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Prevalence of Back Pain and Its Association With Smartphone Usage Patterns Among Young Healthcare Professionals in Karachi, Pakistan: A Cross-Sectional Study

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Abstract

Background:

Smartphone use is increasingly common among healthcare professionals, but its association with back pain remains insufficiently characterized.

Objective:

To assess the association between daily smartphone-use duration and 12-month back pain among young healthcare professionals in Karachi, Pakistan.

Methods:

This cross-sectional study included 168 healthcare professionals aged 20–35 years recruited by convenience sampling at Jinnah Postgraduate Medical Centre and Creek General Hospital, Karachi, between April and October 2025. Back pain was self-reported upper- and/or lower-back pain or discomfort during the previous 12 months. The primary exposure was smartphone use ≥ 4 versus < 4 hours/day. Modified Poisson regression estimated prevalence ratios (PRs) adjusted for age group and gender. Sensitivity analyses included four-category exposure, logistic and penalized logistic regression, and institution adjustment.

Results:

Back pain was reported by 125/168 participants (74.4%; 95% CI, 67.3–80.4%). Prevalence was 80.5% among participants using smartphones ≥ 4 hours/day and 55.0% among those using them < 4 hours/day. Use ≥ 4 hours/day was associated with higher prevalence in crude analysis (PR, 1.46; 95% CI, 1.09–1.96) and after adjustment for age group and gender (adjusted PR, 1.49; 95% CI, 1.09–2.05). Institution adjustment produced a similar estimate. Four-category analysis did not establish a dose–response pattern.

Conclusion:

Daily smartphone use of ≥ 4 hours was associated with higher back-pain prevalence among young healthcare professionals in Karachi. These findings identify smartphone-use duration as a potentially relevant correlate of musculoskeletal health. Prospective studies using objective screen-time measurements and assessing occupational and lifestyle factors are warranted to clarify this association.

1. Introduction

Back pain is a common and multifactorial musculoskeletal problem that can impair physical functioning, daily activities, work performance, and quality of life. Although low back pain is the most extensively studied form, back symptoms may involve different anatomical regions and reflect the combined influence of occupational, physical, behavioral, and psychosocial factors. The global burden of low back pain is substantial: approximately 619 million people were estimated to have experienced low back pain in 2020, making it the leading cause of disability worldwide [1]. Healthcare professionals represent an important occupational population in this context. Recent reviews have documented a substantial burden of work-related musculoskeletal disorders among healthcare professionals and identified physical workload, repetitive tasks, poor ergonomics, and psychosocial stressors as important contributors to low back pain [2, 3]. In Pakistan, this burden is also evident; a cross-sectional study of medical doctors working in teaching hospitals in Karachi reported a high prevalence of low back pain, underscoring the importance of musculoskeletal health within the local healthcare workforce [4].

At the same time, healthcare practice has become increasingly dependent on mobile technology. Smartphones are routinely used by physicians for professional communication, access to clinical information, medical education, clinical decision-making, drug information, and patient-related activities [5]. Smartphone exposure among healthcare professionals therefore extends beyond recreational use and may occur repeatedly throughout the working day. Quantifying this exposure is challenging, however, because self-reported duration may not accurately reflect actual device use. In a study conducted in Pakistan, self-reported smartphone use showed only moderate agreement with objectively recorded use, highlighting the potential for measurement error when daily exposure is assessed by recall [6]. Nevertheless, duration of smartphone use remains a practical exposure measure for epidemiological studies in settings where objective device-derived data are not available.

Growing evidence has raised concerns about the musculoskeletal consequences of frequent handheld-device use. A systematic review of mobile-phone-related musculoskeletal complaints found that pain was the most frequently reported symptom and that the neck and upper back were among the most commonly affected regions, while also emphasizing the limitations of the predominantly observational evidence [7]. Earlier research among mobile handheld-device users similarly identified musculoskeletal symptoms involving the neck, shoulders, upper extremities, and back [8]. Among young populations, greater smartphone addiction has been associated with a higher prevalence of musculoskeletal pain involving multiple anatomical regions [9]. More recently, a 2025 systematic review and meta-analysis found significantly greater odds of neck pain among individuals classified as smartphone overusers, although the included evidence remained observational and heterogeneous [10]. Collectively, these findings support an association between intensive smartphone exposure and musculoskeletal symptoms, but they also reveal an important limitation in the existing literature: research has focused predominantly on neck, upper-extremity, or multisite symptoms, whereas the relationship between daily smartphone-use duration and back pain as a distinct outcome remains less clearly characterized.

There are plausible biomechanical pathways through which prolonged smartphone exposure could contribute to musculoskeletal symptoms. Smartphone use can involve sustained neck and trunk flexion,

reduced postural variation, and prolonged maintenance of relatively static positions. A study comparing young people with and without neck pain examined differences in muscle activity during touchscreen smartphone use [11]. Laboratory research has further demonstrated measurable alterations in spinal posture during smartphone use, including changes in thoracic kyphosis and trunk inclination [12]. Field research among university students has likewise examined spinal posture and postural variation during smartphone use [13]. These findings provide biological and ergonomic plausibility for an association between prolonged smartphone exposure and musculoskeletal symptoms. However, postural changes do not establish that smartphone use causes back pain. Back pain is multifactorial, and occupational workload, physical activity, body composition, psychosocial factors, sleep, and other lifestyle characteristics may influence both musculoskeletal symptoms and smartphone-use patterns [1–3]. Accordingly, smartphone exposure should be evaluated as a potential correlate of back pain rather than presumed to represent a single causal mechanism.

The relevance of this question may be particularly important among healthcare professionals because smartphone exposure occurs alongside established occupational musculoskeletal demands. Recent evidence from healthcare populations is emerging but remains limited. In a 2025 cross-sectional study of 207 healthcare workers in Istanbul, Türkiye, smartphone-related measures were examined in relation to musculoskeletal pain, with associations reported for multisite musculoskeletal outcomes [14]. Although this study provides important evidence from a healthcare-worker population, its primary exposure and outcome framework differed from an analysis of daily smartphone-use duration and back pain specifically. Similarly, a 2025 cross-sectional study among medical and nursing undergraduates reported that participants used smartphones for an average of approximately 4.4 hours per day and that neck pain was the most common musculoskeletal complaint, followed by lower-back and wrist/hand pain [15]. However, the study primarily evaluated smartphone addiction and its associations with neck and wrist/hand symptoms rather than testing daily smartphone-use duration against back pain as the principal outcome. These differences in population, exposure definition, and outcome ascertainment leave uncertainty regarding whether the amount of daily smartphone exposure is associated with back pain among young healthcare professionals.

The Pakistani evidence further defines this unresolved question. The Karachi study by Javed et al. established a substantial local burden of low back pain among medical doctors but did not evaluate smartphone-use duration as an exposure [4]. Meanwhile, Pakistani research has demonstrated that self-reported smartphone-use duration may differ from objectively recorded exposure [6]. Thus, the existing local literature establishes both a considerable burden of back-related symptoms among healthcare professionals and a relevant challenge in measuring smartphone exposure, but it does not clarify whether greater daily smartphone use is associated with a higher prevalence of back pain. This question is particularly relevant among younger healthcare professionals, who may experience frequent smartphone exposure for education, communication, information access, and clinical activities while simultaneously encountering occupational demands associated with musculoskeletal symptoms. Examining this relationship therefore addresses a distinct question from previous prevalence studies of low back pain in Karachi.

Accordingly, the present study investigated the association between daily smartphone-use duration and 12-month self-reported back pain among healthcare professionals aged 20–35 years recruited from two healthcare institutions in Karachi, Pakistan. The primary exposure was smartphone use of ≥ 4 hours/day versus < 4 hours/day, and the primary outcome was any self-reported upper- or lower-back pain or discomfort during the preceding 12 months. We additionally characterized the anatomical distribution and selected characteristics of back pain and described smartphone-use and ergonomic practices. Because of the cross-sectional design, the study was designed to evaluate an association rather than establish causality. The primary analysis therefore used a parsimonious modified Poisson regression model to estimate prevalence ratios adjusted for age group and gender, with alternative exposure categorization, conventional logistic regression, penalized logistic regression, and institution-adjusted analysis used to examine the robustness of the observed association.

2. Methods

2.1 Study design and setting

A cross-sectional study was conducted from April to October 2025 at Jinnah Postgraduate Medical Centre (JPMC) and Creek General Hospital in Karachi, Pakistan. The study assessed the 12-month prevalence of self-reported back pain and its association with smartphone-use duration, smartphone-use behaviors, and ergonomic practices among young healthcare professionals. The two institutions were selected on the basis of accessibility and feasibility of participant recruitment.

2.2 Study population and eligibility criteria

Healthcare professionals aged 20–35 years who were undertaking clinical training or professional duties at either participating institution were eligible. Participants were required to actively use a smartphone, work or train in a clinical setting, and provide informed consent.

Participants were excluded if they had a diagnosed chronic back condition, back injury or trauma within the preceding 6 months, or current pregnancy. Pregnancy status was assessed verbally before questionnaire administration but was not recorded in the anonymous dataset. Previous nonspecific episodes of back pain were not an exclusion criterion unless they met a predefined exclusion condition.

Qualification and current professional status were recorded separately.

2.3 Sample-size calculation

Sample size was calculated using Cochran's formula for estimation of a population proportion:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

where *Z* was 1.96 for a 95% confidence level, *p* was the anticipated prevalence, and *d* was the desired absolute precision. Because the expected prevalence in the target population was uncertain, *p* was set at

50%. An absolute precision of 8% produced an initial sample size of approximately 150 participants.

A 10% allowance for potential nonresponse or incomplete responses increased the recruitment target to 165 participants. This represented a planning allowance rather than an observed response rate. The final analysis included 168 eligible participants.

The calculation was intended primarily for prevalence estimation and was not specifically powered for the smartphone-use/back-pain association or for a highly parameterized regression model.

2.4 Sampling and recruitment

Participants were recruited using non-probability convenience sampling. Potential participants were screened against the predefined eligibility criteria before receiving access to the electronic questionnaire. The same eligibility criteria were applied irrespective of reported smartphone-use duration or back-pain status.

A total of 174 questionnaire responses were received. Six responses were excluded because the respondents reported a back injury or trauma within the preceding 6 months, meeting the prespecified exclusion criterion. The final analytical sample comprised 168 participants. Because the total number of individuals approached or invited was not recorded, a conventional participation rate could not be calculated. The participant flow is summarized in Supplementary Figure S1.

The questionnaire was administered electronically through Google Forms. Participants were informed of the study purpose, voluntary nature of participation, confidentiality, and their right to discontinue before submission. Electronic informed consent was obtained before questionnaire completion. Pasted markdown

2.5 Questionnaire development and pilot testing

The questionnaire comprised four sections. Smartphone-use behavior items were selected and adapted from the Smartphone Addiction Scale–Short Version (SAS-SV) [16], while questions assessing back-pain location and musculoskeletal symptoms were adapted from the Standardised Nordic Musculoskeletal Questionnaire (NMQ) [17]. The SAS-SV was developed as a shortened measure of smartphone addiction, and the original instrument demonstrated reliability and validity in its validation population [16]. The NMQ was developed as a standardized questionnaire for assessing musculoskeletal symptoms [17].

Items were selected because they addressed the study objectives, including smartphone-use duration and behaviors, back-pain location and symptoms, and ergonomic practices. Wording and response options were adapted where necessary for the study population and research objectives. Ergonomic questions concerning posture, breaks, and posture changes were developed with reference to general ergonomic principles [18].

Before the main survey, the questionnaire was pilot-tested in 15 participants, corresponding to 10% of the initial calculated sample size of 150. The pilot assessment examined clarity, comprehensibility,

relevance, and practical usability of the questions and response options. Feedback was used to refine unclear wording and questionnaire presentation. Pilot participants were not included in the final analytical sample.

Because the questionnaire used selected and modified items rather than complete validated instruments, it was not treated as a validated composite scale. The pilot study was used to assess clarity and feasibility of the adapted questionnaire rather than to establish its full psychometric properties. No composite SAS-SV or NMQ score or diagnostic cutoff was calculated; individual items were analyzed separately.

2.6 Data collection

Smartphone use

Participants reported average daily smartphone use in four categories: less than 1, 1–3, 4–6, and more than 6 hours/day. For the primary analysis, these categories were grouped into less than 4 hours/day and at least 4 hours/day, using the boundary between the questionnaire's 1–3-hour and 4–6-hour response categories. This pragmatic grouping allowed comparison of participants reporting lower versus higher daily use while avoiding reliance on the less-than-1-hour category, which included only six participants, as the reference group in the primary analysis. The 4-hour cut point was an analytical categorization, not an established clinical or biological threshold. The original four categories were retained for sensitivity analysis.

Three additional items assessed use of a smartphone longer than intended, use while lying in bed, and remaining in the same position for extended periods. Responses were recorded on five-point Likert scales from strongly disagree to strongly agree.

“Longer than intended” referred to the participant’s own intended duration and did not imply a fixed time threshold. “Extended periods” likewise reflected the wording of the questionnaire item and was not assigned a separate numerical duration.

Back pain

The primary outcome was self-reported back pain or discomfort during the preceding 12 months, assessed separately for the upper/thoracic and lower/lumbar regions. Upper-back pain was defined as the T1–T12 region and lower-back pain as the L1–L5 region.

Any back pain was defined as reporting pain in either region or both. Upper- and lower-back categories were not mutually exclusive; participants reporting both regions were classified as having any back pain and were counted in both anatomical categories for descriptive reporting. Participants selecting “None” were classified as having no back pain. Pasted markdown

Participants reporting back pain were additionally asked about pain duration, frequency during the preceding 6 months, activities affected, healthcare consultation, medication use, and perceived

attribution of symptoms to smartphone use or posture. These variables were used to describe reported symptoms and did not redefine the primary outcome.

Ergonomic practices

Participants reported the frequency of maintaining a neutral neck/back posture, taking breaks every 20–30 minutes during prolonged use, and stretching or changing posture during smartphone use. Responses ranged from never to always. These questions were analyzed individually rather than as a composite ergonomic score. Pasted markdown

2.7 Data management

Responses were exported from Google Forms, checked for eligibility and completeness, and coded before analysis. A binary variable representing any 12-month back pain was derived from the upper- and lower-back responses. The original four-category smartphone-use variable was retained, while the primary exposure variable was created by dichotomizing use at 4 hours/day.

No missing values were identified among variables included in the primary or sensitivity analyses. Follow-up questions applicable only to participants reporting back pain were analyzed within that subgroup. Pasted markdown

2.8 Statistical analysis

All analyses were performed using Stata/SE 15 (StataCorp LLC, College Station, TX, USA).

Categorical variables were summarized using frequencies and percentages. The 12-month prevalence of any back pain was calculated with 95% confidence intervals using the Wilson score method.

Pearson's chi-square test was used for exploratory comparisons of categorical variables.

Because the outcome was common, the primary association analysis used modified Poisson regression with robust variance to estimate prevalence ratios (PRs) [19]. This approach has been evaluated for estimating prevalence ratios in cross-sectional studies and avoids relying on odds ratios as the primary measure when the outcome is common.

The primary exposure was smartphone use of ≥ 4 hours/day versus < 4 hours/day. The primary adjusted model included age group and gender. Age was categorized as 20–24, 25–29, and 30–35 years. The model was intentionally parsimonious because 125 participants reported back pain whereas only 43 did not.

Age and gender were selected a priori as measured demographic covariates. Behavioral and ergonomic variables were not included in the primary model because their temporal relationship with back pain could not be established in this cross-sectional study and their inclusion would increase model complexity.

Sensitivity analyses included: (1) modified Poisson regression using the original four smartphone-use categories, with < 1 hour/day as the reference; (2) conventional logistic regression using the same age- and gender-adjusted specification; (3) Firth penalized logistic regression, used as a small-sample sensitivity analysis; and (4) an institution-adjusted modified Poisson model.

Firth penalization can reduce bias in maximum-likelihood logistic regression and provides finite estimates in situations involving separation, particularly in small or unbalanced datasets [20].

The four-category analysis was considered a sensitivity analysis rather than a formal dose-response analysis because only six participants reported < 1 hour/day of smartphone use.

Results from modified Poisson models were reported as PRs with 95% confidence intervals, while logistic models were reported as adjusted odds ratios (ORs) with 95% confidence intervals. All tests were two-sided, with $P < 0.05$ considered statistically significant. Analyses other than the primary model were considered exploratory.

Clinical trial number:

Not applicable

Ethical considerations

Ethical approval

was obtained from the Institutional Review Board of Jinnah Postgraduate Medical Centre, Karachi, Pakistan (reference number: JPMC/IRB/2025/915). The study protocol was approved on 25 March 2025, and the approval letter was issued on 4 April 2025. The study was conducted in accordance with the principles of the Declaration of Helsinki. Electronic informed consent was obtained from all participants before questionnaire completion. Participation was voluntary, and participants could decline participation or discontinue the questionnaire before submission. Responses were collected without direct personal identifiers, and access to the dataset was restricted to the research team.

Generative artificial intelligence

ChatGPT (OpenAI) was used during manuscript preparation to assist with language editing, manuscript organization, and drafting descriptions of statistical findings. Statistical analyses were performed using Stata/SE 15. The authors reviewed the statistical outputs and verified the AI-assisted text before incorporating it into the manuscript.

3. Results

3.1. Participant characteristics

Of the 174 questionnaire responses received, 6 were excluded during eligibility screening, leaving 168 participants for analysis. The largest age group was 20–24 years (76/168, 45.2%), followed by 25–29 years (72/168, 42.9%) and 30–35 years (20/168, 11.9%). There were 100 female participants (59.5%) and 68 male participants (40.5%).

Most participants reported MBBS as their healthcare qualification (121/168, 72.0%), followed by BDS (20/168, 11.9%), DPT (17/168, 10.1%), and Nursing (6/168, 3.6%); four participants (2.4%) were classified as having other qualifications. Regarding professional status, 102 participants (60.7%) were House Officers/Interns, 47 (28.0%) were Postgraduate Residents/Trainees, and 19 (11.3%) held other professional roles. Participants were recruited from Jinnah Postgraduate Medical Centre (86/168, 51.2%) and Creek General Hospital (82/168, 48.8%). Participant characteristics are presented in Supplementary Table S1.

3.2. Smartphone-use patterns and ergonomic practices

Daily smartphone use was reported as 4–6 hours by 81 participants (48.2%), more than 6 hours by 47 (28.0%), 1–3 hours by 34 (20.2%), and less than 1 hour by 6 (3.6%). Overall, 128 participants (76.2%) reported smartphone use of at least 4 hours per day.

For smartphone-use behaviors, 115 participants (68.5%) agreed or strongly agreed that they often used their smartphone longer than intended. Use while lying in bed was endorsed by 124 participants (73.8%), while 90 (53.6%) agreed or strongly agreed that they remained in the same position for long periods while using their smartphone.

Regarding ergonomic practices, 81 participants (48.2%) reported never or rarely maintaining a neutral neck and back posture. Similarly, 94 (56.0%) reported never or rarely taking breaks every 20–30 minutes, and 85 (50.6%) reported never or rarely stretching or changing posture during smartphone use. The distributions of smartphone-use behaviors and ergonomic practices are presented in Supplementary Table S2.

3.3. Prevalence and characteristics of back pain

Overall, 125 of 168 participants reported back pain during the preceding 12 months, giving a prevalence of 74.4% (95% confidence interval [CI], 67.3–80.4%). Lower-back involvement was reported by 90 participants (53.6%), while upper-back involvement was reported by 57 (33.9%). Twenty-two participants (13.1%) reported pain in both regions. Because anatomical categories overlapped, the upper- and lower-back percentages are not mutually exclusive.

Among the 125 participants reporting 12-month back pain, 75 (60.0%) reported pain lasting less than 1 week, 26 (20.8%) reported 1–4 weeks, 10 (8.0%) reported more than 1 month, and 14 (11.2%) reported chronic or ongoing pain. For the separate question about frequency during the preceding 6 months, responses among these 125 participants were rarely in 32 (25.6%), occasionally in 47 (37.6%), frequently in 33 (26.4%), and daily or nearly daily in 13 (10.4%).

Regarding self-reported interference with activities, 75 participants (60.0%) reported effects on clinical duties, 54 (43.2%) on studying, 50 (40.0%) on sleep, and 36 (28.8%) on exercise. Nine participants (7.2%) selected “None.” Multiple activities could be selected, so these categories were not mutually exclusive.

Among participants reporting back pain, 73 (58.4%) had never consulted a healthcare professional for their symptoms, 30 (24.0%) had consulted once, 15 (12.0%) occasionally, and 7 (5.6%) frequently. Regarding medication use, 31 (24.8%) reported never using medication, 26 (20.8%) using it once, 42 (33.6%) occasionally, and 26 (20.8%) frequently.

When asked whether they believed their back pain was related to smartphone use or posture during use, 48 participants (38.4%) reported slight attribution, 39 (31.2%) moderate attribution, 23 (18.4%) strong attribution, and 15 (12.0%) no attribution. These responses reflect participants’ perceptions rather than confirmation of a causal relationship. Back-pain prevalence and symptom characteristics are summarized in Supplementary Table S3.

3.4. Primary association between smartphone-use duration and back pain

Back pain was reported by 103 of 128 participants (80.5%) who used smartphones for at least 4 hours per day, compared with 22 of 40 (55.0%) who used them for less than 4 hours per day (Fig. 1). The unadjusted Pearson chi-square comparison indicated a difference between these groups ($P = 0.001$).

In the crude modified Poisson model, smartphone use of at least 4 hours per day was associated with a higher prevalence of back pain (PR, 1.46; 95% CI, 1.09–1.96; $P = 0.011$). After adjustment for age group and gender, the association remained similar (adjusted PR [aPR], 1.49; 95% CI, 1.09–2.05; $P = 0.013$). Thus, the prevalence of back pain was approximately 49% higher in the group reporting at least 4 hours of daily smartphone use than in the group reporting less than 4 hours.

In the adjusted model, neither the 25–29-year age group (aPR, 0.94; 95% CI, 0.78–1.13; $P = 0.492$) nor the 30–35-year age group (aPR, 1.02; 95% CI, 0.71–1.46; $P = 0.912$) differed significantly from the 20–24-year reference group. Male gender was also not significantly associated with back-pain prevalence (aPR, 0.98; 95% CI, 0.82–1.18; $P = 0.855$).

3.5. Sensitivity analyses

In the four-category modified Poisson analysis, with smartphone use of less than 1 hour per day as the reference, the adjusted PR was 0.80 (95% CI, 0.41–1.55; $P = 0.503$) for 1–3 hours per day, 1.18 (95% CI, 0.64–2.18; $P = 0.600$) for 4–6 hours per day, and 1.34 (95% CI, 0.72–2.50; $P = 0.358$) for more than 6 hours per day. None of these category-specific comparisons reached statistical significance. The reference category contained only six participants, and the estimates do not establish a dose-response relationship.

The conventional age- and gender-adjusted logistic regression yielded an adjusted odds ratio (aOR) of 3.64 (95% CI, 1.57–8.45; *P* = 0.003) for smartphone use of at least 4 hours per day compared with less than 4 hours. Firth penalized logistic regression produced a similar estimate (aOR, 3.50; 95% CI, 1.54–7.96; *P* = 0.003).

In the additional modified Poisson model adjusted for study institution as well as age group and gender, smartphone use of at least 4 hours per day remained associated with higher back-pain prevalence (aPR, 1.49; 95% CI, 1.09–2.04; *P* = 0.013). The institution-adjusted estimate was essentially unchanged from the primary model.

All primary and sensitivity models included 168 participants, of whom 125 reported back pain and 43 did not. The primary and sensitivity estimates are presented in Supplementary Table S4 and Fig. 3.

4. Discussion

The findings suggest an association between longer daily smartphone use and a higher prevalence of self-reported back pain among young healthcare professionals in this sample. The association remained similar after adjustment for age group and gender and in the additional institution-adjusted model. However, because smartphone-use duration and back pain were assessed cross-sectionally, the temporal sequence cannot be established, and reverse causation remains possible. Residual confounding by occupational, physical, and psychosocial factors may also contribute to the observed association. These findings should therefore be interpreted as evidence of a cross-sectional association rather than a causal effect of smartphone use on back pain.

The findings are relevant to the existing burden of musculoskeletal symptoms among healthcare professionals. Reviews have documented substantial musculoskeletal morbidity in this population, with occupational exposures varying across professions and clinical environments [2, 3]. In Karachi, Javed et al. reported a high prevalence of low back pain among medical doctors working in teaching hospitals [4]. That study provides an important local comparison, but its findings are not directly interchangeable with ours: it focused on doctors and low back pain, whereas the present study considered upper- and lower-back symptoms among a broader group of young healthcare professionals. Differences in professional composition, anatomical definitions, recall periods, and assessment instruments may contribute to variation between estimates. The findings should therefore be understood as complementary evidence concerning musculoskeletal symptoms in local healthcare settings, rather than as evidence that the two studies measured an identical outcome.

Evidence linking smartphone use with musculoskeletal symptoms is increasingly available, although differences in exposure and outcome definitions limit direct comparisons. Among healthcare workers in Türkiye, Is et al. found that higher smartphone-addiction scores were associated with multisite musculoskeletal pain and selected pain-related outcomes, including neck disability [14]. Mustafaoglu et al. similarly reported associations between smartphone-addiction scores and musculoskeletal symptoms, including upper-back pain, in a young population [9]. Research among medical and nursing

undergraduates has also described substantial musculoskeletal symptoms in relation to smartphone-use patterns, although the anatomical outcomes and exposure measures differ from those examined here [15]. Together, these studies support the plausibility of a relationship between smartphone-related behaviors and musculoskeletal symptoms. Nevertheless, problematic-use or addiction scores are not equivalent to daily hours of use, and findings concerning neck, wrist, jaw, or multisite pain cannot automatically be generalized to back pain. The present findings are most appropriately interpreted as evidence concerning the association between reported daily-use duration and a broad back-pain outcome.

Studies examining device-use duration provide a further point of comparison. In a young-adult birth-cohort analysis, Blumenberg et al. reported associations between longer mobile-device use and selected spinal pain outcomes, including low back pain among those reporting particularly long daily use [22]. However, associations differed by anatomical region and exposure category. Similarly, the systematic-review evidence concerning smartphone overuse and neck pain addresses a related but distinct musculoskeletal outcome [10]. The evidence as a whole does not establish a universal daily-use threshold at which back pain develops. In the present study, the four-hour contrast was an analytical categorization, and the four-category sensitivity analysis did not establish a clear dose-response pattern. The results therefore support further investigation of duration as a potentially relevant exposure, but they do not demonstrate that increasing smartphone-use time produces a graded increase in back-pain prevalence.

Several mechanisms may plausibly link smartphone-related behaviors with musculoskeletal symptoms, although none was directly tested in this study. Smartphone interaction can involve sustained cervical and upper-thoracic flexion, reduced variation in spinal posture, and static positioning. Field measurements among university students have documented greater cervical and upper-thoracic flexion during smartphone use than during periods of non-use [13]. Laboratory research has likewise demonstrated changes in spinal posture during smartphone tasks [12]. These observations provide biomechanical plausibility, not proof that such postural changes cause back pain. Symptoms may reflect the combined effects of posture, duration, repetition, recovery time, and individual susceptibility rather than a single behavior. Moreover, healthcare professionals may use smartphones alongside prolonged standing, patient handling, extended shifts, and other physical demands. Occupational and psychosocial factors have been repeatedly implicated in healthcare-worker musculoskeletal complaints [2, 3]; consequently, smartphone duration should be considered one possible correlate within a multifactorial setting rather than an isolated explanation for back pain.

The ergonomic findings should also be interpreted cautiously. Self-reported posture, break-taking, and stretching practices describe behavior but do not establish whether those behaviors preceded symptoms or were adopted in response to them. Participants experiencing pain may change posture, take more frequent breaks, stretch, or deliberately reduce or alter smartphone use. Conversely, participants without symptoms may pay less attention to these practices. Such reverse causation can complicate cross-sectional associations between reported behavior and pain. Furthermore, the present

study did not establish that specific ergonomic practices mediated or modified the association between smartphone-use duration and back pain. The reported behaviors therefore provide useful context for future investigation but should not be treated as evidence that any particular practice is effective or ineffective at preventing symptoms.

These findings have potential relevance for occupational-health research and practice, but they do not justify treating four hours of daily smartphone use as a clinical threshold or a causal boundary. Healthcare institutions may reasonably consider smartphone habits alongside established occupational exposures when assessing musculoskeletal health, particularly because mobile devices are also used for clinical communication, information retrieval, and education [5]. However, prevention strategies should not focus on smartphone duration alone. Future evaluations should consider device-use patterns together with physical workload, work organization, posture, opportunities for movement and recovery, and individual health characteristics. Any ergonomic intervention should be assessed prospectively rather than inferred to be effective from cross-sectional symptom reports.

Several features strengthen the contribution of this study. It examines smartphone-use duration specifically in a young healthcare-professional population and considers back symptoms in both upper- and lower-back regions. Its findings complement local epidemiological evidence on back pain among doctors [4] and international studies of smartphone-related musculoskeletal symptoms [9, 14, 15]. Using a prevalence-based primary association measure also allows the findings to be interpreted directly in relation to the outcome's frequency, while sensitivity analyses provide information about the consistency of the observed association across alternative model specifications.

The findings must nevertheless be interpreted in light of important limitations. First, the cross-sectional design prevents determination of temporal order and leaves reverse causation possible. Second, convenience recruitment at two institutions limits representativeness; the observed burden should not be generalized to all healthcare professionals in Karachi. Third, smartphone use, back pain, and ergonomic behaviors were self-reported. Recall error, imprecise estimation of daily use, and common-method bias may have affected the observed association, and device-generated screen-time data were not available. Although the questionnaire was pilot-tested, selected items were adapted from existing instruments and combined with study-specific questions; the psychometric properties of the resulting questionnaire were not formally re-established. In addition, the analysis could not adequately account for potentially important factors such as body mass index, physical activity, workload, prolonged standing, patient handling, sleep, and psychosocial stress. Previous nonspecific episodes of back pain were not comprehensively measured, and the relatively small number of participants without back pain limits the precision of multivariable estimates. Finally, reported interference with studying, clinical duties, sleep, and exercise was based on individual questionnaire items rather than a validated disability instrument. These outcomes should therefore be interpreted as self-reported interference, not as clinically established functional disability.

Future studies should use prospective designs to establish whether smartphone-use patterns precede the onset or persistence of back pain. Combining device-generated screen-time records with repeated symptom assessment and more comprehensive measurement of occupational and lifestyle exposures would help distinguish the contribution of smartphone use from correlated behaviors and workplace demands. Larger, more representative samples and appropriately validated instruments would also improve precision and allow more reliable evaluation of exposure categories and potential dose-response relationships.

In conclusion, smartphone use of ≥ 4 hours/day was associated with a higher prevalence of self-reported back pain than use of less than 4 hours/day among young healthcare professionals in this Karachi sample. The cross-sectional design does not establish causation or temporal order, and convenience sampling limits generalizability. The four-hour grouping was an analytical categorization rather than a clinical threshold. Prospective studies incorporating objective smartphone-use data and more comprehensive assessment of occupational and lifestyle factors are warranted.

Abbreviations

aOR
Adjusted odds ratio
aPR
Adjusted prevalence ratio
BDS
Bachelor of Dental Surgery
CI
Confidence interval
DPT
Doctor of Physical Therapy
ICMJE
International Committee of Medical Journal Editors
IRB
Institutional Review Board
JPMC
Jinnah Postgraduate Medical Centre
MBBS
Bachelor of Medicine, Bachelor of Surgery
NMQ
Nordic Musculoskeletal Questionnaire
OR
Odds ratio
PR
Prevalence ratio

SAS-SV
Smartphone Addiction Scale–Short Version

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional Review Board of Jinnah Postgraduate Medical Centre, Karachi, Pakistan (reference number: JPMC/IRB/2025/915). The study protocol was approved on 25 March 2025, and the approval letter was issued on 4 April 2025. The study was conducted in accordance with the principles of the Declaration of Helsinki. Electronic informed consent was obtained from all participants before questionnaire completion. Participation was voluntary, and responses were collected without direct personal identifiers. Access to the dataset was restricted to the research team.

Consent for publication

Not applicable. This manuscript contains no identifiable personal information, images, or videos relating to individual participants.

Clinical trial number:

Not applicable

Availability of data and materials

The data supporting the findings are summarized in the manuscript and its tables. The participant-level dataset is not publicly available because public data sharing was not included in the original consent process. A de-identified dataset may be available from the corresponding author on reasonable request, subject to approval from the relevant institutional ethics committee.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

S.K. and I.P. contributed to the conception and design of the study, data curation, statistical analysis, interpretation of findings, visualization, and preparation of the original manuscript draft. Z.A. and S.M.J. conducted participant recruitment and data collection at Creek General Hospital. S.R.A. and S.I. conducted participant recruitment and data collection at Jinnah Postgraduate Medical Centre. H.N., B.H.,

A.I., and I.T. contributed to data acquisition, data validation, and interpretation of the findings. All authors critically reviewed and revised the manuscript, approved the final version for publication, and agreed to be accountable for the work. All authors fulfilled the authorship criteria established by the ICMJE.

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Generative artificial intelligence statement

ChatGPT (OpenAI) was used to assist with manuscript organization, language editing, and the interpretation and presentation of statistical outputs generated using Stata/SE 15. The authors conducted the statistical analyses, reviewed and verified the outputs, interpretations, and references, and take full responsibility for the final manuscript.

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Figures

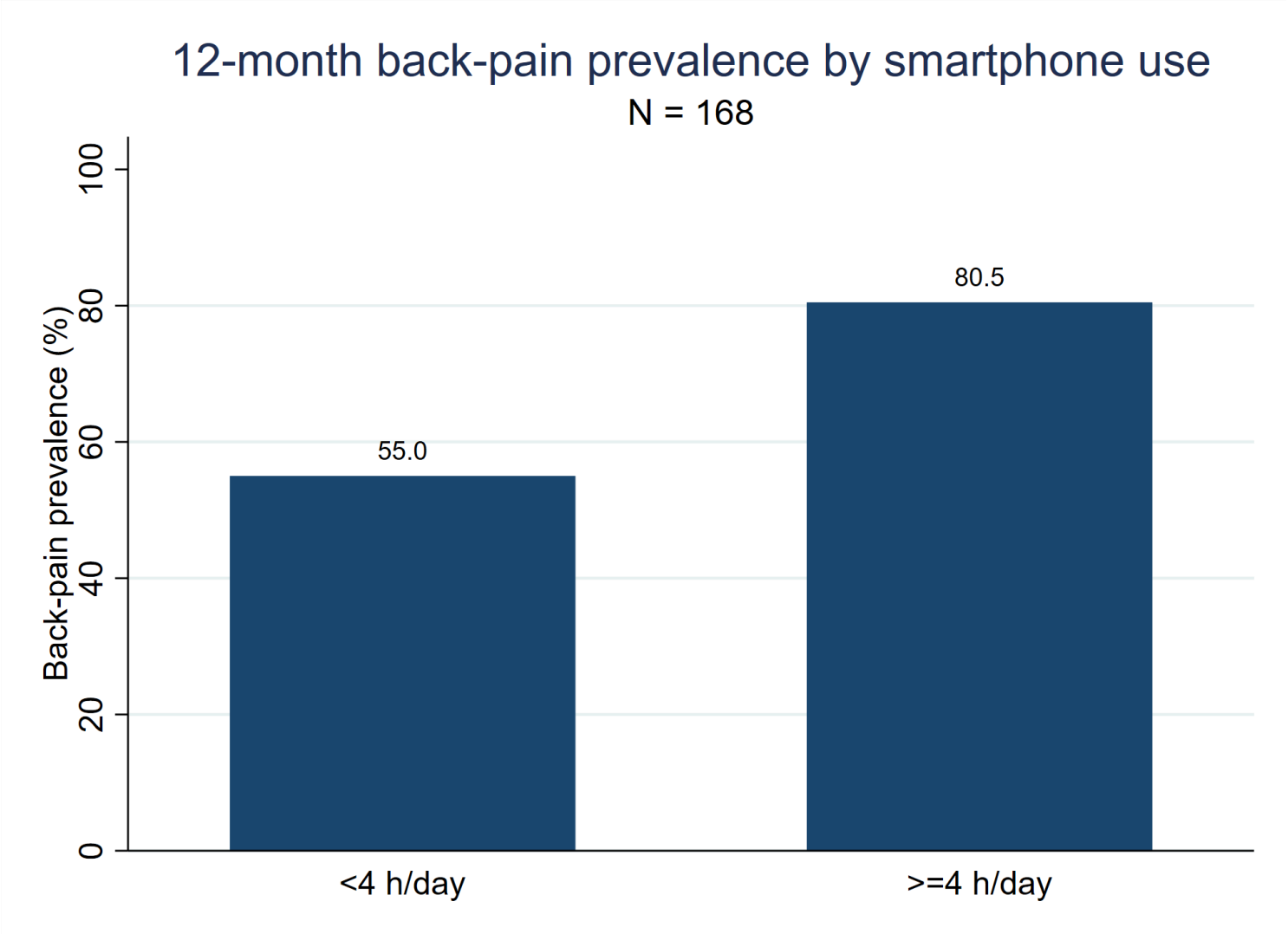


Figure 1

Twelve-month prevalence of back pain by daily smartphone-use duration. *P* = 0.001.

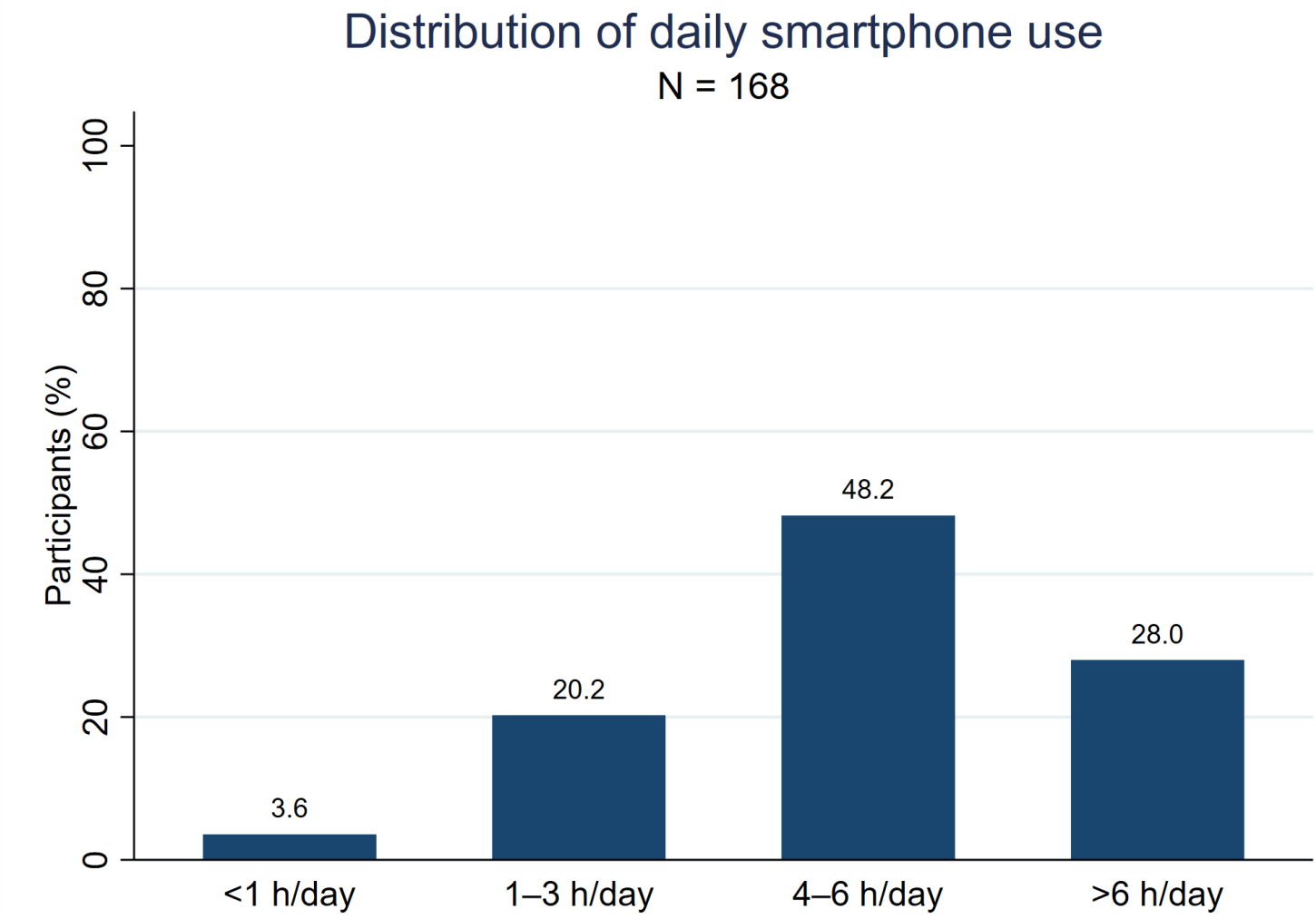


Figure 2

Distribution of daily smartphone-use duration among participants (N = 168).

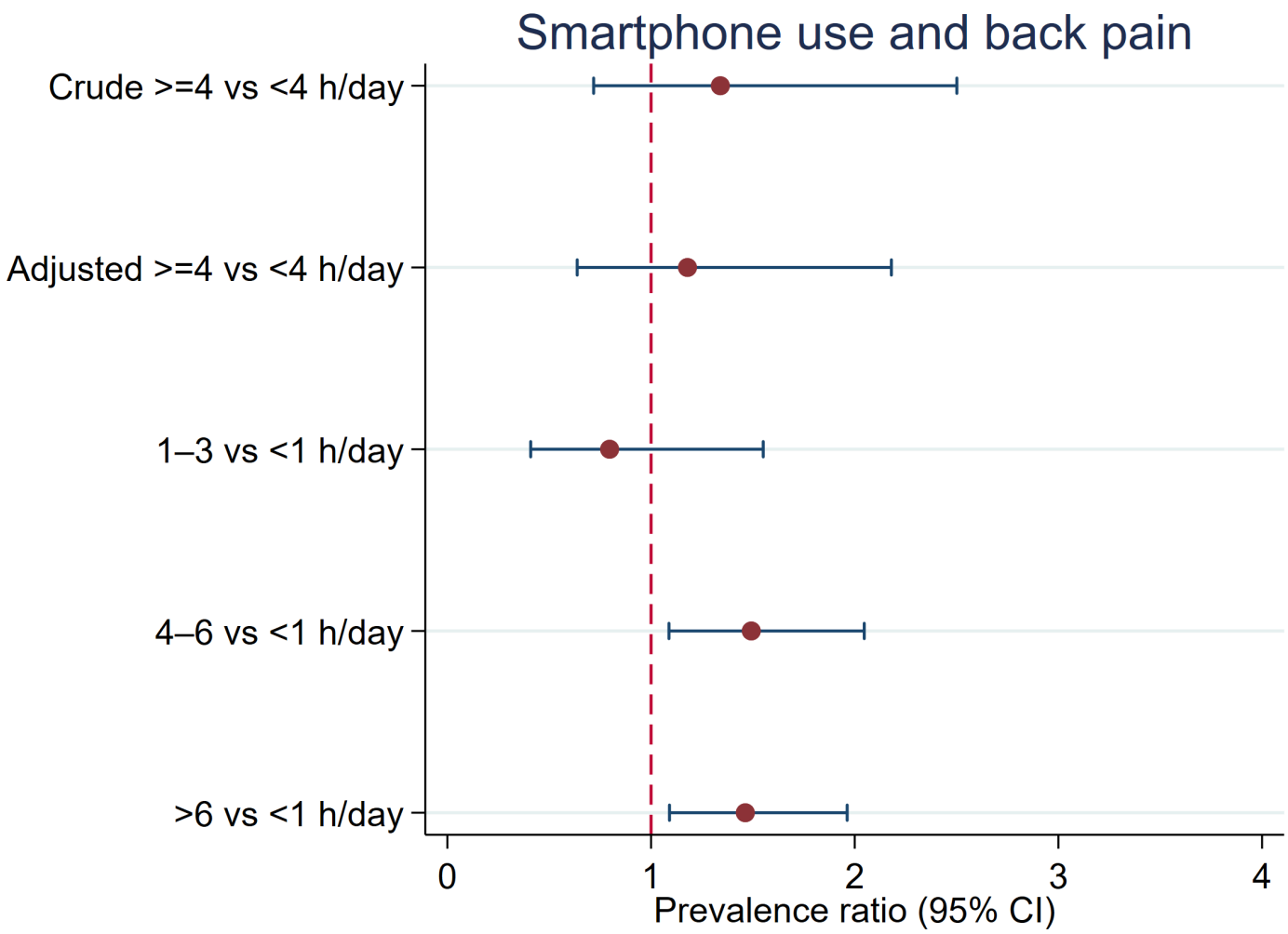


Figure 3

Forest plot of crude and adjusted prevalence ratios (PRs) with 95% confidence intervals (CIs) for the association between smartphone use and back pain. The four-category analysis was adjusted for age and gender.

Supplementary Files

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- SupplementaryMaterials.docx