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Musculoskeletal Discomforts Among Engineering Students: Associations with Laptop Use, Posture, and Task Type

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Abstract

Students in university, especially those studying engineering, need to use laptops. But using a laptop for a long time and having poor posture can make musculoskeletal pain worse. Very few studies have examined the relationship between usage duration, task type, and posture with discomfort among undergraduates in Bangladesh. This cross-sectional study surveyed 238 engineering students in their second to fourth years, gathering data on daily and total laptop usage, prevalent tasks, postures, and self-reported musculoskeletal discomfort. Spearman's rank correlation analyzed substantial correlations between usage characteristics and pain in various anatomical regions. The findings indicate that discomfort in the neck and lower back was the most common. Longer daily use and longer programming tasks were strongly linked to more pain in the neck, shoulders, wrists, and lower back. Back-supported sitting posture while operating a laptop on a table was associated with reduced pain in the upper-middle back, neck, and lower back. Working posture and task-specific demands appear to influence musculoskeletal discomfort more strongly than laptop use alone. These findings point to the importance of targeted ergonomic education and posture-focused interventions for students.

Keywords: Student, Laptop, Musculoskeletal Pain, Postures, Tasks.

1. Background

Laptops are now integral to students' lives. University students and academics urgently want laptops for their academic and research endeavours. Students adopt typical postures, including positioning a back-supported sitting posture while operating a laptop on a table, sitting in a chair at a table without a seat backrest, reclining prone, and sitting cross-legged using a laptop upon a flat surface. Incorrect postural configurations significantly increase the incidence of health injuries among undergraduate learners [1]. Arshad et al. (2020) and Angelica et al. (2021) both observed a significant relationship between laptop use and discomfort in various body parts, most commonly involving the neck and lower back regions [2, 3]. Sylvanus et al. (2022) and Pattath & Webb (2022) further emphasized the impact of prolonged computer use and awkward postures on pain in the musculoskeletal system, particularly in the neck and lower back regions. They concluded that encouraging healthy computer-use habits can help reduce musculoskeletal discomfort among students [4, 5]. The present research attempts to analyze the pervasiveness of muscle soreness associated with laptop use. This study examines the level of problems related to laptop use, including pain in the neck, shoulders, lower back, wrists, fingers, and upper-middle back. This study involved frequent laptop users from three engineering departments at SUST. A comparative study has been conducted to show that students in a certain department might be at a higher risk of injury. Spending long hours on a laptop or sitting with poor posture can lead to physical discomfort. This study aims to examine how prolonged laptop use relates to discomfort, taking into account both years of use and daily usage hours. Students often do a lot of different things with their laptops, like play games and code. The study identified significant correlations between these particular uses and the experience of physical discomfort. After applying the average severity index and frequency distribution techniques, Moras and Gamarra (2007) found that neck pain was the most severe among the different musculoskeletal pains of undergraduate university students who used laptops [6]. Breen et al. (2007) indicated a correlation between improper posture and

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various pains; however, it was unclear whether these pains were associated with sitting posture or computer usage. However, Breen et al. (2007) ultimately found that students with various pains had a higher average RULA score (5.0) than those without any pain [7]. Straker et al. (2008) found that tablet computer use resulted in different musculoskeletal discomforts compared to desktop computer use. These differences were mainly due to changes in posture during device use [8]. The daily computer usage for over two hours increased the likelihood of discomfort in numerous anatomical locations [9]. Obembe et al. (2013) directed research to ascertain the level of musculoskeletal symptoms among bachelor's-level students at a Nigerian University, due to excessive laptop use. Obembe et al. (2013) found that most students had shoulder pain, while the least reported elbow pain was linked to using laptops too much [10]. Amin et al. (2016) conducted a study among 400 computer operators from three banks in Dhaka to investigate the long-term detrimental consequences of prolonged computer usage. Amin et al. (2016) revealed a strong association between the variables "duration of computer usage" and "the reported discomfort intensity," yielding a p-value of 0.019 [11]. Bubric and Hedge (2016) conducted an ergonomic study examining the different laptop usage configurations and the incidence of musculoskeletal problems among college students, and their results showed that female students had far greater rates of shoulder and neck pain ($p \leq 0.05$) than male students [12].

Since among work-related musculoskeletal disorders, neck pain was one of the commonest problems, an investigation by Reggie et al. (2016) revealed that personnel and students of the university who used laptops reported neck pain more frequently than those who used desktop computers [13]. After conducting a cross-sectional study among university staff for excessive computer use, James et al. (2018) found 80% of the staff indicated musculoskeletal difficulty in the year before the survey, with 60% of respondents experiencing neck pain, 53% of the respondents suffering from pain in the shoulder region, and 47% of employees reporting pain in the lower back region of the body [14]. According to a study on 136 students at Shifa Tameer-e-Millat University, Osama et al. (2018) found that musculoskeletal discomfort was significantly related to the duration of computer use ($P<0.05$) [15].

Intolo and colleagues carried out an ergonomic investigation in 2019 by examining shoulder and neck orientations and muscular activity in connection to subjective discomfort during laptop usage in different settings, including a short table along with a bed and sofa. Their findings indicated that participants experienced neck pain while using laptops on the bed and sofa, whereas upper back pain was more commonly reported while performing tasks at a low-rise table [16]. Goyal and Gupta (2023) conducted a study on medical students, revealing that inadequate ergonomics and prolonged postural strain from laptop usage can result in musculoskeletal discomfort. The study found that students who typed at average speed and accuracy and did not follow proper ergonomic practices were more likely to experience musculoskeletal pain [17]. Pattath & Webb (2022) found that a significant number of college students, particularly females, experience musculoskeletal discomforts during or after computer usage. These disorders were predominantly observed in the cervical and lumbar regions and were associated with prolonged sitting, awkward postures, and extended computer use [5]. Argus and Pääsuke (2023) reported that employees who primarily used laptops exhibited a higher prevalence of musculoskeletal disorders in the right shoulder region compared with desktop computer users. Their findings suggested that laptop use may increase the risk of shoulder-related musculoskeletal problems, and its long-term effects on neck function appear to be minimal [18]. Rafiee et al. (2023) found that different laptop workstation setups can significantly affect muscle activity, whereas ground sitting showed the lowest muscular demand [19]. Agatha et al. (2022) reported a high prevalence of musculoskeletal discomfort in a student group, particularly in the waist, back, and neck. Their findings also indicated that ground sitting, as a posture with lower physical demand, may help reduce the risk of musculoskeletal problems among students [19, 20]. However, further studies are necessary to examine how these findings may vary across different cultures and genders.

1.1 Research gap

Experiencing various musculoskeletal discomforts is prevalent among long-term laptop users. According to the above background analysis, a multitude of research studies have been undertaken by various researchers about musculoskeletal pain linked to prevalent postures or tasks related with desktop and laptop computers usage throughout different countries worldwide. However, very few studies have been undertaken on a specific group of undergraduate students (who predominantly use laptops for extended periods daily for different reasons) at a university in Bangladesh using Spearman's rank correlation as a statistical analysis technique.

1.2 Objectives

i. To identify the most severe laptop-related musculoskeletal discomforts and compare the frequency distribution among 2nd- to 4th-year B.Sc. engineering students from the Industrial and Production Engineering (IPE), Software Engineering (SWE), and Computer

Science and Engineering (CSE) departments of Shahjalal University of Science and Technology (SUST), Bangladesh.

ii. To assess the relationship between typical laptop working postures and the prevalence of musculoskeletal discomforts during commonly performed tasks such as programming and gaming using Spearman's rank correlation analysis.

2. Material and Method

A structured action plan was designed to guide the study logically and sequentially. The process plan is illustrated in Figure 1, which outlines the phases encompassed in this research.

2.1. Research Design and Questionnaire Development

This study was conceived to investigate the negative effects of laptop use. This approach was effective for selecting a population that

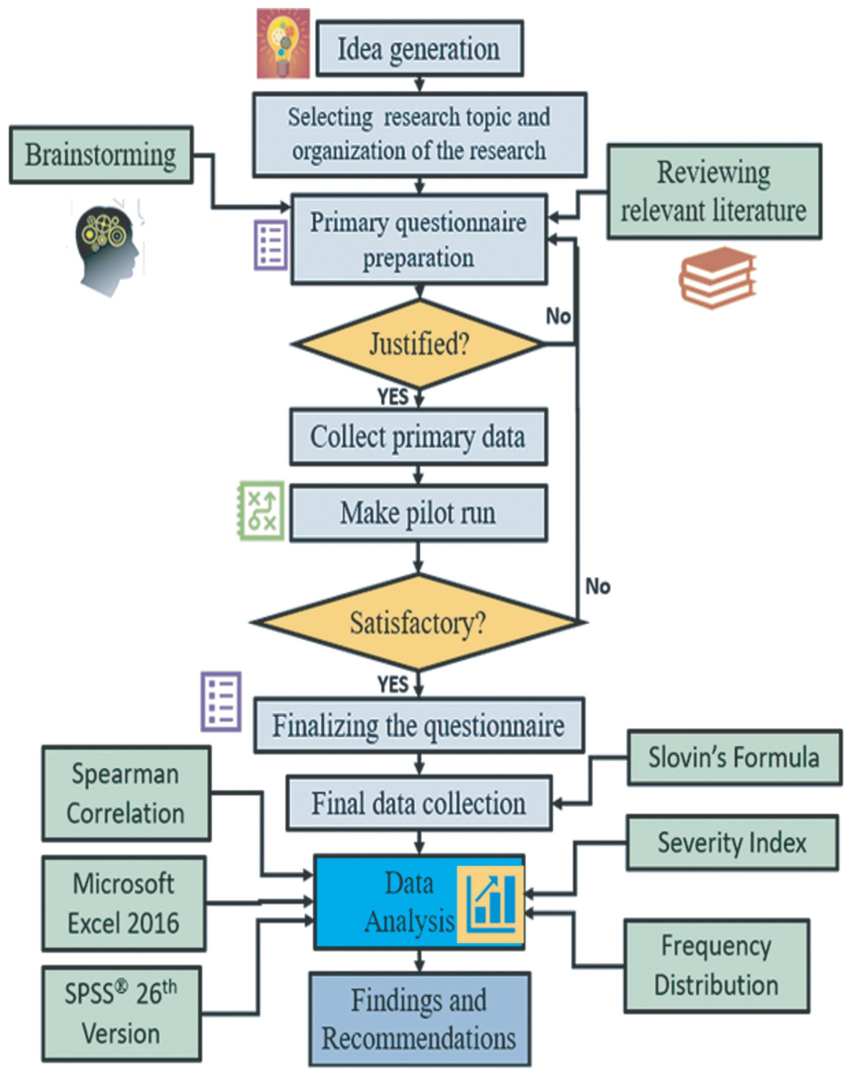

Figure 1. Activities of this Study.

used laptops for comparatively longer durations than other users. So, we thought it was fruitful to undertake the research on the students of three departments, namely IPE, SWE and CSE departments' 2nd to 4th year B.Sc. Undergraduate Engineering students of SUST, Sylhet, who are most involved with laptops. To carry out this survey, a structured questionnaire was designed to gather relevant data.

Participants were enrolled in the study upon getting their agreement, contingent upon being over 18 years of age, having no significant musculoskeletal diseases, and possessing laptops with display sizes between 13 inches and 17 inches and weighs between 1 kg and 3.5 kg. Participants were required to have possessed and utilized their laptops for a minimum of six months preceding this study. The survey's nature was described to the students, and their involvement was voluntary. A survey form containing several questions was generated using the Google Forms application. The Link to the Google form was dispersed to respondents through email, WhatsApp, or via Messenger on Facebook. The created questionnaire had a distinct question aimed at identifying the various discomforts or adverse effects associated with prolonged laptop use beyond thirty minutes. Respondents were explicitly directed to complete the questionnaire with honesty and diligence. The primary part of the survey questionnaire inquired about the academic level, department, gender, and their average daily laptop usage during the previous 3 months. In another segment of the questionnaire, students were questioned regarding the presence of particular pains during continuous laptop use exceeding half an hour, the regularity of using four identified postures, and how often they carried out two designated tasks on the laptop. Pain severity was assessed using a modified six-point

Table 1: Pain scale used in the survey [21].

Grade 0	No discomfort.
Grade 1 (little)	Pain occurs during typing, is consistent rather than occasional, and subsides when typing stops.
Grade 2 (mild)	Pain during typing; mild tenderness; occasional weakness or brief loss of control; does not affect other activities involving that body part.
Grade 3 (moderate)	Pain occurs during typing and persists beyond laptop use, extending to other activities and associated with weakness, loss of control, or reduced muscular responsiveness and dexterity.
Grade 4 (severe)	Like grade 3 – pain occurs during all common activities involving this body part (housework, driving, turning knobs, using tools, playing an instrument), but these tasks can still be done since the pain is tolerated.
Grade 5 (extreme)	As in Grade 4, but with disabling pain that prevents use of the affected body part.

graded scale adapted from Fry and Rowley in 1989, which evaluates functional impact and symptom duration [21]. The scale is featured in Table 1. When calculating severity index or identifying the most severe pain this scale is used but for comparing the sum level of pain among three department and analysis using Spearman's rank correlation, we considered Grade 0: no pain and Grade 1 to Grade 5: feeling pain by the participants for smooth analysis.

2.2. Data Collection

In this survey, research data were gathered from the students of three departments of SUST. The number of participants was identified on the basis of Slovin's formula. To measure a suitable sample size from a known population with a defined error, a random sampling technique-was employed namely Slovin's formula [22].

$$n = \frac{N}{1 + Ne^2}$$

In this formula, *N* refers to the total population, n to the required sample size, and *e* to the acceptable margin of error. The margin of error (e) was set at 0.05 with a 95% level of confidence. The total population were2nd to 4th-year Bachelor of Science (engineering) students from the three selected departments was approximately 538. Using Slovin's method and rounding the answer to the nearest whole number, the sample size was found to be 238. Therefore, 238 respondents were selected to participate in the survey for data collection.

2.3. Frequency Distribution

A frequency distribution represents the count of each specific response or event present in the data. Comparison of different musculoskeletal effects among the students of the selected three departments was developed by the frequency distribution technique. This technique was also used for selecting the most severe pain by illustrating the severity index chart.

2.4. Mean Pain Severity index

The mean severity index (MSI) is a simple average of the different grades (Grade 1 to Grade 5) frequency for each pain category. The mean severity index ranks different musculoskeletal pains in terms of their severity for excessive use of laptops. The severity index was used effectively by Moras and Gamarra (2007), who conducted a study about musculoskeletal issues and non-musculoskeletal issues associated with using a specific laptop in the USA [6]. The formula which is used for calculating the mean severity index is given below:

$$MSI = \frac{\sum_{i=1}^{n} (Grade(i) \times Grade(i)\ frequency\ of\ \ pain}{Total\ Number\ of\ Samples}$$

2.5. SPSS (26.0v)

SPSS is a commercially available application software that was used for analysis and graphical representation [23]. SPSS was employed in this study for calculating Spearman's Rank Correlation coefficient values and p-values.

2.6. Spearman's Rank Correlation

The Spearman's Rank Correlation is commonly used for testing the strength of a link or relationships between categorical variables [24]. The Spearman Correlation technique was applied to examine the incidence of musculoskeletal issues associated with typical laptop postures and frequently performed laptop-related tasks. Table 2 shows the strength of the correlation coefficient in the positive and negative directions.

Table 2. Strength of the correlation coefficient [23].

Strong relationships	Moderate relationships	Weak relationships
0.5 to 1.0	0.3 to 0.49	0.1 to 0.29
-1.0 to - 0.5	- 0.49 to - 0.3	- 0.29 to - 0.1

If a significant relationship exists between two variables, the relationship can be strong, moderate, and weak according to the rho (r) value. The positive and negative correlation coefficient (rho=r) has been found maintaining a 95% confidence level for the results (Table 4). Relationships between the reported pains and the variables studied were deemed statistically noteworthy if the p-values were below 0.05.

3. Results and Discussion

As shown in Figure 2, male students comprised 76% (180) of the study participants. Female representation

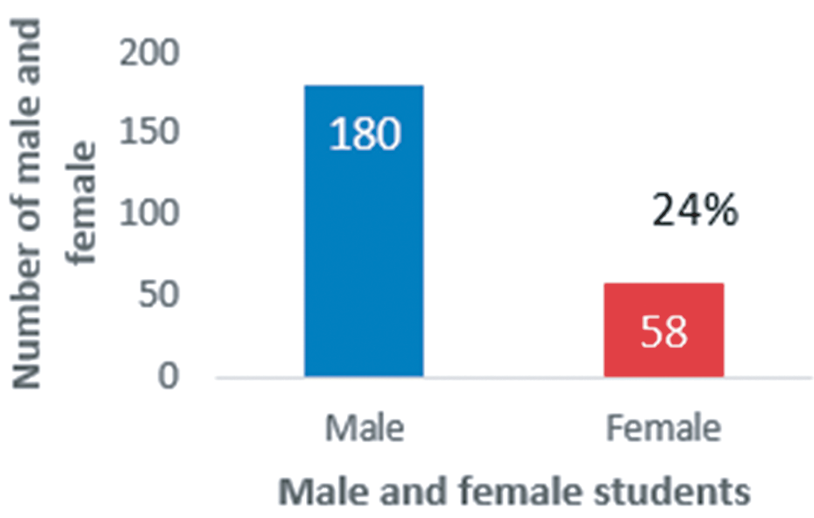

Figure 2. Gender-wise count proportion of participants.

was 24%, which was consistent with their comparatively lower participation in the engineering discipline at SUST, Sylhet.

Figure 3 presents the frequency distribution of participants across three different departments at SUST. The distribution of participants across departments shows that 40% were from IPE, 34% from CSE, and 26% from SWE. The outcome of the calculation from the severity index, comparison of three departments, and results from Spearman's rank correlation are outlined below.

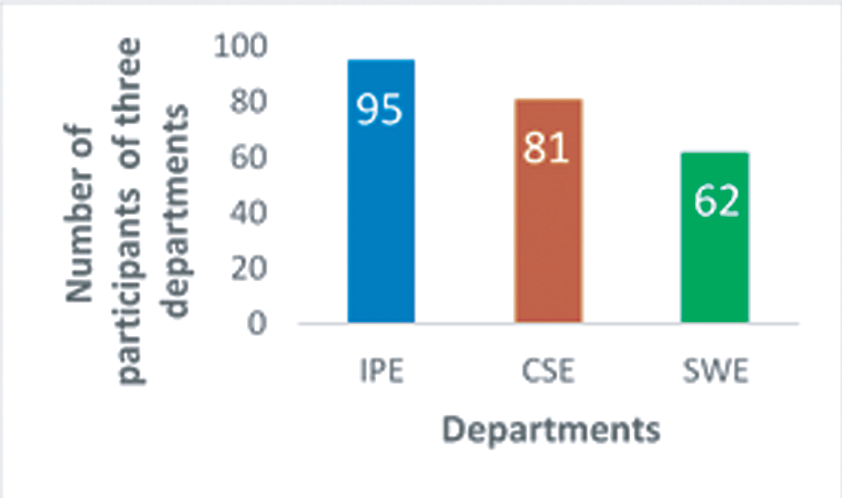

Figure 3. Department-wise count of participants.

3.1. Severity Index

Severity index indicates the ranking of different musculoskeletal pains for excessive use of laptop based on six (0-5) point grade scale. A comparative study among the different categories of pain is shown in **Figure 4.**

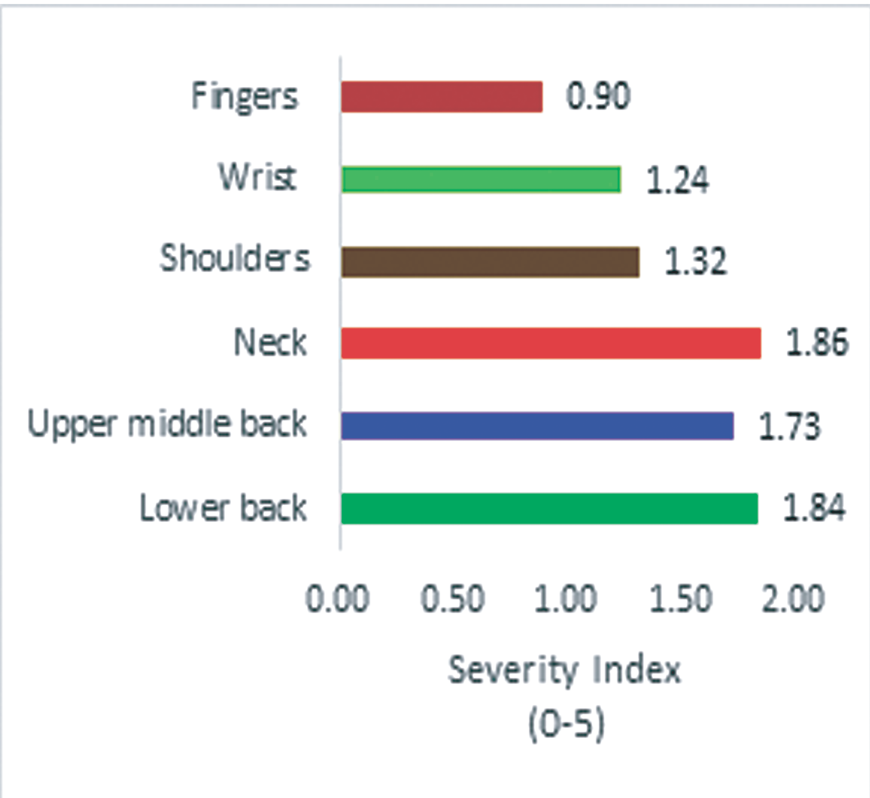

Figure 4. Mean pain severity index where the scale was used from 0 (no pain) to 5 (extreme).

The most severe pain is reported as neck pain with a mean of severity index of 1.86 and the second highest pain is lower back pain having the mean of severity index of 1.84. Consequently, the mean severity index was 1.73 for upper-middle back pain, 1.32 for shoulder pain, 1.24 for wrist pain, and 0.90 for finger pain.

3.2. Comparison of the effects of laptop use among students in three selected departments

Table 3 summarizes the prevalence of self-reported musculoskeletal pain while using laptops among students from three selected departments. Finger pain was most prevalent among students from the IPE department (64%), compared with lower proportions among CSE (42%) and SWE (47%). Although CSE and SWE students use computers extensively, programming tasks typically involve intermittent typing interspersed with prolonged cognitive processing and code reading. These natural pauses may reduce continuous finger loading. On the other hand, IPE students spent a lot of time working on spreadsheet tasks, data analysis software, and report preparation. Frequent use of the keyboard and mouse was necessary for these tasks, which could cause finger strain.

There were differences in wrist pain between departments. CSE students reported the highest prevalence (78%), followed by SWE students (68%). Among IPE students, the prevalence was significantly lower (42%). In general, programming tasks necessitate constant keyboard use with minimal postural variation, especially when external input devices are not utilized. Because of this, there may be more mechanical strain on the wrist and forearm muscles, which could account for the higher incidence of wrist pain in programming-based fields.

52% of IPE students reported having shoulder pain, compared to higher rates among CSE (71%) and SWE (77%) students. The arms are frequently kept in fixed positions with little movement during extended coding sessions. The shoulder and upper trapezius muscles become continuously active as a result. So, students studying SWE who worked on development projects for extended periods of time had the highest incidence of shoulder pain. Neck pain was frequently reported in every department, as shown in Table 3. 91% of students studying CSE reported feeling uncomfortable, which was the highest prevalence. Programming tasks necessitate prolonged mental and visual focus, which frequently causes a forward head posture. Long-term laptop use results in decreased postural awareness, which puts more strain on the cervical spine. Compared to 67% of CSE students and 71% of SWE students, 54% of IPE students reported having upper-middle back pain. 51%, 79%, and 72% of students in the corresponding

Table 3. Comparison of students reported pain from three department.

Variables		Fingers Pain		Wrist Pain		Shoulders Pain		Neck Pain		Upper Middle Back Pain		Lower back Pain	
Report		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Department	IPE	64%	36%	42%	58%	52%	48%	59%	41%	54%	46%	51%	49%
	CSE	42%	58%	78%	22%	71%	29%	91%	9%	67%	33%	79%	21%
	SWE	47%	53%	68%	32%	77%	23%	76%	25%	71%	29%	72%	28%

departments reported having lower back pain. These results show limited postural changes during screen-based tasks, especially in programming-intensive activities, prolonged static sitting, and sustained flexion of the thoracic and lumbar spine. However, CSE and SWE students reported higher rates of wrist, shoulder, neck, and back pain. Prolonged static postures and repetitive input demands related to programming tasks are consistent with this pattern. IPE students, on the other hand, reported less discomfort in proximal body regions but more finger pain, which could be explained by variation in computer-based activities.

3.3. Prevalence of Musculoskeletal Pain and Spearman Correlation Analysis

Much research has been conducted in various countries regarding the negative effects of laptop use. Iqbal et al. (2021) investigated the relationship between different computer users' postures and reported pains for Bangladeshi university students using chi-square statistical analysis [25]. But very few studies have been conducted regarding musculoskeletal discomfort while using laptops among Bangladeshi students, using Spearman's rank correlation as a statistical technique. Accordingly, the present study investigated the associations between six musculoskeletal discomforts and daily laptop use duration, commonly adopted postures, and typical laptop-related tasks using Spearman's rank correlation. This statistical analysis technique validates the previous results and shows the degree of existing relationship by showing the correlation coefficient values.

Spearman's rank correlation was used to identify the strength and significance of the associations between the examined variables and different musculoskeletal discomforts, including finger, upper-middle-back, wrist, neck, shoulder, and lower back pain, during laptop use. Spearman's rank correlation was employed in this study because several of the tested variables were ordinal in nature and did not meet the assumptions required for parametric correlation analysis. Specifically, postural configuration and tasks (Programming, Gaming) variables were measured using ordered categorical responses (Never, Rarely, Occasionally, Frequently, Very frequently), which represent ranked data rather than continuous, normally distributed measurements. In addition, musculoskeletal pain outcomes were recorded as dichotomous responses (No: No pain / Yes: adding Grade 1 to Grade 5 responses in scale), further limiting the suitability of parametric methods such as Pearson correlation.

Spearman's rank correlation is appropriate for assessing monotonic relationships between variables measured on ordinal or non-normally distributed scales. Compared to parametric correlation techniques, it does not require assumptions of linearity or normality and is robust when applied to ranked or categorical exposure variables. This makes it particularly suitable for examining associations between laptop usage characteristics, postural exposure frequency, and the presence of musculoskeletal pain.

According to Table 4, students who were using laptops for 3 years to 4 years mostly suffered from neck pain (88.9%), lower back pain (82.2%), shoulder pain (75.6%), wrist pain (75.6%). It is also seen that the maximum number of students considering this study use their laptops for more than 4 years, and there was a significant relationship between "how many years a student has used a laptop" and musculoskeletal discomforts such as wrist, neck, shoulder, and lower back pain ($p < 0.05$). Among students with an average daily laptop use exceeding six hours, neck and wrist pain were most prevalent (100%), followed by shoulder pain (93.3%), lower back pain (73.3%), and upper-middle back pain (67%). However, the strongest positive association was observed in the duration of laptop use (years) and neck pain, where $r=.357$ and $p<.05$. As shown in Table 4, maximum students of this study use their laptops average 2 hours in a day and the mean time of laptop use was associated with all pain categories, except pain in fingers ($p = 0.077$). Among the considered discomforts, pain in the wrist ($r=.441$, $p=.001$), shoulder pain ($r=.314$, $p=.001$), neck pain ($r=.408$, $p=.001$), and lower back pain ($r=.333$, $p=.001$) had a positive significant relation with the mean daily laptop usage period. So, pain in the wrist, shoulder, neck, and lower back increases if daily laptop usage time increases. All six discomforts originating from laptop use did not exhibit any significant association with students' laptop gaming frequency, except neck pain ($r=.144$, $p=.026$). The findings suggest that more frequent laptop-based gaming is associated with a higher prevalence of neck pain among students. But wrist pain ($r=.263$, $p=.001$), shoulder pain (r=.187, p=.004), neck pain (r=.165, p=.011), and lower back pain (r=.255, p=.001) showed significant relationships with how often students engaged in programming on their laptops; however, these associations were of moderate magnitude because the correlation coefficient value is close to zero.

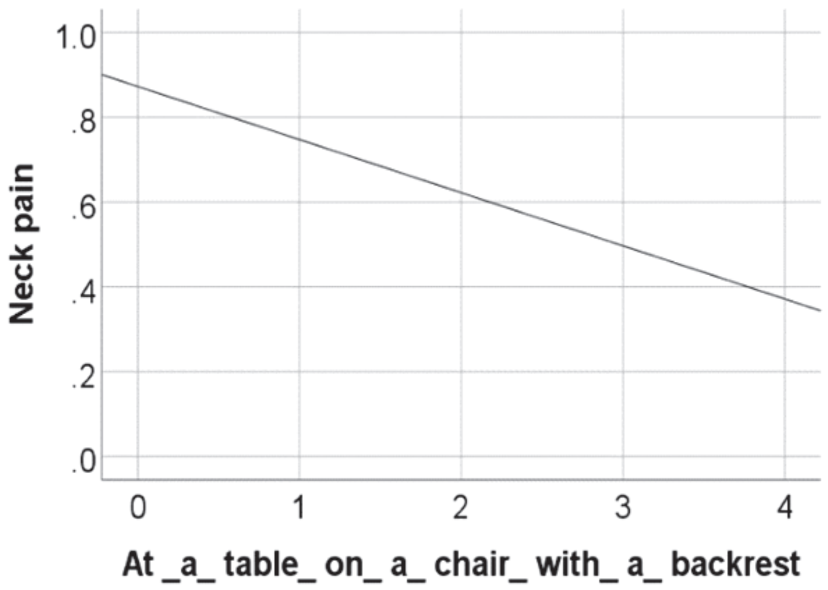

Figure 5. Negative linear relationship of the "Back-supported sitting posture while operating a laptop on a table" posture with upper-middle back pain.

Statistically significant inverse association of the posture (back-supported sitting posture while operating a laptop on a table) was found with wrist pain (r = -.254, p = .001), neck pain (r=-.369, p=.001), upper-middle back pain (r=-.542, p = .001), and lower back pain (r=-.412, p=.001).

However, a strong negative correlation was identified between upper-middle-back discomfort and the posture (back-supported sitting posture while operating a laptop on a table). Figures 5, 6, and 7 show negative linear relationships of the posture, namely "back-supported sitting posture while operating a laptop on a table", with the effects of upper-middle-back pain, neck pain, and pain in the lower back region, respectively. The straight line expressing the relationship of upper-middle back pain is steeper than that of lower back pain and neck pain.

The negative relationship indicates that the increasing number of adopting the posture (back-supported sitting posture while operating a laptop on a table) would diminish the level of pain in the wrist, upper-middle back, neck, and lower back regions. Back-supported sitting posture likely reduces musculoskeletal pain by promoting neutral spinal alignment, decreasing static muscle activation, and redistributing upper-body load from active musculature to passive support structures. No significant relationship was found between the posture, namely "sitting without back support while laptop positioned on table", and the musculoskeletal

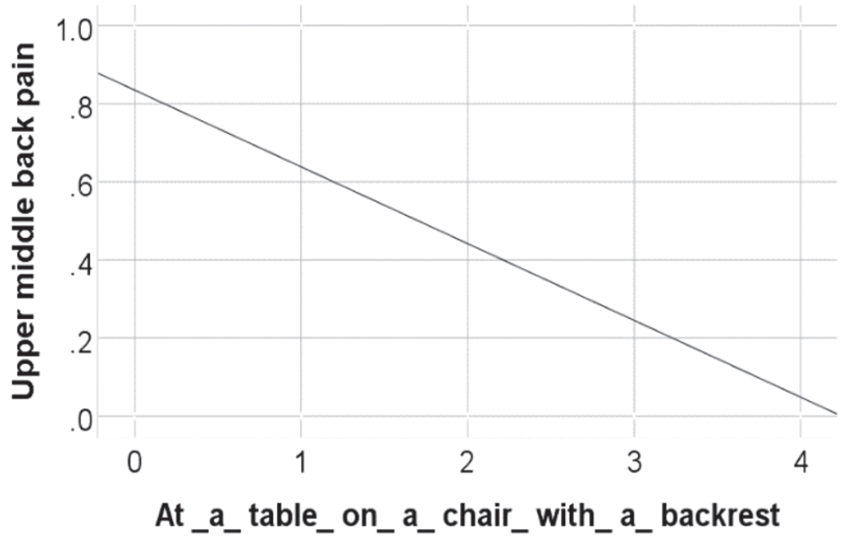

Figure 6. Negative linear relationship of the "Back-supported sitting posture while operating a laptop on a table" posture with neck pain.

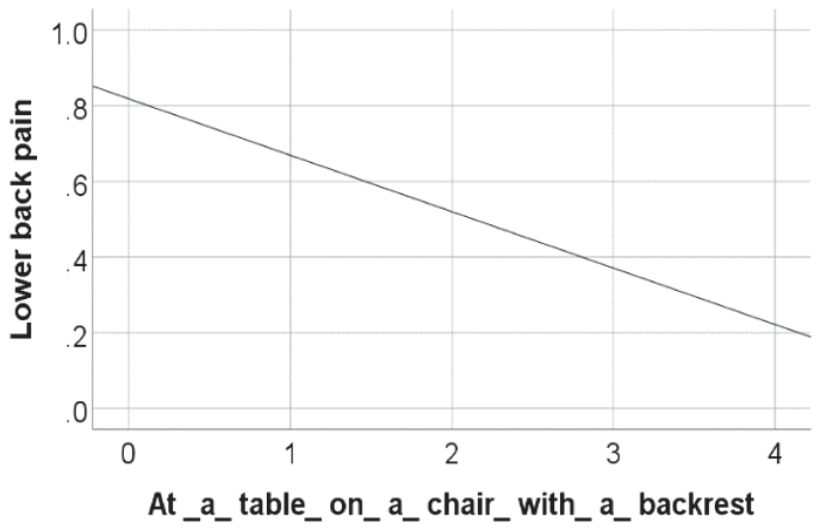

Figure 7. Negative linear relationship of the "back-supported sitting posture while operating a laptop on a table" posture with lower back pain.

discomforts since the p-value > 0.05. It is also found that the posture, namely lying on the stomach, had no significant relationship with the musculoskeletal discomforts. The non-significant association may reflect insufficient cumulative exposure and high inter-individual variability in posture adoption, limiting detectable musculoskeletal impact. A weak but statistically significant association was observed between cross-legged sitting while using a laptop on a flat surface and lower back pain (r = 0.155, p = 0.016). This association may be explained by asymmetrical pelvic positioning and reduced lumbar support during cross-legged sitting.

Therefore, posture, task requirements, and duration of use are significant factors influencing musculoskeletal discomfort in students using laptops. These results highlight the significance of encouraging ergonomically favourable postures and regulating task-related exposure to mitigate musculoskeletal risks among university students.

Table 4. Percentages of students suffering from different pains and Spearman's Rank Correlation summary for different tested variables and different effects of using a laptop.

Variables		**N = 238**	**Fingers Pain**		**Wrists pain**		**Shoulders Pain**	
		No of students	**% with FP**	**Rho(r) and p-value**	**% with WP**	**Rho(r) and p-value**	**% with SP**	**Rho(r) and p-value**
Time span of laptop use	Below one year	29	69.0%	r=-0.208 p=0.001	48.3%	r=0.183 p=0.005	51.7%	r=0.187 p=0.004
	1 to below 2 yrs	22	77.3%		27.3%		45.5%	
	2 to below 3 yrs	31	48.4%		54.8%		48.4%	
	3 to below 4 yrs	45	55.6%		75.6%		75.6%	
	More than 4 years	111	42.3%		66.7%		71.2%	
Average time on laptop use (daily)	Below 2 hours	144	20.0%	r=-0.115 p=0.077	51.4%	r=0.441 p=0.00	58.3%	r=0.314 p=0.00
	2 to below 4hours	52	25.9%		67.3%		67.3%	
	4 to below 6 hours	27	46.2%		77.8%		74.1%	
	More than 6 hours	15	62.5%		100%		93.3%	
Programming (task)	Never	25	64.0%	r=-0.146 p=0.022	28.0%	r=0.263 p=0.00	36.0%	r=0.187 p=0.004
	Rarely	39	56.4%		46.2%		53.8%	
	Occasionally	59	59.3%		64.4%		71.2%	
	Frequently	42	47.6%		69.0%		69.0%	
	Very frequently	73	42.5%		72.6%		71.2%	
Gaming (task)	Never	69	49.3%	r=0.001 p=0.985	52.2%	r=0.077 p=0.235	62.3%	r=0.012 p=0.057
	Rarely	52	55.8%		67.3%		73.1%	
	Occasionally	61	54.1%		60.7%		59.0%	
	Frequently	27	55.6%		77.8%		63.0%	
	Very frequently	29	44.8%		55.2%		65.5%	
Sitting without back support while the laptop is positioned on a table (posture)	Never	105	49.5%	r=0.050 p=0.440	66.7%	r=-0.065 p=0.319	67.6%	r=-0.056 p=0.391
	Rarely	55	52.7%		45.5%		58.2%	
	Occasionally	38	52.6%		73.7%		71.1%	
	Frequently	19	63.2%		63.2%		63.2%	
	Very frequently	21	52.4%		47.6%		52.4%	
Back-supported sitting posture while operating a laptop on a table (posture)	Never	112	47.1%	r=0.030 p=0.649	58.6%	r=-0.254 p=0.000	55.6%	r=-0.182 p=0.005
	Rarely	49	20.6%		14.5%		16.3%	
	Occasionally	42	17.6%		15.2%		13.1%	
	Frequently	20	8.4%		7.6%		9.2%	
	Very frequently	15	6.3%		4.1%		5.9%	
Cross-legged sitting while handling a laptop on a flat surface (posture)	Never	121	47.9%	r=0.079 p=0.223	62.0%	r=-0.009 p=0.896	62.8%	r=0.656 p=0.387
	Rarely	56	51.8%		58.9%		58.9%	
	Occasionally	35	74.3%		54.3%		74.3%	
	Frequently	15	46.7%		73.3%		73.3%	
	Very frequently	11	36.4%		63.6%		63.6%	
Lying on stomach (posture)	Never	86	45.3%	r=0.121 p=0.063	60.5%	r=0.022 p=0.730	61.6%	r=0.070 p=0.284
	Rarely	68	52.9%		58.8%		63.2%	
	Occasionally	44	52.3%		61.4%		59.1%	
	Frequently	27	66.7%		70.4%		85.2%	
	Very frequently	13	61.5%		53.8%		61.5%	

* FP= Pain in Fingers, WP=Pain in wrist, SP=Pain in Shoulders, NP =Pain in neck, LBP=Lower Back Pain, UMBP=Upper-Middle Back Pain.

Table 4. (continued). Percentages of students suffering from different pains and Spearman's Rank Correlation summary for different tested variables and different effects of using a laptop.

Variables		N = 238	Neck Pain		Upper-Middle Back Pain		Lower Back Pain	
		No of students	% with NP	Rho(r) and p-value	% with UMBP	Rho(r) and p-value	% with LBP	Rho(r) and p-value
Time span of laptop use	Below 1 year	29	24.1%	r=0.357 p=0.00	65.5%	r=0.001 p=0.991	48.3%	r=0.160 p=0.010
	1 to below 2 yrs	22	50.0%		36.4%		27.3%	
	2 to below 3 yrs	31	80.6%		77.4%		74.2%	
	3 to below 4 yrs	45	88.9%		66.7%		82.2%	
	More than 4 years	111	83.8%		61.3%		69.4%	
Average time of laptop use (daily)	Below 2 hours	144	67.4%	r=0.408 p=0.000	60.4%	r=0.249 p=0.00	61.8%	r=0.333 p=0.000
	2 to below 4hours	52	76.9%		65.4%		69.2%	
	4 to below 6 hours	27	88.9%		66.7%		77.8%	
	More than 6 hours	15	100.0%		66.7%		73.3%	
Programming (task)	Never	25	48.0%	r=0.165 p=0.011	40.0%	r=0.125 p=0.053	36.0%	r=0.255 p=0.000
	Rarely	39	66.7%		61.5%		56.4%	
	Occasionally	59	83.1%		61.0%		66.1%	
	Frequently	42	71.4%		73.8%		69.0%	
	Very frequently	73	80.8%		65.8%		79.5%	
Gaming (task)	Never	69	65.2%	r=0.144 p=0.026	56.5%	r=0.080 p=0.222	62.3%	r=-0.005 p=0.944
	Rarely	52	73.1%		61.5%		69.2%	
	Occasionally	61	77.0%		72.1%		73.8%	
	Frequently	27	81.5%		40.7%		59.3%	
	Very frequently	29	82.8%		79.3%		58.6%	
Sitting without back support while the laptop is positioned on a table (posture)	Never	105	79.0%	r=-0.084 p=0.196	57.1%	r=0.070 p=0.282	62.9%	r=0.023 p=0.725
	Rarely	55	69.1%		69.1%		69.1%	
	Occasionally	38	65.8%		65.8%		76.3%	
	Frequently	19	84.2%		84.2%		78.9%	
	Very frequently	21	66.7%		47.6%		42.9%	
Back-supported sitting posture while operating a laptop on a table (posture)	Never	112	58.0%	r=-0.369 p=0.000	67.8%	r=-0.542 p=0.000	61.8%	r=-0.412 p=0.000
	Rarely	49	17.0%		15.4%		15.3%	
	Occasionally	42	14.8%		10.1%		15.9%	
	Frequently	20	7.4%		4.7%		3.8%	
	Very frequently	15	2.8%		2.0%		3.2%	
Cross-legged sitting while handling a laptop on a flat surface (posture)	Never	121	73.6%	r=0.035 p=0.595	57.9%	r=0.123 p=0.057	58.7%	r=0.155 p=0.016
	Rarely	56	69.6%		60.7%		71.4%	
	Occasionally	35	77.1%		74.3%		77.1%	
	Frequently	15	80.0%		73.3%		66.7%	
	Very frequently	11	81.8%		72.7%		81.8%	
Lying on stomach (posture)	Never	86	74.4%	r=-0.002 p=0.975	62.8%	r=0.032 p=0.626	61.6%	r=0.094 p=0.147
	Rarely	68	70.6%		57.4%		61.8%	
	Occasionally	44	81.8%		63.6%		77.3%	
	Frequently	27	74.1%		81.5%		74.1%	
	Very frequently	13	61.5%		46.2%		61.5%	

* FP= Pain in Fingers, WP=Pain in wrist, SP=Pain in Shoulders, NP =Pain in neck, LBP=Lower Back Pain, UMBP=Upper-Middle Back Pain.

4. Conclusion

This study demonstrates that musculoskeletal discomfort in undergraduate engineering students is not solely attributable to laptop usage. Instead, discomfort is affected by how long laptops are used each day, how often they are used, and how they are used in relation to posture and the type of task. The findings indicate a clear pattern in which longer daily laptop use and prolonged programming activities are associated with increased discomfort in the neck, shoulders, wrists, and lower back, especially among students from computing-focused departments in Bangladesh. These findings indicate that ergonomic interventions ought to be customised to particular task requirements instead of being uniformly implemented for all students.

A key contribution of this study is the identification of posture as a changeable protective factor. A strong negative relationship was found between back-supported sitting while using a laptop on a table and discomfort in the upper-middle back, neck, and lower back. This finding emphasizes the importance of proper spinal support and suggests that musculoskeletal risk can be reduced by improving workstation posture rather than limiting academic laptop use.

The findings support the inclusion of basic ergonomic education, posture awareness, and regular breaks within laptop usage. Simple measures, such as using back-supported seating, varying posture, and avoiding prolonged uninterrupted laptop use, may help reduce early musculoskeletal risk among students. While the cross-sectional design limits causal inference and the reliance on self-reported data may introduce bias, the use of Spearman's rank correlation allowed robust assessment of monotonic relationships among ordinal exposure variables common in real-world ergonomic settings. Future studies should follow students over a longer period of time. Direct posture measurements using sensors should also be used to better understand how laptop use leads to musculoskeletal pain. Overall, this study contributes actionable evidence that ergonomic posture adoption and task management, rather than reduced laptop use, are central to preventing musculoskeletal discomfort among university students.

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Ethics Approval and Consent to Participate

This study was executed in alignment with the ethical principles outlined in the Declaration of Helsinki. The study utilized an anonymous, non-invasive questionnaire survey and excluded any clinical intervention. Participation was voluntary, and all participants were informed about the study's purpose prior to data collection. All participants gave their informed consent before filling out the questionnaire. No personally identifiable information was gathered, and confidentiality and anonymity among respondents were rigorously upheld throughout the study.

Competing Interests

There is no conflict of interest.

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