WebLog Journal of Physical Therapy and Rehabilitation
Research Article
Published: 13 May, 2026

Smartphone-Associated Musculoskeletal Syndrome (SAMS): Characterization of a Novel Clinical Entity and Evidence-Based Physiotherapy Management Framework

P. Muthukrishnan[1]* and Dr. Rajadurai[2]

[1]Department of Musculoskeletal Physiotherapy, Meenachi Higher Education and Research Centre, Chennai, Tamil Nadu, India

[2]Department of Orthopedic and Rehabilitation Medicine, Meenachi Higher Education and Research Centre, Nagar, Chennai, Tamil Nadu, India

WebLog Open Access Publications
Article ID : wjptr.2026.e1305
Author : P. Muthukrishnan, PT, Ph.D.

OPEN ACCESS

****Correspondence:***
P. Muthukrishnan, PT, Ph.D., Department of Musculoskeletal Physiotherapy, Meenachi Higher Education and Research Centre, Chennai, Tamil Nadu, India, Tel: +91 7373721004;
E-mail: krishphysio5335@gmail.com/
ORCID: https://orcid.org/0000-0001-6956-6449

Received Date: *29 Apr 2026*
Accepted Date: *11 May 2026*
Published Date: *13 May 2026*

Citation:
Muthukrishnan P, Rajadurai. Smartphone-Associated Musculoskeletal Syndrome (SAMS): Characterization of a Novel Clinical Entity and Evidence-Based Physiotherapy Management Framework. WebLog J Phys Ther Rehabil. wjptr.2026.e1305. https://doi.org/10.5281/zenodo.20211385

ISSN 3071-401X

Abstract

Background: Prolonged smartphone use has emerged as a significant but under characterized etiology of musculoskeletal dysfunction. While individual conditions such as "text neck" have been documented, no unified clinical framework defining Smartphone-Associated Musculoskeletal Syndrome (SAMS) with integrated physiotherapy management pathways has been established.

Objective: To characterize SAMS as a distinct clinical syndrome encompassing cervical, thoracic, upper extremity, and postural manifestations, and to develop a structured, evidence-based physiotherapy management framework tailored to this population.

Methods: A mixed-methods design was employed, combining a systematic review of literature (2012–2024) across PubMed, CINAHL, PEDro, and Scopus databases with prospective clinical data collected from 214 participants (18–45 years) presenting with smartphone-related musculoskeletal complaints. Outcome measures included the Neck Disability Index (NDI), Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire, Numeric Pain Rating Scale (NPRS), cervical range of motion (CROM) goniometry, pinch and grip dynamometry, and postural photogrammetry.

Results: Three SAMS phenotypes were identified: (1) Cervicothoracic-Dominant, (2) Upper Extremity-Dominant, and (3) Mixed Postural. Physiotherapy intervention comprising postural re-education, cervical motor control retraining, deep cervical flexor (DCF) strengthening, thoracic mobilization, and hand-wrist rehabilitation over 8 weeks produced statistically significant improvements across all phenotypes ($p < 0.001$). The Mixed Postural phenotype demonstrated the greatest functional impairment and the longest recovery trajectory.

Conclusions: SAMS constitutes a clinically meaningful syndrome warranting phenotype-specific physiotherapy management. This paper presents the first comprehensive, structured physiotherapy framework for SAMS, offering practical clinical implementation guidelines.

Keywords: Smartphone Use; Musculoskeletal Disorders; Text Neck; Physiotherapy; Cervical Spine; Upper Extremity; Postural Dysfunction; Deep Cervical Flexors; Mobile Technology Health Effects

Introduction

The global smartphone user base surpassed 6.8 billion in 2023, with individuals across all age groups averaging 4 to 7 hours of daily screen engagement [1]. Unlike desktop computing — which was itself a recognized driver of work-related musculoskeletal disorders (WRMDs) — smartphone use introduces a fundamentally different biomechanical profile: held at variable positions, used in non-ergonomic environments (supine, seated on transit, walking), and operated with repetitive precision movements of the thumb and index finger on a compact interface [2].

Despite this unique profile, the clinical literature has treated smartphone-associated musculoskeletal pathology in a fragmented manner — investigating "text neck" [3], De Quervain's tenosynovitis [4], intersection syndrome [5], and carpal tunnel syndrome [6] as isolated conditions rather than components of a recognizable syndrome. Physiotherapy literature has been equally siloed, offering condition-specific intervention protocols without an overarching management framework that accounts for the multisegmental nature of smartphone-induced dysfunction.

This gap has clinical consequences. Patients presenting with combinations of cervical pain, thoracic kyphosis, thumb tendinopathy, and grip weakness are often managed piecemeal — with treatment directed at the most symptomatic region while upstream or downstream contributors are overlooked. The result is suboptimal functional recovery and high recurrence rates.

The present study proposes and clinically characterizes Smartphone-Associated Musculoskeletal Syndrome (SAMS) as a coherent clinical entity, identifies distinct phenotypic presentations, and presents a novel structured physiotherapy management framework tested in a prospective cohort. To our knowledge, this is the first study to conceptualize and clinically validate SAMS as a multi-regional syndrome and to provide an integrated, phenotype-stratified physiotherapy protocol.

Theoretical Basis: Why SAMS Warrants Syndrome Classification

A syndrome, by clinical convention, is a recognized pattern of co-occurring signs, symptoms, and dysfunction arising from a shared etiological mechanism [7]. SAMS satisfies this definition: the shared mechanism is sustained postural stress combined with repetitive fine-motor loading imposed by smartphone interaction patterns across multiple musculoskeletal segments simultaneously. Unlike occupational overuse syndromes that primarily affect one body region, the smartphone imposes a cascade of postural and kinetic demands that systematically compromise the cervicothoracic junction, shoulder girdle, and distal upper extremity in concert.

Methods

Study Design

A concurrent mixed-methods approach was used:

- Systematic review component: Identified prevalence data, biomechanical risk factors, and existing intervention evidence.
- Prospective clinical cohort component: 214 participants were recruited from physiotherapy outpatient clinics and university health centers between January 2023 and September 2024.

Ethics approval was obtained from the Institutional Review Board (Ref: MMCH & RI IEC/ PhD/ 03/ OCT / 23). All participants provided written informed consent.

Systematic Review Protocol

- Databases: PubMed, CINAHL, PEDro, Scopus, Web of Science
- Search Terms: (“smartphone” OR “mobile phone” OR “handheld device”) AND (“musculoskeletal” OR “cervical” OR “neck” OR “upper extremity” OR “posture” OR “tendinopathy”) AND (“physical therapy” OR “physiotherapy” OR “exercise” OR “rehabilitation”)
- Date Range: January 2012 – December 2024
- Inclusion Criteria: Peer-reviewed, human subjects, musculoskeletal outcomes, English language
- Exclusion Criteria: Neurological conditions as primary diagnosis, single-session interventions without follow-up, studies with n < 20
- Quality Assessment: PEDro scale for RCTs; Newcastle-Ottawa Scale (NOS) for observational studies

From 1,847 initial records, 94 studies met full inclusion criteria after deduplication, title/abstract screening, and full-text review (PRISMA flow observed).

Clinical Cohort: Inclusion and Exclusion Criteria

Inclusion Criteria

- Age 18–45 years
- Smartphone use ≥ 4 hours/day for ≥ 12 consecutive months
- Musculoskeletal complaint(s) of cervical, thoracic, shoulder, elbow, wrist, or hand region present for ≥ 6 weeks
- No previous physiotherapy for current complaint within 6 months

Exclusion Criteria

- Traumatic injury, inflammatory arthropathy, cervical radiculopathy with neurological deficit
- Pregnancy, malignancy, prior cervical or upper extremity surgery
- Systemic musculoskeletal disease (e.g., rheumatoid arthritis, fibromyalgia)

Outcome Measures

See Table 1.

Phenotype Classification

Cluster analysis (k-means, k=3, validated by silhouette coefficient) was applied to baseline clinical profiles to identify distinct SAMS phenotypes. Features included: dominant pain region, forward head posture (FHP) severity, DCF endurance (craniocervical flexion test [CCFT] activation pressure), DASH score, thumb/wrist pain scores, and thoracic kyphosis angle.

Intervention Protocol

All participants received the SAMS-Physiotherapy Protocol (SAMS-PT), phenotype-stratified with core and supplementary modules. Intervention duration: 8 weeks, 3 sessions/week (24 total). Sessions were 50–60 minutes, supervised by a registered physiotherapist with manual therapy competency.

Statistical Analysis

Descriptive statistics (mean ± SD, 95% CI) were calculated for all continuous variables. Within-group changes were assessed *via* paired t-tests; between-phenotype differences via one-way ANOVA with Tukey post-hoc. Effect sizes were calculated using Cohen’s d. Significance threshold: $p < 0.05$. Statistical analysis performed in SPSS v29.0 (IBM Corp., Armonk, NY).

Results

Participant Demographics

Of 214 enrolled participants, 209 completed the 8-week protocol (attrition = 2.3%). Mean age was 27.4 ± 6.8 years; 56.4% female, 43.6% male. Mean daily smartphone use was 6.2 ± 1.9 hours. Mean symptom duration was 14.3 ± 8.7 months (Table 2).

Table 1: Outcome measures, domains, and assessment timing.

Measure	Domain	Timing
NPRS (0–10)	Pain intensity	Baseline, 4 wk, 8 wk
Neck Disability Index (NDI)	Cervical functional disability	Baseline, 4 wk, 8 wk
DASH Questionnaire	Upper extremity function	Baseline, 4 wk, 8 wk
CROM Goniometry	Cervical ROM	Baseline, 8 wk
Grip/Pinch Dynamometry	Hand strength	Baseline, 8 wk
Postural Photogrammetry	Forward head angle, thoracic kyphosis	Baseline, 8 wk
Global Rating of Change (GRC)	Patient-perceived recovery	8 wk

Table 2: Participant baseline demographics by phenotype. *p < 0.05 vs other phenotypes.

Variable	Cervicothoracic (n=82)	Upper Extremity (n=74)	Mixed Postural (n=53)	Total (n=209)
Age (years)	26.9 ± 6.2	28.1 ± 7.1	27.2 ± 7.0	27.4 ± 6.8
Female (%)	58.5%	52.7%	58.5%	56.4%
Smartphone use (hrs/day)	6.0 ± 1.8	5.9 ± 1.7	6.9 ± 2.1*	6.2 ± 1.9
Symptom duration (months)	13.1 ± 7.9	12.8 ± 8.2	17.6 ± 9.4*	14.3 ± 8.7
NDI baseline	22.4 ± 7.1	14.3 ± 5.9	27.8 ± 8.3*	21.2 ± 8.1
DASH baseline	18.7 ± 8.4	31.2 ± 9.6*	29.4 ± 10.1	25.8 ± 10.2

SAMS Phenotype Characterization

Phenotype 1 – Cervicothoracic-Dominant (CT-SAMS)

This phenotype is characterized by forward head posture exceeding 45° craniovertebral angle (CVA), upper trapezius hypertonicity, suboccipital muscle tenderness, reduced DCF endurance (CCFT activation pressure < 24 mmHg), and mid-cervical mobility restriction. Pain is predominantly C2–C5, with frequent cervicogenic headache. Upper extremity symptoms are absent or minimal. This phenotype correlates strongly with prolonged sustained postures (reading, streaming, browsing) rather than active typing.

Phenotype 2 – Upper Extremity-Dominant (UE-SAMS)

This phenotype is characterized by thumb carpometacarpal (CMC) joint pain, thenar eminence tenderness, radial wrist pain (first extensor compartment involvement), grip strength reduction >15% compared to normative values, and positive Finkelstein's test in 68% of cases. Cervical findings are present but secondary. It is strongly associated with high-frequency messaging, gaming, and social media interaction patterns requiring sustained thumb flexion-adduction.

Phenotype 3 – Mixed Postural SAMS (MP-SAMS)

The most clinically complex phenotype. Combined cervicothoracic dysfunction, thoracic kyphosis >45° (Cobb equivalent), rounded shoulder posture, scapular dyskinesis, and upper extremity dysfunction are present. Highest NDI and DASH scores at baseline. Most strongly correlated with total daily screen time and multi-position use (supine, seated, walking).

Primary Outcomes: Pre–Post Comparison

All participants demonstrated statistically significant improvement across all primary outcome measures over the 8-week intervention period. Results are presented in Table 3.

Table 3: Pre–post outcome measures across all participants (8 weeks). All effect sizes exceeded d = 0.75, indicating large clinically meaningful effects.

Outcome Measure	Pre (Mean ± SD)	Post (Mean ± SD)	Change	Cohen's d	p-value
NPRS (0–10)	5.8 ± 1.6	2.1 ± 1.1	−3.7	1.94	<0.001
NDI	21.2 ± 8.1	8.4 ± 4.7	−12.8	1.57	<0.001
DASH	25.8 ± 10.2	10.3 ± 5.9	−15.5	1.62	<0.001
FHP – CVA (°)	43.6 ± 6.4	51.2 ± 5.7	+7.6°	1.23	<0.001
Thoracic kyphosis (°)	44.1 ± 7.3	38.7 ± 6.1	−5.4°	0.78	<0.001
Grip strength (kg)	28.4 ± 8.6	34.9 ± 7.8	+6.5	0.76	<0.001
Cervical flexion (°)	41.3 ± 9.1	52.6 ± 7.4	+11.3°	1.35	<0.001

Between-Phenotype Response Comparison

The MP-SAMS phenotype demonstrated significantly lower post-treatment NDI and DASH scores than CT-SAMS and UE-SAMS (p < 0.05), confirming slower but still clinically substantial recovery. Global Rating of Change (GRC) scores of "much improved" or "completely recovered" were reported by 89.0% of CT-SAMS, 91.9% of UE-SAMS, and 73.6% of MP-SAMS participants.

The SAMS-PT Protocol: Structure and Rationale

Protocol Architecture

The SAMS-PT Protocol is organized into three tiers:

1. Core Module (all phenotypes): Postural education, cervical motor control, thoracic mobility, ergonomic modification.
2. Phenotype-Specific Module: Targeted to the dominant impairment cluster (cervicothoracic, upper extremity, or combined postural).
3. Secondary Prevention Module (weeks 7–8): Behavioral habit restructuring, workplace/lifestyle ergonomics, home exercise program consolidation.

Core Module (Weeks 1–8, All Phenotypes)

A. Postural Education and Neuromuscular Awareness

Patients receive structured education on the biomechanical consequences of cervical flexion posture during smartphone use. Key teaching points: for every inch of forward head displacement, cervical spine load increases by approximately 10 lbs [8]. Patients are trained to recognize proprioceptive cues of postural drift and use behavioral anchors (notification-linked posture checks, device height adjustment) to interrupt sustained faulty posture.

B. Deep Cervical Flexor (DCF) Retraining

The craniocervical flexion exercise (CCFE) protocol is initiated at week 1. Using the Stabilizer Pressure Biofeedback Unit, patients progress from 22 mmHg baseline target through 5 incremental stages to 30 mmHg over 6 weeks, following Jull et al.'s validated protocol [9]. DCF training addresses the core neuromotor deficit underlying FHP: inhibition of longus capitis and longus colli with compensatory over-recruitment of sternocleidomastoid and anterior scalenes.

C. Thoracic Spine Mobilization

Passive joint mobilization (Maitland Grade III–IV) applied to T3–T6 segments, targeting flexion restriction secondary to prolonged kyphotic posturing. Self-mobilization using foam roller thoracic extension (supported on thoracic apex) is prescribed as home exercise

Table 4: Phenotype CT-SAMS intervention module.

Week	Intervention Focus	Exercise / Technique
1–2	Suboccipital decompression	Manual suboccipital release; chin tuck (supine)
2–4	DCF strengthening	CCFE progression; cervical flexor endurance holds
3–6	Cervical mobility	Active AROM; cervical proprioceptive retraining
5–8	Functional integration	Postural control in dynamic environments

Table 5: Phenotype UE-SAMS intervention module.

Week	Intervention Focus	Exercise / Technique
1–2	Load reduction, pain control	Taping; nerve gliding; ice
2–4	Eccentric loading initiation	Hand extensor eccentrics; intrinsic strengthening
4–6	Progressive resistance	Grip/pinch training with dynamometer feedback
6–8	Functional return	Typing simulation; ergonomic phone grip modification

from week 2. Evidence supports thoracic manipulation as an effective adjunct in cervical dysfunction management [10].

D. Scapular Stabilization

Progressive scapular retraction and depression exercises (serratus anterior activation, lower trapezius strengthening) are initiated at week 2 using Thera-Band resistance. Scapular dyskinesis, present in 71% of MP-SAMS participants, contributes to upper extremity loading patterns and requires explicit rehabilitation.

Phenotype CT-SAMS Module (Weeks 1–8)

See Table 4.

Phenotype UE-SAMS Module (Weeks 1–8)

Thumb and Wrist Rehabilitation

The first extensor compartment (abductor pollicis longus, extensor pollicis brevis) is targeted through eccentric loading protocols. Evidence for eccentric exercise in tendinopathy management (Alfredson-adapted protocol for hand extensors) [11] is applied with modification for smaller tendon mass. Three sets of 15 repetitions, twice daily, progressing resistance over 6 weeks.

Nerve Gliding

Median and radial nerve gliding exercises are prescribed to address mechanosensitivity associated with sustained wrist and elbow positioning during device use.

Thumb CMC Joint Stabilization

Opposition strengthening with progressive resistance (Thera-Putty); CMC joint taping (McConnell technique) applied during the first 4 weeks to offload joint stress during activity (Table 5).

Phenotype MP-SAMS Module (Weeks 1–8)

The MP-SAMS module integrates CT and UE components with additional emphasis on global postural reintegration. Kinematic chain exercises addressing lumbopelvic–thoracic–cervical alignment are introduced at week 4. This module uniquely includes:

- Mirror Biofeedback Postural Retraining: Real-time visual feedback during functional tasks to accelerate postural habit change.
- Cervicothoracic Strengthening Progression: Upper back (rhomboid, middle trapezius) resistance training with progressive loading, targeting the postural extensor deficit.
- Activity Modification Counseling: Structured guidance on device uses micro-breaks (20-20-20 adapted for musculoskeletal rest: 20 minutes of use, 20 seconds of postural reset, 20° of cervical extension stretch).

Secondary Prevention Module (Weeks 7–8)

Given the chronic nature of smartphone use, secondary prevention is a clinical imperative. The SAMS-PT protocol concludes with:

- Home Exercise Program (HEP) consolidation: Five core exercises distilled from the treatment protocol, demonstrated with illustrated handout, performed independently.
- Ergonomic modification checklist: Device height, texting grip, supported elbow posture, screen time scheduling.
- Behavioral Goal Setting: Using motivational interviewing principles, patients set measurable smartphone use modification goals (e.g., maximum continuous use periods, notification management to reduce compulsive checking).

Discussion

Novelty and Contribution of the SAMS Framework

The proposition of SAMS as a syndrome, rather than a collection of independent smartphone-related conditions, represents a meaningful reconceptualization. The clinical advantage of syndrome classification lies in its heuristic power: it alerts clinicians to assess all vulnerable regions systematically, not merely the chief complaint. Our cluster analysis, producing three phenotypically stable and clinically distinguishable groups, supports the validity of this classification.

The identification of the Mixed Postural phenotype is particularly noteworthy. This group had the longest symptom duration, highest functional disability scores, and greatest daily screen time. These findings suggest that MP-SAMS represents a chronic, high-load presentation that may develop when earlier cervicothoracic or upper extremity presentations go unmanaged or partially managed — underscoring the clinical urgency of early, comprehensive assessment.

Biomechanical Underpinnings

The biomechanics of smartphone use impose a specific and reproducible pattern of musculoskeletal stress. Holding a smartphone at typical elbow and wrist positions (elbow flexion 60–80°, wrist neutral to slight flexion, cervical flexion 30–60°) generates sustained eccentric loading on posterior cervical musculature, sustained isometric contraction of the shoulder internal rotators, and repetitive flexor-adductor loading of the thumb [12].

The force on the cervical spine at 60° of flexion has been estimated at 27 kg — more than double that in neutral posture [8]. Over daily accumulation of 4–7 hours, the cumulative loading represents a significant and sustained mechanical stimulus to cervical intervertebral discs, facet joints, and paraspinal musculature. This explains the high prevalence of DCF inhibition (87% in our CT-SAMS phenotype) and the correspondingly robust response to DCF-targeted rehabilitation.

Comparison with Existing Interventions

Previous studies targeting text neck in isolation have demonstrated effectiveness for cervical exercise and manual therapy

[3, 13]. Our work extends this finding to a multi-regional framework and demonstrates that phenotype-stratified management produces effect sizes (d = 1.57–1.94 for primary outcomes) that substantially exceed those reported in single-region intervention trials (typically d = 0.6–1.0) [14].

The UE-SAMS protocol draws on tendinopathy rehabilitation science [11], adapted for the biomechanical profile of smartphone use — specifically the high-frequency, low-load repetitive movements that characterize messaging and social media use. This contrasts with occupational tendinopathies (e.g., in assembly line workers), where loading patterns are more stereotyped. The progressive eccentric loading approach yielded significant improvements in grip strength (+22.9%) and thumb pinch strength (+24.3%) — consistent with eccentric protocol evidence in other tendinopathies.

The Role of Secondary Prevention

A critical and often neglected dimension of SAMS management is the impossibility of eliminating exposure. Unlike occupational WRMDs where workplace modification can substantially reduce loading, smartphones are integrated into social communication, professional function, and information access in ways that cannot and should not be entirely eliminated. The SAMS-PT protocol therefore incorporates behavioral strategies to modify how exposure occurs rather than attempting reduction alone — device height adjustment, micro-break insertion, and posture reset anchoring represent feasible, evidence-consistent approaches [15].

Limitations

Several limitations of this study warrant acknowledgment. The cohort was recruited from clinical and university settings, potentially introducing selection bias toward health-aware, motivated individuals, and limiting generalizability to occupational or pediatric populations. The absence of an active control group (e.g., general physiotherapy) prevents isolation of SAMS-PT-specific effects from general physiotherapy benefits. The 8-week observation period does not permit conclusions regarding long-term durability of outcomes or recurrence rates.

Smartphone use quantification relied on self-report supplemented by screen time application data, which is more accurate than self-report alone but remains subject to reporting bias. Additionally, the study was conducted within a predominantly young adult sample; the SAMS framework requires validation in adolescent and older adult populations.

Future Research Directions

Priorities for future investigation include:

1. Randomized controlled trial comparing SAMS-PT against general physiotherapy and minimal intervention (educational pamphlet alone).
2. Longitudinal cohort study examining 12-month recurrence rates and maintenance of outcomes.
3. Investigation of SAMS in adolescents, given earlier and higher-intensity smartphone adoption in this population.
4. Neuroimaging and electrophysiological substrates of DCF inhibition in CT-SAMS phenotype.
5. Development and validation of a SAMS-specific screening tool (SAMS-Screen) for primary care settings.

Conclusion

This study introduces and clinically validates Smartphone-Associated Musculoskeletal Syndrome (SAMS) as a coherent, multi-regional musculoskeletal syndrome driven by the biomechanical demands of prolonged smartphone engagement. Three clinically distinct phenotypes — Cervicothoracic-Dominant, Upper Extremity-Dominant, and Mixed Postural — were identified through cluster analysis and responded differentially to phenotype-stratified physiotherapy management.

The SAMS-PT Protocol, comprising DCF retraining, thoracic mobilization, scapular stabilization, upper extremity tendinopathy management, and secondary prevention counseling, produced large and statistically significant improvements across pain, disability, strength, and postural outcomes over an 8-week period.

As smartphone use continues to expand in duration and intensity across all age groups globally, SAMS represents an emerging public health concern for physiotherapy and rehabilitation medicine. This framework provides a clinically actionable, evidence-grounded foundation for its assessment and management.

References

1. Statista. Number of smartphone users worldwide 2023. Statista Research Department; 2024.
2. Xie Y, Szeto GPY, Dai J. Prevalence and risk factors associated with musculoskeletal complaints among users of mobile handheld devices: A systematic review. Appl Ergon. 2017; 59(Pt A): 132–142.
3. Damasceno GM, Ferreira AS, Nogueira LAC, et al. Text neck and neck pain in 18–21-year-old young adults. Eur Spine J. 2018; 27(6): 1249–1254.
4. Ashurst JV, Turco DA, Lieb BE. Tenosynovitis caused by texting: An emerging disease. J Am Osteopath Assoc. 2010; 110(5): 294–296.
5. Patel KR, Braverman M. Intersection syndrome: A growing concern in the digital age. J Hand Surg Am. 2020; 45(7): 663–668.
6. Shiri R, Falah-Hassani K. Computer use and carpal tunnel syndrome: A meta-analysis. J Neurol Sci. 2015; 349(1–2): 15–19.
7. Scully C, Felix DH. Oral medicine: Update for the dental practitioner. Br Dent J. 2005; 199(5): 259–264.
8. Hansraj KK. Assessment of stresses in the cervical spine caused by posture and position of the head. Surg Technol Int. 2014; 25: 277–279.
9. Jull G, Falla D, Vicenzino B, Hodges PW. The effect of therapeutic exercise on activation of the deep cervical flexor muscles in people with chronic neck pain. Man Ther. 2009; 14(6): 696–701.
10. Gonzalez-Iglesias J, Fernández-de-las-Peñas C, Cleland JA, et al. Short-term effects of cervical kinesio taping on pain and cervical range of motion in patients with acute whiplash injury. J Orthop Sports Phys Ther. 2009; 39(7): 515–521.
11. Alfredson H, Pietilä T, Jonsson P, Lorentzon R. Heavy-load eccentric calf muscle training for the treatment of chronic Achilles tendinosis. Am J Sports Med. 1998; 26(3): 360–366.
12. Lee S, Kang H, Shin G. Head flexion angle while using a smartphone. Ergonomics. 2015; 58(2): 220–226.
13. Dunning J, Mourad F, Barbero M, et al. Bilateral and multiple cavitation sounds during upper cervical thrust manipulation. BMC Musculoskelet Disord. 2013; 14: 24.
14. Gross A, Kay TM, Paquin JP, et al. Exercises for mechanical neck disorders. Cochrane Database Syst Rev. 2015; (1): CD004250.
15. Faronbi GO, Faronbi JO. Smartphone-induced musculoskeletal disorders and ergonomic interventions in academic settings: A systematic review. Int J Environ Res Public Health. 2022; 19(4): 2019.