

Risk Factors Associated with Musculoskeletal Pain in Undergraduate Students: A Systematic Literature Review

Jimena Saori Barrenachea-Arakaki, Yomara Aurora Eusebio-Huerta
Industrial Engineering Bachelors

Faculty of Engineering, Industrial Engineering Career, University of Lima, Peru,
20180186@aloe.ulima.edu.pe, 20173333@aloe.ulima.edu.pe

Juan Carlos Quiroz-Flores
Research Professor

Faculty of Engineering, Industrial Engineering Career, University of Lima, Peru,
jcquiroz@ulima.edu.pe

Abstract

Background: Musculoskeletal pain is a problem many workers suffer worldwide, triggering more severe diseases and decreased quality of life. In addition, several studies have shown that university students are no strangers to suffering from these pains, and it is known that more and more of them report pains in different body areas. Therefore, this study aims to determine undergraduate students' risk factors associated with musculoskeletal pain.

Methodology: A systematic literature review followed the process proposed in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement. The searches were conducted in Scopus, Web of Science, and Scielo, obtaining 3311 articles, of which 89 were included for this review.

Results: Of the 38 possible risk factors, five factors were evaluated, and it was found that physical activity, time in front of a screen, and having a history or family history of musculoskeletal pain/trauma do represent a risk factor, while no association was found for gender and time in a sedentary position.

Conclusion: Three risk factors for the presence of musculoskeletal pain were found in the review. In turn, there is little existing literature on COVID-19 and its effect on the presence of musculoskeletal pain and associated risk factors in undergraduate students, so it is advisable to conduct further research in this context.

Keywords

Musculoskeletal disorders, causes, undergraduates, pain, musculoskeletal injuries.

1. Introduction

Musculoskeletal pain is pain in ligaments, tendons, muscles, or joints due to repetitive movements, awkward postures, or musculoskeletal disorders (Felemban et al. 2021; Ogunlana et al. 2021). According to the World Health Organization (WHO 2021), in a study conducted in 2019, it was found that musculoskeletal pain had affected about 1710 million people worldwide, having negative repercussions on their daily activities, hours of sleep and a significant decrease in their productivity (Alkhateeb et al. 2020; Alrumi et al. 2020; Torbey et al. 2023).

Likewise, according to the existing literature, several studies have shown that university students are no strangers to suffering from such pain. Such is the case that, concerning medical school students, in a study conducted in Egypt, it was found that the most frequent area of pain was the neck and lower back at 81.1%, followed by the neck with 74.4% and the back with 73.1% (Alian et al. 2021). Similarly, another study conducted in Israel found that 80% of students suffered from neck pain, 60% from upper back, and 33.3% from shoulder pain (Kaufman-Cohen et al. 2018).

On the other hand, in the Faculty of Medical Sciences students, a higher prevalence of pain in the neck and lower back, also known as the lumbar area, was found. For example, 69.2% of dental students suffer from neck pain, 67.1% in the shoulders, and 46.9% in the upper back (Felemban et al. 2021). Likewise, in a study conducted on medical students at a university in Brazil, it was found that 51% of university students have a prevalence of cervical pain, that is, pain in any of the structures of the neck, while 54.5% present low back pain (Morais et al. 2019). Similarly, a study

was conducted on 90 Physiotherapy students at a University in Zimbabwe, which found that there was a higher prevalence of low back pain, and 57.1% of participants experienced at least three episodes of recurrent low back pain in the last 12 months (Chiwaridzo et al. 2018). Furthermore, in research conducted on 250 nursing students at the University of Johannesburg, it was obtained that 81.1% of undergraduates had low back pain. In contrast, 65.9% of students suffered from neck pain and 63.6% from shoulder pain (Moodley et al. 2020).

In turn, with students in general, 43% were found to suffer from neck and lower back pain, 31.6% from upper back pain, and 27.9% from shoulder pain (Santoshi et al., 2019). Similarly, in another study conducted in Nigeria, 67.3% of students had low back pain, 59.4% in the neck, and 43.7% in the upper back (Adeyemi et al. 2020). In a study conducted in Turkey, 17.9% of students had neck and shoulder pain, and 27.6% had low and upper back pain (Can & Karaca 2019).

1.1 Objective

According to the analysis previously presented, it is evident that there needs to be more systematic review articles about the risk factors associated with musculoskeletal pain in undergraduates. Therefore, this research aims to synthesize and determine the risk factors associated with musculoskeletal pain in undergraduate students from the reviewed academic articles.

2. Literature Review

2.1 Risk Factors

A risk factor encompasses all conditions or variables at the psychological, cultural, community, biological, or familial level, which are more likely to have harmful or socially undesirable outcomes (WHO 2004; Substance Abuse and Mental Health Services Administration, 2019). It is important to emphasize that such factors can be short- or long-term, as well as of different intensity (Barnová & Tamášová 2018).

They can also be classified according to the International Classification of Functioning, Disability and Health (ICF) into four components: body functions and structures (physiological, psychological and anatomical functions), activity and participation (tasks performed by the person and the way he/she relates in daily situations), environmental factors (physical, social or attitudinal environment) and personal factors (age, gender, education, profession, habits and lifestyles) (Fernández-López et al. 2009; WHO 2002).

It should be noted that the factor evaluated will be considered a risk factor if the variables are statistically significantly associated, for which there must be a $p < 0.05$ or a 95% confidence interval that is not greater than 1 (Jahre et al., 2020). Thus, a study in Serbia of university students found that the risk factors related to back pain were smoking, stress, and sedentary posture (Ilic et al.2021). In contrast, a study in Saudi Arabia found that the risk factors were age, time in front of a screen, and frequency of physical activity (Sina et al.2021).

It should be emphasized that young people with more risk factors are more likely to develop a condition that negatively affects their long-term mental and physical health (Substance Abuse and Mental Health Services Administration, 2019). Therefore, reducing exposure to these risk factors would improve global health and increase life expectancy (European Patient's Academy on Therapeutic Innovation 2017).

2.2 Musculoskeletal pains

Musculoskeletal pain or disorders (MSDs) are injuries at a physical level that are generally caused by cumulative trauma over a long period; that is, a repetitive strain that is acted on a part of the body and mainly affects the bones, muscles, joints, tendons, ligaments, nerves, and vascular system (Ríos 2018; Secretariat of Occupational Health and Environment 2019). Consequently, minor aches and pains can trigger more severe diseases or even cause some disability (European Agency for Safety and Health at Work, n.d.).

Such pain can be classified as acute or chronic. Acute pain is of short duration, in other words, within the average healing time (generally three months). It is named according to the region affected, for example, back pain, neck pain,

or shoulder pain. Chronic pain lasts longer than the average healing time and can be considered an illness or injury (Feizerfan & Sheh 2015; Grichnik & Ferrante, 1991; Ogunlana et al. 2021).

Also, a European study shows that musculoskeletal disorders affect approximately 45 million workers. They are the leading cause of temporary disability, generating high economic losses (European Agency for Safety and Health at Work [EU-OSHA], 2004). On the other hand, according to the Directorate of Epidemiology and Research of the National Institute of Prevention, Occupational Health and Safety of Venezuela, MSDs were registered as the first cause of occupational disease from 2002 to 2006. In Peru, according to a study on diseases registered by an occupational contingency that required medical rest issued by the Social Health Insurance (EsSalud) at the national level from 2015 to 2016, the highest percentage corresponds to musculoskeletal disorders (Caraballo-Arias, 2013; Jhonston et al. 2018).

3. Methods

This review article is a selective and detailed study that collects data from previously published articles, analyzes them, and concludes (Guirao-Goris et al. 2008; Icart & Canela 1994). There are various types of review articles; however, in this case, we have opted for the systematic literature review (SRL) article, which is characterized by collecting and critically analyzing through a systematic process, various studies or research papers to provide a comprehensive summary of the literature with a research question (García Peñalvo 2017).

The methodology proposed by García Peñalvo (2017) will be considered when writing a systematic review, as shown in Figure 1.

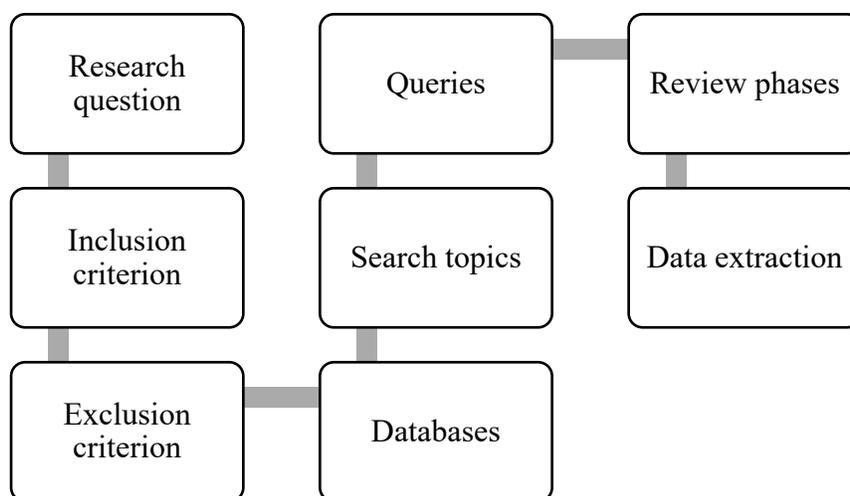


Figure 1. Steps for conducting a systematic review

First, a research question is established, which, considering the context presented previously, as well as the objective of the study, is the following: What are the risk factors associated with musculoskeletal pain present in undergraduate students?

Subsequently, concerning the inclusion criteria, we considered those documents, either scientific articles or publications in congresses, published in the selected databases, which mention the prevalence of musculoskeletal pain and the associated risk factors. Likewise, these must be written in Spanish or English, must have a publication date from 2018 to September 2023, must have undergraduate or university students as the study population, must be complete and fully available, and must present at least one of the keywords either in the title and abstract. On the other hand, the exclusion criteria do not comply with those above.

In turn, for the selected databases, search topics, and queries to compile as much information as possible, the studies were searched in the following databases: Web of Science, Scopus, and Scielo. Likewise, the search was carried out using keywords such as: "musculoskeletal pain", "university students", "students," and "risk factors" and using the

Boolean operator "AND". Thus, for example, the following combinations were used: musculoskeletal pain and student and musculoskeletal pain and students and risk factors.

In addition, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement was used for the literature review, which is a guideline that guides authors doing systematic reviews and meta-analyses (Page et al. 2021). Thus, at the time of performing the search with the keywords in the databases mentioned, 3311 documents were obtained. After applying the exclusion and inclusion criteria, only 89 articles were considered to be included in the review, as shown in Figure 2.

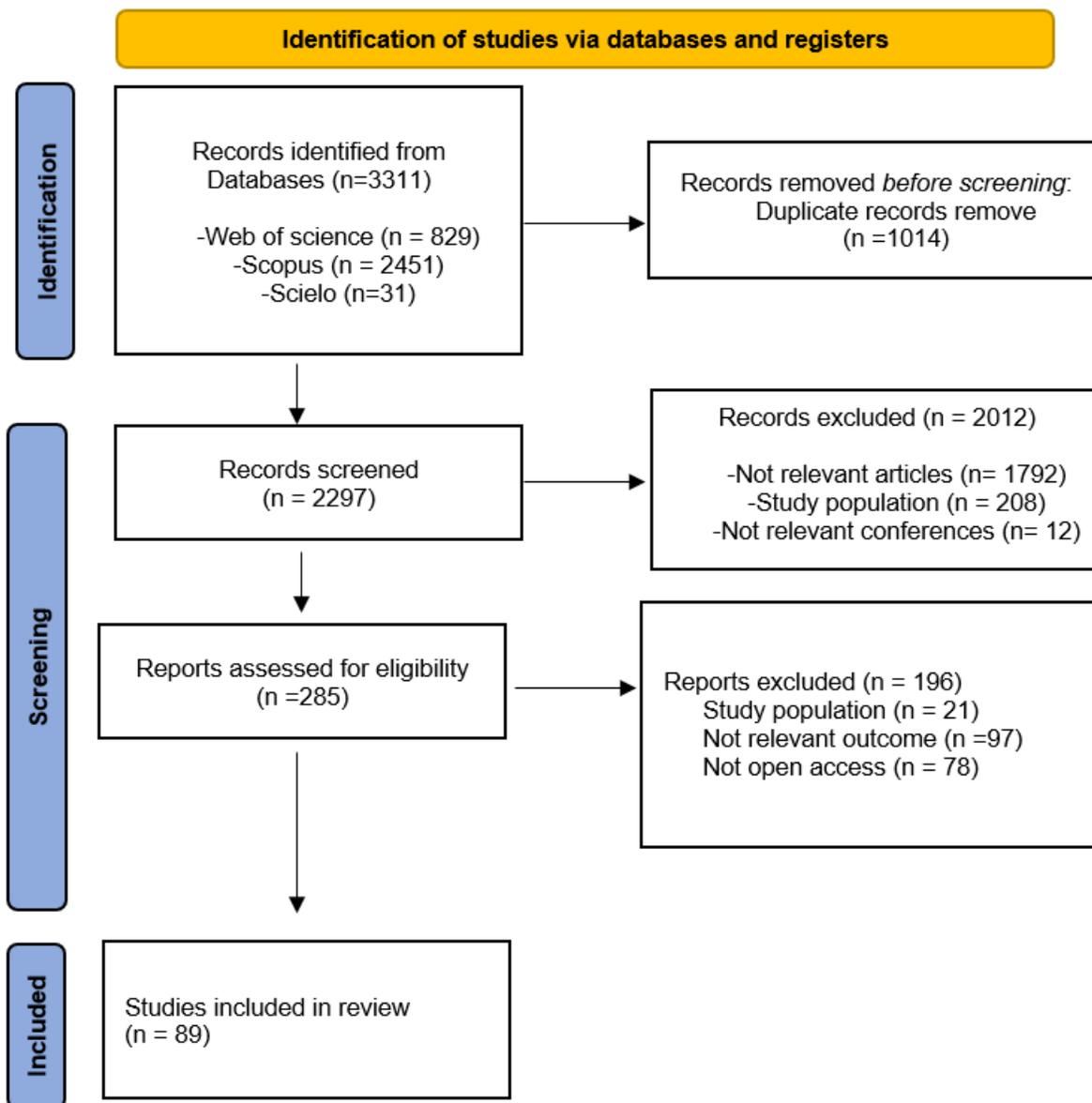


Figure 2. PRISMA statement

Finally, for data extraction, a matrix was developed in Microsoft Excel detailing the information of each paper, including the database, title, author, abstract, journal name, publication date, study design, country, selected sample, pains found, associated risk factors ($p < 0.05$) and non-associated risk factors ($p > 0.05$). This was done to identify the similarities and differences in the results obtained among the selected articles.

4. Results

Of the 89 studies selected, 81 are cross-sectional studies, 2 are descriptive studies, 1 is an exploratory study, 2 are longitudinal studies, 1 is an observational, descriptive, cross-sectional study, 1 is a survey, and 1 is a cross-sectional observational study.

4.1 Bibliometric analysis

Two software packages were used to perform the bibliometric analysis: Bibliometrix and VOSviewer. In both cases, the analysis was performed only for the articles found in the Scopus database of one of the queries performed, which is shown in Table 1:

Table 1. Scopus search

Search performed	Advanced Query	Articles found
Musculoskeletal and students and Published form 2018 to 2023	(TITLE-ABS-KEY (musculoskeletal) AND TITLE-ABS-KEY (students)) AND PUBYEAR > 2017 AND PUBYEAR < 2024	1844

4.1.1 Bibliometrix

Several investigations have been carried out regarding the risk factors associated with musculoskeletal pain in undergraduate students. For this reason, it is convenient to identify the leading countries where this topic has been studied. This information is shown in Figure 3 (considering darker blue indicates a higher prevalence of articles). It can be identified that the United States is the country where most research has been carried out, followed by China, Australia, India, and Germany.

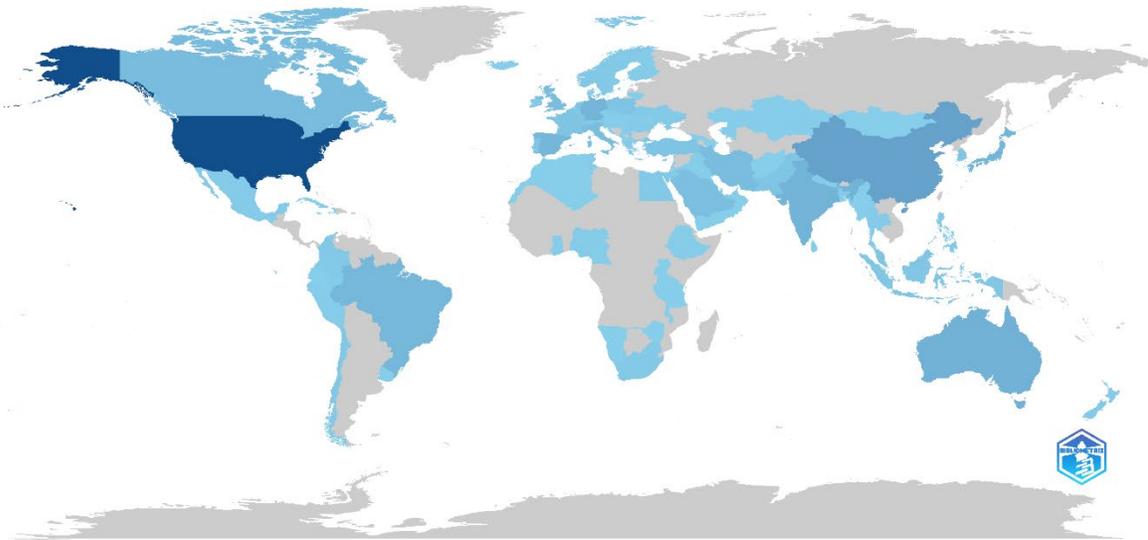


Figure 3. Scientific production by country of study

Likewise, for the most relevant journals in the chosen topic of study, Figure 4 shows that the most significant number of articles were published in the International Journal of Environmental Research and Public Health, followed by BMC Musculoskeletal Disorders, Plos One, and Work.

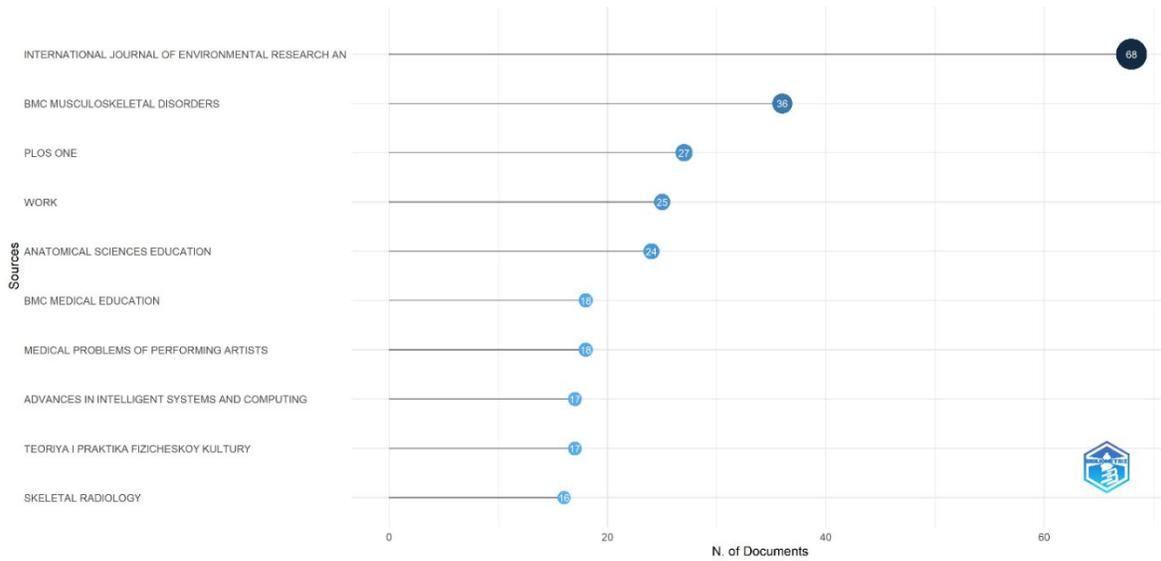


Figure 4. Articles according to their relevance to the topic studied.

On the other hand, regarding the year of publication of the articles, as shown in Figure 5, the trend according to the year is as follows: in 2018, 236 articles were published, while in 2019, there were 275. In 2020, there were 315; in 2021, there were 384 articles; in 2022, 390 articles were published; and from 2023 until September, 245 researches were published, evidencing that the topic of study is still relevant nowadays.

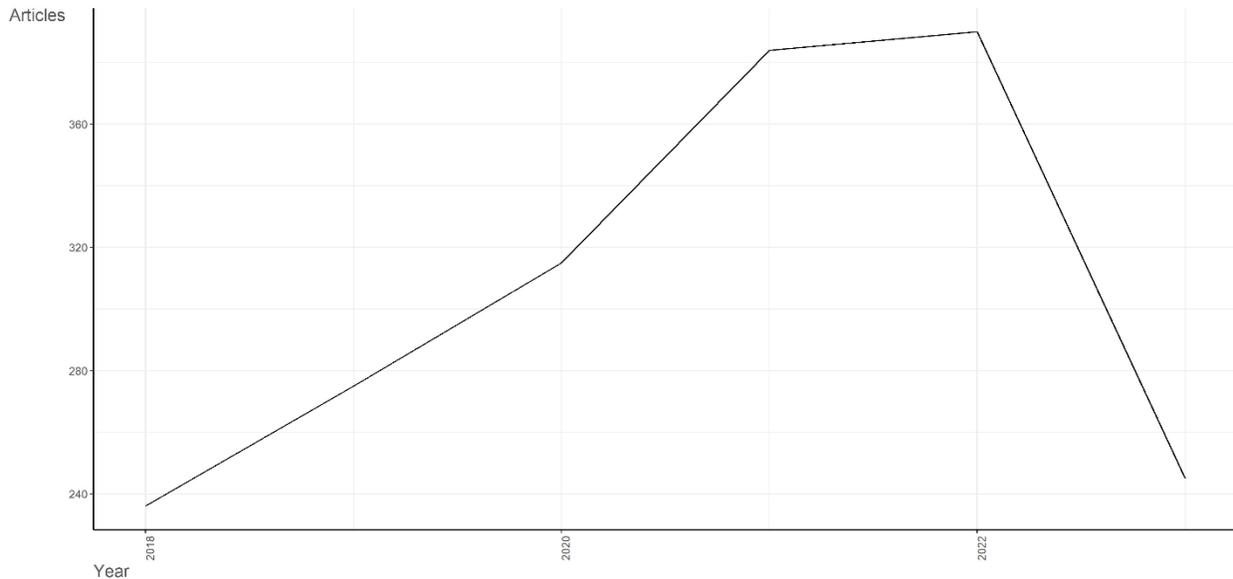


Figure 5. Year of publication of articles

Likewise, Figure 6 shows the most relevant authors in the field of study. The most relevant being Glumasing MJJ, followed by Ohlendorf D, Partido BB, and Bucley TA.

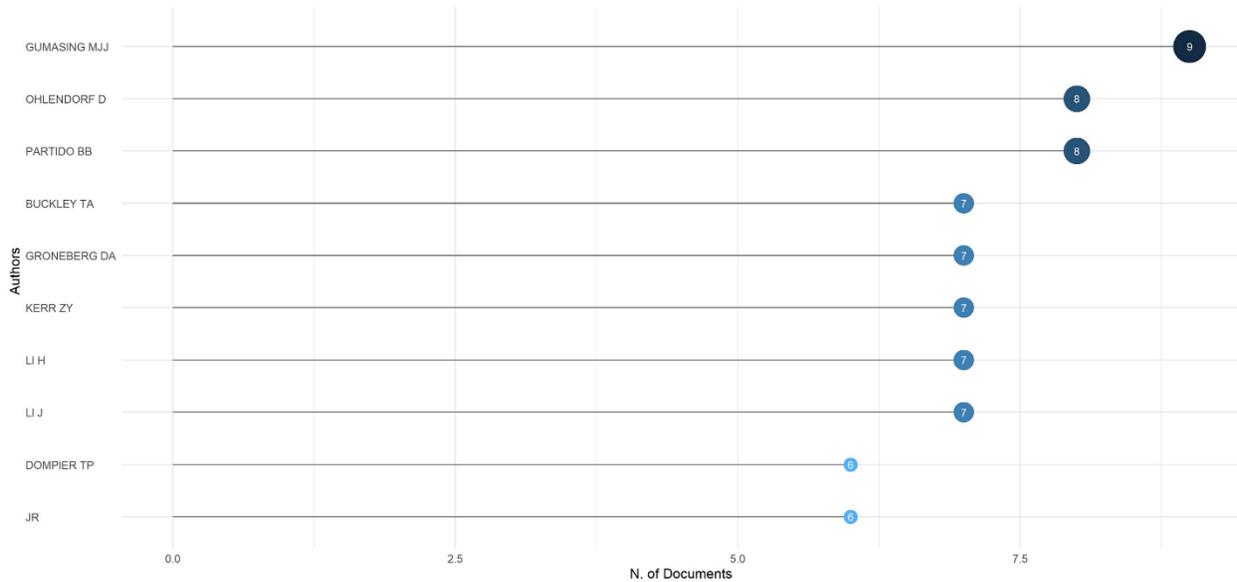


Figure 6. Relevant authors

4.1.2 VOS viewer

As shown in Figure 7, the VOS Viewer software was used to analyze the relationship between the keywords. For this, a 12-fold occurrence of the keyword was chosen, obtaining 6 clusters. In the first cluster (red color), 18 related words were found, such as anatomy, musculoskeletal, musculoskeletal disease, musculoskeletal disorders, musculoskeletal system, and prevention. In the second cluster (green color), 13 keywords are found: body mass index, musculoskeletal pain, musculoskeletal symptoms, pain, prevalence, quality of life, smartphone, stress, and university students. In the third cluster (blue color), 12 keywords were found: adolescents, body composition, exercise, injury prevention, physical activity, risk factors, obesity, and musculoskeletal discomforts. Eight words were obtained in the fourth cluster (yellow color), such as posture, work-related musculoskeletal disorders, and dental students. Eight words were obtained in the fifth cluster (purple color), such as back pain, Covid-19, low back pain, medical students, and neck pain. Finally, four related words were found in the sixth cluster (light blue color): gross anatomy education, medical education, musculoskeletal anatomy, and undergraduate education.

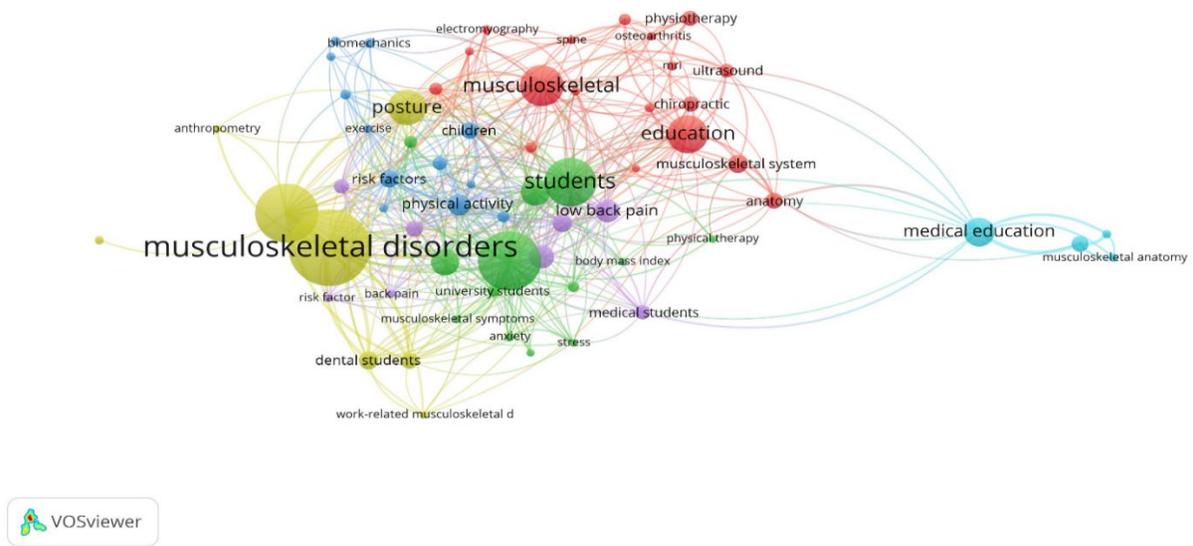


Figure 7. Evaluation of keywords

Likewise, Figure 8 shows the relevant keywords' relationship according to the study year. For example, for the year 2020, in the selected studies, some of the most relevant keywords were dental students, undergraduate education, exercise, and body composition. In 2021, some of the most recurrent keywords were musculoskeletal disorders, musculoskeletal pain, quality of life, university students, and anxiety. Finally, for the year 2022, the most recurrent word was Covid-19.

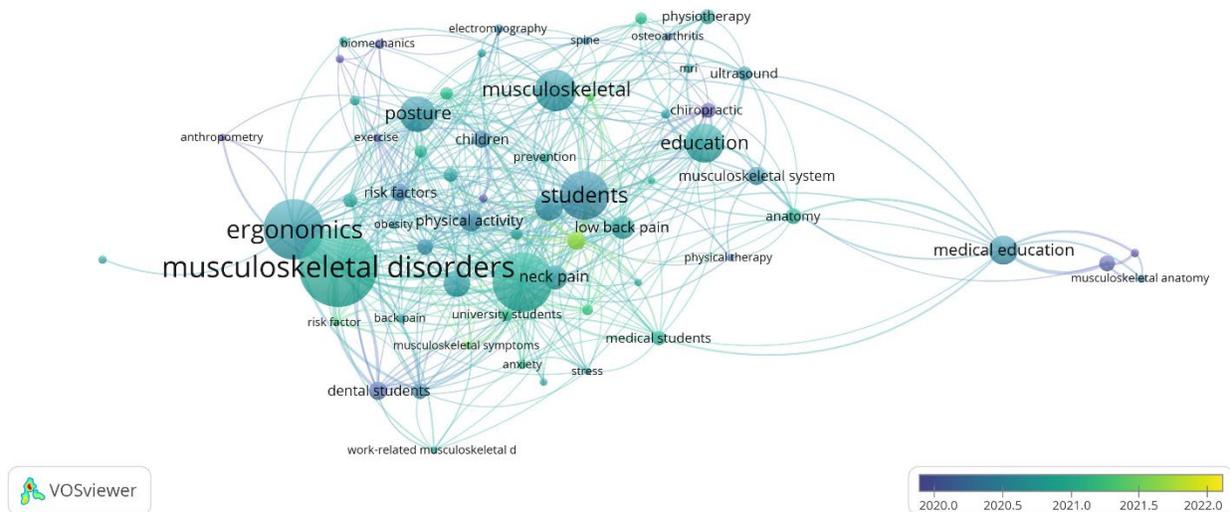


Figure 8. Relevant keywords' relationship according to the study year

4.2 Main risk factors

The systematic review identified 38 possible risk factors, of which gender, physical activity, screen time, age, body mass index, year of study, stress, and smoking were the most mentioned in the articles reviewed. As seen in Table 2, 75.28% of the articles assessed gender as a possible risk factor, followed by physical activity at 52.81%, screen time at 44.94%, age at 40.45%, body mass index at 40.45%, stress at 26.97% and smoking 26.97%.

Table 2. Possible risk factors associated with musculoskeletal pain in university students.

Factors	Weight
Gender	75.28%
Physical Activity	52.81%
Screen time (cell phone, tablet, laptop, or computer), including study/leisure time	44.94%
Age	40.45%
Body mass index	40.45%
Year of Study	34.83%
Estress	26.97%
Smoking	26.97%
The posture adopted (position of arms/legs, among others)	20.22%
History or family history of musculoskeletal pain/trauma	19.10%
Time in a sedentary position	17.98%
Hours of study	16.85%

Specialty of study (career)	14.61%
Alcohol consumption	12.36%
Depressive symptoms or anxiety	12.36%
Weight	11.24%
Height	10.11%
Lack of rest/breaks	10.11%
Hand dominance	10.11%
Coffee consumption	7.87%
Use of ergonomic material	7.87%
Sleeping time (hours of sleep)	7.87%
Cell phone gripping style	5.62%
Use of backpack	4.49%
Standing time	3.37%
Screen size	3.37%
Location of study	3.37%
Environmental conditions	2.25%
Knowledge of ergonomics	2.25%
Doing household chores	2.25%
Hours of practice with the musical instrument	2.25%
Repetitive movements	2.25%
Playing instruments	2.25%
Lack of diet	2.25%
Lack of use of optical devices	1.12%
Arm position	1.12%
GPA	1.12%
Duration of classes	1.12%

The five factors with the most significant findings and studied by the authors (gender, physical activity, time in front of a screen, history or family history of musculoskeletal pain/trauma, and time in a sedentary position) will be used for the results.

Table 3 shows the analysis of 3 articles for each associated risk factor.

Regarding the gender factor, 31 articles evidenced that it is a significant risk to the prevalence of musculoskeletal pain (Dos Santos et al. 2019; Felemban et al.2021; Karingada & Sony 2022). However, 36 investigations found that the mentioned factor was not risky (Alsaadi, 2022; Kapitan et al., 2021; Namwongsa et al. 2018; Wami et al. 2021).

Frequency of physical activity was another significant risk factor found in 29 of the reviewed articles (Behera et al. 2020; Fatih & Feride 2021; Weleslassie et al. 2020). In contrast, 18 articles indicated no significant association

between the presence of musculoskeletal pain and the level of physical activity (Myint et al., 2021; Sirajudeen et al., 2022; Srirug et al. 2023).

The third risk factor was students' time in front of a screen (cell phone, tablet, laptop, or computer). In 28 articles included in the review, it was found to be a risk factor (Morais et al.2019; Thamrin et al. 2023; Yaseen & Salah 2021). However, 11 articles indicated no significant correlation between a university student's screen time and musculoskeletal pain (Boussaid et al. 2022; Hawamdeh et al.2023; Yao et al. 2021).

Regarding the fourth factor, history or family history of musculoskeletal pain/trauma, in the review, nine articles were found that indicated that it is a risk factor, as having a history or family history was conducive to the development of musculoskeletal pain (Dighriri et al. 2019; Ilic et al. 2021; Maayah et al. 2023). In contrast, eight articles pointed out the opposite (Kapitan et al. 2021; Namwongsa et al. 2018; Yaseen & Salah, 2021).

The fifth risk factor considered in the systematic review is time in a sedentary position. Eight articles reviewed were found to have a significant association (Daher & Halperin, 2021; Mashhadi et al. 2022; Santoshi et al.2019). However, eight articles showed no significant correlation between musculoskeletal pain and sitting time (Kashif et al. 2020; Rodriguez-Nogueira et al. 2021; Weleslassie et al. 2020).

Table 3. Prevalence of musculoskeletal pain and main finding with the evaluated factor

Risk Factor	Author	Musculoskeletal pain	Main finding	Effect
Genre	(Dos Santos et al., 2019)	<u>Presence of pain in the last 12 months:</u> Neck (51.5%) Upper back (48.1%)	Being female was related to a more significant presence of pain (p=0.027)	25% of participants reported that pain interfered with the performance of their daily activities
	(Felemban et al., 2021)	<u>Presence of pain in the last 12 months:</u> Neck (69.2%) Shoulders (67.1%)	Women are more likely than men to have pain (p<0.05)	-
	(Karingada & Sony, 2022)	<u>During online classes:</u> Head, neck, and eyes (80%) Right shoulder (58%)	Women reported higher pain scores than men in the shoulder (p=0.016) and elbow (p=0.039)	40% of students experienced pain in most parts of the body due to online classes
Physical activity	(Behera et al., 2020)	Neck (58.3%)	Students who engage in regular physical activity are less likely to have neck pain (p= 0.037)	-
	(Weleslassie et al., 2020)	Neck (49.2%)	Exercising is associated with less pain (p=0.006)	-
	(Fatih & Feride, 2021)	-	Exercise habits are correlated with neck pain (p=0.002), back pain (p=0.002), and low back pain (p=0.031)	Students' quality of life is seriously affected due to the presence of musculoskeletal pain

Screen time (cell phone, tablet, laptop, or computer) includes study/leisure time.	(Morais et al., 2019)	Lumbar (54.5%) Upper limbs (54.1%) Cervical (51%)	Cell phone use for more than 6 hours/day generates more significant musculoskeletal pain in undergraduate students ($p<0.05$).	-
	(Thamrin et al., 2023)	Lower back (37.9%)	Excessive screen time makes a person 2.19 times more likely to suffer low back pain	-
	(Yaseen & Salah, 2021)	Aches and pains during desktop/laptop use in online classes Neck (32.2%) Left shoulder (20%)	The use of desktop/laptop computers for online learning is related to duration ($p<0.01$) and pain severity ($p<0.001$)	The pain experienced by some students can be severe and affect their ability to perform some of their activities of daily living
History or family history of musculoskeletal pain/trauma	(Dighriri et al., 2019)	Pain in the past 12 months: Low back (61.4%) Neck (60.9%) Shoulders (39.8%)	A history of trauma was 2.7 times more likely to have musculoskeletal pain in any area of the body at any time	-
	(Ilic et al., 2021)	Low back (20.8%)	Persons that have a family history of lower back pain have more possibility to have more pain ($p=0.006$)	-
	(Maayah et al., 2023)	Neck (48.44%) Right shoulder (16.03%) Left shoulder (6.57%)	A history of neck and shoulder pain was associated with a longer time and prevalence of pain in the indicated areas ($p<0.05$)	-
Time in a sedentary position	(Santoshi et al., 2019)	Neck and lower back (43%) Shoulders (27.9%)	Duration of continuous sitting is related to neck and shoulder pain ($p<0.005$)	-

	(Daher & Halperin, 2021)	Neck (35.6%)	College students sitting for over three hours/day had a significantly higher risk of neck pain (p<0.005)	-
	(Mashhadi et al., 2022)	Low back (64.6%) Shoulders (59.7%) Upper back (59%)	The time undergraduate students spent in sedentary positions is related to low back (p=0.002), head (p=0.032), and hip (p=0.012) pain	-

5. Discussion

After performing the review, it can be indicated that gender does not represent a risk factor since, in most of the articles, it was found that women are not more likely to suffer from musculoskeletal pain. This result is in line with what was found in a study conducted in Saudi Arabia, where it is evident that there was no significant association between gender and shoulder, neck, or lower back pain (p= 0.458) (Algarni et al., 2017). Similarly, in a study in Pakistan, it was obtained that gender was not associated with musculoskeletal pain (p= 0.084) (Hasan et al. 2018). In contrast, research conducted in India found that musculoskeletal pain was significantly associated with being female p<0.05 (Abooj et al. 2020). Another research conducted in Australia found that women are 3.1 times more likely to have musculoskeletal pain in the past 12 months than men (p=0.018) (Morabito et al. 2021).

Regarding the second factor, physical activity, the review found that it is a risk factor because a lower frequency of physical activity is related to a higher prevalence of musculoskeletal pain. Such result follows the result obtained in a study directed to undergraduate students in Brazil, where it was evidenced that those who do not exercise are 1.61 times more likely to have pain in the upper limbs (p=0.015) (Morais et al. 2019). Another review found that physical activity was a protective factor against neck pain (Chowdhury & Chakraborty 2017). However, other authors found that there was no significant association between physical activity and the presence of pain. In a review of medical students in Saudi Arabia, no significant relationship was found between the factor in mention and pain. Likewise, in a study conducted in Pakistan, no relationship was found between the frequency of physical activity and the prevalence of musculoskeletal pain in the last seven days (p= 0.80) (Morais et al. 2019; Ul Ain et al. 2018).

In turn, the time students spend in front of a screen (cell phone, tablet, laptop, or computer) was found to be a risk factor since the more time spent in front of the screen, the greater the probability of suffering musculoskeletal pain. This result is related to research conducted on students of a faculty of applied medical sciences, where it was found that people who use their cell phones more times per day are 1,046 times more likely to have low back pain (Almhdawi et al. 2017). In turn, in another study conducted in Turkey, it was evidenced that students with complaints of musculoskeletal pain spent more time on the cell phone (p=0.049) and computer (p=0.036) than students who had no pain complaints (Can & Karaca 2019). However, a study conducted in Saudi Arabia on medical students found no correlation between the number of hours per day using the computer and the presence of musculoskeletal pain (Algarni et al. 2017). In turn, in a study conducted on medical students in Tunisia, it was found that time in front of the screen does not represent a risk factor for the presence of pain (p>0.05) (Boussaid et al. 2022).

About the factor, history, or family history of musculoskeletal pain, in the review, it can be indicated that it is indeed a risk factor. A study of music students from the Netherlands found that those who had previously experienced pain had a higher risk of developing it again (Baadjou et al. 2016). In turn, in a systematic review study, it was concluded in 9 articles that there was a significant association between a history of back pain and a new episode of back pain (Øiestad et al. 2020). Likewise, a study directed at undergraduates of the School of Dentistry found that one of the main factors significantly associated with pain in at least one side of the body was having a history of trauma (p=0.009)

(Hashim et al. 2021). On the other hand, in another study conducted on medical students in Pakistan, no correlation was found between the two factors (Ain et al.2018).

Finally, regarding the time spent in a sedentary position, after analyzing the articles included in the review, it is impossible to indicate whether or not it is a risk factor since eight articles indicated that it was. Eight articles indicated that it was not. A study conducted on dental students in Iran found that time in a sedentary position had a relationship with pain $p < 0.001$ (Aghahi et al. 2018). Likewise, another research on medical students in Serbia found a correlation between the time spent by a student in a sedentary position at university and a higher prevalence of musculoskeletal pain ($p = 0.002$) (Vujcic et al. 2018).

6. Conclusion

The objective of the literature review was to determine the risk factors associated with musculoskeletal pain in university students, and 38 possible risk factors were found in the 89 articles reviewed. Gender, physical activity, time in front of the screen, family history, and time in a sedentary position were the most critical risk factors. Regarding gender, it was concluded that it is not a risk factor since 36 of the 67 articles reviewed showed no significant correlation. On the other hand, physical activity, time in front of the screen, and family history are risk factors. Concerning the first factor, 29 of the 47 studies indicated that the greater the frequency of physical activity, the lower the prevalence of pain in some areas of the body. Likewise, 28 of the 39 studies showed that the longer a university student remains in front of a screen, the more pain he or she suffers. Concerning family history, nine articles found a significant correlation between this factor and musculoskeletal pain.

On the other hand, little existing literature analyzes the effect of Covid-19 on the presence of musculoskeletal pain along with the associated risk factors in undergraduate students, making it an important area for future research.

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Biographies

Jimena Saori Barrenachea Arakaki is a Bachelor of Industrial Engineering from the University of Lima with experience in the commercial area. She currently works as a sales executive in an aeronautical company in the cargo business.

Yomara Aurora Eusebio Huerta is a Bachelor of Industrial Engineering from the University of Lima with experience with experience in the commercial area in retail. She is currently working as a commercial analyst.

Juan Carlos Quiroz-Flores holds an MBA from Universidad ESAN. Industrial Engineer from Universidad de Lima. Ph.D. in Industrial Engineering from Universidad Nacional Mayor de San Marcos, Black Belt in Lean Six Sigma. He is currently an undergraduate professor and researcher at the University of Lima. Expert in Lean Supply Chain and Operations with more than 20 years of professional experience in the direction and management of operations, process

improvement, and productivity; specialist in implementing Continuous Improvement Projects, PDCA, TOC, and Lean Six Sigma. Leader of transformation, productivity, and change generation projects. Able to form high-performance teams aligned with the company's "Continuous Improvement" strategies and programs. He has published journal articles and conferences indexed in Scopus and Web of Science. His research interests include supply chain and logistics management, lean manufacturing, Lean Six Sigma, business process management, agribusiness, design work, facility layout design, systematic distribution planning, quality management, Industry 4.0, Digital Transformation, and Lean Manufacturing. He is a classified researcher by the National Council of Science, Technology, and Technological Innovation of Peru (CONCYTEC) and a member of IEOM, IISE, ASQ, IEEE, and CIP (College of Engineers of Peru).