K, et al. Reliability and comparison of trunk and pelvis angles, arm distance and center of pressure in the seated functional reach test with and without foot support in children. *Gait Posture*. 2017;53:86-91.
- Assiri A, Mahfouz AA, Awadalla NJ, et al. Classroom furniture mismatch and back pain among adolescent school-children in Abha City, Southwestern Saudi Arabia. *Int J Environ Res Public Health*. 2019;16(8):1395.
- Geldhof E, Cardon G, De Bourdeaudhuij I, et al. Effects of back posture education on elementary schoolchildren's back function. *Eur Spine J*. 2007;16(6):829-39.
- Garcia-Moreno JM, Calvo-Muñoz I, Gómez-Conesa A, et al. Effectiveness of physiotherapy interventions for back care and the prevention of non-specific low back pain in children and adolescents: a systematic review and meta-analysis. *BMC Musculoskelet Disord*. 2022;23:314.
- Partido BB, Henderson R, Lally M. Impact of a seated-standing protocol on postures and pain among undergraduate dental hygiene students: a pilot study. *J Dent Hyg*. 2021;95(4):70-8.
- McEvoy MP, Grimmer K. Reliability of upright posture measurements in primary school children. *BMC Musculoskelet Disord*. 2005;6:35