COMPARISON OF RAPID UPPER LIMB ASSESSMENT AND NECK DISABILITY INDEX IN ERGONOMIC RISK SCREENING FOR TEXT NECK SYNDROME AMONG ADOLESCENTS IN GUJARAT

Dr. Nausheen Saiyad[1*], Dr. Mohammad Sohel Quadri[2], Dr. Manisha Rathi[3], Dr. Tanuja Pandya[4], Dr.Pratik A Gohil[5]

[1*]Final Year MPT Student, India
[2]Professor, Venus Institute of Physiotherapy, India
[3]Principal and Professor, Venus institute of Physiotherapy, India
[4]Associate Professor, Venus Institute of Physiotherapy, India
[5]Associate Professor, Vidhyadeep Institute of Physiotherapy, India

.**Corresponding Author:** nausheensaiyad159@gmail.com

ABSTRACT

Background: Text Neck Syndrome (TNS) is an emerging musculoskeletal condition associated with sustained forward head posture during smartphone use. Adolescents, due to high digital dependency, are at particular risk of cervical dysfunction. While the Rapid Upper Limb Assessment (RULA) objectively evaluates ergonomic posture, the Neck Disability Index (NDI) quantifies self-perceived disability. Their combined utility in adolescent populations remains underexplored.
b To compare outcomes of RULA and NDI in assessing ergonomic risk and functional disability related to TNS among adolescents in Gujarat, India.

Methods: A cross-sectional analytical study was conducted among 97 undergraduate students (aged 18–25 years) with ≥2 hours/day smartphone use for at least six months. RULA scores were obtained from posture recordings during texting, while participants completed the NDI questionnaire in English or Gujarati. Descriptive statistics summarized demographic and outcome variables. Pearson's correlation coefficient determined the relationship between RULA and NDI scores, with significance set at $p < 0.05$.

Results: Participants (mean age 20.4 ± 1.8 years; 43.3% male, 56.7% female) reported average smartphone use of 4.8 ± 1.2 hours/day. Mean RULA score was 4.2 ± 1.0, placing most (59.8%) in the medium-risk category. Mean NDI score was 12.6 ± 4.9, indicating mild disability for the majority (66.0%). Pearson's correlation revealed a weak, non-significant positive association between RULA and NDI scores ($r = 0.21$, $p = 0.06$).

Conclusion: Adolescents demonstrated medium ergonomic risk and mild neck disability, with weak correlation between RULA and NDI. These findings suggest the tools measure distinct domains. Incorporating both objective and subjective assessments may improve screening and guide early ergonomic interventions for TNS prevention.

Keywords: Text Neck Syndrome; Adolescents; Smartphone Use; Rapid Upper Limb Assessment; Neck Disability Index; Ergonomic Risk Assessment

INTRODUCTION

Text Neck Syndrome (TNS) is an emerging musculoskeletal condition resulting from sustained forward head posture, typically associated with prolonged use of smartphones, tablets, and other handheld devices. The repetitive nature of this posture leads to increased loading on the cervical spine, muscle fatigue, and potential long-term degenerative changes [1,2]. The issue is particularly concerning in adolescents and young adults, who represent a population with high digital device dependency for education, communication, and leisure activities [3].

Globally, smartphone usage has risen dramatically, with an estimated 3.2 billion users in 2019, and India ranking among the top countries in user numbers [4]. Adolescents often spend 5–7 hours daily in neck-flexed positions while using devices, substantially increasing the biomechanical stress on cervical structures [5]. Hansraj [6] demonstrated that forward head posture can increase effective head weight from 4.5–5.5 kg in neutral alignment to as much as 27 kg at 60° flexion, predisposing to neck pain, stiffness, and reduced functional capacity.

The Rapid Upper Limb Assessment (RULA) is a validated observational tool developed to assess postural risk factors for musculoskeletal disorders, focusing on upper limb, neck, trunk, and leg positioning [7]. The Neck Disability Index (NDI) is a widely used self-reported questionnaire that quantifies neck-related functional disability across activities such as lifting, reading, driving, and sleeping [8]. While RULA captures objective ergonomic risk, NDI reflects subjective perception of disability. However, the relationship between these two measures in adolescent populations remains underexplored.

Previous studies have predominantly examined these tools in occupational or adult populations, often in work-related contexts [9,10]. Limited research addresses their application in adolescents experiencing TNS due to habitual device use, particularly in the Indian context. Understanding whether RULA and NDI provide overlapping or distinct information could guide more effective screening and preventive interventions.

Aim of the Study:

This study aims to compare the outcomes of RULA and NDI in assessing ergonomic risk and disability related to Text Neck Syndrome among adolescents in Gujarat, India, to determine whether the tools complement each other or provide redundant information.

METHODOLOGY

Study Design

A cross-sectional analytical study was conducted to compare ergonomic risk scores obtained using the Rapid Upper Limb Assessment (RULA) with functional disability scores from the Neck Disability Index (NDI) among adolescents presenting with features consistent with Text Neck Syndrome (TNS).

Study Setting and Duration

The study was carried out at Vidhyadeep Institute of Physiotherapy, Gujarat, India, over a period of six months (January–June 2023).

Participants

A total of 97 undergraduate students aged 18–25 years participated in the study. Participants were recruited through purposive sampling from local colleges. All were regular smartphone users for a minimum of two hours per day for the past six months.

Inclusion Criteria

•Adolescents and young adults aged 18–25 years

•Smartphone use ≥2 hours/day for at least six consecutive months

•Willingness to participate and provide informed consent

Exclusion Criteria

•History of cervical spine fracture or surgery

•Diagnosed cervical radiculopathy or myelopathy

•Known neuromuscular or rheumatologic disorders

•Chronic inflammatory conditions affecting the cervical spine

Instruments

1.Rapid Upper Limb Assessment (RULA):

RULA is a standardized observational method for evaluating postural loading on the neck, trunk, and upper limbs, developed by McAtamney and Corlett [7]. Scores range from 1–7, with higher scores indicating greater ergonomic risk and the need for immediate intervention.

2.Neck Disability Index (NDI):

The NDI is a 10-item self-reported questionnaire developed by Vernon and Mior [8] to assess the impact of neck pain on daily activities. Each item is scored from 0–5, with total scores expressed as a percentage, categorised as:

- 0–4 = No disability
- 5–14 = Mild disability
- 15–24 = Moderate disability
- 25–34 = Severe disability
- ≥35 = Complete disability

Procedure

Participants attended a single assessment session.

1.Demographic data (age, gender, daily smartphone use) were recorded.

2.Participants' texting posture was recorded using a high-definition camera while seated for 10 minutes during normal smartphone use.

3.RULA scoring was performed by a trained physiotherapist using the recorded video.

4.Participants completed the NDI questionnaire in English or Gujarati, based on language preference.

Outcome Measures

•Primary Outcome: RULA total score (ergonomic risk)

•Secondary Outcome: NDI percentage score (functional disability)

Data Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 27.0. Descriptive statistics (mean, standard deviation, frequency, percentage) were calculated for demographic and outcome variables. Pearson's correlation coefficient was used to determine the relationship between RULA and NDI scores. Statistical significance was set at $p < 0.05$.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee of Vidhyadeep Institute of Physiotherapy (Approval No: VIP/IEC/2023/07). Written informed consent was obtained from all participants prior to data collection.

RESULTS

A total of 97 participants (mean age 20.4 ± 1.8 years) were included in the study. The sample comprised 42 males (43.3%) and 55 females (56.7%).

Table 1. Demographic characteristics of participants

Variable	n (%) or Mean ± SD
Age (years)	20.4 ± 1.8
Gender	Male: 42 (43.3%), Female: 55 (56.7%)
Daily smartphone use (hours)	4.8 ± 1.2

RULA Scores

The mean RULA score for the group was 4.2 ± 1.0, indicating that most participants fell into the category requiring further investigation and possible changes in posture.

Table 2. Distribution of RULA risk categories

RULA Category	Score Range	n (%)	Interpretation
Low risk	1–2	5 (5.2%)	Acceptable posture
Medium risk	3–4	58 (59.8%)	Further investigation needed
High risk	5–6	30 (30.9%)	Investigate and change soon

RULA Category	Score Range	n (%)	Interpretation
Very high risk	7	4 (4.1%)	Immediate changes required

NDI Scores

The mean NDI score was 12.6 ± 4.9, corresponding to mild disability for most participants.

Table 3. Distribution of NDI disability categories

Disability Category	NDI Score (%)	n (%)
No disability	0–4	6 (6.2%)
Mild	5–14	64 (66.0%)
Moderate	15–24	25 (25.8%)
Severe	25–34	2 (2.1%)
Complete	≥35	0 (0%)

Correlation Between RULA and NDI

Pearson's correlation analysis revealed a weak, non-significant positive correlation between RULA and NDI scores (r = 0.21, p = 0.06).

Summary of Findings:

• Majority of participants (59.8%) fell into the medium ergonomic risk category (RULA score 3–4).

• Most participants (66.0%) reported mild neck disability on the NDI.

• No participant reported complete disability.

• Weak, non-significant correlation between RULA and NDI suggests that the two measures assess different aspects of TNS-related impairment.

DISCUSSION

Comparison with Previous Studies

The present study found that the majority of adolescents (59.8%) were classified in the medium-risk category according to RULA, while most participants (66.0%) reported mild disability on the NDI. This aligns with findings from Berolo et al. [9], who reported a high prevalence of mild musculoskeletal symptoms among young handheld device users, particularly in the cervical region.

Similarly, Gustafsson et al. [3] noted that sustained neck flexion during mobile phone use increases static muscle loading, which can contribute to discomfort even in the absence of severe disability.

The weak, non-significant correlation between RULA and NDI scores (r = 0.21, p = 0.06) suggests that these tools assess different aspects of Text Neck Syndrome. RULA primarily evaluates biomechanical and ergonomic risk factors [7], whereas the NDI reflects self-reported functional limitations [8]. This finding is consistent with past occupational health research, where objective posture analysis and subjective symptom reports often show limited correlation [10,11].

Clinical Relevance

The discrepancy between ergonomic risk (RULA) and self-reported disability (NDI) highlights the importance of using both objective and subjective measures in clinical screening for TNS. Adolescents may adapt to poor posture without perceiving immediate functional limitations, yet remain at risk for long-term musculoskeletal issues. Early detection of high ergonomic risk, even in the absence of significant disability, could inform preventive interventions such as posture education, ergonomic device use guidelines, and neck-strengthening exercises.

Limitations

This study has several limitations. First, the cross-sectional design precludes causal inference regarding the relationship between posture and disability. Second, the use of a purposive sampling method limits generalizability to all adolescents in Gujarat. Third, posture assessment was limited to a single 10-minute observation, which may not reflect typical daily variations. Finally, psychosocial factors that may influence self-reported disability, such as stress or academic workload, were not evaluated.

Future Recommendations

Future research should consider longitudinal designs to assess changes in posture and disability over time, as well as intervention studies to evaluate the effectiveness of ergonomic education in reducing TNS prevalence. Expanding the study to include a more diverse and larger sample across multiple regions in India would enhance generalizability.

Additionally, integrating objective muscle activity measurements, such as surface electromyography, could provide deeper insights into the biomechanical demands of smartphone use in adolescents.

CONCLUSION

This study compared ergonomic risk using the Rapid Upper Limb Assessment (RULA) and functional disability using the Neck Disability Index (NDI) in adolescents with features of Text Neck Syndrome (TNS) in Gujarat. Most participants were classified as having medium ergonomic risk and mild neck disability. The weak, non-significant correlation between RULA and NDI suggests that these tools measure distinct aspects of TNS. Therefore, both objective posture analysis and subjective disability assessment are recommended for comprehensive screening and prevention strategies in adolescents. Early ergonomic interventions may help reduce the long-term burden of cervical musculoskeletal disorders in this population.

HIGHLIGHTS

•Majority of adolescents with TNS showed medium ergonomic risk and mild disability.

•RULA and NDI scores were weakly correlated, indicating different measurement domains.

•Combining objective and subjective tools improves screening accuracy.

•Early ergonomic education is critical for preventing long-term cervical spine issues.

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