Cureus
Part of SPRINGER NATURE

Open Access Original Article

Published via Krishna Vishwa Vidyapeeth (Deemed to be University), Karad.

Prevalence of Pelvic Postural Alignment and Hamstring Flexibility Among Sedentary Working Professionals

Received 09/01/2026
Review began 10/29/2026
Review ended 11/07/2026
Published 11/13/2026

© Copyright 2026
Shewale et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI: 10.7759/cureus.119643

Samruddhi P. Shewale [1], Shraddha Mohite [1]

1. Physiotherapy, Krishna Vishwa Vidyapeeth (Deemed To Be University), Karad, IND

Corresponding author: Samruddhi P. Shewale, samruddhipshewale8909@gmail.com

Abstract

Background: Prolonged occupational sitting is increasingly common among desk-based professionals and may be associated with alterations in lumbopelvic posture and reduced hamstring flexibility. However, limited evidence is available regarding the prevalence of altered pelvic alignment and reduced hamstring flexibility within the same sedentary working population and whether these characteristics are directly associated.

Objective: To determine the prevalence of altered pelvic postural alignment and reduced hamstring flexibility among sedentary working professionals and to examine the relationships between pelvic alignment, hamstring flexibility, and daily occupational sitting duration.

Method: A cross-sectional observational study was conducted among 111 sedentary working professionals aged 35-50 years who reported at least six hours of occupational sitting per working day. Pelvic postural alignment was assessed in standing using standardized lateral photographs and the PhysioCode Postural Assessment application. Hamstring flexibility was assessed bilaterally using the Straight Leg Raise (SLR) and 90-90 popliteal angle tests. A mean popliteal angle >20° was operationally classified as reduced hamstring flexibility. Pearson correlation analysis was used to examine relationships between continuous variables, Fisher's exact test was used to assess the association between pelvic alignment and hamstring flexibility categories, and one-way analysis of variance (ANOVA) was used to compare flexibility measures across 6-, 7-, and 8-hour sitting-duration groups. Statistical significance was set at $p<0.05$.

Results: Among the 111 participants, 99 (89.2%; 95% confidence interval (CI): 82.0-93.7) demonstrated altered pelvic alignment, with mild posterior pelvic tilt being the most frequently observed category (30.6%). Reduced hamstring flexibility was identified in 86 participants (77.5%; 95% CI: 68.9-84.3) based on the predefined popliteal-angle criterion. Pelvic tilt magnitude was not significantly correlated with mean popliteal angle (r=0.112, p=0.243) or mean SLR (r=−0.178, p=0.062). Similarly, the categorical association between pelvic alignment and hamstring flexibility was not statistically significant (Fisher's exact test, p=0.065). In contrast, daily sitting duration demonstrated a moderate negative correlation with mean SLR (r=−0.444, p<0.001). BMI was positively correlated with mean popliteal angle (r=0.262, p=0.005), while age was not significantly correlated with mean popliteal angle (r=0.086, p=0.371).

Conclusion: A high prevalence of altered pelvic alignment and reduced hamstring flexibility was observed among sedentary working professionals aged 35-50 years. However, the findings did not demonstrate a statistically significant direct association between pelvic alignment and hamstring flexibility. Greater daily occupational sitting duration was significantly associated with lower SLR values, suggesting that sitting exposure may be relevant when assessing hamstring flexibility in sedentary workers. As the study was cross-sectional, these findings represent associations rather than causal relationships.

Categories: Occupational Health, Physical Medicine & Rehabilitation, Orthopedics
Keywords: hamstring flexibility, occupational sitting, pelvic alignment, pelvic tilt, physiotherapy, popliteal angle, sedentary behavior, straight leg raise

Introduction

With the widespread adoption of computers and office-based jobs, sedentary occupations were defined as jobs involving predominantly desk-based activities with prolonged sitting and minimal physical movement during working hours. Examples included office employees, computer operators, administrative staff, accountants, and other professionals whose work required sitting for at least six hours per working day. Certain administrative, desk-based occupations, such as information technology and banking, require long periods of sitting for work.

Prolonged sitting is linked to low levels of physical activity and the need to maintain static positions for so long that it could lead to musculoskeletal adaptations and a decrease in flexibility [1]. Some previous

research among administrative and desk-based workers has reported high levels of hamstring tightness among those sitting for prolonged periods, and that sitting occupations may have an effect on the postures and flexibility of the lumbopelvic area [2,3]. The hamstring muscle group is important for hip and knee movement, and is responsible for the functional coupling of the pelvis and lower limb [4]. Prolonged maintenance of sedentary postures may contribute to adaptive changes in muscle flexibility, a phenomenon also demonstrated in studies investigating sustained cervical posture. In sedentary individuals, the prolonged maintenance of hip position in flexed position has been suggested as one of the factors that brings about adaptive changes in muscle flexibility [5,6]. The pelvis is a mechanism connecting the trunk and lower limb, thus it is an important aspect of lumbopelvic biomechanics [4]. Changes of pelvic position can change muscle length and the mechanical relationship between the pelvis, hip and lumbar spine [7]. Among sedentary people, the association between alignment of the pelvis, flexibility of the hamstrings and core muscle function has been specifically studied, and a complex relationship has been identified that may be influenced by position, age, sex, and habitual posture [4]. The hamstring flexibility is frequently evaluated through clinical examinations like the Straight Leg Raise (SLR) and the 90-90 popliteal angle test [8,9]. The reliability of clinical flexibility tests has also been tested and evidence has shown that hamstring flexibility is best assessed using standardized SLR and an active knee-extension test [9]. In addition, age and sex could affect the length of the hamstring muscle, suggesting that these factors should be taken into account when interpreting tests of flexibility [10]. Changes in hamstring flexibility and changes in lumbopelvic posture have been studied with relation to musculoskeletal disorders, and in particular LBP, making the potential relationship between hamstring flexibility and lumbopelvic posture clinically relevant [11,12]. While there is some evidence that limitations in hamstring flexibility or other measures of spinal or lower-limb mobility may have a relationship to the subsequent development of low back pain, the evidence was inconsistent regarding the relationship between hamstring flexibility, pelvic alignment and occupational sitting [12]. Other studies have found differences in hamstring length and lumbar posture in various groups and work environments, so that occupational exposure does not necessarily account for the variability in flexibility characteristics among individuals [11].

As sedentary behavior becomes more common, it has significant implications for occupational musculoskeletal health [1]. Increasingly, there has been a focus on physiotherapists to include appropriate screening and ergonomic education, movement breaks and preventative exercise strategies for sedentary working populations, in an attempt to prevent the onset of clinically significant musculoskeletal problems that might be prevented by early identification of flexibility deficits and postural alterations [13,14]. Although there is some evidence of the relationship between prolonged sitting and hamstring flexibility, there is relatively little research that has looked at both altered pelvic postural alignment and reduced hamstring flexibility in sedentary working professionals, especially within the middle-aged working population [3]. In addition, it is crucial to understand if there is a direct relationship between changes in pelvic alignment and reduction in hamstring flexibility and between duration of daily occupational sitting and clinically assessed flexibility [4]. Evidence also suggests that interventions aimed at reducing sedentary behavior may have potential relevance for the prevention and management of workplace musculoskeletal problems [15]. Postural assessment increasingly uses digital tools alongside clinical examination. A preliminary study of the PhysioCode Posture application reported good-to-excellent inter-examiner reliability, while intra-examiner reliability ranged from poor to moderate, indicating that digital assessment may support quantitative measurement but that consistency can vary by examiner and assessment view [16].

Materials And Methods

Study design and setting

A cross-sectional observational study was conducted among sedentary working professionals in and around Karad, Maharashtra, India. Study preparation commenced in January 2026; however, participant recruitment and data collection were initiated only after obtaining approval from the Institutional Ethics Committee (IEC) of Krishna Vishwa Vidyapeeth (Deemed To Be University), Karad. Ethical approval was granted on 27 February 2026 (Ref. No. KVV/IEC/03/2026; Protocol No.489/2025-2026). Following ethical clearance, participant recruitment and data collection were carried out from February to June 2026.

Participants

A convenience sampling method was used to recruit male and female sedentary working professionals aged 35-50 years who were engaged in desk-based occupations and reported occupational sitting for at least six hours per working day. Participants were screened according to the predefined inclusion and exclusion criteria. Those who met the eligibility criteria, provided written informed consent, and completed all required assessments were included in the final analysis. A total of 111 participants were included in the study.

Inclusion criteria

Participants were included if they were aged 35-50 years, irrespective of gender, and were engaged in a desk-based occupation. Participants were required to spend at least six hours sitting per working day as part of their occupational requirements and were willing to participate in the study. They were also required to be able to stand independently for postural assessment and perform the required hamstring flexibility tests.

Exclusion criteria

Participants were excluded if they were younger than 35 years or older than 50 years, had undergone spinal or lower-limb surgery within the previous six months, regularly performed flexibility training, or had a diagnosed neurological condition affecting posture.

Sample size and sampling

The minimum sample size was calculated using a 95% confidence interval (CI), an assumed prevalence of 50%, and an allowable error of 9.4%, resulting in a minimum of 109 participants. A total of 111 participants were included in the final analysis. The required sample size was calculated using the formula: $n = (Z^2 \times P \times Q)/L^2$, where Z=1.96 (95% CI), P=50% (assumed prevalence in the absence of a reliable prevalence estimate for the target population), Q=50% (100 − P), and the allowable error (L)=9.4%.

$$n = (1.96^2 \times 50 \times 50)/9.4^2$$

$$n \approx 109$$

Variables

The demographic and occupational variables recorded were age, gender, BMI,and daily sitting duration. The primary assessment variables were pelvic postural alignment, pelvic tilt magnitude, popliteal angle, and SLR angle.

Outcome measures

Pelvic Postural Alignment

Pelvic postural alignment was assessed in standing using standardized lateral photographs and the PhysioCode Postural Assessment application. Pelvic tilt was recorded in degrees and categorized into five categories: anterior tilt, mild anterior tilt, neutral, mild posterior tilt, and posterior tilt. For analysis, participants classified as anything other than neutral were considered to have altered pelvic alignment. The study did not independently assess the intra-rater or inter-rater reliability or criterion validity of the application for pelvic tilt measurement. The angular thresholds used to distinguish the five categories could not be verified from the available study documentation and are therefore not specified.

Popliteal Angle Test

Hamstring flexibility was assessed bilaterally using the 90-90 Active Knee Extension test with a universal goniometer. Participants were positioned supine with the hip flexed to 90° and instructed to actively extend the knee as far as possible. The examiner manually stabilized the pelvis to prevent compensatory movements. The knee extension deficit was measured in degrees on both sides, and the mean popliteal angle was calculated. A mean angle greater than 20° was considered indicative of reduced hamstring flexibility. The remaining knee flexion angle was measured using a universal goniometer. Right and left popliteal angles were recorded separately, and the mean popliteal angle was calculated as:

$$Mean\ popliteal\ angle = (Right\ popliteal\ angle + Left\ popliteal\ angle)/2$$

.

A mean popliteal angle greater than 20° was used as the operational cutoff for reduced hamstring flexibility in this study.

SLR Test

The SLR test was performed with the participant in the supine position and the knee maintained in extension. Passive hip flexion was performed until firm resistance was perceived or compensatory pelvic movement commenced. The hip flexion angle achieved was measured using a universal goniometer. Right and left SLR values were recorded separately, and the mean SLR angle was used for analysis.

Data collection procedure

Following ethical approval, eligible participants were approached and the purpose and procedures of the study were explained. Written informed consent was obtained before participation. Participants were screened according to the inclusion and exclusion criteria. Demographic and occupational information, including participant identification number, age, gender, occupation, years of work experience, BMI, and daily sitting duration, was recorded using a standardized data collection proforma. Pelvic postural alignment was subsequently assessed in standing using the Physio Code Postural Assessment application, and the pelvic tilt category and magnitude were documented. Hamstring flexibility was assessed bilaterally

using the 90-90 popliteal angle test and SLR test with a universal goniometer. The measurements were recorded in the standardized data collection proforma. The completed data were entered into a master chart for statistical analysis. The final dataset consisted of 111 complete records.

Statistical analysis

Statistical analysis was performed using SPSS software. Descriptive statistics were used to summarize the data. Continuous variables were expressed as means and standard deviations, whereas categorical variables were presented as frequencies and percentages. Pearson's correlation coefficient was used to examine the relationships between continuous variables, including pelvic tilt magnitude, mean popliteal angle, mean SLR, daily sitting duration, BMI, and age. Fisher's exact test was used to assess the association between pelvic alignment classification and hamstring flexibility classification. One-way analysis of variance (ANOVA) was used to compare mean popliteal angle values across the 6-, 7-, and 8-hour daily sitting-duration groups. The statistical analyses were based on the 111 complete participant records included in the final dataset. Formal assessments of normality and homogeneity of variance were not documented. A p-value of less than 0.05 was considered statistically significant. No adjustment for multiple comparisons was performed; therefore, the possibility of an inflated Type I error rate was acknowledged.

Ethical considerations

The study protocol was presented to the Protocol Committee and IEC of Krishna Vishwa Vidyapeeth (Deemed To Be University), Karad, India, before commencement of participant recruitment. Written informed consent was obtained from all participants before assessment. Participants were informed about the purpose and procedures of the study, their rights and responsibilities, and their right to withdraw from participation at any time without providing a reason. The study information also stated that data could be used for scientific publication or presentation without revealing participant identity.

Results

A total of 111 complete records of sedentary working professionals were included in the final analysis. The participants were aged 35-50 years, and all reported occupational sitting for six-eight hours per day. Continuous variables are presented as mean ± SD and range, whereas categorical variables are presented as frequency and percentage.

All 12 participants with neutral pelvic alignment demonstrated reduced hamstring flexibility (12/12, 100%), compared with 74 of 99 participants (74.7%) with altered pelvic alignment. However, the association between pelvic alignment classification and hamstring flexibility classification was not statistically significant (two-sided Fisher's exact test, p=0.065). The effect size was small (Cramér's V=0.188).

Detailed participant characteristics are presented in Table *1*. The mean age of the participants was 42.02 ± 4.72 years, with a mean BMI of 27.51 ± 3.96 kg/m^2.The mean daily sitting duration was 7.10 ± 0.83 hours. The mean SLR angle was 72.73 ± 7.98°, and the mean popliteal angle was 26.75 ± 8.55°. The mean pelvic tilt magnitude was 13.55 ± 2.87°.

Variable	Mean ± SD	Range
Age (years)	42.02 ± 4.72	35–50
BMI (kg/m²)	27.51 ± 3.96	20.3–34.4
Daily sitting duration (hours/day)	7.10 ± 0.83	6–8
Right SLR (°)	71.75 ± 7.95	56–86
Left SLR (°)	73.70 ± 8.01	58–88
Mean SLR (°)	72.73 ± 7.98	57–87
Right popliteal angle (°)	27.73 ± 8.53	12–44
Left popliteal angle (°)	25.77 ± 8.58	10–42
Mean popliteal angle (°)	26.75 ± 8.55	11–43
Pelvic tilt magnitude (°)	13.55 ± 2.87	8–20

TABLE 1: Descriptive characteristics of the study participants (n=111)

SLR: Straight Leg Raise

The distribution of gender and sitting duration is presented in Table 2. Of the 111 participants, 60 (54.1%) were male and 51 (45.9%) were female. Regarding daily occupational sitting duration, 33 participants (29.7%) reported six hours/day, 34 (30.6%) reported seven hours/day, and 44 (39.6%) reported eight hours/day.

Variable	Category	Number of Participants (n)	Percentage of Participants (%)
Gender	Male	60	54.1%
	Female	51	45.9%
Daily sitting duration	6 hours/day	33	29.7%
	7 hours/day	34	30.6%
	8 hours/day	44	39.6%
Total		**111**	**100.0%**

TABLE 2: Distribution of participants according to gender and daily sitting duration (n=111)

Pelvic postural alignment was categorized into anterior tilt, mild anterior tilt, neutral, mild posterior tilt, and posterior tilt. Mild posterior tilt was the most frequently observed category, occurring in 34 participants (30.6%), followed by anterior tilt in 32 participants (28.8%). Mild anterior tilt was observed in 16 participants (14.4%), posterior tilt in 17 participants (15.3%), and neutral pelvic alignment in 12 participants (10.8%). Overall,99 participants (89.2%) demonstrated non-neutral pelvic alignment, while 12 participants (10.8%) demonstrated neutral alignment. The distribution of participants according to pelvic postural alignment categories is presented in Table 3.

Pelvic alignment category	Number of participants (n)	Percentage of participants (%)
Anterior tilt	32	28.8%
Mild anterior tilt	16	14.4%
Neutral	12	10.8%
Mild posterior tilt	34	30.6%
Posterior tilt	17	15.3%
Total	**111**	**100.0%**

TABLE 3: Distribution of pelvic postural alignment categories (n=111)

Altered pelvic alignment, defined as any non-neutral pelvic alignment category, was observed in 99 of 111 participants (89.2%; 95% CI: 82.0-93.7), whereas 12 participants (10.8%; 95% CI: 6.3-18.0) demonstrated neutral alignment. Reduced hamstring flexibility was operationally defined as a mean popliteal angle >20°. Based on this criterion, reduced hamstring flexibility was observed in 86 participants (77.5%; 95% CI: 68.9-84.3),while 25 participants (22.5%; 95% CI: 15.7-31.1) demonstrated normal hamstring flexibility. The prevalence of altered pelvic alignment and reduced hamstring flexibility, along with their respective 95% CIs, is presented in Table 4.

Outcome	Number of participants (n)	Percentage of participants (%)	95% CI (%)
Altered pelvic alignment (non-neutral)	99	89.2	82.0–93.7%
Neutral pelvic alignment	12	10.8	6.3–18.0%
Reduced hamstring flexibility/tightness	86	77.5	68.9–84.3%
Normal hamstring flexibility	25	22.5	15.7–31.1%

TABLE 4: Prevalence of altered pelvic alignment and reduced hamstring flexibility (n=111)

CI: Confidence interval

Reduced hamstring flexibility was defined as a mean popliteal angle >20°.

The mean right SLR angle was 71.75 ± 7.95°, while the mean left SLR angle was 73.70 ± 8.01°. The mean right and left popliteal angles were 27.73 ± 8.53° and 25.77 ± 8.58°, respectively. The corresponding side-wise measurements are presented in Table 5.

Outcome measure	Right, Mean ± SD (°)	Left, Mean ± SD (°)
SLR	71.75 ± 7.95	73.70 ± 8.01
Popliteal angle	27.73 ± 8.53	25.77 ± 8.58

TABLE 5: Side-wise hamstring flexibility measurements (n=111)

SLR: Straight Leg Raise

The association between pelvic alignment classification and hamstring flexibility classification is presented in Table 6.

Pelvic Alignment Classification	Reduced Flexibility/Tightness, Number of Participants	Normal Flexibility, Number of Participants	Total Number of Participants
Altered alignment	74	25	99
Neutral alignment	12	0	12
Total	**86**	**25**	**111**

TABLE 6: Association between pelvic alignment classification and hamstring flexibility classification (n=111)

Participants were categorized according to reported daily sitting duration of six, seven, or eight hours. The mean SLR decreased across the groups from 78.06 ± 8.34° among participants sitting for six hours/day to 71.88 ± 6.44° among those sitting for seven hours/day and 69.38 ± 6.73° among those sitting for eight hours/day. The mean popliteal angle was 24.45 ± 9.24° in the six-hour group, 29.65 ± 7.15° in the seven-hour group, and 26.23 ± 8.41° in the eight-hour group. One-way ANOVA demonstrated a statistically significant difference in mean SLR and mean popliteal angle across the three sitting-duration groups (F=3.36, p=0.038). The comparison of hamstring flexibility measurements according to daily sitting duration is presented in Table 7.

Daily Sitting Duration	Number of Participants	Mean SLR ± SD (°)	Mean Popliteal Angle ± SD (°)
6 hours/day	33	78.06 ± 8.34	24.45 ± 9.24
7 hours/day	34	71.88 ± 6.44	29.65 ± 7.15
8 hours/day	44	69.38 ± 6.73	26.23 ± 8.41

TABLE 7: Hamstring flexibility measurements according to daily sitting duration

Correlation analysis

Pearson's correlation analysis demonstrated a statistically significant positive correlation between BMI and mean popliteal angle (r=0.262, p=0.005). No statistically significant correlation was observed between daily sitting duration and mean popliteal angle (r=0.068, p=0.481). Pelvic tilt magnitude showed a weak positive correlation with mean popliteal angle (r=0.112, p=0.243), which was not statistically significant. Daily sitting duration demonstrated a moderate negative correlation with mean SLR (r=-0.444, p<0.001), indicating lower SLR values with greater sitting duration in this dataset.

Statistical significance

A p value <0.05 was considered statistically significant. Significant findings were observed for the correlation between daily sitting duration and mean SLR,BMI and mean popliteal angle, mean SLR and mean popliteal angle, and the comparison of mean popliteal angle across sitting-duration groups. The association between pelvic alignment and hamstring flexibility did not reach statistical significance. No adjustment for multiple comparisons was performed. Therefore, the statistical findings should be interpreted cautiously, particularly for the exploratory correlation and subgroup analyses. Spearman's rank correlation coefficient was used to assess the relationship between daily sitting duration and mean SLR, as sitting duration was recorded in three discrete categories (six, seven, and eight hours). Pearson's correlation coefficient was used for the other continuous-variable correlations. One-way ANOVA was used to compare mean SLR and mean popliteal angle across the three sitting-duration groups.

Discussion

The present study identified a high prevalence of altered pelvic alignment (89.2%) and reduced hamstring flexibility (77.5%) among sedentary working professionals aged 35-50 years. The frequency of reduced hamstring flexibility observed in the present study is comparable with previous findings among administrative and desk-based workers exposed to prolonged sitting [1,2]. Similar evidence has indicated that extended sitting may contribute to hamstring tightness and reduced flexibility [3]. Yadav and Basista also examined the effects of prolonged sitting on hamstring flexibility and lumbar lordosis, supporting the relevance of evaluating flexibility and lumbopelvic posture in sedentary populations [4].

Mild posterior pelvic tilt was the most frequently observed pelvic alignment pattern in the present study. Although altered pelvic alignment and reduced hamstring flexibility were both highly prevalent, no statistically significant relationship was identified between pelvic tilt magnitude and mean popliteal angle ($r=0.112$, $p=0.243$). Similarly, the categorical relationship between pelvic alignment and hamstring flexibility was not significant ($p=0.065$). These findings suggest that the presence of pelvic alignment changes does not necessarily correspond to the degree of hamstring flexibility impairment. Previous research has demonstrated that pelvic positioning can influence the popliteal angle obtained during a 90-90 hamstring-length assessment, indicating that test positioning may influence the measured value [6]. In addition, different clinical tests may assess different components of hamstring flexibility and, therefore, should not automatically be considered equivalent [7].

A moderate negative correlation was observed between occupational sitting duration and mean SLR ($r=-0.444$, $p<0.001$). Participants with longer sitting durations tended to demonstrate lower SLR values, which is consistent with previous research involving sedentary and desk-based populations. No statistically significant association was observed between pelvic alignment and hamstring flexibility ($p=0.065$; Cramer's $V=0.188$). The negative correlation between sitting duration and mean SLR ($r=-0.444$, $p<0.001$) does not establish a causal relationship [1,2,4]. However, the cross-sectional design of the present study does not permit a causal interpretation of this relationship. Hamstring flexibility can also be influenced by individual characteristics such as age and sex [8], as well as physiological factors including muscle-tendon properties and stretch tolerance [11]. Therefore, occupational sitting should be considered as one possible contributor rather than the sole determinant of reduced flexibility.

The absence of a significant relationship between sitting duration and mean popliteal angle ($r=0.068$, $p=0.481$), despite the significant association with SLR, may reflect differences between the two assessment procedures. Evidence regarding the reliability and measurement characteristics of SLR and active knee-extension testing suggests that different flexibility measures may provide different information about hamstring extensibility [9]. This may explain why sitting duration showed a relationship with SLR but not with the popliteal angle in the present study.

The clinical relevance of these findings lies in the high frequency of musculoskeletal alterations identified among sedentary workers. Sedentary behavior has been associated with musculoskeletal problems in occupational populations, emphasizing the importance of preventive strategies [10]. Workplace physiotherapy approaches incorporating ergonomic education, regular movement breaks, increased physical activity and appropriate flexibility or exercise program may therefore be beneficial [11,12]. These findings emphasize the importance of early identification of postural alterations and preventive interventions among sedentary working professionals to reduce the potential risk of musculoskeletal problems [13]. Postural assessment increasingly uses digital tools alongside clinical examination. A preliminary study of the PhysioCode Posture Assessment application reported good-to-excellent inter-examiner reliability, while intra-examiner reliability ranged from poor to moderate, indicating that digital assessment may support quantitative measurement but that consistency can vary by examiner and assessment view [16].

Limitations

This study has certain limitations. The cross-sectional design does not allow causal relationships to be established between occupational sitting duration, pelvic alignment, and hamstring flexibility. Participants were recruited from a limited geographical area, which may limit the generalizability of the findings to other working populations. Sitting duration was self-reported, which may have introduced recall bias. Furthermore, pelvic alignment and hamstring flexibility were assessed at a single time point, without evaluating changes over time. The reliability and validity of the PhysioCode Posture Assessment application for the specific pelvic tilt assessment used in this study were not independently evaluated. The angular cut-offs for the five pelvic alignment categories could not be verified. Therefore, the reported prevalence of altered pelvic alignment (89.2%) should be interpreted cautiously. Future studies should use clearly defined angular cut-offs and establish the reliability and validity of the assessment method. All SLR and popliteal angle measurements were performed by a single examiner; however, the examiner was not blinded to the participants' assessment information. Furthermore, formal intra-rater and inter-rater reliability assessments were not conducted. Therefore, examiner-related bias and measurement variability cannot be ruled out, which may have influenced the consistency and reproducibility of the measurements. Additionally, potential confounding factors, including physical activity levels, occupational ergonomic conditions, workplace posture, and duration of employment, were not adequately assessed or controlled. These factors may have influenced pelvic alignment and hamstring flexibility and should be considered when interpreting the findings. Future studies involving larger and more diverse populations, objective measurement of sitting duration, assessment of potential confounding factors, and longitudinal or interventional designs are recommended.

Conclusions

The present study demonstrated a high prevalence of altered pelvic postural alignment and reduced hamstring flexibility among sedentary working professionals aged 35-50 years. Altered pelvic alignment was observed in 89.2% of participants, while 77.5% demonstrated reduced hamstring flexibility based on the

mean popliteal angle. Mild posterior pelvic tilt was the most frequently observed pelvic alignment category. Despite the high prevalence of both altered pelvic alignment and reduced hamstring flexibility, no statistically significant direct association was found between pelvic tilt magnitude and mean popliteal angle or between pelvic alignment classification and hamstring flexibility classification. In contrast, daily sitting duration showed a significant moderate negative correlation with mean SLR, indicating that greater occupational sitting duration was associated with lower SLR values. BMI was also significantly positively correlated with mean popliteal angle. These findings suggest that pelvic alignment and hamstring flexibility are common musculoskeletal considerations among sedentary working professionals but should be assessed as related yet distinct clinical characteristics. The significant relationship between sitting duration and SLR further highlights the relevance of occupational sitting exposure when assessing flexibility in sedentary workers. Longitudinal and interventional studies are required to determine the temporal and causal relationships between sedentary behavior, pelvic alignment, and hamstring flexibility. The conclusion reflects the study's major statistical findings, including the high prevalence of altered alignment and reduced flexibility and the significant relationship between sitting duration and SLR.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Samruddhi P. Shewale, Shraddha Mohite

Acquisition, analysis, or interpretation of data: Samruddhi P. Shewale, Shraddha Mohite

Drafting of the manuscript: Samruddhi P. Shewale, Shraddha Mohite

Critical review of the manuscript for important intellectual content: Samruddhi P. Shewale, Shraddha Mohite

Supervision: Samruddhi P. Shewale, Shraddha Mohite

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Krishna Vishwa Vidyapeeth (Deemed to be University), Karad issued approval 489/2025-2026. The study was approved by the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India (Ref. No. KVV/IEC/03/2026; Protocol No. 489/2025–2026). **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Jabbar M, Mustansar A, Arif S, Ayub T, Latif W, Laique T: Prevalence of hamstring tightness due to prolonged sitting among administrative staff of Government College University, Faisal Hospital and Commissioner Office Faisalabad. Pak J Phys Ther. 2021, 4:28-32. 10.52229/pjpt.v4i1.994
2. Bashyal P, Bhatbolan S, Billore N, Sindhu N: Flexibility in muscles around the hip among middle aged Indian men engaging in prolonged desk jobs: a cross-sectional study. Int J Phys Educ Sports Health. 2018, 5:223-9.
3. Fatima G, Qamar MM, Ul Hassan J, Basharat A: Extended sitting can cause hamstring tightness. Saudi J Sports Med. 2017, 17:110-14. 10.4103/sjsm.sjsm_5_17
4. Yadav R, Basista R: Effect of prolonged sitting on hamstring muscle flexibility and lumbar lordosis in collegiate student. Int J Health Sci Res. 2020, 10:280-289.
5. Hegde N, Srivastava S: Influence of core strength on hamstring flexibility and pelvic tilt among sedentary individuals: a cross-sectional study. J Clin Diagn Res. 2026, 20:Y27-32. 10.7860/JCDR/2026/81857.22386
6. Herrington L: The effect of pelvic position on popliteal angle achieved during 90:90 hamstring-length test . J Sport Rehabil. 2013, 22:254-6. 10.1123/jsr.22.4.254
7. Davis DS, Quinn RO, Whiteman CT, Williams JD, Young CR: Concurrent validity of four clinical tests used to measure hamstring flexibility. J Strength Cond Res. 2008, 22:583-8. 10.1519/JSC.0b013e31816359f2
8. Youdas JW, Krause DA, Hollman JH, Harmsen WS, Laskowski E: The influence of gender and age on hamstring muscle length in healthy adults. J Orthop Sports Phys Ther. 2005, 35:246-52. 10.2519/jospt.2005.35.4.246
9. Neto T, Jacobsohn L, Carita AI, Oliveira R: Reliability of the active-knee-extension and straight-leg-raise tests in subjects with flexibility deficits. J Sport Rehabil. 2015, 24: 10.1123/jsr.2014-0220
10. Arab AM, Nourbakhsh MR: Hamstring muscle length and lumbar lordosis in subjects with different lifestyle

and work setting: comparison between individuals with and without chronic low back pain. J Back Musculoskelet Rehabil. 2014, 27:63-70. 10.3233/BMR-130420

11. Magnusson SP, Simonsen EB, Aagaard P, Boesen J, Johannsen F, Kjaer M: Determinants of musculoskeletal flexibility: viscoelastic properties, cross-sectional area, EMG and stretch tolerance. Scand J Med Sci Sports. 1997, 7:195-202. 10.1111/j.1600-0838.1997.tb00139.x
12. Sadler SG, Spink MJ, Ho A, De Jonge XJ, Chuter VH: Restriction in lateral bending range of motion, lumbar lordosis, and hamstring flexibility predicts the development of low back pain: a systematic review of prospective cohort studies. BMC Musculoskelet Disord. 2017, 18:179. 10.1186/s12891-017-1534-0
13. Dzakpasu FQ, Carver A, Brakenridge CJ, Cicuttini F, Urquhart DM, Owen N, Dunstan DW: Musculoskeletal pain and sedentary behaviour in occupational and non-occupational settings: a systematic review with meta-analysis. Int J Behav Nutr Phys Act. 2021, 18:159. 10.1186/s12966-021-01191-y
14. Chandrasekaran B, Bairapareddy KC, Rao CR: Resistance exercise training on musculoskeletal, metabolic and psychological health in sedentary office workers - systematic review and meta-analysis. J Occup Rehabil. 2026, 36:23-42. 10.1007/s10926-025-10273-8
15. Du Z, Xiong C, Li T, Huang J, Shimomura Y: Impact and prevention of sedentary behavior on musculoskeletal disorders in the workplace: a meta-analysis and LDA topic model. BMC Musculoskelet Disord. 2026, 27:635. 10.1186/s12891-026-09974-9
16. Barbosa AC, Silva EC, Sabino GS, Trede Filho RG: Inter- and intra-examiner reliability of the PhysioCode Posture application for quantitative assessment of postural alterations: preliminary data. Braz J Phys Ther. 2025, 29:101516. 10.1016/j.bjpt.2025.101516