Epidemiology and Society Health Review
ESHR
Vol. 7, No. 2, 2025, pp. 105-114 ISSN 2656-6052 (online) | 2656-1107 (print)
http://journal2.uad.ac.id/index.php/eshr/index eshr@ikm.uad.ac.id

Research Article

The Relationship Between Sitting Posture When Using Digital Devices and the Risk of Low Back Pain in Final Year Students

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Received 06 July 2025; Accepted 13 July 2025; Published 13 Sept 2025

ABSTRACT

Background: Low Back Pain (LBP) refers to discomfort in the lower back and is recognized as the leading cause of global disability, with 619 million cases reported in 2020. This number is expected to rise as students become increasingly dependent on digital devices due to technological advancements. Non-ergonomic sitting postures while using laptops or smartphones may increase spinal pressure and contribute to functional impairments. This study aims to examine the relationship between sitting posture when using digital devices and the risk of LBP among final-year Public Health students.

Method: A cross-sectional analytical study was conducted with 117 respondents selected through simple random sampling from a population of 168 students. Sitting posture was assessed using the Rapid Entire Body Assessment (REBA) method, and the risk of LBP was measured using the Oswestry Disability Index (ODI) questionnaire.

Results: The results showed that most students adopted non-ergonomic sitting postures (60.7%), with the highest proportion experiencing moderate disability (41.9%). Statistical analysis revealed a significant association between sitting posture and LBP risk (P = 0.00).

Conclusion: There is a significant relationship between sitting posture and the risk of LBP among students. Poor posture increases the likelihood of functional limitations due to back pain. It is recommended that students adopt ergonomic sitting habits and perform regular stretching to reduce LBP risk. These findings may serve as a reference for developing targeted health promotion and prevention strategies within the university setting.

Keywords: Low back pain; Sitting posture; Ergonomic; Students; REBA

10.26555/eshr.v7i2.13897

INTRODUCTION

Low Back Pain (LBP) is a musculoskeletal complaint characterized by pain in the area between the lower ribs and upper buttocks. This pain may manifest as a dull ache, sharp sensation, or general discomfort, and can radiate to the lower extremities. LBP can affect individuals across all population groups, impairing mobility, reducing quality of life, limiting work activities, and decreasing productivity.[1] This condition is commonly caused by musculoskeletal disorders and exacerbated by biomechanical factors, such as non-ergonomic sitting posture.[2] According to the Global Burden of Disease (GBD) report, LBP is the leading cause of global disability, affecting approximately 619 million people in 2020 and projected to increase to 843 million cases by 2050.[3]

Advances in information technology have brought significant changes to student learning patterns in the digital age. Learning activities are increasingly shifting to digital platforms, including online learning systems, access to electronic journals, and the use of academic support applications. As a result, students have become highly dependent on digital devices such as laptops, tablets, and smartphones to support their daily academic tasks.[4]

However, prolonged use of digital devices is not always accompanied by proper ergonomic behaviour. Many students tend to use laptops or smartphones in sitting positions that do not adhere to ergonomic principles, such as slouching, leaning the head too far forward, raising the shoulders, or positioning the screen at an angle misaligned with the line of sight.[5] Such improper posture, if maintained over time, can lead to excessive pressure on the lumbar region (lower back),[6] thereby increasing the risk of musculoskeletal disorders, including lower back pain (LBP).[7]

An ergonomic sitting posture is characterized by a straight back, relaxed shoulders, buttocks in contact with the backrest of the chair, both feet flat on the floor, and a stable overall body position.[8] When using a laptop or computer, the wrists should remain straight, the elbows and arms should form a 90-100 degree angle, the neck should be aligned with the screen, and the hips should form a 90-degree angle with the thighs.[9] The same principles apply when sitting on the floor; maintaining neutral posture remains essential, whether sitting cross-legged or with legs extended and the back straight. Sitting cross-legged with a hunched back can increase pressure on the spine and impair the proprioceptive system (i.e., the body's ability to sense position) in the lumbar region.[10]

According to the 2019 National Health Interview Survey (NHIS), the prevalence of low back pain among individuals aged 18 years and older reached 39% and tends to increase with age. (The most recent NHIS data from 2023 also indicates that approximately 24.3% of adults aged 18 and older report experiencing chronic pain lasting three months or more, while 8.5% are affected by high-impact chronic pain that interferes with daily activities and work. In Indonesia, the 2021 National Health Survey (RISKESDAS) recorded 12,914 cases of low back pain (LBP), accounting for 3.7% of the population. Several provinces, including Aceh, have a prevalence rate higher than the national average.[11]

Previous studies have shown that the use of digital devices is closely associated with an increased risk of LBP. A study conducted by Purnomo at University X in Makassar found that 85% of students used digital devices for 4–8 hours per day. Poor ergonomic sitting posture was reported by 78% of students as the second most frequent complaint, typically involving sitting in a hunched position and looking at screens positioned below eye level. Additionally,

68% of students reported experiencing back pain after sitting for extended periods in non-ergonomic postures.[12]

An initial survey of 13 final-year students at Teuku Umar University revealed that 7 of them reported pain ranging from the upper to lower body, including the shoulders, back, buttocks, and even extending to the legs. These complaints were often accompanied by persistent and disruptive soreness, especially when sitting for prolonged periods or while resting at night. Some students reported difficulty sleeping due to ongoing pain and stated that they frequently used topical analgesics, such as medicated oils, to relieve discomfort.

However, to date, no specific research has examined the relationship between sitting posture while using digital devices and the risk of low back pain (LBP) among students at Teuku Umar University. Final-year students tend to have prolonged sitting durations and exhibit poor ergonomic posture habits while working on their final projects, thereby increasing their risk of developing musculoskeletal disorders. This study aims to evaluate the relationship between sitting posture during digital device use and the risk of LBP among final-year students in the Public Health Program at Teuku Umar University. The findings of this study are expected to serve as a foundation for promoting ergonomic awareness in educational settings to help prevent musculoskeletal disorders among students.

METHOD

This research employed a quantitative method with an analytical approach and a cross-sectional design. It was conducted from March to April 2025 in the Public Health Study Program at Teuku Umar University, Meulaboh, Aceh Barat, Indonesia. The study population consisted of all active students from the 2021 cohort who were registered in the university's academic system, totalling 168 individuals. The sample size was calculated using a proportion formula for a finite population, with a 95% confidence level and a 5% margin of error, resulting in a final sample of 117 respondents.

The sample in this study was selected using simple random sampling. The inclusion criteria were active enrollment in the current semester and willingness to participate in the research procedures. The exclusion criteria included respondents who declined to participate in the research procedures and those with a history of severe musculoskeletal disorders or spinal injuries that could affect body posture. Data were collected through direct observation and face-to-face questionnaire administration.

Sitting posture was assessed using the Rapid Entire Body Assessment (REBA) method, an ergonomic observation tool used to evaluate posture-related risk based on the analysis of specific body parts, including the neck, back, upper and lower arms, wrists, and legs.[13] In this study, REBA scores were classified into three categories: low risk (scores 1–3, categorized as ergonomic), moderate risk (scores 4–7, categorized as less ergonomic), and high risk (scores 8–10, categorized as non-ergonomic). The risk of low back pain was assessed using the standardized Oswestry Disability Index (ODI) questionnaire, which consists of 10 items designed to evaluate the level of disability caused by low back pain in relation to daily functional activities. The ODI classifies disability into five categories: minimal disability, moderate disability, severe disability, crippled, and bedbound.

The independent variable in this study was the students' sitting posture while using digital devices, and the dependent variable was the level of risk for low back pain (LBP). Data were analyzed using univariate analysis to describe the frequency distribution of respondent

characteristics and research variables. Bivariate analysis was conducted using the chi-square test to determine the relationship between sitting posture and LBP risk. The significance level was set at $p < 0.05$.[14]

This study received ethical approval from the Health Research Ethics Committee of the Faculty of Public Health, Teuku Umar University (No. 1116/UN59.F2/DT.01/2025). Informed consent was obtained from all respondents prior to data collection.

RESULTS

Of the 117 respondents presented in Table 1, the majority were aged ≤ 21 years (67.5%) and female (87.2%). The most common duration of sitting while using digital devices was 2–4 hours per day (38.5%). A total of 66 respondents (56.41%) reported performing stretching exercises while sitting, and the most frequently used digital device was a laptop (54.5%). Regarding the type of final project, most respondents were working on a scientific paper (68.4%).

Table 1. Frequency Distribution of Characteristics of Final-Year Public Health Program Respondents, Class of 2021

Characteristics of Respondent	n = 117	Percentage (%)
Age Group		
≤ 21 Years	79	67.5
22 Years	34	29.1
≥ 23 Years	4	3.4
Gender		
Male	15	12.8
Female	102	87.2
Sitting Duration		
≤ 2 Hours	29	24.8
2 - 4 Hours	45	38.5
≥ 4 Hours	43	36.8
Applying Stretching		
Yes	66	56.4
No	51	43.6
Type of Digital Device		
Laptop	64	54.5
Smartphone	53	45.3
Type of Final Project		
Thesis	37	31.6
Scientific Paper	80	68.4

The majority of respondents had non-ergonomic sitting postures (60.7%). Additionally, 30.8% of respondents exhibited less ergonomic sitting postures, while only 8.5% had ergonomic sitting postures. Regarding the level of LBP risk based on the Oswestry Disability Index (ODI), most respondents were categorized as having minimal disability (45.3%), followed by moderate disability (41.9%). Furthermore, 9.4% of respondents were classified as having severe disability, 2.6% as crippled, and only 0.9% fell into the bedbound/exaggerating category (Table 2).

 10.26555/eshr.v7i2.13897

Table 2. Univariate analysis results of sitting posture and low back pain (LBP) risk levels among respondents

Variable	n = 117	Percentage (%)
Sitting Posture		
Ergonomic	10	8.5
Less Ergonomic	36	30.8
Not Ergonomic	71	60.7
Risk of LBP		
Minimal Disability	53	45.3
Moderate Disability	49	41.9
Severe Disability	11	9.4
Crippled	3	2.6
Bedbound/ Exaggerating	1	0.9

Table 3. The results of the bivariate analysis of 117 respondents showed that among students with ergonomic sitting postures, the majority were in the minimal disability category, with 4 individuals (3.4%), followed by moderate disability with 6 individuals (5.1%). In the group with less ergonomic sitting postures, most respondents were in the minimal disability category (26 individuals, 22.2%), followed by moderate disability (7 individuals, 6.0%), crippled (3 individuals, 2.6%), and none in the bedbound category (0 individuals, 0.0%).

Meanwhile, the group with non-ergonomic sitting postures demonstrated a broader distribution of risk. A total of 36 respondents (30.8%) were in the moderate disability category, 23 respondents (19.7%) in the minimal disability category, and 11 respondents (9.4%) in the severe disability category. Additionally, 3 respondents (2.6%) were categorized as crippled, and 1 respondent (0.9%) was categorized as bedbound.

Furthermore, the chi-square test yielded a *p*-value of 0.000 ($p < 0.05$), indicating a statistically significant association between sitting posture while using digital devices and the level of low back pain risk among students.

Table 3. Relationship between sitting posture when using digital devices and the risk of low back pain

Sitting Posture	Risk of Low Back Pain										P- Value
	Minimum Disability		***Moderate Disability***		***Severe Disability***		***Crippled***		***Bedbound***		
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
Ergonomic	4	3.4	6	5.1	0	0.0	0	0.0	0	0.0	0,00
Less Ergonomic	26	22.2	7	6.0	0	0.0	3	2.6	0	0.0	
Not Ergonomic	23	19.7	36	30.8	11	9.4	3	2.6	1	0,9	
Total	53	45,3	49	41,9	11	9,4	3	26	1	9,9	

DISCUSSION

The majority of respondents in this study were female, reflecting the general demographic composition of the Public Health Study Program, which is predominantly female. Most respondents were aged ≤21 years, placing them in the young age category, typically

 10.26555/eshr.v7i2.13897

characterized by relatively optimal tissue regenerative capacity and spinal stability. However, a non-ergonomic sitting posture combined with prolonged sitting time still presents a potential risk for musculoskeletal disorders.[15] In this study, most students reported a sitting duration of 2 to 4 hours per day, with laptops being the primary device used to complete final assignments. Additionally, several respondents were noted to rarely perform stretching exercises while sitting. A lack of stretching activities may increase biomechanical stress on the spine and contribute to the development of lower back pain.

In terms of sitting posture, several respondents in this study demonstrated non-ergonomic postures, making this group the largest among the three posture categories. This finding is consistent with research by Salva and Putri at Ibnu Khaldun University, Bogor, which found that students with poor posture and prolonged sitting habits exhibited higher levels of functional disability.[16] Based on direct observations using the Rapid Entire Body Assessment (REBA) instrument, respondents in this category were generally found to sit with markedly hunched backs, sharply inclined necks, and a lack of lumbar support. Indicating high risk and requiring immediate corrective actions.[17]

These observations are consistent with the findings presented in Table 1, which shows that the majority of respondents with non-ergonomic sitting postures experienced moderate disability. This category reflects moderate functional impairment, typically characterized by lower back pain that begins to interfere with daily activities such as prolonged sitting, lifting light objects, or reduced concentration during academic tasks.[18] This correlation reinforces the understanding that the poorer the quality of sitting posture, the greater the risk of developing musculoskeletal disorders, particularly low back pain (LBP). However, the data also reveal variations in disability levels within this group, including some respondents categorized as having minimal disability and even one case of bedridden status. This suggests that, beyond posture, other contributing factors such as sitting duration, lack of stretching habits, previous injuries, academic stress, and insufficient physical activity also influence the severity of LBP in a multifactorial manner.

Furthermore, these findings highlight the research by Almeida at the State University of São Paulo (UNESP), Brazil, which highlighted that habitual slouching and insufficient activation of core muscles (core stability) can lead to muscular weakness in the spinal support system and contribute to the development of LBP.[19] Likewise, Tae Sung In from Gimcheon University, Korea, demonstrated that incorrect sitting posture during digital device use can result in alterations to spinal curvature, which is closely associated with LBP complaints.[20]

In addition, the less-ergonomic sitting posture category represented the second largest group in this study. Based on observational findings, postures in this group typically exhibited mild deviations from the neutral sitting position, such as a moderately forward-leaning back, a downward-tilted neck, and insufficient arm or lumbar support. These positions often occur when students use laptops on flat surfaces without adjusting screen height or sit on chairs that lack lower back support. According to the REBA method, such postures are classified as moderate risk, indicating the need for medium-term preventive interventions to avoid the development of musculoskeletal complaints. This finding is consistent with Sari, who conducted a study among nursing students at Poltekkes Kemenkes Tanjungkarang, Lampung, who found that students with less ergonomic sitting postures had a 1.8 times higher risk of experiencing mild to moderate low back pain compared to those with ergonomic posture.

Statistically, most respondents in this group fell into the *minimal disability* category, in which lower back pain has only a mild impact on daily activities and has not yet resulted in significant functional limitations. However, several respondents were also classified in the *moderate disability* category, indicating that the pain had begun to interfere with functional tasks such as prolonged sitting, carrying light loads, and completing academic assignments.[18,21] Of particular concern is the presence of respondents in the *crippled category,* which clinically describes significant limitations in daily functioning and a substantial decline in physical capacity. The emergence of this severe condition within a group that does not exhibit extreme postural abnormalities suggests that other contributing factors, such as prolonged sitting duration, academic stress, and insufficient physical activity, may be involved. These findings reinforce the notion that even slight postural deviations, when combined with extended sitting periods and poor movement patterns, can contribute to LBP. Light muscle activation and periodic postural adjustments are therefore essential to preventing further musculoskeletal deterioration.

A 12-week *Active Break* intervention study involving young individuals demonstrated that taking short breaks, including stretching and hip/lumbar mobilization exercises, every 30 minutes of sitting significantly reduced the intensity of lower back pain and discomfort.[22] A Previous study also emphasizes that even slight deviations from a neutral posture, such as mild bending or leaning forward, if sustained over prolonged periods without active stretching, can increase pressure on the spine and surrounding tissues, eventually contributing to lower back pain.[23]

Meanwhile, in the group with ergonomic posture, a more unique and contrasting pattern was found compared to the previous two categories. The ergonomic sitting posture category was the group with the fewest respondents in this study. Based on direct observation, the posture in this category is characterized by an upright sitting position, with the back and neck in a neutral position, and the use of a desk and chair that properly support the body. Based on the REBA method, this posture is categorized as low risk, meaning it does not require urgent ergonomic intervention, but it still needs to be maintained to prevent musculoskeletal complaints.

Although the respondents in this group technically maintained postures that complied with ergonomic principles, the data indicate that some still experienced moderate disability. This suggests that prolonged sitting, limited body movement, and the habit of studying without breaks may contribute to an increased risk of low back pain, even when posture appears visually correct. Previous research reported that remaining in a static sitting position for extended periods can restrict natural movement and result in uneven weight distribution across the spine, thereby sustaining muscle tension even when the body appears to be in a neutral position. This perspective aligns with biomechanical principles, which emphasize the importance of movement variability in preventing muscle fatigue and reducing excessive static load.[24,25]

This finding is also supported by previous research, who state that proper sitting posture does not necessarily guarantee the absence of LBP complaints—particularly when it is combined with prolonged sitting durations and a lack of physical activity. Therefore, even if one's sitting posture meets ergonomic standards, incorporating active habits such as regular stretching and routine changes in sitting position remains essential as part of a comprehensive LBP prevention strategy.[26]

This finding is consistent with the relationship patterns observed across the three sitting posture categories, indicating that the risk of LBP may arise in all groups, albeit with varying levels of severity. These findings underscore the central role of sitting posture in maintaining musculoskeletal health, particularly among final-year students, who belong to the productive age group. The application of ergonomic principles—such as using appropriately designed desks and chairs, positioning screens at eye level, and incorporating regular stretching—remains crucial as part of a long-term prevention strategy for low back pain (LBP).

Furthermore, the findings of this study also contribute to the development of educational ergonomics theory, particularly for digital-native groups such as contemporary university students. These individuals face not only physical risks from poor sitting posture but also academic pressures that influence sitting duration, concentration levels, and a tendency to disregard physical comfort. According to a previous study, an orthopedic specialist at Seoul National University Bundang Hospital, maintaining the spine's natural curvature (lumbar lordosis) while sitting is essential to avoid excessive pressure on the spinal discs, which may lead to chronic pain.[27] Therefore, promoting ergonomic sitting behavior and enhancing learning environments that support such practices are essential components of promotional and preventive efforts to reduce the risk of LBP within the university setting.

However, there are several limitations in this study that should be considered when interpreting the results. The assessment of sitting posture using the REBA method was conducted manually by researchers without professional certification in ergonomics, which may have introduced bias in determining postural angles and scores, despite the method's inherently objective framework. Additionally, the use of the Oswestry Disability Index (ODI) for pain assessment relies on self-reported data, which is inherently subjective and may be influenced by various psychological and social factors. The use of simple random sampling in this study also presents limitations, as it does not account for variations in sitting habits or duration of digital device use in a more stratified or targeted manner. These limitations should be taken into account in future research to achieve more standardized, objective, and generalizable findings.

CONCLUSION

This study found a significant relationship between sitting posture and the risk of low back pain among final-year students. Students with non-ergonomic sitting postures were more likely to experience low back pain, ranging from minimal to severe disability levels. These findings indicate the need for promoting ergonomic sitting behaviors, adjusting study environments to meet ergonomic standards, and incorporating active breaks to reduce the risk of musculoskeletal disorders in students.

Acknowledgement

We would like to thank the supervisors and examiners of the public health study program and the Faculty of Public Health for granting research permission.

Declarations

Authors' contribution

EF contributed to the preparation of the research proposal. LE contributed to the preparation of the discussion and data analysis and discussion. JM and DF contributed to the improvement of the research article for submission.

Funding statement

This study was conducted without financial support from any party.

Conflict of interest

The authors declare that this study is free from conflict of interest.

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