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**STUDY ON ERGONOMIC RISK FACTORS FOR
MUSCULOSKELETAL DISORDERS IN THE
ACADEMIC ENVIRONMENTS OF ENGINEERING
TECHNOLOGY STUDENTS**

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Department of Mechanical Engineering

University of Moratuwa

Sri Lanka

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree
Degree of Master of Engineering

Department of Mechanical Engineering

University of Moratuwa
Sri Lanka

June 2025

DECLARATION

I declare that this is my work, and the dissertation does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other University or Institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text. I reserve the right to use this content in whole or part in future works (such as articles or books).

Signature:

Date: 12/06/2025

The above candidate carried out research for the master's dissertation under my supervision. I confirm that the student's declaration above is true and correct.

Name of Supervisor: Prof. H.K.G. Punchihewa

Signature of the Supervisor:

Date: 13/06/2025

DEDICATION

This dissertation is dedicated to my parents, especially my mum Zumbra, who have always loved me unconditionally and looked after my kids and whose good examples have taught me to work hard for the things that I aspire to achieve. This work is also dedicated to my beloved husband who has been a constant source of support, care, and encouragement throughout this research work. I am truly thankful for having you to achieve whatever I can.

ACKNOWLEDGMENT

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ABSTRACT

The students can pursue careers as technologists with relevant engineering competencies in technological institutes. Since students studying technology spend most of their time in academic settings and have a constant posture, most individuals may exhibit musculoskeletal disorder symptoms (MSD). Therefore, the study aims to identify the prevalence rate and possible risk factors associated with developing MSD among technology students in Sri Lanka. The objectives were to ascertain the prevalence rate, identify potential risk factors for the development of MSDs, and propose interventions to mitigate the risks to lessen the MSDs among Sri Lankan technology students.

The quantitative descriptive and cross-sectional study was carried out among 244 technology students at the Advanced Technological Institutes in Sri Lanka's Southern and Western provinces to determine the possible ergonomic risk factors associated with MSD and analyze the outcomes behavior of students for one year, which may cause MSD-related issues.

A standard Nordic Musculoskeletal Questionnaire (NMQ) including 15 body parts was used to assess the prevalence of musculoskeletal disorders. Ultimately, the statistical analysis procedure was performed using the software SPSS-22 for this study. The Quick Exposure Checklist (QEC) was used to examine the four main body parts (neck, wrist/hand, shoulder/arm, and back); meanwhile, the psychosocial factors checklist was also validated through the Perceived Stress Score (PSS).

The study revealed an 86% prevalence of MSDs and the highest prevalence in the lower back (65.6%, n = 160). Then, in the next range, the neck is 59.4%, the knees 50.8%, the wrists 34%, the shoulders, and the lowest fingers (14.6%). The demographic factors affecting MSDs are BMI, family status, and daily travel. Physical and environmental risk factors include desk and bench configurations, aging tools and equipment, and awkward posture due to repetitive actions. In addition, time pressure, exposure to bullying, and raging aggression were identified as psychological elements.

It is possible to reduce the prevalence of students' MSD by raising awareness programs, ergonomic seating arrangements, eliminating hazards by implementing preventative measures for productivity, and promoting a safe environment.

Keywords: Ergonomics Risk factors, Musculoskeletal Disorders, academic, Intervention

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1.0 INTRODUCTION

1.1 Context

Technology institutes in part of Sri Lanka offer technology courses for advanced-level qualified school leavers with specialized mathematics knowledge, who can become middle-level technologists with applicable engineering skills. Consequently, the program's goal is to give students a thorough understanding of engineering principles, their practical applications, and the new requirements for advancements and modifications that will be necessary as the industry evolves for technologists.

Health is one of the most essential elements of life. This implies that one cannot expect a good life based merely on the lack of symptoms and sickness. Work-related Musculoskeletal disorders (WRMSDs) can only be linked to specific work-related factors [1]. Here, we define work as “students’ engagements in academic environment work as technological institutes”. This is because the existing literature being synthesized in this paper focuses mainly on students' work-related factors.

For academic purposes, students use computers, tools, equipment, and other technology for extended periods of exposure and simultaneously the traveling mode and time to the institutes. Promoting students' long-term health and well-being can be achieved by recognizing and reducing ergonomic risk factors, which can help prevent musculoskeletal illnesses [1].

Musculoskeletal disorders must be considered in the context of student participation. The habits that students develop during their time in institutes can have a lasting effect on their well-being throughout the future. Assessing and reducing ergonomic hazards in educational institutions can help clear a long-time musculoskeletal discomfort or disorder for an adult. Another fact is the usage of outdated tools and equipment with un-ergonomic infrastructures. Any of the unexamined risk factors of students is one of the most common ways in which a student’s MSD can occur.

Some researchers reported, “WRMSD is known by many terms and is used interchangeably, such as repetitive motion injuries, cumulative trauma disorder, repetitive strains injuries, overuse syndrome, regional MSD, and soft tissue

disorders” [1]. The consequences of MSDs are significant for the student who is experiencing an MSD as well as for the institutes [2].

Technology students often engage in continuous learning through in-class, workshops, canteen, and participation in surveys and mini-projects [3]. Students are frequently in the front of innovation, carrying out practical studies and various mini projects to create novel technologies and problem-solutions, among societies that have the potential to develop MSDs with high prevalence rates worldwide.

1.2 Aim and objectives of the study

1.2.1 Aim

This study aimed to identify the prevalence rate and possible risk factors associated with developing MSD among technology students in Sri Lanka.

1.2.2 Objectives

1. To establish the current knowledge of the MSD encountered during the academic tasks of technology students.
2. To conduct an MSD prevalence study among technology students to identify the risk factors in academic tasks.
3. To propose interventions to mitigate the possible risks to minimize MSDs.

The results of this study inform efforts to prevent MSDs in technology students.

1.3 Brief methodology

A literature review using widely accepted databases such as Scopus, Research Gate, Google Scholar, and Science Direct was carried out to achieve the objective. A cross-sectional survey, the Nordic Musculoskeletal Questionnaire (NMQ), Questionnaire for Perceived Stress Scale (PSS), and Quick Exposure Check (QEC) were used. The data were analyzed using IBM SPSS Statistics 22 analysis software and qualitative techniques. Finally, through a literature review, remedial actions were identified to mitigate risk factors.

1.4 Outlines of the dissertation

The dissertation contains five chapters. The first and second chapters include the introduction and the literature review including the survey details. The methodology is described in the third chapter. Chapter four contains the results, the interpretation, and the discussion. The fifth and final chapter contains the conclusion including the suggested future work.

2.0 LITERATURE REVIEW

2.1 Musculoskeletal Disorders (MSDs)

Impairments of body structures, including muscles, ligaments, nerves, bones, joints, tendons, and cartilage, are referred to as musculoskeletal disorders (MSDs). The musculoskeletal system consists of the muscular system and the skeletal system.

2.1.1 Risk factors for musculoskeletal disorders

The risk factors for MSDs are still being researched by various authors. However, most of the literature showed that some of the dependent or independent themes could have an impact on musculoskeletal conditions, and, categorizes the themes explorative as demographic or individual risk factors, physical & environmental, and psychosocial stressors in most reviews [8]. Many studies strongly suggested that these themes have some level of positive correlation of MSDs among students.

One research study has discovered that the most common incidence of discomfort among students is in the right shoulder (23.9%) based on computer-related MSD. Meanwhile, the upper arm, right side of the neck, and right side of the hip respectively (2.29 %, 3.30%, and 2.8% respectively) were reported as the most painful zones [1].

In 2016, a study found significant differences between non-performing active pauses and neck symptoms ($P = 0.007$), not stretching versus neck symptoms [OR = 2.4048 (1.0133–5.707)]; laptop use versus eyes [OR = 2.7132 (1.457–5.0526)], shoulders [OR = 10.6364 (4.9905–22.6697)], elbows ($P = 0.04$); non-mouse usage versus elbows ($P = 0.028$), hand-wrist ($P = 0.043$); non-forearm support versus lower back ($P = 0.009$) in general studying students [2].

In 2017, another study revealed that neck pain (60.3%), lower back pain (59.5%), and shoulder pain (49.6%) were the most reported body regions affected by work-related MSD. The elbow (18.2%), wrist/hand (35.5%), upper back (42.1%), hips (24.8%), knee (23.1%), and ankle/feet (14%) were the least affected regions [3].

Students' work-related musculoskeletal symptoms vary depending on the course, the academic institution, and even the nature of the place they study. These symptoms

appear to be related to many different occupational risks associated with WRMSDs in academia.

In 2021, another study revealed that the most common discomfort among students was neck problems (41.6%), the highest percentage of trouble during the last 12 months. Among nine anatomical regions, students suffered from ankle/ foot problems (18.9%) mostly which prevented their day-to-day activities, comparably high involvement of lower back problems (8.6%) led to taking medications and more students sought physiotherapy for their neck problems (7.4%) [4].

The low back, neck, knees, forearms, and hands are the body areas wherein MSDs are most prevalent, while more attention has recently been given to the lower extremities. This review in 2022 showed the prevalence of a range of MSDs in the neck (24.8-69.9%), shoulders (17.5-25.3%), upper and lower back (18-63.4%), and wrists (30.7%) among the students but these are for general discipline [5].

The term musculoskeletal disorder encompasses a variety of conditions, ranging from those that have an acute onset and a short duration to lifelong disorders [6]. Every year Sri Lankan students are affected by some form of MSD. A musculoskeletal disorder complaint is known as an explicit health problem experienced by individuals” [7].

2.1.2 Research gap

Some researchers have checked the possibility of MSD among students in general disciplines. However, no detailed studies have been carried out yet in this regard and to identify the causes of WRMSDs of students in academic environments in Sri Lanka. Meanwhile, there is a lack of research regarding the changes in WRMSD methodology in engineering institutes. Unfortunately, ergonomic issues among students are not widely documented compared to other safety issues.

2.1.3 Conceptual framework for the ergonomic risk factors

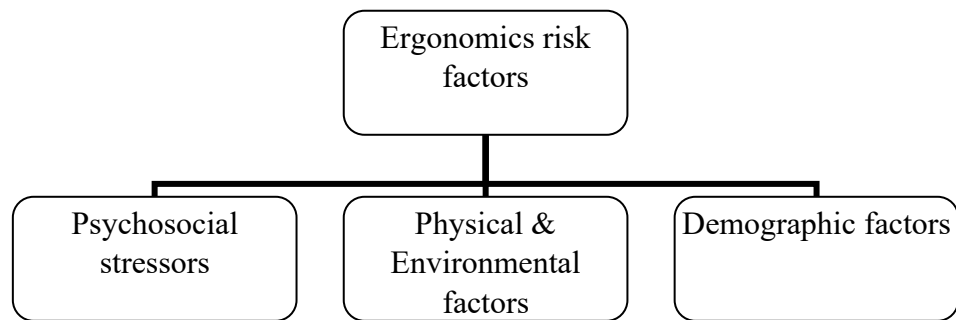


Figure 1 Conceptual framework of risk factors

The literature review served as the foundation for the development of the conceptual framework and acted as a guide [4],[8]. The present study was based on a conceptual framework as shown above.

2.2 Demographic or individual risk factors

Demographic factors are information that characterizes an individual or an entire population. One study revealed that BMI was statistically higher in technical education students than in general education [9].

Student demographics may interact with teacher demography and be jointly dependent on teacher experience. Understanding the relationship between the demography of students and their academic achievement may therefore assist academics in improving their teaching practice [10]. The same study above concluded that younger students under twenty-one passed more than older students, those over twenty-four.

In his research, Dr. John Chen found that higher test anxiety results in a higher GPA for females and non-binary-identifying students; there were no additional differences in test anxiety for any racial or ethnic socioeconomic group [11]. Therefore, demographic factors play a significant role in decision-making to reduce students' MSDs. Some recent studies do not agree with the statement that "gender does not impact risk tolerance." "Many researchers have investigated which demographic variables influence an individual's risk-taking in financial investments" [12].

This section aims to analyze previous literature that has documented any correlation linking various individual risk factors. The demographic variables for this study are gender, body mass index, field of study, duration of daily study, laptop usage time, traveling from/to the institute, family status, habit of writing, etc.

2.3 Physical & environmental risk factors

Physical and environmental factors encompass a wide range of elements that influence various aspects and play a vital role in the development of MSDs among students in academic environments in much of the literature [11]. Biomechanical exposures such as muscular and external forces, repetition, vibrations, and awkward postures are among the physical risk factors associated with MSDs.

There is evidence linking physical risk factors such as high force levels, unusual postures, and repetitive motions to the development of MSDs. Musculoskeletal disorders can be influenced by various physical and environmental factors, especially among students who may spend extended periods engaged in activities that contribute to these issues. Each of these has been linked to an increase of student discomfort in research and institutional settings.

It has been shown that ergonomic treatments that minimize the impact of these risk factors not only minimize discomfort but also boost productivity. Inadequate temperature control and poor lighting can also affect concentration and contribute to physical discomfort as environmental factors. Most computer monitors have glare, and in the neutral position, they have too much light in their workstation or environment [13].

Different environmental conditions may either amplify or reduce the detrimental effects of awkward posture. Eventually, this uncomfortable static position deviating from the neutral posture will increase the likelihood of injuries.

Some researchers have found that the design of academic furnishings is most frequently associated with pain or discomfort in students. According to research “furniture and workstations should suit the students’ body sizes and anthropometric body dimensions” [14], highlighting that to enhance students' comfort level, work performance, and posture, an ergonomic intervention is required. Many physical

factors affect the health of students in technology-related fields when performing their academic or daily tasks in the academic environment even in the cafeteria zone. Numerous case studies have documented the connection between physical and environmental risk factors, the discomfort may cause, and productivity. However, few efforts have attempted to explore and model this link.

2.4 Psychosocial stressors

The prevalence of adverse psycho-social health issues is rising among these young people globally. Some of the psycho-social outcomes: being bullied, loneliness, feeling anxious, and considering attempting suicide are prevalent in notable proportions among school children aged 13-17 years in Sri Lanka [15]. If these issues are left unaddressed then the next move in the technology students is an increase in MSDs which affects the quality and balance of their work and life.

In addition, most Sri Lankan students studying technology in public educational institutions also have additional obligations to care for their families in some form, which adds to the physical and mental strain. Surveys suggest that students who attend seem to be more susceptible to developing MSD than those who attend private institutions. “Presenting with a current mental health problem, negative rumination, parental separation, experiences of sexual harassment, and parental depression significantly predicted depression outcomes. Childhood adversity, baseline mental health problems, and financial difficulties are predictors of suicide-related outcomes”[16].

Exams and assessments that follow traditional methods cause students under significant stress, which can have a variety of effects on memory formation and learning [17].

However, among other things, an individual’s characteristics affects how they respond to stress. “Having mental health problems is linked to lower academic performance and higher dropout rates; in the last four years, the number of students quitting their studies due to mental health problems has increased by 210%” [16].

David Bueno et al. stated that “when learning and testing take place in the same context, recall is spared from the damaging effects of stress and may contribute to

consolidating memory and developing executive functions, making the process of learning more efficient” [17].

Researcher Dr. John Chen concluded, “Higher test anxiety results in a higher GPA for female students and those who identify as non-binary; there were no additional differences in test anxiety for any racial/ethnic or socioeconomic group. Regardless, anxiety is harmful to students’ health and well-being. Therefore, although these students have higher GPAs, their increased level of anxiety and the testing culture of engineering could put them at risk of leaving engineering” [18]. Students deal with a variety of psychosocial problems during their academic journey that contribute to their MSDs. A study on the ergonomic risk factors for musculoskeletal disorders (MSD) in technology students in educational institutions is important because it has the potential to address and enhance students' physical well-being as well as their academic achievement.

2.5 Nordic Musculoskeletal Questionnaire (NMQ)

The uniformity of assessment questions is necessary for the indirect methods of musculoskeletal symptom identification and analysis across persons and geographical locations. Therefore, many studies have used the NMQ as a standard tool [3], [21] such that the prevalence of MSDs of the participants and exposure to the risk factors were collected using the NMQ. This NMQ has been widely validated for use in academic settings and has been used with students in previous studies [3],[20]. To do so, an online version of the NMQ was developed using Google Forms so that the link could be circulated using online platforms. In the current study, the following 15 body parts are associated with the NMQ neck, shoulder, upper arm, elbow, forearms, wrist, hands, fingers, upper/middle back, lower back, hips/thighs, upper legs, knees, lower legs, ankle, or feet. In addition, the extension to the NMQ proposed [22] was included to collect the MSD risk factors that participants perceived. As such, demographic information such as personal and family background; Biomechanical stressors/Physical Environmental factors; and psychosocial stressors that possibly cause MSDs in students were captured concerning each body segment included in the NMQ.

In the beginning, a brief explanation was given about the nature and purpose of the questionnaire to the respondents. This was used as informed consent to participate in the study. Some respondents were unsure with no idea how to proceed and had a mutual discussion via social media upon special approval from the relevant higher authority in the technology institutes. The questionnaire was in English. Meanwhile, the standardized “The Nordic Musculoskeletal Questionnaire” tool was used and the main three themes (risk factors) were included as conceptual sub-questions, which derived the literature review.

2.5.1 Nordic Musculoskeletal Questionnaire used in different areas

“Previous researchers Jannatbi Nigudgi and Shrinivas Reddy found that the most disabling MSDs among study subjects were upper back (16.83%), lower back (16.08%), neck (12.81%), and wrists/hand (8.54%). The same study reveals that the most disabling MSDs affecting study subjects were upper back (16.83%), lower back (16.08%), neck (12.81%), and wrists/hand (8.54%)” [3].

One of the studies by Shubhi Kul Shrestha, Pragya Kumar, Soumya Singh, Sukriti Raj, and Shubham Sharma [19] revealed that the majority of subjects exposed discomfort in the neck (70%), lower back (60%), upper back (50%) and shoulder (49%) in the past 12 months. Maximum activity limitation occurred due to pain and discomfort in the neck region (39%) followed by lower back, knee, and ankle (11%). The less commonly involved regions included hips/ thigh (2%), shoulders (4%), elbow and wrist (8%) followed by upper back (10%).

Almost all participants suffered from at least one episode of disabling musculoskeletal pain in the past 7 days. “Early identification, prevention, and management strategies need to be explored to improve overall health in such cases” [19].

2.5.2 NMQ tool’s limitations for the study.

- Responses to the questions are required with an expected yield rate of 80%
- Challenges in verifying the accuracy of the answers.

- Restriction of exhaustive questions to three areas of the body: lower back, neck, and shoulders.
- Identification is limited to symptoms only (without further diagnostic evaluation)

2.6 Quick Exposure Check (QEC)

The QEC tool is used to evaluate the risk of musculoskeletal disorders mostly by analyzing exposure to risk factors. QEC has established itself as a legitimate, accurate, and highly sensitive rapid tool for ergonomic risk assessment over time [22]. The QEC tool has scores to measure the levels of exposure. It has instructions on how to use the tool and carry out assessments, according to the practitioners' requirements for an exposure tool. It takes only 10 to 20 minutes to complete. The scoring system and exposure levels have been designed to guide priorities for intervention in the workplace.

2.7 Perceived Stress Scale (PSS)

First, the perceived stress for the previous month was measured using the PSS-10 (Perceived Stress Scale) questionnaire. PSS has 10 statements in total, four of which are positive remarks, and six negative remarks [23].

There were 4 positive statements in numbers 4, 5, 7 and 8. The remaining were six negatives. Each participant was answered using a Likert scale very often, fairly often, sometimes, almost never, and never. To calculate a total score very often was rated as 4, fairly often rated as 3, sometimes rated as 2, almost never rated as 1, and never rated as 0: [2], [23]. Using a Likert scale with four possible responses: strongly agree, agree, disagree, and strongly disagree, each participant responded. Scores ranged from 4 to 1. After that, the sum of all the statements analyzed was calculated. Higher scores correspond to higher levels of stress.

3.0 METHODOLOGY

This research was a quantitative descriptive cross-sectional study conducted at the Technological institutes (engineering) in the Western and Southern provinces of Sri Lanka. The objectives of this study were achieved using the methodology road map shown in Figure 2.

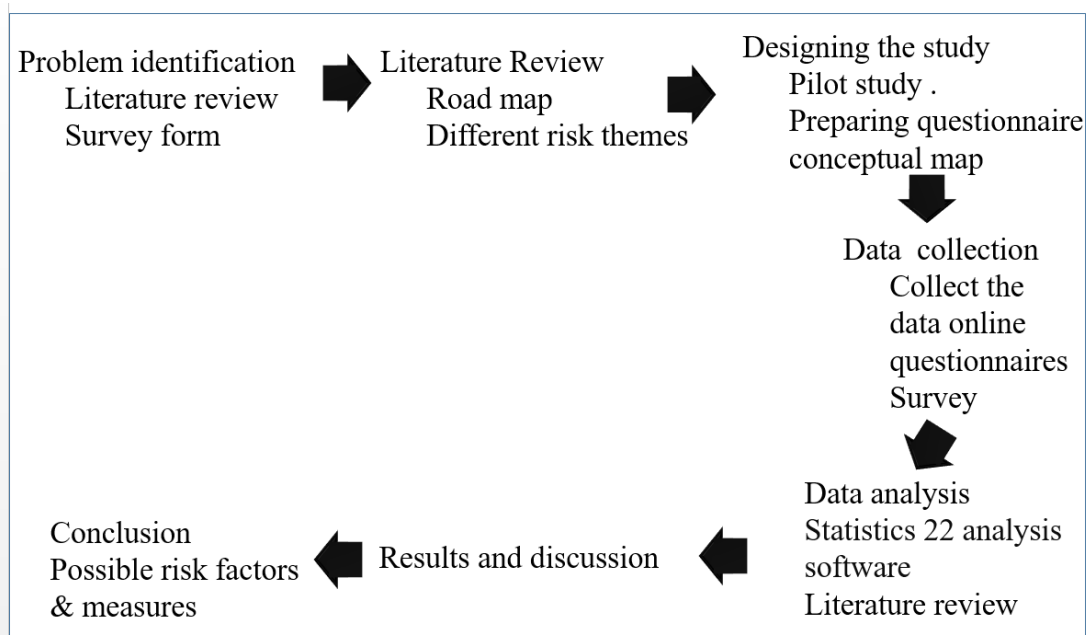


Figure 2 Methodology-road map

This methodology roadmap demonstrates the steps involved in doing the study, including where data were gathered, what sources were used to review the literature, how the collected data was analyzed, etc. From the conceptual framework, the study's objectives are identified, including which risk factors have an impact on the human body, how musculoskeletal disorders (MSDs) occur in the body, and how MSDs affect an individual capability biomechanically, physically, psychologically, and mentally.

3.1 Study design

Within this methodology, a literature survey was carried out. Subsequently, a study was carried out to establish the current knowledge of the prevalence of musculoskeletal disorders among technology students (Objective 1). The different

themes were identified as factors to MSD and followed by a pilot study (Objective 2). To meet these objectives, a comprehensive questionnaire was developed to elicit information on design aspects. A questionnaire survey using the NMQ was then conducted to evaluate its feasibility in relation to current practices and its role in reducing MSDs. Finally, the possible risk factors associated with MSDs were identified and recommendations for mitigating ergonomic risks and promoting musculoskeletal health (Objective 3). The dissertation concludes by providing an overall discussion of the research and proposed recommendations on current issues.

3.1.1 Participants for the study

A total of 500 students of both genders with MSD pains, those who studied for more than 6 months in the technology course, were purposefully recruited for the study". "They followed their primary and secondary education mostly in government schools covering all twenty-five districts of Sri Lanka", according to Sarasvati et al. [8]. Hence, schools have become ideal settings for the exploration of students' issues where they experience discomfort due to prolonged exposure as discussed by some researchers [15]. The prevalence-related findings of these students of exposure and outcomes could be assessed. Hence, a pilot study was performed for the development of observation techniques and questionnaires for this study design.

3.1.2 Sample size for the study

In this pilot study, after reviewing various sampling techniques used in qualitative research, purposeful sampling was chosen for this study since previous studies have used this formula [20],[21]. A sample size of 222 students in $n=N/(1+Ne^2)$ was generated using Taro Yamane's formula. The selection of subjects for the study was based on inclusion and exclusion criteria.

$$n = N/[1 + N(e)^2]$$

Where n = sample size of students

N= population size of students studying in the course, N= 500,

E= level of precision or sampling error = 5%

Finally, by approximation n= 222

The set questionnaires were shared with the total estimated population of students to 500 with a 5% margin of error and an assumed response rate of 80%. Finally, 244 students were randomly selected. Data was collected using content-validated, pre-tested, and self-structured questionnaires [23]. Meanwhile, it was developed by systematically reviewing the literature, and quantitative observations and considering the researchers' experiences with students' risk factors in technology courses. In addition, a brief explanation was given about the nature and purpose of the questionnaire to the respondents (students). The set number of prepared questionnaires was delivered to students according to the arranged link and time. Some respondents left responses blank and were provided with additional explanations and social media upon official approval from the relevant higher authority in the technology institutes. Meanwhile, a standardized instrument was used as the Nordic Musculoskeletal Questionnaire and three main themes of sub-questions were provided, as described in literature review segment. The QEC tool is used to evaluate the risk of musculoskeletal disorders mostly by analyzing exposure to risk factors. The perceived stress for the previous month was measured using the PSS-10 (Perceived Stress Scale) questionnaire.

3.2 Method of analysis

The respondents of the survey questionnaire provided personal and background information about the individuals" or "the participants involved in the study. It was determined which percentage of respondents answered the affirmative to each question on each phase of themes (factors) [22], which measured theme priority based on a frequency distribution table (univariate analysis).

As part of NMQ, prevalence and severity statistics for the 15 body locations were summarized and the percentages were graphically represented. The chi-square test was conducted using contingency charts to show an association of any MSDs with prevalence findings, "as stated in the null hypothesis, prevalence is statistically independent of the respondents with MSDs" MSD was associated with prevalence findings"[15].

Ultimately, SPSS version 20 was used for the statistical analysis process [3] as covariates in the analysis of MSD risk factors, and bivariate analysis (Chi-square test). The dependent variables would be musculoskeletal disorders while the different themes were the independent variables. Meanwhile, the four primary body parts (back, shoulder/arm, wrist/hand, and neck) were evaluated using the QEC tool, which also includes practitioners and students in the process of assessment. The validity and reliability test of the psychosocial factors' checklist was through the perceived stress score. Through multiple regression analysis, Pearson's Correlation Coefficient (PCC) as shown below, also analyzed the correlation between each risk theme and MS disorders [15], [21].

$-1.0 < PCC < - 0.6$	= strongly negative correlation
$-0.6 < PCC < - 0.4$	= moderately negative correlation
$-0.4 < PCC < 0$	= weak negative correlation
$0 < PCC < 0.4$	= weak positive correlation
$0.4 < PCC < 0.6$	= moderately positive correlation
$0.6 < PCC < 1.0$	= strong positive correlation

Finally, the most significant factors possible were summarized for the current study and some suggestions to mitigate the MSD risk of the students were proposed.

4.0 RESULTS AND DISCUSSION

The previous chapter reported on the questionnaire study to collect data from students at technology education institutes. The data obtained from this study were analyzed using SPSS version 22. This chapter presents the results obtained through this analysis. Descriptive statistics are presented as graphs and tabulations for the collected data.

4.1 Section A - Demographic information

The questionnaire was distributed among nearly 500 students following different engineering technology programs offered by the Sri Lanka Institute of Advanced Technological Education (SLIATE). Out of these, 84 female and 160 male students between the ages of 18 and 26 years participated in the study (i.e., response rate = 80%). Concerning the number of students in different academic disciplines, 19.7% of building services technology, 26.6% of civil technology, 18.4% of electrical technology, 33.2% of mechanical technology, and 2% of quantity surveying technology responded to the questionnaire. The demographic information of the sample (i.e., age, gender, and BMI) is presented in Table 1 while the field of study, preferred handedness, and daily study duration are presented in Table 1.

Table 1 Frequency distribution of BMI by gender and age

		Gender		Age		
		Female	Male	20-22	22-24	24 or more
BMI	<18.5	4	19	3	15	5
	18.5-24.5	19	60	15	50	14
	25.0-29.5	17	38	10	30	15
	≥ 30	44	43	13	47	27
Total		84	160	41	142	61

Table 1 shows that the institutes have a greater number of male students (65.6%). It further indicates that 58.2% of the students are between the ages of 22 and 24. The group's mean BMI was 26.8 kg/m² (std. dev. = 6.4 kg/m²). According to the WHO classifications [1], which is widely used as a standard scale for various studies, 35.7% of students are classified as obese, while 79% fall within the normal BMI range.

In Table 2, data illustrates the preferred handedness of the students. Out of all the respondents, 77.5% are right-handed. Loraine Suyu Tattao [24] points out "left-handed students appreciate their uniqueness, as they are relatively rare" [24]. However, they also face challenges in a predominantly right-handed academic environment. "Despite these obstacles, left-handed students adapt through various strategies. Indeed, left-handed students are flexible for they can fit in a world intended for the right-handed" [24].

Table 2 Frequency distribution of the field of study, handedness, and study duration

Variables	Sub-variables	Frequency	Percentage
Field of study	BSE	48	19.7
	Civil	65	26.6
	Electrical	45	18.4
	Mechanical	81	33.2
	QS	5	02.0
Preferred hand	Left-Handed	55	22.5
	Right-handed	189	77.5
Daily study duration	> 6hr	114	46.7
	4-6 hr.	86	35.2
	0-3 hr.	44	18.0

18% of students dedicate at least 3 hours daily to self-study, while 35.2% study for four to six hours each day. The remaining students devote more than 6 hours to self-study. The remainder devotes more than 6 hours to self-study. According to research [25], if students want to improve their grades, they must dedicate sufficient study time. Therefore, enhancing learning skills is essential, i.e. they can discover effective learning strategies and manage their time well. An analysis of students' computer usage patterns revealed the following results. These trends are illustrated in the figure below.

28.7% of students spend 4 to 6 hours daily on computers, 54.5% spend at least 3 hours daily, and 16.8% spend more than 6 hours daily.

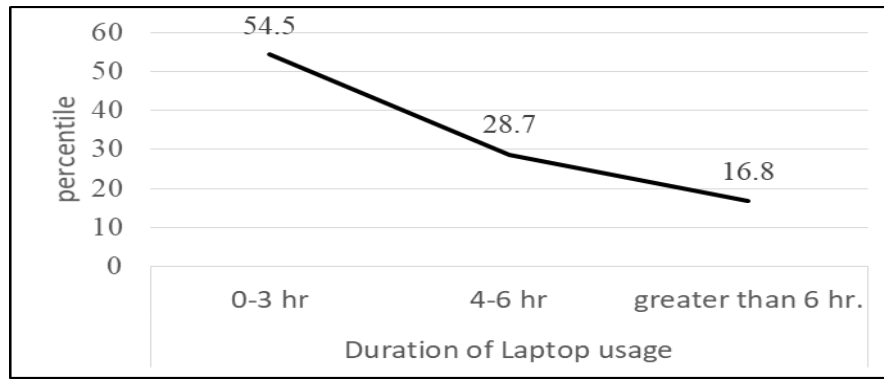


Figure 3 Frequency distribution of student daily internet usage

Half of the students spent at least three hours online each day. Additionally, some students mentioned that most of their tasks were completed in person (physically) rather than online.

The information in Table 3 highlights the frequency distribution of family backgrounds of existing students in these institutes. According to this study's findings, 68.4% of students live with both parents, while the remaining percentage report living with single or separated/divorced parents. A parent's decision to separate can have a variety of effects on children. One of the most common outcomes of divorce is that a child might end up with one or two stepparents. Depending on the circumstances, children may experience positive or negative emotions in either situation. However, parents who live with their children are generally less likely to connect with informal networks of friends, neighbors, and relatives [26].

Table 3 Frequency distribution of students' family background

Variables	Frequency	Percentile
Status of Family Background	Both parent	68.4
	Single parent	20.1
	Separated /Divorced	11.5

Table 4 shows that nearly 60.7% of students travel daily between their home or boarding and the institute for at least 3 hours, indicating proximity has less effect on their dwelling and the institute.

Table 4 Frequency distribution of daily traveling duration

Variables	Frequency	Percentile
Daily travel from boarding /home to the institute	0-3 hr.	148
	4-6 hr.	66
	>6hr	30

4.2 Section B - Physical & environmental factors

Physical risk factors for ergonomics are aspects of work or activities that place individuals under biomechanical stress, which increases the risk of illnesses or injuries related to ergonomics. These include awkward postures, static and prolonged work postures, intense exertion, and repetition, all of which put them in danger in the course of their academic-related tasks when exposed to different environmental exposures. Typical physical factors with patterns and trends are shown in Figure 4 by frequency distribution.

The prevalence and likelihood of developing MSD were affected by a combination of physical risk factors, specifically seating arrangements in the classroom and computer labs, use of laptops, features and the location of chairs and desks, proximity to the whiteboard, the duration of sitting, and awkward and static posture due to mismatched ergonomics [27].

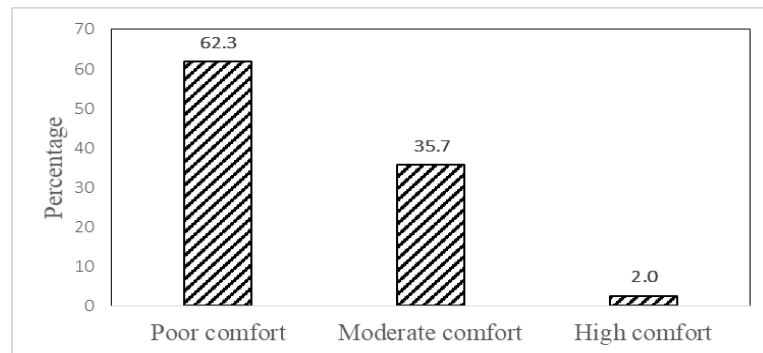


Figure 4 Seating arrangement and features of bench /desks

According to the findings shown in Figure 4, 62.3% of students suffered from MSD due to poor comfort and complained of recurrent musculoskeletal pain. 35.7% of students experienced moderate comfort while the rest of the students reported high comfort.

Considering students stay for 8 hours per day, five days per week over a semester, (4 weeks × 6 months), the total notional hour's amount to 960 hours. In this study, technology students spent an average of 8 hours per day, while in classrooms and computer labs, similarly, students commented that the workload in the academic setting were high, resulting in more extended usage and also ergonomics mismatches. As a result, prolonged sedentary activity limits the variation in working postures. Sitting postures can influence students' visual perception. According to Samira Ansari, "Static posture and long-term sitting cause damage to the spine due to decreased disc nutrition, limiting blood flow, and increased muscle tiredness, resulting in decreased elasticity and softness of the intervertebral discs, as well as severe physiological stress on the muscles and ligaments"[27]. Figure 5 illustrates the workshops and labs equipped with aging machinery and tools for practical, surveys and executing projects. This highlights the problem raised by technology students in the technological context of the need for ergonomic awareness.

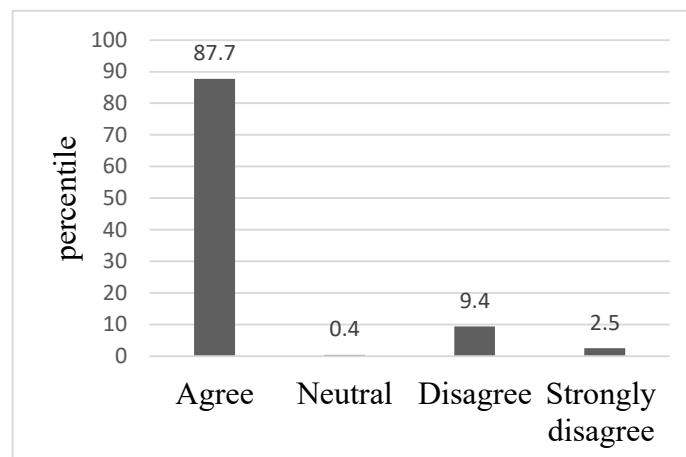


Figure 5 Workshops and labs equipped with aging machinery, equipment, and tools for practical, surveys and carrying projects

During lab sessions, problems with outdated laboratory equipment and tools have been raised by students. Students lodged complaints that the workshops were not running smoothly causing delays. Upon inspecting the manufacturing year of the equipment, it was found that some equipment in the workshops and certain labs was unused and ideal. However, due to inadequate training provided for the newly joined demonstrators, practical work was skipped, despite a shortage of resource personnel.

According to the present findings as shown in Figure 5, 87.7% of students acknowledged outdated machinery, equipment, and tools during practical surveys and while working on minor projects. Less than 12% of respondents disagreed with this statement regarding risk factors. When asked for elaborate, they expressed uncertainty about this issue whether outdated equipment posed a significant risk. Some researchers have noted that although most problems in laboratories are not severe, when incidents occur, they can negatively impact students' performance and efficiency by causing delays and missed practical sessions.

Figure 6 focuses on the respondents' perceptions of inadequate physical facilities in the institute, which may contribute to musculoskeletal pain or discomfort, impacting the well-being of the students and staff. Approximately 67% of students strongly agreed that a lack of physical facilities in the institutes is likely to increase musculoskeletal pain or discomfort.

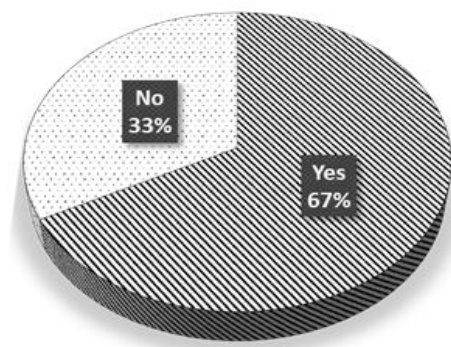


Figure 6 Discomfort due to lack of physical facilities

Current final-year students pointed out that the infrastructure of institutes has a significant impact on how many students attend and dropout rates from this course. Students indicated that attendance fully mediated the relationship between infrastructure and grades. They also added institutes requiring structural repairs, using temporary buildings, or being understaffed are less likely to attract student enrollment. Meanwhile, Figure 7 shows the respondents' percentile of the food quality and canteen facilities.

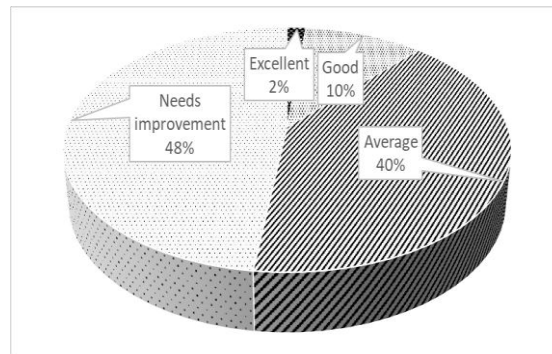
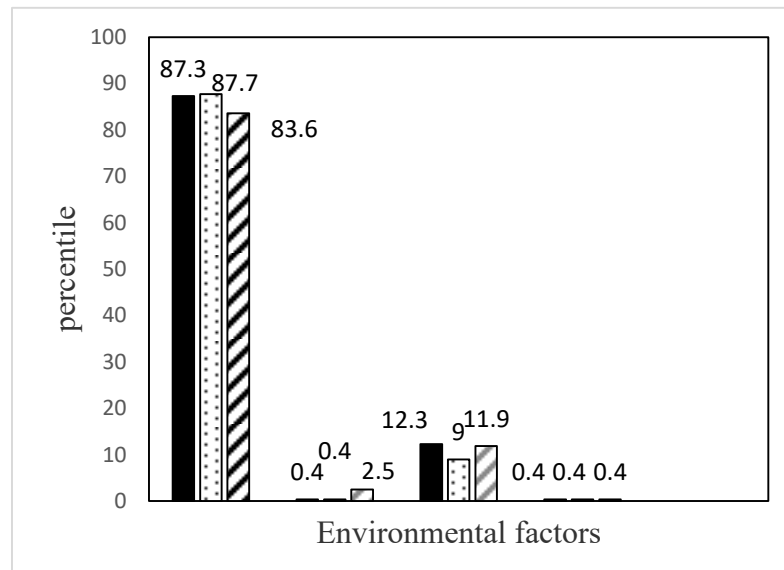


Figure 7 Food quality and facilities of the canteen

Several issues are frequently encountered in canteens, including inefficient service times, limited accessibility, inadequate room capacity, and canteen furniture arrangements that are too closely together, hindering movement and walking within the space. Despite health guidelines, unhealthy food items are still being sold in institutional canteens.

Many of the respondents replied that they were not happy with the facilities in the institute. The facilities in the canteen are not ergonomic, so it can harm the students' posture [28]. The furniture is arranged too close together to make mobility difficult.

Figure 7 reveals that 48% of them stated an improvement was needed to enhance the food quality and the facilities, while 40% accepted what is being provided and equipped while others are also greatly satisfied. In contrast to this study, relocating the canteen area is required to enhance the ergonomics conditions. Figure 8 illustrates the frequency distribution of environmental factors affecting academic performance during the past 12 months.



Noise ■ Heat/radiant temp ▨ Lighting /Glare ▩

Figure 8 Environmental factors affecting academic performance during the past twelve months

Some respondents complained that they were occasionally affected both psychological and academic performance due to changes in environmental factors (Figure 8). The primary reason for this is likely due to most of the classes being equipped with high-elevation glass shutters. In certain laboratories, the problem is caused by broken light fixtures, causing insufficient lighting in the space.

It's critical to identify and address such insufficient lighting to establish a setting that supports productive learning. Furthermore, some lecture halls lack blinds or drapes. These lecture halls' direct ultraviolet (UV) radiation entry contributes to excessive lighting, which makes it uncomfortable. This issue concerns the students even during their assessments and exam times; they feel uncomfortable with heat, radiation, and glare. These factors can influence their posture as well.

Furthermore, most classrooms lack air conditioning. As Sri Lanka is a tropical country, this contributes to fluctuating temperature conditions. Such an environment may lead to discomfort and dissatisfaction among technology students, negatively impacting their enthusiasm and productivity. Additionally, it may cause discomfort and even injuries, by highlighting the importance of promoting proper ergonomics among students. Figure 9 reveals the distribution of external environmental factors that induce during working postures, such as repetitive movements.

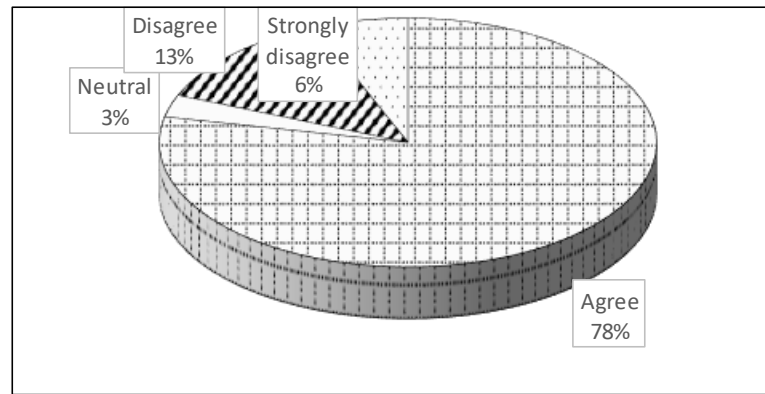


Figure 9 *External environmental factors induce awkward working postures (such as repetitive movements)*

The majority of the students indicated that their classrooms were well-lit, with glass windows mostly exposed to the sun. The radiant heat from the sun affects students during academic tasks, often causing changes in posture. According to the above pie chart, 78.3% agreed that these external environmental factors induced awkward postures during repetitive movements. Several researchers have noted that both static or dynamic repetitive movements can induce awkward posture, which may affect the user's well-being [29],[30].

4.3 Section C - Psychosocial stressors

Students may experience psychosocial stress as a result of obstacles in the educational system and institutional demands. Thus, psychological stress is another factor that should be considered as a risk factor for MSD. If these are brought forward without being assessed or diagnosed, MSD cases among technology students may affect the quality and balance of their work and life. There are some variables related to psychosocial stressors in this study associated with the risk or development of MSD, as illustrated in the frequency distribution in Table 5.

When questioned about how the students felt about lectures' overall speed (through recordings or physical interactions), a significant majority of 70.5% (n=17) rated as 'normal' rating,' while 24.2% (n=59) answered as 'too fast.'

The prevalence of stress symptoms during assessments and exams affects students' learning and performance and may cause MSD. It was found that 51.2% of the

sample reported experiencing stress, with 34.9% indicating a manageable level of stress. Additionally, another study revealed that students rated their lecturers' writing and teaching speeds positively, with an average rating of 70.5% (n=172). Therefore, it is not surprising that, given the interaction of psychosocial stressors and lecturers' speed, a significant association may exist, as half of the respondents acknowledged this connection as a contributing factor to MSD. Furthermore, 51.2% of respondents stated that ineffective teaching quality and speed could contribute to psychosocial unfitness.

Table 5 Frequency distribution of psychosocial stressors

Variables		Frequency	Severity in percentage
Speed of lecture delivery	Too slow	11	4.5
	Too fast	59	24.2
	Normal	172	70.5
	Fast	2	0.8
How far does the assessment and exam affect students' learning and performance that causes MSD?	No stress	34	13.9
	Manageable	125	51.2
	Being stressed	85	34.9
Do lecturers' speed affect students' Physical /mental activities?	Disagree	47	19.3
	Strongly agree	125	51.2
	Neutral	2	0.8
	Disagree	43	17.6
	Agree	27	11.1
The time pressure	No	33	13.9
	Yes	211	86.1
Suffering from less family support	Yes	178	73.0
	No	66	27.0
Poor computer skills/Interaction	Yes	161	65.7
	No	83	44.3
Suffering from lack of adequate sleepiness	Yes	130	53.1
	No	114	46.9
Knowledge of ergonomics risk factors may cause or induce MSD if not improved or controlled at the earliest stage	Yes	43	18.0
	No	98	40.0
	No idea	103	42.0
Invited or participated in any social group activities or isolated	Participated	182	74.2
	Isolated	38	15.9
	No participated	24	9.8
Exposure to bullying and raging violence	Yes	228	93.5
	No	16	6.5
Suffering from peer pressure meeting closer to deadline -project, assignments, phase test, etc.	Yes	112	45.7
	No	132	54.3

Lecture capture is popular among students, with many believing that access to the recordings is needed to perform well in their exams. According to Susanne Voelkel et al., their study suggested that for most students, lecture capture does not appear to affect attendance. However, their findings suggested that lecture capture might contribute to some students' perception of learning as memorization of the lecturer's spoken word and a small group of students' unhelpful study habits, such as skipping class, increase their perceived dependency on a lecture transcript and detailed notes and foster surface learning behavior [31].

The majority of students (86.1%, n=211) reported that time pressure affects their learning and enthusiasm, and may contribute to musculoskeletal disorders (MSD), while the rest opposed. Time pressure also interacts with peer pressure, particularly meeting deadlines for projects, assignments and phase tests. In addition, there were many social events and inter-functional activities mainly arranged by small groups of students without adequate time management or preparation, which could adversely affect the students' performances and directly affect the grades of male students since self-study lowered. A decline in self-study may result from insufficient family support. In this current study, 73% (n=178) of students reported being affected by less family support by any means, which in turn has a direct effect on the student's quality of life and work balance.

One study conducted by Mukun Liu showed that students' self-study has a significant and positive association with their academic performance, indicating that academic performance improves as self-study hours increase [25]. The same author reported that excessive involvement in social activities adversely affects their grades. Additionally, female students tend to be better time managers and allocate more time to self-study.

Many researchers have revealed a stronger association between poor computer skills and interaction and MSD. MSD was particularly high among students who were under time pressure due to poor computer skills (65.7%), lack of adequate sleep (53.1%), bullying violence (93.1%), and peer pressure.

4.4 Prevalence of musculoskeletal disorders

The first objective of this study is to determine the prevalence of MSD during the academic tasks of technology students. Table 6 highlights the distribution of the prevalence of MSD in the current students in the institutes.

Table 6 Prevalence of MSD

Body parts affected by MSD	Frequency	Prevalence in 12-month (%)	Frequency	Prevalence in any 7-days (%)	Frequency of high prevalence of any MSD	P-value
Any MSD	226	92.6	210	90.1	86.5	-
Neck	145	59.4	127	52	54.2	0.00
Shoulder	83	34.0	66	27	27.6	0.001
Upper arms	63	26.6	56	23	22.0	0.01
Elbow	61	25.0	92	37.7	36.2	0.002
Forearms	72	29.5	66	27.9	28.9	0.00
Wrists	94	38.5	91	39.8	37.3	0.000
Hands	83	34.0	85	36.1	35.6	0.04
Fingers	43	17.6	33	13.9	12.5	0.018
Upper/middle back	46	18.9	37	15.2	12.7	0.012
Lower backs	160	65.6	124	54.8	63.5	0.000
Hips /thighs	54	22.1	50	26.2	20.2	0.004
Upper legs	80	32.8	87	42.6	32.3	0.003
Knees	124	50.8	140	51.4	52.4	0.000
Lower legs	101	41.4	72	29.5	25.3	0.000
Ankles or feet	48	19.7	89	36.5	30.6	0.034

More than 92.6% (n = 226) of technology students had significantly experienced any form of MSD in 15 different parts of their body in the past 12 months, and the records still show the same results in the past 7 days (>90%, n = 210). Meanwhile, Table 6 shows that the highest prevalence of musculoskeletal discomfort is in students in the lower back (65.6%, n = 160) during the past 12 months. Then, the neck (59.4%, n = 145), knees (50.8%, n = 124), and elbows (25%), while wrists are in the range (38.5%, n = 94), 32.8% upper legs, and 34% shoulders. The prevalence rate of fingers was the lowest, recorded at 14.6%.

Examining the rise in prevalence rates over the previous 12 months and the past seven days, both believed to have the highest prevalence rates, respectively, was another key goal. Among the 15 body parts of 244 technology students, the prevalence rate of MSD decreased most in the lower back joints, with a maximum

incidence of 54.8% over the previous seven days. Likewise, the lowest prevalence rate (13.9%) was still seen in fingers, whereas the neck (52%), knees (51.4%), lower thighs (29.5%), shoulder (27%), and forearms (27.1%). As seen in Table 6, there is no variation in the overall prevalence of MSD reporting across body parts when comparing the highest prevalence and 12-month period. Table 7 reveals the body parts associated with different MSD occurrences during a year and the prevalence in the past seven days.

Table 7 Frequency significant distribution of body parts between the prevalence of MSD in 12 months versus any 7 days

Different MSD	Count	Prevalence of MSD in 12-month (%)	Count	Prevalence of MSD in any 7-days (%)
Neck	145	59.4	127	52
Shoulder	83	34	66	27
Upper arms	63	26.6	56	23
Forearms	72	29.5	66	27.9
Wrists	94	38.5	91	39.8
Fingers	43	17.6	33	13.9
Lower backs	160	65.6	124	54.8
Knees	124	50.8	140	51.4
Lower legs	101	41.4	63	29.5

Test for the difference between the prevalence of any MSD and across significant body sections, p is less than 0.001. Table 7 shows that lower back complaints were statistically significant the most common ($p < 0.001$, 54.8%) among students with MSD, followed by neck and knee complaints ($p < 0.001$, $> 50\%$). Fingers ($p = 0.15$, 17.6%) were the least common, while the remaining areas such as shoulder, upper arms, forearms, and lower legs ($< 50\%$) were statistically significant. While the body parts ($< 50\%$) are not directly to blame, they may have a slight risk of triggering MSD because $p < 0.05$. Similar findings were obtained from several other studies; one study showed there was a significant increase in MSD (68.2% vs. 74.6%) and its intensity (2.83 ± 2.36 vs. 3.50 ± 2.79 points) among the student population ($p < 0.001$) [14] and another study showed MSDs affected the upper back ($n=67$, 16.83%), lower back ($n=64$, 16.08%, $\chi^2 = 53.14$), neck ($n=51$, 12.81%, $\chi^2 = 64.514$), and wrists/hands ($n=34$, 8.54%, $\chi^2 = 9.452$), which was statistically significant[3]. Figure 10 illustrates the behavioral pattern of prevalence over the 12 months compared to the past 7 days.

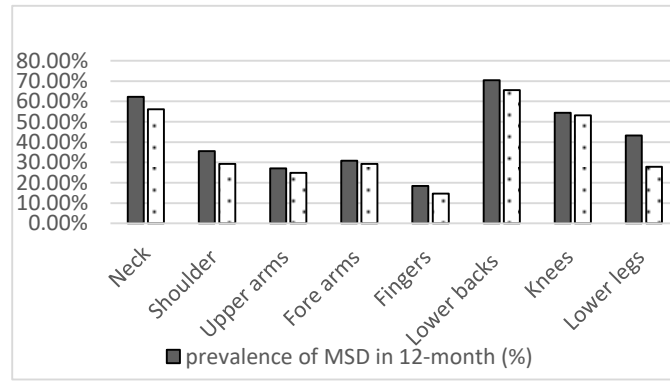


Figure 10 Behavioral pattern of prevalence in 12 months versus in 7 days

According to the chart in Figure 10, the results of this study on MSD in the previous 12 months follow the same pattern as MSDs in the past 7 days. Many studies also found the same behavioral pattern [3], [8].

4.5 Exposure level

The tasks were examined using the Quick Exposure Check (QEC) to determine the postures and frequency of severity movements or postures of four body parts for the current study. Table 8 shows the results of the QEC for the back, shoulders/arms, wrists, and neck.

Table 8 Quick Exposure Check exposure levels

Body area score	Exposure level			
	Low (n %)	Moderate (n, %)	High (n, %)	Very High (n, %)
Exposure score for back	77 (31.5)	127 (52.0)	32 (13.11)	8 (5.56)
Exposure score for shoulder	142 (58.2)	90 (36.89)	12 (4.92)	
Exposure score for wrist	141 (57.8)	93 (38.11)	10 (4.09)	
Exposure score for neck	8 (5.56)	29 (11.9)	116 (47.54)	91 (37.3)

The highest exposure levels to ergonomic stress were found in the neck and back, where 47.54% and 52% of students, respectively, had exposure levels classified as "very high" or "moderate" separately. Meanwhile, 38.11% and 36.89% of students who participated had a "moderate" exposure level to shoulder and wrist issues, highlighting these issues as a shared concern. Similarly, Table 8 QEC exposure level, reports 127 (52.0%) moderate, 142 (58.2%) low, 141 (57.8%) low, and 116 (47.54%) high levels for the back, shoulders/arms, wrists, and neck, respectively, the

comparison of results obtained in both Table 7 and Table 8 was much similar to the results for the body parts.

4.6.1 Association of risk factors with MSDs

A number of risk factors are a growing concern to musculoskeletal disorders (MSDs). Risk factors and MSDs are correlated with evidence of how strong or not they are among technology students.

4.6.1.1 Association of MSD prevalence with demographic factors

Detailed information on the association of MSD for each demographic factor group is available in Table 9. Grouping the prevalence values according to gender allows us to compare the rates between males and females to see if there's any marked difference. In a similar vein, findings regarding the substantial variations in MSD prevalence based on demographic risk factors-based variations in MSD prevalence among students can be observed in other variables such as study discipline, study time, travel, etc.

Table 9 Association of MSDs with demographic factors

Variables		Frequency	Percentage	P-value	Pearson's Coefficient
Gender	Male	160	65.6	0.817	0.015
	Female	84	34.4		
BMI	Underweight	23	9.4	0.009	0.551
	Normal	79	32.4		
	Overweight	55	22.5		
	Obese	87	35.7		
Study discipline	Mechanical	81	33.2	0.376	0.188
	Civil	65	26.6		
	Electrical	45	18.4		
	BSE	48	19.7		
	QS	5	2.0		
Duration of daily Study	0-3 hr.	114	46.7	0.875	-0.50
	4-6 hr.	86	35.2		
	Greater than 6 hr.	44	18.0		
Age	20-22	43	17.6	0.010	-0.114
	22-24	140	57.4		
	24 or more	61	25.0		
Duration of Laptop usage	0-3 hr.	133	54.5	0.127	0.098
	4-6 hr.	70	28.7		
	Greater than 6 hr.	41	16.8		
Time taken for daily travel from your boarding /home	0-3 hr.	167	68.4	0.02	0.513
	4-6 hr.	52	21.3		

Variables		Frequency	Percentage	P-value	Pearson's Coefficient
to the institute?	Greater than 6 hr.	25	10.2		
Status of Family background	Both parent	171	70.1	0.008	-0.69
	Single parent	45	18.4		
	Separated /Divorced	28	11.5		
Habit of writing	Left-handed	55	22.5	0.486	-0.047
	Right-handed	189	77.5		

NOTE: Excluding non-significant factors for Pearson's correlation

Grouping the prevalence values according to gender allows us to compare the rates between males and females to see if there's any marked difference. In a similar vein, findings regarding the substantial variations in MSD prevalence based on demographic risk factors-based variations in MSD prevalence among students can be observed in other variables such as study discipline, study time, travel, etc.) The time taken for daily travel from the boarding/home to the institute and students' BMI, is moderately positively correlated to MSD while the family background of parents, and age signifies a weak negative correlation, the duration of their daily study shows a beneficial effect on students, as evidenced by the strong negative correlation.

4.6.1.2 Relationship between BMI versus MSDs

Table 10 indicates that there appears to be a positive relationship, with the risk of MSD increasing as BMI increases. Technology students in the highest BMI group (n = 26), had a 2.65 times greater risk rate of MSD compared to the underweight students (n = 23).

Table 10 BMI versus any MSD with the highest prevalence

BMI	Any MSD with the highest prevalence		Total	Incidence rate /prevalence	Risk ratio
	Yes	No			
Underweight <18.5	21	2	23	0.0870	
	91.3%	8.7%	100.0%		
Normal 18.5 -24.9	123	19	142	0.134	1.54
	86.6%	13.4%	100.0%		
Overweight 25.0-29.9	47	6	53	0.1132	1.39
	88.7%	11.3%	100.0%		
Obesity > 30	20	6	26	0.231	2.65
	76.9%	23.1%	100.0%		

Variables		Any MSD with the highest prevalence		Total	Prevalence ratio/incidence ratio	Risk ratio
		No	Yes			
Status of Family Background	Both parent	20 11.7%	151 88.3%	171 100	151/171 = 0.883	
	Single parent	4 8.9%	41 91.1%	45 100%	0.911	1.032
	Separated /divorced	9 32.1%	19 67.9%	28 100.0%	0.6785	0.7632

According to research on the impact of pain experienced during the previous 12 months, students who were obese recovered from musculoskeletal diseases less frequently than students of normal weight [16], [23], [32]. In people with severe obesity, pain, particularly severe pain was highly prevalent, and which were correlated with clinical factors, the level of obesity, and a sedentary lifestyle. BMI data showing a high prevalence of MSD ($p=0.009$, 95% CI) were used to examine this connection [33]. Table 11 highlights the status of family background and any MSD with the highest prevalence.

Table 11 Status of family background and MSDs prevalence

Variables		Any MSD with the highest prevalence		Total	Prevalence ratio/incidence ratio	Risk ratio
		No	Yes			
Status of Family Background	Both parent	20 11.7%	151 88.3%	171 100	151/171 = 0.883	
	Single parent	4 8.9%	41 91.1%	45 100%	0.911	1.032
	Separated /divorced	9 32.1%	19 67.9%	28 100.0%	0.6785	0.7632

As per the records shown in Table 11, students from single-parent families are more at risk than pupils from two-parent families who are studying technology. Although the percentage is rising quickly, children of single parents still have an uncertain challenge in society and prone to suffer from a range of mental health issues. Therefore less enthusiasm for learning, lower performance, and an inclination for other addictions [16], [23], [32] Table 12 reveals the prevalence finding between the daily travel from the boarding/home to the institute and any MSD.

Table 12 Duration of daily travel from boarding/home to the institute and MSDs

Variables		Any MSD with the highest prevalence		Total	Prevalence ratio/incidence ratio	Risk ratio
		No	Yes			
Duration of Daily Travel from your boarding /home to the institute	0-3 hr.	26 15.6%	141 84.4%	167 100.0%	0.844	
	4-6 hr.	7 13.5%	45 86.5%	52 100.0%	0.865	1.024
	Greater than 6 hr.	0	25	25	1	1.18

The highest daily travel of more than 6 hours duration is 1.18 times the risk than the shortest duration, as revealed in Table 12. This duration has a higher propensity to induce or develop symptoms of MSD. This makes sense, particularly given that they are exposed to "driving vibrations" and spend most of the day seated in confined spaces, primarily while using public transport. Low back pain is one of the primary reasons why pupils who use technology are facing difficulties. They also have to cope with time limits and stress, which can lead to muscle stiffness in the knee. Another study revealed that carrying heavy bag which likely induces neck and shoulder discomfort [15].

Similarly, respondents of this study also stated that the posture while carrying loaded bags create issues with lower back discomfort, which they found dissatisfactory. In contrast, a well-known recommendation for proper backpack posture improves ergonomics and lowers the possibility of discomfort or injury [34].

4.6.2 Association of MSD prevalence with physical & environmental factors

Physical and environmental factors are some of the contributors to the development and progression of musculoskeletal disorders. These factors are particularly prominent in working environments with repetitive tasks, poor ergonomics, exposure to physical strain, or environmental stressors, and the relationship between these factors and their prevalence is shown in Table 13. They are often associated with these factors that can exacerbate or contribute to the onset and progression of these conditions.

The configuration and characteristics of classroom seating and desks have a strong positive link with risk factors for any MSD, while external factors such as repetitive motions cause uncomfortable working postures. Moderately positive correlation risk factors include outdated equipment, tools, and machinery used for conducting practical surveys and carrying out projects in labs and workshops as shown in Table 13.

In Table 13, the absence of physical facilities at the institute raises MSD pain or discomfort, which indicates a weak positive correlation risk factor. A crucial ergonomic issue in the classroom and computer laboratory is the seating arrangement. The characteristics of chairs and desks, as well as their relative position

to the whiteboard, are crucial components of seating arrangements. MSD appears to be the primary adverse effect of inadequate ergonomic seating [35]. The students spent a considerable amount of the day in the institute.

Table 13 Relationship between the prevalence of MSD with physical factors

Variable		Sub category	Frequency	Percent	Pearson Correlate	P-value
Seating arrangement and features of classroom chairs and desks		Poor comfort	151	61.9	0.744	0.000
		Moderate	87	35.7		
		High Comfort	6	2.5		
Are workshops and labs equipped with outdated machinery, equipment, and tools for practical surveys and carrying projects?		Agree	214	87.7	0.420	0.036
		Neutral	1	0.4		
		Disagree	23	9.4		
		Strong disagree	6	2.5		
Lack of physical facilities in the institute increases your MSD pain /discomfort?		Yes	175	71.7	0.081	0.034
		No	69	28.3		
Food quality and facilities of our canteen		Excellent	4	1.6	0.131	0.239
		Good	25	10.2		
		Average	98	40.2		
		Needs Improvement	117	48		
Do these environmental factors below affect you physically and mentally in your academic performance during the past 12 months?	Acoustic condition (Noise)	Agree	213	87.3	0.047	0.766
		Neutral	1	0.4		
		Disagree	30	12.3		
		strong disagree				
	Poor Lighting system/ Glare / in classroom	Agree	214	87.7	0.079	0.511
		Neutral		0.4		
		Disagree	23	9.4		
		Strong disagree	6	2.5		
	Heat radiant temperature in workshops Poor ventilation	Agree	204	83.6	0.059	0.840
		Neutral	6	2.5		
		Disagree	29	11.9		
		Strong disagree	5	2.0		
Do these external environmental factors induce awkward working postures (such as repetitive movements)?	Agree	191	78.3	0.640	0.036	
	Neutral	7	2.9			
	Disagree	31	12.7			
	Strong disagree	15	6.1			

Most technology students gave a negative response when asked if the location and features of their seats in the classroom caused them any difficulties. Of those who had any MSD, the majority (n = 151, 61.9%) were reported as comfortless, which was significantly (p = 0.049) higher in number than those who reported high comfort (n = 6, 2.5%) in their seating arrangements. Only a few pupils out of 244 sounded with high comfort, whereas some reported as having intermediate comfort was reported as (n=87, 35.7%). According to this, roughly 2.5% of students are either unaware of or unconcerned about the ergonomic problems associated with MSDs.

Sadly, the large space between the desk and bench, which is the cause of the issue, cannot be reduced. Because they could not alter the distance between the bench and the table, students could not change their seating posture during prolonged study sessions. Consequently, the ergonomic design flaw may lead to discomfort and ultimately chronic back pain. Recognizing and addressing this problem is essential to fostering a more comfortable and healthy learning environment [13], [36]. Table 14 demonstrates the severity of body parts that are more fatigued when operating with existing machines which address the discomfort issues for the need for ergonomic awareness.

Table 14 Severity of body parts more fatigued when operating the machine

Body parts	Frequency	Percentage
Hand	43	17.6
Neck	122	50.0
Lower back	43	17.6
Knees	13	5.3
Lower legs	18	7.4
Buttock	2	.8
Hands	3	1.2

Figure 11 displays the graphical distribution of affected body parts due to fatigue caused by deviation while operating the machine to highlight the issues with the current context.

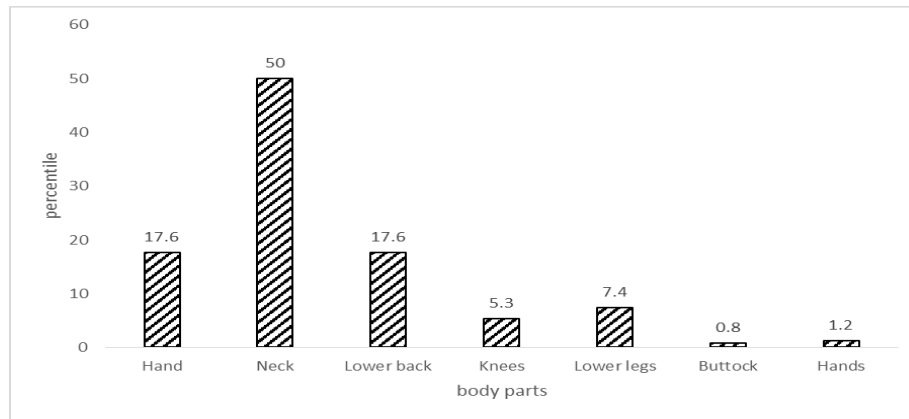


Figure 11 *Distribution of affected body parts according to fatigue deviation when operating the machine*

The bar chart in Figure 11 indicates that, as a result to fatigue, half of the students in the sample show that the neck has a higher prevalence of developing MSD than other body regions. Outdated tools, machinery, and equipment for conducting practical surveys and carrying out projects in labs and workshops are part of the moderately positive correlation risk factor [37]. Therefore, the awkward posture used during the operation of versatile machines (milling, lathe, hydraulic shearing, grinding, and welding) is a result of workplace layout design and repetitive operations. In contrast to the other parts, the buttocks exhibit the lowest percentage (n=2, 0.8%, CI=95%), these repeated tasks typically involve standing for extended periods when working on weekly practical mini-case projects.

In contrast, using equipment that can be adjusted to fit a variety of body shapes and sizes is one sensible strategy for creating an inclusive and ergonomic work environment [14],[21]. Reducing ergonomic hazards requires written signage (boards) and thorough training to teach students proper use and handling those hand tools precisely. It is important to consider the significance of using appropriate personal protective equipment (PPE). Making sure students wear the proper PPE strengthens their protection against potential ergonomic risks [6].

4.6.2.1 Exposure to surrounding noise

Based on the noise's frequency, intensity, duration and noise exposure levels are determined. Table 15 illustrates exposure to surrounding noise particularly in

academic environments can have significant physical and mental effects on students, especially with regard on their musculoskeletal disorders (MSD).

Table 15 Distribution of exposure level for noise

		Any MSD with a high prevalence			Incidence rate	Risk ratio
		No	Yes	Total		
Do the external environmental factors noises in institute surroundings affect students physically and mentally in their academic performance?	Agree	30	183	213	0.8591	-
	Neutral	0	1	1	1	1.064
	Disagree	3	27	30	0.9	1.0476
	Strong disagree	0	0	0	0	0

The incidence rate in students who responded neutrally (n=1, 0.5%) and technology students who disagree with causing MSD (n=27, 12.3%) who disagreed that noise causes MSD (n = 27, 12.3%) has a risk ratio of one. This suggests no risk and indicates that students in academic vicinity with lower noise intensity are less likely to develop MSD. Certain physiological stress indicators are constantly elevated by noise. Long-term exposure to noise levels exceeding 70 dB may harm hearing [38], although this is less likely at the institute now as short-term practical sessions are conducted in machine shops.

4.6.3 Association of MSD prevalence with psychosocial stress factors

4.6.3.1 Psychosocial stress scale (PSS)

The Perceived Stress Scale (PSS) is a 10-item questionnaire developed to evaluate the self-identified level of stress in individuals by analyzing their feelings and ideas during the previous month. There is a total possible score range of 0 to 40, with each question having a score ranging from 0 (never) to 5 (very often). Higher PSS denotes a higher stress level [2], [23].

- Scores ranging from 0-13 would be considered low stress.
- Scores ranging from 14-26 would be considered moderate stress.
- Scores ranging from 27-40 would be considered high perceived stress

0 – never, 1 - almost never, 2 – sometimes, 3 - fairly often, 4 - very often

Table 16 shows the information regarding the descriptive statistics of PSS items of technology students in Sri Lanka. Descriptive statistics such as mean, percentage, frequency, skewness, and kurtosis index were used.

Table 16 Descriptive statistics of items of PSS technology students

ITEMS OF PSS In the last month, how often have you felt.....	N Statistic	Mean Statistic	Std. Dev Statistic	Skewness		Kurtosis	
				Statistic	Std. error	Statistic	Std. error
upset because of something that happened unexpectedly	244	1.05	1.345	1.077	.156	-.069	.310
that you were unable to control the important things in your life?	244	1.40	1.352	.788	.156	-.504	.310
nervous and stressed?	244	1.23	1.427	.916	.156	-.488	.310
Confident about your ability to handle your personal problems?	244	1.36	1.402	.789	.156	-.586	.310
that things were going your way?	244	1.08	1.480	1.086	.156	-.343	.310
that you could not cope with all the things that you had to do?	244	1.47	1.338	.702	.156	-.526	.310
able to control irritations in your life?	244	1.34	1.410	.712	.156	-.756	.310
that you were on top of things?	244	1.20	1.333	.954	.156	.066	.310
angered because of things that happened that was outside of your control?	244	1.03	1.351	1.131	.156	.111	.310
difficulties were piling up so high that you could not overcome them?	244	1.53	1.389	.683	.156	-.700	.310

Table 17 highlights the frequency distribution for each score scale of PSS items where the data used: 0 - never, 1 - almost never, 2 - sometimes, 3 - fairly often and 4 - very often.

Table 17 Frequency distribution for each score scale

Items of PSS	0	1	2	3	4
In the last month, how often have you been upset because of something that happened unexpectedly?	126	42	40	10	26
In the last month, how often have you felt that you were unable to control the important things in your life?	76	76	47	9	36
In the last month, how often have you felt nervous and stressed?	108	53	39	7	37
In the last month, how often have you felt confident about your ability to handle your personal problems?	90	59	52	4	39
In the last month, how often have you felt that things were going your way?	135	38	25	8	38
In the last month, how often have you found that you could not cope with all the things that you had to do?	70	68	65	3	38
In the last month, how often have you been able to control irritations in your life?	98	47	51	14	34
In the last month, how often have you felt that you were on top of things?	102	55	49	15	23

Items of PSS	0	1	2	3	4
In the last month, how often have you been angered because of things that happened that were outside of your control?	129	39	42	8	26
In the last month, how often have you felt difficulties piled up so high that you could not overcome them?	102	55	49	15	23

As in Tables 16 and 17, for PSS item analysis and demographics, descriptive statistics such as mean, percentage, frequency, skew-ness, and kurtosis were used. The PSS total score is 12.69, with a standard deviation of 7.38309. The scale's internal consistency was evaluated using Cronbach's alpha test [23] for validity and reliability (Table 18), where Cronbach's alpha was 0.721.

Table 18 Reliability statistics of PSS score

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No of Items
0.721	0.721	10

In terms of internal consistency, the current Cronbach's alpha was 0.721. A variety of descriptors have been applied to Cronbach's alpha values recorded in Table 18. That said, 0.7 is often considered a threshold value in terms of acceptable internal consistency, and a value could be considered “good” [2], [23].

4.6.3.2 Relationship between psychosocial stressor factors and MSD

Musculoskeletal diseases (MSDs) and psychosocial stressors are strongly related; researchers have found that psychosocial factors influence the severity and course of MSDs. Table 19 provides a summary of how students' psychosocial stressors affect MSDs. Developing thorough workplace interventions and fostering well-being requires an understanding of the connection between psychosocial stressors and MSDs.

Table 19 Relationship between psychosocial stressors and MSDs

Variables	Pearson Correlation	Sig. (2-tail)
How is the overall lecturers' speed?	-0.039	0.541
How far does the assessment and Exam affect students' learning and performance and cause MSD?	0.004	0.951
Do lecturers' speed affect students' Physical /mental activities?	0.202	0.001
Do you suffer from less family support?	0.830	0.195
Do you have poor computer skills/Interaction in academics?	0.018	0.783

Variables	Pearson Correlation	Sig. (2-tail)
Do you suffer from a lack of adequate sleepiness which may cause MSD?	0.126	0.60
Does the time Pressure affect student learning/enthusiasm and induce MSD	0.173	0.007
Do you know that ergonomics risk factors may cause or induce MSD if not improved or controlled at the earliest stage?	-0.050	0.441
Have you been invited or participated in any social group activities or isolated?	0.057	0.376
Have you been exposed to bullying and raging violence?	0.124	0.010
Do you suffer from peer pressure meeting closer to the deadline	0.19	0.763

Exams and evaluations that follow traditional methods may expose students to an excessive amount of stress, which can have a variety of adverse impacts on memory formation and learning. However, among other things, an individual's mentality affects how they react to stress [17]. The findings of the multivariate analysis for the MSDS and the sources of psychosocial stress among students is displayed in Table 19. Time pressure has a substantial impact on students' learning and enthusiasm and causes MSD ($p=0.007$). Additionally, lecturers' pace affects students' physical and mental activities ($p=0.01$), and bullying, rage and violence also affect students' MSDs ($p=0.010$).

Table 19 demonstrates that female students were more affected than male students ($n=79$, 49.4%) by peer pressure when it came to meeting deadlines for projects and other related coursework ($n=54$, 64.3%). Additionally, bullying and raging violence were significant psychosocial stressors for 11.8% of female students and 25.3% of male students ($p=0.01$).

Table 20 Relationship between gender and significant psychosocial stressors

Variables		Gender			
		Female		Male	
		Count	N %	Count	N %
Does the time Pressure affect student learning/enthusiasm and induce MSD	No	6	2.4	27	11
	Yes	78	31.7	133	54.3
Have you been exposed to bullying and raging violence?	No	55	22.4	98	40
	Yes	29	11.8	62	25.3

Technology students are exposed to high academic stress, especially during examination periods. This could be significantly associated with musculoskeletal disorders depending on the stressors, reactions to stress, and strategies adopted to cope with the stress. These factors should be considered in any intervention to reduce MSDs associated with academic stress among college students [39].

According to certain research, MSD indicates that college students' mental health is much worse when they experience higher levels of perceived academic stress. Techniques for lowering stress perception and its clinical expression should be studied to reduce the prevalence of mental problems in adolescents [23]. Similarly, a study by Obadah Mohammed Hendi et al. [38], which found a non-significant association between the onset of musculoskeletal disorders and the level of stress among students, the cross-sectional analysis results of PSS scores, as shown in Table 20, do not show any association between any disciplines and MSD.

4.6.4 Summary of factors affecting specific to technology education

The factors specific to technology education, which significantly musculoskeletal disorders (MSDs) are multifaceted, and often linked to physical demands, the environment, and the nature of tasks students and workers perform in tech-driven environments. Table 21 provides a comprehensive summary of the risk factors to guide the well-being and safety of students.

Table 21 Summary of the risk factors

Body region	Demographic R.F.	Physical & Environmental R.F.	Psychosocial R.F
Neck	BMI	Seating arrangements and features of bench/desks	Time pressure,
Lower back	Status of Family Background	Aging tools and equipment	Exposed to bullying and raging violence
Knees	Daily travel from boarding /home to the institute	Awkward posture due to repetitive movement	
Shoulders		Lack of physical activities.	

4.6.5 Measures and respondents' feedback on mechanisms to mitigate the risk.

According to observations and the responses gathered, students experienced discomfort in their working postures and academic environment. "If the institute observes a decline in productivity and retention of students, we could quickly investigate and analyze the issue using proposed suggestions for the improvement of students' ergonomics in the institute" [40].

“Promoting open communication creates a cooperative approach to preserving a safe and healthy environment by enabling students to express concerns and ideas for enhancement and analysis through students feedback” [37], [41].

The frequency distribution of ergonomic risk factors that may cause or are likely to cause MSD is shown in Table 22.

Table 22 Frequency distribution feedback of ergonomics risk factors that may cause or induce MSDs if not improved or controlled at the earliest stage

Outcomes	Frequency	Percent
Yes	43	17.5
No	98	40.0
No idea	103	42.0

According to Table 22, if not improved or controlled at the earliest stage, the results indicate that more than 2/3 of the students have no background idea of the cause of musculoskeletal discomforts due to negligence of ergonomic risk factors.

Further, it is essential to address the lack of guidance regarding correct posture, ergonomics, and the importance of break intervals. Table 23 focuses mainly on the frequency distribution of familiarization for the need for Ergonomic awareness practices.

Table 23 Frequency distribution of familiarization with the concept of ergonomic awareness practice

Severity	Frequency	Percentile
Not familiar	155	63.3
Somewhat familiar	39	15.9
Very familiar	50	20.4

According to Table 23, 63.3% of respondents are not familiar with the concept of ergonomic awareness practice, while (n=50) 20.4% have some knowledge of this concept by passively absorbing it through social media. The students address the same issue, unaware of how to apply it in a practical setting to achieve this goal due to their lack of expertise in this field or their lack of specialty in any of their study modules. It emphasizes the importance to the institutes to have ergonomic awareness initiatives to guarantee a secure and comfortable academic environment [40]. A strategy that incorporates appropriate equipment selection, attention to ergonomic design principles, user education, and regular assessment is essential [42].

Meanwhile, Table 24 exhibits the frequency distribution of the importance of ergonomic practices for addressing these challenges in the academic environment.

Table 24 Importance of ergonomic practices in addressing challenges in the academic environment

Variables	Frequency	Percent
Less important	15	6.1
No idea	147	60.0
Not important	11	4.5
Somewhat important	27	11.0
Very important	22	9.0

Table 24 also reveals some mitigation strategies that respondents and various studies have suggested. The purpose of this summary is to reduce the MSD risk factors that are prevalent in technological institutes, Table 25 highlights a broad method for detecting and addressing risk factors in contemporary research contexts and modifying these risk factors and applying suitable mitigation methods.

Table 25 Summary of the risk factors and mitigating efforts that could be developed

Risk factor	Mitigation measure	Suggested by participants or suggested in the literature
Outdated equipment in workshops and labs	Eliminating hazards would be a more effective intervention	Propose Preventive Maintenance
	the department should formulate preventive strategies in workshops and labs and maintain effectively	
Seating arrangements and features of bench Workshops /labs	Ergonomics awareness programs	This training can be incorporated into the orientation course for new batch intake
	Redesign layouts	
	Personal protective equipment PPE is another control that can be utilized in most of the workshops and labs	
Awkward posture due to repetitive movement	The proper ergonomic checklist is suggested to be conducted periodically every six months for the existing academic setting	No idea
	It is needed to create a safe working environment and provide psychosocial support for the students while conducting educational programs	
	Coping strategies for MSD which will lead to promoting efficiency in time management	
	Increase the peer staff support	
Time pressure	Reduce workload stress by revising the syllabus	Revise the syllabus Reduce the student's workload

Risk factor	Mitigation measure	Suggested by participants or suggested in the literature
Lack of physical activities.		Each module assessment should be assessed with a time gap interval Enhance the time management
Daily travelling	Redesign ergonomically the bag load	The institute could arrange for the institute's bus
	Support with a private mode of travel from the institute to the bus or railway stop	Set fifteen minutes aside, before students finish their evening work- session

5.0 CONCLUSION

The current findings highlight the importance of addressing musculoskeletal issues among students to prevent potential discomfort and mitigate the risks associated with these conditions. The study revealed an 86% prevalence of MSDs in students. Of the 15 body parts included in the study, the lowest prevalence rate was for finger and elbow pain, with the highest prevalence rates were observed in the lower back and neck, followed by knee, wrist, and shoulder pain.

There are significant differences among students, but the differences largely depend on the frequency, intensity, and duration of risk exposure. The demographic factors are significantly associated with the prevalence of pain and discomfort in the knees, lower back, and neck. Mismatched ergonomics have several detrimental effects on health and may have an impact on the economic growth of academic students.

Students' grades are known to be significantly affected by the amount of time they spend studying. Depending on their goals, chosen learning styles, and degree of knowledge, students must exert varying amounts of effort. They also need to adjust their seated posture in various environments. Considering that over half of the respondents spent at least four hours a day on the Internet, the study concluded that students were strongly obligated to use it for academic or private needs, increasing the duration of their daily screening time.

Additional physical and environmental risk factors include desk and bench configurations, aging tools and equipment, poor posture from repetitive motions, and inactivity. On the other hand, several departments should take the appropriate steps to replace or upgrade aging tools and equipment in workshops and to properly maintain them.

Additionally, time pressure, exposure to bullying, and aggression are psychological elements that led to the current study; these conditions also contribute to the symptoms of MSDS. According to our research, students who use technology are more likely to experience academic stress, particularly during exam times. Depending on the level of stress, response to stress, and coping mechanisms used, these factors may be strongly linked to musculoskeletal problems.

The present findings would be beneficial for the higher authorities to offer straightforward ergonomic solutions at the institutional level of our country. Higher education institutions must regularly conduct in-depth assessments of the risk variables affecting academic performance to cultivate the greatest human capital and student's academic success.

Some modifications included raising the awareness of youth and implementing preventative measures. Present problems and potential risk factors that exist in the institute can be addressed by this awareness campaign. This training can be integrated into the new student orientation program to increase productivity by ensuring that everyone understands the importance of ergonomic procedures and how to minimize associated risks.

According to study data, eliminating hazards would be a more successful intervention for enhancements when utilizing aging items or equipment, desk and bench sitting arrangements. To detect the concerns deemed ergonomic, it is also recommended that a complete ergonomic checklist be conducted regularly in academic spaces.

PPE can be used in most workshops and labs and is beneficial in reducing ergonomic risks; however, its effectiveness is limited. Most people in the technology institute showed no interest in wearing personal protective equipment (PPE) because they perceived it as unnecessary and believed both students and teachers were unaware of its importance

5.1 Future work

Results suggest that further studies are needed to establish various measures and many related ergonomics interventions to reduce the risks of MSDs among students in academic environments. Since this study only looked at a small number of the risk variables for participants in the academic setting, future researchers recommend conducting more studies on this topic with a larger sample of technology students. It should be taken into account that there are additional factors that could influence the students' attitudes towards ergonomics.

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APPENDICES

APPENDIX A Nordic Musculoskeletal Questionnaire

Please answer all the questions in the first column (☐). If yes, please answer the questions in the other three columns for that body area.

Have you at any time in the last 12 months had trouble (such as aches, pains, discomfort, numbness or tingling) in:	Have you had any trouble during the last 7 days?	Have you at any time in the last 12 months been prevented from carrying out any of your normal activities (e.g. task, housework, sport) because of this trouble?	In your opinion, what do you think the reason for your pain?	What should be done to remove your pain? Any comments?
1. Neck No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
2. Shoulders No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
3. Upper arms No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
4. Elbows No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
5. Forearms No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
6. Wrists No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
7. Hands No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
8. Fingers No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
9. Upper/Middle back No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
10. Lower back No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
11. Hips or buttocks No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
11. Upper legs No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
13. Knees No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
14. Lower legs No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	
15. Ankles or feet No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	No Yes 2 ☐ 1 ☐	No 2 Yes ☐ 1 ☐	

APPENDIX B Interview guide

1.0 SECTION A - DEMOGRAPHIC INFORMATION -

a) PERSONAL

Q1 - What is your Gender?

Q2 -Your Age?

Q3 -What is your BMI?

b) FAMILY BACKGROUND

Q4 - What is your present academic year?

Q5 - Your Course of Study?

Q6 -How many hours do you use Laptop?

Q8 - What is your duration of Daily Travel from your boarding /home to the institute?

Q9 - What would be the duration of your daily Study?

Q10 - Your habit of Writing?

Q11 - Do you have any Family History of Musculoskeletal problems?

Q12 - How is your health in general? (Mark only one)

- 4) How important do you think ergonomic practices are in addressing these challenges for you and your academic environment? Very important, somewhat important, less important, no idea
- 5) Have you received any formal awareness training related to ergonomic risks and practices? Yes No

b) Psychosocial Risk Factors

1. How is the overall lecturers' speed?
2. Do lecturers' speed affect students' Physical /mental activities? How far does the assessment and Exam affect students' learning and performance?
3. Does the time Pressure affect student learning/enthusiasm mentally and physically?
4. Do you suffer from less family support?
5. Do you have poor computer skills/Interaction in academics?
6. Do you suffer from a lack of adequate sleep?
7. Do you know that ergonomics risk factors may cause or induce MSD if not improved or controlled at the earliest stage? Yes no no idea

SECTION B psychosocial stressors of students

a) student's perspective of the technology course-

- 1) What is the present perspective of our technology course? Please Comment simply.
Being stressed, Manageable, No stress
- 2) How familiar are you with the concept of Ergonomic practices? Very familiar, somewhat familiar, not familiar
- 3) In your opinion, what are the primary challenges faced by technology students in an academic environment?

- 4) How important do you think ergonomic practices are in addressing these challenges for you and your academic environment? Very important, somewhat important, less important, no idea
- 5) Have you received any formal awareness training related to ergonomic risks and practices? Yes No

b) Psychosocial Risk Factors

1. How is the overall lecturers' speed?
2. Do lecturers' speed affect students' Physical /mental activities? How far does the assessment and Exam affect students' learning and performance?
3. Does the time Pressure affect student learning/enthusiasm mentally and physically?
4. Do you suffer from less family support?
5. Do you have poor computer skills/Interaction in academics?
6. Do you suffer from a lack of adequate sleep?
7. Do you know that ergonomics risk factors may cause or induce MSD if not improved or controlled at the earliest stage? Yes no no idea

Section C – Physical & Environmental factors causes for MSD

- 1) Are classroom chairs and desks suitable (not causing issues) for working postures?
- 2) Are workshops and labs equipped with proper tools for practical, surveys and carrying projects?
- 3) Which part of the body becomes more fatigued when operating the machine?
- 4) Can the computer lab chairs be adjustable according to our heights and reach?
- 5) What is the food quality and facilities of our existing canteen?
- 6) Do these external environmental factors as below affect students' physically and mentally?
 - a. Noise
 - b. Heat and lighting in workshops (less ventilation).....
 - c. Heat / Glare in classroom

APPENDIX C Perceived stress scale

10-item questionnaire developed to evaluate the self-identified level of stress in individuals by analyzing their feelings and ideas during the previous month

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?.....	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?.....	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?.....	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?.....	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?.....	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?.....	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?.....	0	1	2	3	4

Please feel free to use the *Perceived Stress Scale* for your research. The PSS Manual is in the process of development, please let us know if you are interested in contributing.

Scores

- **0-13 - Low stress.**
- **14-26 - Moderate stress.**
- **27-40 - High perceived stress**