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Postural Balance in Young Adults with Smartphone Addiction: A Cross-Sectional Study

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ABSTRACT:

Background: Smartphones have become central to how young people communicate, study, and unwind, and it is often assumed that the postures and habits that come with heavy use carry a physical cost alongside the psychological one. Balance depends on the visual, vestibular, and somatosensory systems working together, and while it is a plausible target for this kind of harm, it has rarely been tested directly against a graded measure of addiction severity.

Objective : This study set out to test whether smartphone addiction severity is associated with impaired static, dynamic, and reactive balance in young adults.

Methods: In this cross-sectional study, 285 participants aged 18–35 years were recruited through stratified random sampling. Smartphone addiction was measured with a validated scale (range 10–60) and used to split participants into mild (score ≤28, n = 95), moderate (29–45, n = 98), and severe (≥46, n = 92) tertiles. Balance was assessed with the Berg Balance Scale (BBS, static), the Star Excursion Balance Test (SEBT, dynamic), and the Push-and-Release Test (reactive). Associations were tested with Pearson correlation (Spearman as a sensitivity check, given non-normal distributions on Shapiro-Wilk testing) and one-way ANOVA with Bonferroni-corrected pairwise comparisons; significance was set at $p < 0.05$.

Results: Mean addiction score was 36.09 ± 14.70. Mean BBS was 38.65 ± 10.46, SEBT 79.10 ± 11.52%, and Push-and-Release 2.14 ± 1.39. Addiction score correlated negligibly with BBS ($r = -0.024$, $p = 0.693$), SEBT ($r = -0.024$, $p = 0.685$), and Push-and-Release ($r = -0.056$, $p = 0.345$). ANOVA across addiction tertiles was non-significant for BBS ($F(2,282) = 0.28$, $p = 0.754$) and Push-and-Release ($F(2,282) = 0.82$, $p = 0.443$). SEBT showed a significant but small and non-monotonic group difference ($F(2,282) = 4.48$, $p = 0.012$, $\eta^2 = 0.031$), driven by the moderate group scoring higher than the severe group ($p = 0.007$, Bonferroni-corrected); mild and severe groups did not differ (p = 0.685). Neither age nor BMI was related to BBS score.

Conclusion: In this sample, smartphone addiction severity showed no meaningful association with static or reactive balance, and only a small, non-dose-dependent difference in dynamic balance. The data do not support the idea that smartphone addiction meaningfully impairs balance in healthy young adults, and the null hypothesis is retained for the primary outcomes. Larger, longitudinal studies with objective usage tracking are needed before any causal or dose-response relationship can be inferred.

1. INTRODUCTION

Smartphone ownership has gone from a convenience to a near-universal habit [1,2]. Global penetration is now estimated at over 80% of the population, and young adults make up the largest share of users [3,4]. These devices bundle together calls, messages, social media, gaming, navigation, entertainment, and academic tools, which is a large part of why they have become so hard to put down [3]. When use tips over into compulsive checking, discomfort when separated from the phone, and interference with daily responsibilities, it is generally described as smartphone addiction — and its prevalence among university students and young professionals keeps climbing [4,5].

Most of the research attention on this behaviour has understandably gone to its psychological footprint: anxiety, stress, sleep disruption, and reduced attention span are all well documented [5,6]. What has had comparatively little scrutiny is the physical toll, and specifically what heavy, posture-dependent smartphone use does to balance. Balance itself is not a single reflex but the product of continuous integration between the visual, vestibular, and somatosensory systems, so anything that interferes with one of these inputs — or with the muscular response to them — can leave a person less stable than they realise.

There are several plausible ways smartphone overuse could erode this stability. The most visible is postural: sustained neck flexion, a forward head position, and rounded shoulders are the default posture of scrolling, and these deviations shift the body's centre of gravity and blunt the proprioceptive feedback that the cervical spine normally contributes to upright control [1,11]. Repetition matters here — near-constant, low-level static loading of the neck and shoulder girdle fatigues exactly the muscles that would otherwise correct small perturbations to stance [7,12].

A second route is attentional rather than mechanical. Texting or gaming while walking is a dual-task condition, and dual-tasking is known to degrade gait and postural control because the visual and cognitive resources that would normally monitor the environment and body position get redirected to the screen [7,8]. Several experimental studies have found that dynamic balance measures — sway velocity, path length, reach distance — worsen measurably once a smartphone task is layered onto a standing or walking task [8,9,10].

A third, more indirect route runs through lifestyle. Heavy smartphone users tend to be more sedentary, and physical inactivity is itself an established risk factor for poor balance and higher fall risk, independent of any direct postural effect of the device [2,13]. Poor sleep, common among frequent late-night users, compounds this by slowing reaction time and reducing alertness — both of which feed back into postural control [13,15].

Despite this plausible chain of mechanisms, direct evidence linking graded smartphone addiction to measured balance performance — as opposed to addiction and psychological outcomes, or acute dual-tasking and balance — remains sparse, particularly in the 18–35 age bracket, where addiction rates are highest and balance would ordinarily be expected to be at its best. This study was designed to close part of that gap: to assess static, dynamic, and reactive balance across mild, moderate, and severe smartphone addiction categories in a large young-adult sample, and to formally test the strength of the association between addiction severity and balance performance.

Accordingly, the study tested two competing hypotheses: the null hypothesis (H_0), that there is no statistically significant association between smartphone addiction severity and balance performance among young adults; and the alternate hypothesis (H_1), that increasing smartphone addiction severity is associated with a statistically significant decline in static, dynamic, and/or reactive balance.

2. MATERIALS AND METHODS

2.1 Study Design and Setting

This was an observational cross-sectional study conducted in the outpatient department of the Department of Physiotherapy, JNCT Professional University, Bhopal, Madhya Pradesh, India, between 2024 and 2026. Ethical approval was obtained from the Institutional Review Board of the Department of Physiotherapy prior to recruitment, and the trial was registered with the Clinical Trials Registry of India (CTRI).

2.2 Participants and Sampling

Participants were healthy individuals aged 18–35 years who owned and regularly used a smartphone, recruited through stratified random sampling. Individuals were excluded if they had a history of musculoskeletal injury or surgery likely to affect balance, a congenital abnormality or deformity affecting balance, or vestibular pathology or reported dizziness. Written informed consent was obtained from every participant before enrolment.

Sample size was calculated from an expected smartphone addiction prevalence of 24.6%, a 95% confidence level ($Z = 1.96$), and a precision of 0.05, giving a minimum requirement of 285 participants. After accounting for an anticipated 10% attrition, recruitment was extended to 317, of whom 285 completed the protocol and were included in the final analysis.

2.3 Outcome Measures

Smartphone addiction severity was quantified using a validated smartphone addiction scale (score range 10–60), administered once at enrolment. Because no universally agreed clinical cut-points exist for three-level severity grading on this instrument, participants were divided into tertiles of the observed score distribution: mild (score ≤28, $n = 95$), moderate (29–45, $n = 98$), and severe (≥46, $n = 92$). Balance was evaluated using three complementary, previously validated measures: the Berg Balance Scale (BBS, 14 items, 0–56) for static functional balance; the Star Excursion Balance Test (SEBT), with reach distances normalised to limb length and expressed as a percentage, for dynamic balance; and the Push-and-Release Test (0–4 ordinal score) for reactive postural control. Testing was carried out on a flat, standardised surface under controlled lighting and noise conditions to limit external influences on performance.

2.4 Procedure

After screening and consent, demographic details (age, height, weight; BMI calculated as weight in kilograms divided by height in metres squared) were recorded, followed by administration of the addiction scale. Balance testing was then performed in a fixed order — BBS, SEBT, Push-and-Release — for all participants, with brief rest periods between tests to limit fatigue effects unrelated to the study variables. Assessors were trained in standardised administration of all three balance tests prior to data collection. Sex was not recorded in the final dataset and could therefore not be analysed as a subgroup variable in this report.

2.5 Statistical Analysis

Data were analysed in Python (pandas/SciPy) and cross-checked against descriptive output from IBM SPSS Statistics, version 25.0. Descriptive statistics (mean ± standard deviation, minimum, maximum) summarised demographic and outcome variables. Distributional normality of the addiction score and each balance measure was assessed with the Shapiro-Wilk test; all four variables departed significantly from normality ($p < 0.001$), so Pearson correlation coefficients between addiction score and each balance measure were computed as the primary analysis and cross-checked with Spearman's rank correlation as a non-parametric sensitivity analysis. One-way ANOVA compared each balance measure across the mild, moderate, and severe addiction tertiles; where the omnibus F-test was significant, pairwise group comparisons were made with independent-samples t-tests and a Bonferroni-corrected alpha of 0.0167 (0.05/3 comparisons), with effect size reported as eta-squared (η^2). Pearson correlations were additionally run between age, BMI, and BBS score to screen for potential confounding. A p-value below 0.05 was taken as the threshold for statistical significance for all primary tests.

3. RESULTS

Two hundred and eighty-five participants completed the study protocol and were included in the final analysis. Mean age was 26.54 ± 5.16 years (range 18–35), mean height 171.28 ± 11.69 cm, mean weight 67.05 ± 13.28 kg, and mean BMI 23.12 ± 5.37 kg/m². Mean smartphone addiction score was 36.09 ± 14.70 (range 10–60).

Table 1. Demographic characteristics of participants (N = 285)

Variable	Mean ±SD	Range
Age (years)	26.54 ±5.16	18–35
Height (cm)	171.28 ±11.69	150–190
Weight (kg)	67.05 ±13.28	45–90
BMI (kg/m²)	23.12 ±5.37	12.6–38.1

Using tertiles of the observed addiction-score distribution, 95 participants (33.3%) were classified as mild (score ≤28), 98 (34.4%) as moderate (29–45), and 92 (32.3%) as severe (≥46) smartphone addiction — a roughly even three-way split, in contrast to earlier reports where the moderate category dominated.

Table 2. Descriptive statistics for smartphone addiction score and balance outcome measures (N = 285)

Measure	Mean ±SD	Range
Smartphone addiction score	36.09 ±14.70	10–60
Berg Balance Scale (0–56)	38.65 ±10.46	20–56
Star Excursion Test (%)	79.10 ±11.52	60.16–99.81
Push-and-Release Test (0–4)	2.14 ±1.39	0–4

Shapiro-Wilk testing showed that the addiction score and all three balance measures departed significantly from a normal distribution ($p < 0.001$ for each), so Spearman correlations were run alongside Pearson correlations as a sensitivity check; both pointed to the same conclusions, and only the Pearson results are reported below for readability.

Table 3. Correlation between smartphone addiction score and balance outcome measures

Balance measure	Pearson r	p-value
Berg Balance Scale	-0.024	0.693
Star Excursion Test	-0.024	0.685
Push-and-Release Test	-0.056	0.345

None of the three balance measures correlated meaningfully with smartphone addiction score — all coefficients were close to zero, and none reached statistical significance. Age was likewise unrelated to Berg Balance Scale score ($r = -0.005$, $p = 0.930$), as was BMI ($r = 0.073$, $p = 0.219$), suggesting neither variable confounded the addiction–balance relationship in this sample.

Table 4. One-way ANOVA comparing balance measures across smartphone addiction severity tertiles

Measure	Mild (n=95)	Moderate (n=98)	Severe (n=92)
Berg Balance Scale	38.13 ±10.79	38.58 ±9.90	39.27 ±10.77
Star Excursion Test	77.98 ±10.98	81.87 ±11.71	77.31 ±11.45
Push-and-Release Test	2.12 ±1.44	2.28 ±1.35	2.02 ±1.37

F / p (η^2): Berg Balance Scale F=0.28, p=.754; Star Excursion Test F=4.48, p=.012 (η^2=.031); Push-and-Release Test F=0.82, p=.443.

Group comparisons echoed the correlation results: balance scores did not differ meaningfully across addiction tertiles for the Berg Balance Scale or the Push-and-Release Test. The Star Excursion Test showed a statistically significant, though small, omnibus difference ($F(2,282) = 4.48$, $p = 0.012$, $\eta^2 = 0.031$ — meaning the addiction grouping accounted for roughly 3% of the variance in SEBT scores). Bonferroni-corrected pairwise comparisons ($\alpha = 0.0167$) showed this difference was carried entirely by the moderate group scoring higher than the severe group (mean difference 4.56%, $p = 0.007$); the mild group did not differ significantly from either the moderate group ($p = 0.018$, above the corrected threshold) or the severe group ($p = 0.685$). This non-monotonic pattern — moderate performing best, mild and severe performing similarly to each other — does not describe a dose-response relationship, and reads more like sampling variability than a genuine, graded effect of addiction severity on dynamic balance.

Taken as a whole, the results give no statistical support to the alternate hypothesis that smartphone addiction severity is associated with a graded decline in static, dynamic, or reactive balance in this sample of young adults; the null hypothesis is retained for all three balance outcomes.

4. DISCUSSION

This study set out to test, formally and with three separate balance measures, whether smartphone addiction severity is associated with impaired balance in young adults. Contrary to what the alternate hypothesis predicted, the data showed no meaningful association: correlations between addiction score and all three balance outcomes were close to zero and non-significant, and group comparisons across addiction tertiles were non-significant for both the Berg Balance Scale and the Push-and-Release Test. The one statistically significant group difference, on the Star Excursion Test, was small ($\eta^2 = 0.031$) and non-monotonic — the moderate-addiction group outperformed the severe group, but the mild group was statistically indistinguishable from both. That pattern does not describe a graded, dose-dependent effect of addiction severity, and is more plausibly explained by sampling variability than by any real postural consequence of heavier smartphone use.

This null result sits somewhat apart from the mechanistic case built up in prior literature. Sustained neck flexion and forward head posture during smartphone use have repeatedly been linked to altered cervical proprioceptive input and musculoskeletal strain [1,11], and dual-task paradigms have shown that adding a phone-based task to standing or walking measurably degrades balance in the moment [7,8,9]. A few explanations could reconcile those earlier findings with the absence of an effect here. First, most of the strongest prior evidence comes from acute, experimentally induced dual-task or fatigue conditions [8,9,10] rather than from a cross-sectional comparison of habitual addiction severity; an acute attentional load may degrade balance measurably in the moment without leaving any detectable trace in a person's baseline balance test performance weeks or months later. Second, this sample was restricted to healthy 18–35-year-olds — an age group whose balance systems sit close to their physiological peak, with correspondingly large functional reserve. A postural deficit that is present but small could simply be absorbed without showing up on standardised balance tests in this population, even if it would be more apparent in older adults with less reserve [14]. Third, the addiction scale used here is self-report, and like all such measures it is subject to recall and social-desirability bias, which would tend to dilute any true underlying association by adding noise rather than by removing a real effect. Fourth, tertile-based grouping — while a defensible, transparent way to categorise a continuous score in the absence of an agreed clinical cut-off — is itself somewhat arbitrary, and may not line up with whatever threshold of use actually produces measurable postural change, if one exists.

It is also worth taking the null result at face value rather than explaining it away. Balance is a robustly regulated, multiply redundant system, and it is entirely plausible that everyday smartphone use — even at addiction-scale levels — simply does not impose enough mechanical or attentional load to meaningfully disturb it in an otherwise healthy young adult, even though the same behaviour may still carry real costs for neck pain, visual strain, or sleep that fall outside the scope of a balance assessment [1,2]. Sedentary behaviour and reduced physical activity, often assumed to be an intermediate step between smartphone addiction and poorer balance [2,13], were not measured directly in this dataset, so their role here cannot be confirmed or ruled out.

Age and BMI were both unrelated to Berg Balance Scale score in this sample, which is not surprising given the narrow, physiologically similar age range studied, and suggests that neither variable confounded the addiction-balance relationship reported above.

A few limitations temper these conclusions. The sample was restricted to 18–35-year-olds, so the findings cannot be extended to older adults, in whom lower baseline balance reserve might make a smartphone-related effect more detectable. Sex was not recorded in the analysed dataset, so a sex-stratified comparison — planned in the original study protocol — could not be performed here. Smartphone addiction was measured through a single self-report scale rather than objective usage logs, and the cross-sectional design rules out any causal or temporal interpretation even where associations are found. The isolated, non-monotonic Star Excursion Test finding should be treated as hypothesis-generating rather than confirmatory, and would need replication in an independent sample before being taken as evidence of a real effect.

5. CONCLUSION

In this cross-sectional sample of 285 healthy young adults, smartphone addiction severity showed no statistically meaningful association with static balance (Berg Balance Scale) or reactive postural control (Push-and-Release Test), and only a small, non-dose-dependent difference in dynamic balance (Star Excursion Test) that does not support a genuine graded effect. The null hypothesis is retained for the primary outcomes of this study: within this population and with these measures, smartphone addiction does not appear to meaningfully impair balance. This runs counter to some assumptions in the wider literature, and suggests that claims of a direct, clinically relevant link between smartphone addiction and balance impairment in healthy young adults should be treated cautiously until replicated with larger samples, objective usage measures, and longitudinal or older-adult cohorts capable of detecting smaller or slower-developing effects.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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