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Review Article

Musculoskeletal pain in college students: a systematic review

Galit Wohlmuth-Cohen[a1]*, Felix León-Avila[a2]

[a]Universidad Anáhuac México, Campus Norte, Facultad de Ciencias de la Salud, Huixquilucan, Estado de México, México.

ID ORCID:
[1]https://orcid.org/0000-0002-3892-5776, [2]https://orcid.org/0000-0001-6570-6133.

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ABSTRACT

Introduction: To date, there is no systematic study focused on posture-related musculoskeletal pain in college students. **Objective:** Summarize the evidence of musculoskeletal pain in college students. **Eligible criteria:** Year of publication between 2015 and 2020, observational studies published in English, full text available, and analysis of the presence of musculoskeletal pain in college students. MESH terms and Boolean operators used for the search were pain AND musculoskeletal AND college students. **Data sources:** Databases used were PubMed, ClinicalKey, ProQuest, ResearchGate, and ScienceDirect. **Results:** A total of 318 records were identified out of which 296 were excluded, and only 22 were included for analysis. The majority of the records involved college students form the general population, while five involved dental students and five, health science students. The majority of the records involved a setting in which the student was in a constant sitting position, only two involved a dental setting, and one involved a laboratory setting. **Conclusions:** The most reported sites of pain were neck, shoulders, and upper and lower back.

Key words: musculoskeletal pain; college students.

RESUMEN

Introducción: A la fecha no hay una revisión sistemática cuyo enfoque sea dolor musculoesquelético en estudiantes de universidad. **Objetivo:** Resumir evidencia de dolor musculoesquelético en estudiantes de universidad. **Criterios de selección:** Año de publicación entre 2015 y 2020, estudios observacionales en idioma Inglés, texto completo disponible, análisis de la presencia de dolor musculoesquelético en estudiantes de universidad. Se usaron los términos MeSH y operadores booleanos dolor Y musculoesquelético Y estudiantes de universidad. Fuentes de información: PubMed, ClinicalKey, ProQuest ScienceDirect y ResearchGate. **Resultados:** Un total de 318 artículos fueron identificados, de los cuales 296 fueron excluidos; solo 22 fueron incluidos en el análisis. La mayoría de los estudios involucra a estudiantes de la población universitaria en general, cinco artículos involucran a estudiantes de odontología y cinco más, a estudiantes de ciencias de la salud. La mayoría de los artículos incluyen espacios en los que el estudiante debe permanecer en una posición sentada constantemente; solo dos artículos involucran un espacio de consultorio dental y uno, el espacio de laboratorio médico. **Conclusiones:** Los sitios de dolor más reportados fueron cuello, espalda alta y baja y hombros.

Palabras clave: dolor musculoesquelético; estudiantes de universidad.

* *Corresponding author*: Galit Wohlmuth Cohen. Universidad Anáhuac México, Campus Norte, Facultad de Ciencias de la Salud. Address: Av. Universidad Anáhuac 46, Lomas Anáhuac, C.P. 52786. Huixquilucan, Estado de México. Tel.: +52 55 5627 0210. Email: galit.wohlmuthco@anahuac.mx

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INTRODUCTION

College students often use notebooks and electronic devices for notetaking during class time. They tend to adopt inadequate postures while using these electronic devices, which predisposes them to develop musculoskeletal dysfunction.[1,2] The overuse of the upper extremities due to repetitive activities, maintaining postures while writing, brief periods of rest, and academic/life stress can cause the muscles to be in constant activation. Maintaining postures can lead to conditions as tendinitis and carpal tunnel syndrome, among others.[1] The fact that a laptop keyboard and screen are linked and do not move independently will force a user to choose a convenient hand/wrist or head/neck posture.[2-4] In the 2015–2016 school year, there were approximately 3.6 million, 945 higher-education students in Mexico; 364,894.5 of them at the National Autonomous University of Mexico (UNAM) and 11,527 at Universidad Anahuac México Norte, as well as 386,219 higher-education teachers. Of these 3.6 million students, 51% use computers and/or electronic tablets for notetaking and schoolwork.[5] It is essential to identify the sites and prevalence of musculoskeletal pain among college students as the previous history of pain is a risk factor for a new episode of pain,[6] pain intensity, and disability.[7] If untreated, pain can cause a person to go into disability leave.[8-10] Musculoskeletal pain in multiple sites and depressive symptoms are associated with predicting long-term disability leave.[11] Among healthcare workers, musculoskeletal problems and mental health problems account for the most working days lost. The most reported pain sites are lower back and lower and upper limbs; pain in the latter resulted in the most prolonged absence from work. Furthermore, women accounted for 87.9% of absences and had longer return to work time than men.[12] In a study involving a one-year follow-up of disability leave due to musculoskeletal pain, those workers who had sick days due to pain and decreased over the year and people who had sick days and increased over the year all had modifiable lifestyle factors at the time they were in disability leave, such as BMI, smoking status and vigorous leisure-time physical activity.[8-10] There are previous systematic reviews on musculoskeletal pain in different populations like young workers,[13] dental professionals,[14] office workers,[15] waste collection workers,[16] and farmers.[17] To the author's knowledge, there is no systematic review that covers musculoskeletal pain in college students. The aim of this systematic review is to summarize the existing literature regarding musculoskeletal pain among college students.

METHODS

Literature search. This review was done according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Registration of this review was not possible since the preliminary search of the literature had already started by the time the registration was intended to be done, and PROSPERO only allows registration when the review is in its initial stages. The research question was formulated using Condition, Context, Population (CoCoPop) guidelines.[18] Data extracted was as follows: authors, year of publication, country of origin, condition studied, context studied, population studied, and measurement instrument.

Study selection. The databases used to search for records were PubMed, ClinicalKey, ProQuest, ResearchGate, and ScienceDirect. Records were considered eligible if they had been published between 2015 and 2020, they were observational studies published in English, the full text was available, they analyzed the presence of musculoskeletal pain, and the study population were college students. MESH terms and Boolean operators used for the search were pain AND musculoskeletal AND college students. Two researchers individually identified records, and if necessary, decisions to include or exclude a record were made through consensus.

Quality assessment. The appraisal of the records was done by one researcher using the AXIS tool.[18] Records were not excluded based on the appraisal. Both researchers had full access to all records, appraisal, and data extraction spreadsheets through a shared Google Drive folder. A meta-analysis was not possible due to the heterogeneity of the sample size, population, outcomes, and measurement instruments.

RESULTS

Figure 1 shows the record selection process. A total of 318 records were identified. After duplicates were removed, 315 records remained while 275 records were excluded after the title and/or abstracts review. The full texts of the remaining records (38) were then assessed. After the full text assessment, 16 records were excluded: three on the studied population, ten on the relationship between furniture and pain, and three on cell phone usage and pain. Only 22 records were included in the analysis. The data extraction is summarized in Table 1.

Study Characteristics

Publication dates ranged from 2015 to 2020. Four records were from Saudi Arabia, three from India, two from USA, two from Brazil, one from South Africa, one from Australia, one from Ethiopia, one from China, one from the United Arab Emirates, two from Pakistan, one from Turkey, one from Ireland, and one from Spain.

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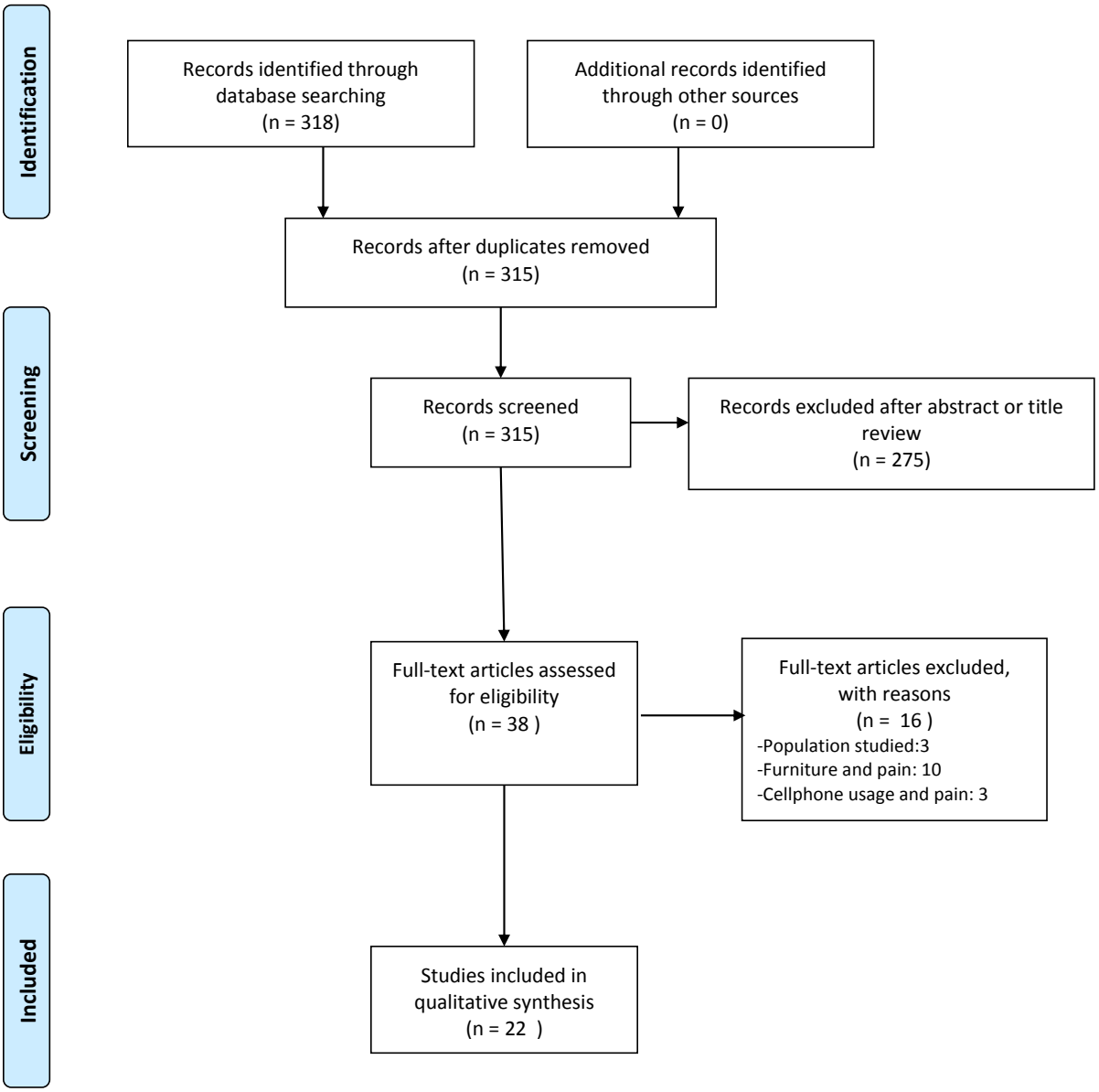

FIGURE 1. Diagram of search strategy.

Musculoskeletal pain sites and prevalence

One record studied the presence of musculoskeletal symptoms in neck (59.5%), lower back (46.8), and shoulder (40.0%)[30]; another reported the prevalence of musculoskeletal symptoms: 91% in at least one body part, 69.7% in the neck, 61.8% in the upper back, and 55.1% in the lower back.[19] One record studied the presence and site of musculoskeletal pain caused by computer use (14.2% neck, 13.8% upper back) and aggravated by computer use (28.9% neck, 25.9% lower back, 24.3% upper back).[20] One record studied the prevalence of lower-back pain (56.6% overall, 12-month prevalence 48.8%).[21] One studied the prevalence of musculoskeletal pain in the past 12 months (65.4% lower back, 53.9% upper back, 48.6% neck pain).[22] One studied the prevalence of neck pain (49.2% in the previous 12 months).[20] Three records studied the prevalence of musculoskeletal pain among females and males. One studied the prevalence of musculoskeletal discomfort (53.8% of total students) and its difference between males and females (neck, 28.9% males and 42.7% females; wrist, 24.4% males and 29.2% females; lower back, 21.1% males and 27.1% females; upper back, 16.7% males and 17.7% females). Females reported a significantly higher prevalence of neck ($p = 0.05$) and shoulder ($p = 0.006$) discomfort.[23] Others studied general musculoskeletal disorders and reported their prevalence in males (65%) and females (89.1%) without a statistically significant difference ($p = 0.083$).[19] Some studies focused on the prevalence of work-related

Table 1. Study characteristics.

	Authors	Year	Country	Condition	Context	Population (N=6,500)	Instrument of measure
1	AlShayhan and Saadeddin [39]	2017	Saudi Arabia	"Low back pain (56.6% overall, 12-month prevalence 48.8%)"	No specific setting	"Health science students (n=1,052,746 females and 306 males)"	Nordic musculoskeletal Questionnare
2	Bubric and Hedge [21]	2016	USA	"Musculoskeletal discomfort amongst males and females (neck 28.9% males and 42.7% females; wrist 24.4% males and 29.2% females; lower back 21.1% males and 27.1%; upper back 16.7% males and 17.7%)"	Laptop use	"Undergraduate and graduate students (n=186, 148 undergraduate and 38 graduate students;90 males and 96 females)"	Online questionnare
3	Bueno et al. [35]	2019	Brazil	"Musculoskeletal symtpoms (61.49% neck,22.03% elbow/forearm and 49.62% lumbar region in the last 12 months)"	Smartphone use	"University students (n=522, 329 females and 193 males)"	Nordic Musculoskeletal Questionnare for the neck and shoulder region
4	Hosteng et al. [26]	2019	USA	"Physical discomfort (68.5% reported pain in at least one area over the past 12 months; positive association between sitting time and discomfort(r=.28,p<0.01))"	Classroom setting	"Undergraduate college students (n=54, 36 females and 18 males)"	General Comfort Scale
5	Hough and Nel [32]	2017	South Africa	"Musculoskeletal discomfort (62.5% regards to pain or numbness(neck 63.9%), stiffness(neck 47.2%) and spasms(44.4%))"	Laptop use	"Third year students residing on campus who owned a laptop (n=72, 55 females and 17 males)"	Self administered questionnare
6	Kamal et al. [21]	2020	Saudi Arabia	"Musculoskeletal disorders (89.1% female and 65% male)"	Clinical settings	"Preclinical dental students (n=86, 40 females and 36 males)"	Short survey questionnare
7	Nahar and Sayed [36]	2018	India	"Musculoskeletal pain (neck pain 65%,lower back pain 61%, 35% upper back pain and 30% shoulder and wrists pain)"	Workstation use in university	"Students in computer science bachelor (n=100, 42 females and 58 males)"	Cornell Musculoskeletal Dysfunction Questionnare
8	Osama, Ali and Malik [31]	2018	Islamabad	"Musculoskeletal discomfort (Neck 75.7%, lower back 62.5%, upper back 58.8%, right shoulder 62.5%, left shoulder 44.1%, buttocks/hips 36%)"	Computer use	"Undergraduate university students (n=136)"	Student spcecific Cornel Musculoskeletal Discomfort Questionnare
9	Penkala, El-Debal and Coxon [37]	2018	Australia	"Musculoskeletal problems (34.5% in the last 12 months (lower back 27.3%, neck 23.6%, upper back 20.0% and soulders (15.5%); 21.8% in the last 7 days (lower back15.5%, neck 10.0%, upper back 13.6% and shoulders (6.4%))"	Laboratory setting	"Medical science students (n=110, 76 female 32 males and 2 others)"	Modified Standarised Nordic musculoskeletal Questionnare
10	Rambhad, Pande and Radke [27]	2020	India	"Musculoskeletal disorders (51% reported having pain, 41% reported sometimes having pain)"	Preclinical setting	"Second year undergraduate dental students (n=100)"	General questionnare
11	Weleslassie et al. [40]	2020	Ethiopia	"Neck pain (49.2% in the previous 12 months)"	No specific setting	"Undergraduate students (n=419, 144 females and 275 males)"	Adapted Nordic Questionnare
12	Woo, White and Lai [33]	2016	China	"Musculoskeletal complaints (49.9% experiencie musculoskeletal symptoms (78.1% shoulder, neck 72.9%, wrist/hand 43.4%, lower back 39.4%, upper back 38.6%, elbow 18.7%)"	Use of electronic devices	"University students (n=503, 299 males and 204 females)"	Multiple choice questionnare

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Table 1. Study characteristics (*continuation*).

	Authors	Year	Country	Condition	Context	Population (N=6,500)	Instrument of measure
13	Nadeem et al. [22]	2019	Pakistan	"Musculoskeletal pain lower back pain (last 12 months 65.4%) upper back (last 12 months 53.9%),neck pain (last 12 months 48.6%)"	No specific setting	"Undergraduate physical therapy students (n= 321, 50 males and 271 females)"	Nordic Musculoskeleal Questionnare
14	Zafar and Almosa [28]	2019	Saudi Arabia	"Work related musculoskeletal disorders Females (shoulder 47%, neck 43%, lower back 42%, upper back 33%) Males (lower back 33%, upper back 26% neck 26% shoulder 24%)"	No specific setting	"Undergraduate dental students (n=142, 88 females and 54 males)"	Self made questionnare
15	Caromano et al. [24]	2015	Brazil	"Discomfort by body region cervical (42.40%) shoulder (left 38.75%, right 34.57%) lumbar area (36.22%) head (31.37%) sacral (32.91%)"	Sitting posture in different activities	"University students (n=47, 42 females and 5 males)"	Self reported diary
16	Kim et al. [25]	2016	India	"Musculoskeletal disorders postgraduates (neck 53%, lower back 44%, shoulder 35%, upper back 33%, wrist and ankle 13%) undergraduates(upper back 44%, lower back 45%, neck 40%, shoulder 48%, wrist 25%)"	No specific setting	"Postgraduates and undergraduate dental students (n=320, 160 postgraduates and 160 undergraduates)"	Standard Nordic Questionnare
17	Hashim et al. [38]	2021	United Arab Emirates	"Musculoskeletal disorders one body site (past week 48.5%, previous year 68.3%), low back (38.6% previous week, 61.4% previous year) neck (28.7% previous week, 52.5% previous year) shoulder (23.3% previous week, 44.1% previous year)"	No specific setting	"Undegraduate dental students (n=202,152 female and 50 males)"	Modified Standarised Nordic musculoskeletal Questionnare
18	Haroon et al. [4]	2018	Pakistan	"Musculoskeletal pain at least in one body site (74.4% past 12 months, 38.9% past seven days) low back (38.6% past 12 months, 16.1% past seven days)neck(33.1% past 12 months, 13.6% past seven days) shoulders(27.8% past 12 months, 119% past seven days) knees(24.2% past 12 months, 11.1% past seven months)"	No specific setting	"Medical students (n= 360, 256 females and 104 males)"	Standard Nordic Questionnare
19	Ekşioğlu [19]	2015	Turkey	"Musculoskeletal symptoms 91% at least in one body part, neck (69.7%), upper back (61.8%), lower back (55.1%)"	No specific setting	"Undergraduate university students (n=89, 35 females and 54 males)"	Improved version of the Student Specific Cornell Musculoskeletal Discomofort Questionnare
20	Dockrell, Bennet and Culleton-Quinn [20]	2015	Ireland	"Musculoskeletal symptoms caused by computer use (14.2% neck, 13.8% upper back) aggravated by computer use (28.9% neck, 25.9%low back, 24.3%upper back)"	Computer use	"Undergraduate university students (n= 239, 199 females and 40 males)"	Modified Standarised Nordic musculoskeletal Questionnare
21	Rodríguez et al. [29]	2020	Spain	"Musculoskeletal pain previous 12 months(68.8% neck, 61.9% lumbar, 39.1% dorsal area) during lockdown (69.9% neck, 63.4% lumbar area, 41.2% dorsal area)"	Prior and during COVID-19 lockdown	"University students (n= 1,198, 846 females and 352 males)"	Spanish Standardized Kuorinka Modified Nordic Questionnare
22	Alsalameh et al. 30	2019	Saudi Arabia	"Musculoskeletal symptoms Neck (59.5%) lower back (46.8) shoulder (40.0%)"	Smartphone use	"Medical students (n= 242, 85 females and 157 males)"	Nordic Musculoskeletal Questionnare

musculoskeletal disorders in females (shoulder 47%, neck 43%, lower back 42%, upper back 33%) and males (lower back 33%, upper back 26% neck 26%, shoulder 24%).[28] One record studied discomfort by body region: cervical region (42.40%), shoulder region (left 38.75%, right 34.57%), lumbar region (36.22%), head region (31.37%), and sacral region (32.91%).[24] One record studied the prevalence of musculoskeletal disorders in postgraduate (neck 53%, lower back 44%, shoulder 35%, upper back 33%, wrist and ankle 13%) and undergraduate (upper back 44%, lower back 45%, neck 40%, shoulder 48%, wrist 25%) dental students.[25] One record studied the prevalence of musculoskeletal disorders in the past week and the previous year, in regards to only one body site they found a prevalence of 48.5% in the past week and 68.3% in the previous year and per body site they found a prevalence of low back 38.6% previous week and 61.4% previous year in low back, 28.7% previous week and 52.5% previous year in the neck, 23.3% previous week and 44.1% previous year in the shoulder.[38] One record studied the prevalence of musculoskeletal pain in one body site during the last 12 months (74.4%) and the last seven days (38.9%). The prevalence in the lower back was 38.6% in the past 12 months and 16.1% in the past seven days; in neck-shoulders, 33.1% in the past 12 months and 13.6% in the past seven days; in shoulders, 27.8% in the past 12 months and 11.9% in the past seven days; and in the knee, 24.2% in the past 12 months and 11.1% in the past seven days.[4]

One record studied physical discomfort in undergraduate college students during class; the authors found a positive association between sitting time and discomfort ($r = .28$, $p < 0.01$). Furthermore, 68.5% of the students reported pain in at least one area over the past 12 months.[26] One record reported the prevalence of musculoskeletal pain: 51% of dental students reported having pain while 41% often suffered pain during preclinical work.[27] The most reported pain sites were neck, shoulders, and lower and upper back.[19, 20, 22, 24, 25, 28-30] Additionally, other studies reported pain in buttocks/hip[31] and the knees.[4] Only two records reported differences in sex besides the previously mentioned most reported sites of pain, and one reported a difference in sex regarding lower back pain. One record reported a higher prevalence of pain or wrist numbness in females (7 females, 12.7%; and 6 males, 35.3%; 95% CI –46.8%, –1.3%),[32] and another found females had a higher prevalence of upper limb musculoskeletal disorders (59.3% vs 43.5% in males, $p < 0.001$) and shoulder discomfort (84.3% vs 72.3% in males, $p < 0.050$).[33] An additional record reported that males had a higher lifetime prevalence of lower back pain (65% vs 53.1% in females, $p < 0.001$)[9]. Only one record studied the prevalence of musculoskeletal pain in the last 12 months and during the COVID-19 lockdown. It reports a prevalence of 68.8% in neck, 61.9% in lumbar area, and 39.1% in dorsal area in the last 12 months against 69.9% in neck, 63.4% in lumbar area, and 41.2% in dorsal area during the COVID-19 lockdown. [29]

Context studied

Two records involved laptop use,[7,26] two involved smartphones,[30,35] one involved classroom setting,[26] one involved clinical setting (dental students),[21] one involved workstation in university (computer science students),[36] and two involved computer use.[20,31] Only one involved laboratory setting (medical science students),[37] one involved preclinical setting (dental students),[23] one involved use of electronic devices,[10,] eight involved no specific setting, [4,19,22,25,28,38-40] one involved different sitting postures,[24] and one involved the COVID-19 lockdown.[29]

Population studied

In regards to population (Total N = 6,500), four records involved medical (n = 1,052, 746 females and 306 males[39]; n = 360, 256 females and 104 males[4]; and n = 242, 85 females and 157 males[30]) and health science students (n = 110, 76 females, 32 males, and 2 others).[37] Two records involved dental students (n = 86 total, 40 females, 36 males,[21] and n=100 total[27]), two involved undergraduate dental students (n=202 total,152 female and 50 males[27] and n=142 total, 88 females and 54 males[28]) and one involved postgraduates and undergraduate dental students (n = 320 total, 160 postgraduates and 160 undergraduates[25]). One record included undergraduate physical therapy students (n = 321, 50 males and 271 females[22]) and another one, computer science students (n = 100, 42 females and 58 males).[36] The rest involved undergraduate and graduate students (n = 186 total, 148 undergraduate and 38 graduate students[23]) university students (n = 522 total, 329 females and 193 males[35]; n = 1,198, 846 females and 352 males[29]; and n = 47 total, 42 females and 5 males[24]), undergraduate college students (n = 54 total, 36 females and 18 males,[26]) third-year students residing on campus (n = 72 total, 55 females and 17 males[32]) undergraduate university students (n = 239 total, 199 females and 40 males[20]; and n = 89 total, 35 females and 54 males[19]), undergraduate students (n = 419 total, 144 females and 275 males[40]) and university students (n = 503 total, 299 males and 204 females). [33]

Instruments used to measure musculoskeletal pain

Four records used the Nordic Musculoskeletal Questionnaire (NMQ),[22, 25, 30, 39] one used the NMQ for neck and shoulder region,[35] one used the Spanish Standardized Kuorinka Modified NMQ,[29] one used the General Comfort Scale,[26] one used the Cornell Musculoskeletal Dysfunction Questionnaire (CMDQ),[40] one used the Student Specific CMDQ (SS-CMDQ),[31] and another one used an improved version of the SS-CMDQ.[19] Three studies used a modified version of the standardized NMQ,[20, 37, 38] one used an adapted form of the NMQ,[40] one was an online questionnaire,[23] one used a self-reported diary,[24] and five used a self-made questionnaire.[21, 27, 32, 33,28]

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Record appraisal

The summary of the record appraisal is shown in Table 2. All records but one (not explicitly stated[28]) had clear aims/objectives while the study design was appropriate for those aims.[4, 19, 20, 22, 25, 28, 29, 32, 35, 36, 38] Only five records justified their sample by sample size calculations.[4, 29-31, 40] Only one record did not explicitly state the target population.[28] Four records stated the sample used might not be representative of the target population.[26,32,33,4] Two used a convenience sample,[26, 33] one used a non-randomized sample,[32] and one found the sample used was too small.[4] In all but two records the selection process was likely to represent the target population.[24, 30] Although only eight records had non-responders, none of the records provided details as to what had been done to address this.[4, 20, 28, 33, 37-40] All the risk factors and outcome variables were properly measured according to the aims of the studies.[4, 19-26, 28-31, 33, 37, 38, 41] All but one record defined a clear statistical significance[25] while only three failed to specify their statistical methods sufficiently.[25, 27, 36] In all records except one, basic data were described.[27] In all records, the response rate was described using either a numerical or percentage value, as in the three non-responder records,[33, 37, 40] or the rest of the records with a response rate of 100%.[21-27, 29-32, 35, 36, 39] Six of the eight non-responder records provided information about non-responders[4, 20, 28, 33, 38, 39] and two provided no information.[37, 40] All records showed internally consistent results; the results of the analysis were followed by discussions and justified conclusions.[4, 19-26, 28-33, 35-39] Eight records did not discuss limitations of the study.[22, 24, 25, 27, 30, 33, 36, 38] None of the records reported funding or conflict of interests that could affect results. Only three records did not get approval by local ethics committees or showed signed informed consent.[19, 27, 36] One of those three records explained the procedures to participants prior to the commencement of the study but did not get the participants' signed informed consent.[36]

DISCUSSION

According to Szczygieł E. et al. it was until 1980 when Majeske and Buchanan were able to demonstrate the favorable changes in the body when sitting with good lumbar support, preventing lower back pain. Lengsfeld and De Carvalho noted the importance of having a lower backrest, as it maintains the correct angulation between the L-5 and S-1 vertebrae, thus preventing the overload of L-4 to L-5 intervertebral discs1.[13] The pelvis position is essential to maintaining the curvature of the spine, as it decreases the intervertebral pressure of the discs, preventing spine overload and reducing tension in soft tissues. Furthermore, it is also essential to have an accurate head and neck placement. To decrease the additional tension at the neck and shoulder muscles, the eyes should be at the same height as the computer screen/monitor (30º of cervical flexion according to Burgess-Limerick), as it has been shown to decrease neck hyperextension (between the joints of C0-C1 and C1-C2)[42].Over the past decade, there has been an increase in sedentary lifestyles. People spend more time sitting (at school, in the car, or in front of a computer) than performing a physical activity that demands a higher energy consumption.[43] In 1997, on average, a person spent around 5.9 hours a week sitting while, in 2003, it was 14.6 hours, approximately. However, since 2012, people sit more than 7 hours a day (above all, young adults between ages 18 and 25), and most of the time, it is with an incorrect posture.[42] From 2006 to 2015, the sedentary lifestyle increased on average by 18 minutes a day, 8% more than in previous years.[42]

Several studies have shown that in older adults sitting for too long in a single position is associated with cardiometabolic problems, cancer, type 2 diabetes, and early death, while reducing the time of sitting (or interrupting the periods with moderate physical activity) lowers LDL cholesterol levels, reduces joint pain, and may improve a person's mental health.[44] A short-term sedentary lifestyle contributes to hepatic insulin resistance and characteristic dyslipidemia, resulting in liver triglyceride aggregation from a metabolic point of view. Sedentary time can represent 60% of our day, increasing the risk of cardiovascular mortality, type 2 diabetes, hypertension, and can be associated with visceral fat buildup (adipose tissue).[45] In 2017, there were 38 million deaths due to non-communicable diseases, of which 82% were in developing countries. These deaths were caused by three main factors: 1) physical inactivity, 2) unbalanced diet, and 3) time spent in a sitting position (e.g., in front of a computer, commuting, schools, and office).[46] People who sit for 8 to 11 hours a day increase their chance of mortality by 15% every three years and increase the risk of developing obesity, type 2 diabetes, cancer, and cardiovascular disease.[47] It is necessary to identify the population groups that are more likely to have a sedentary life: students (mostly college students), women, and people who use computer/electronics devices.[31] In recent years, laptop use among college students has increased by 77%. Unlike a desktop computer, the laptop allows for different body postures when using it, benefiting the person from maintaining the same position for a long time.[33] A study was conducted at Shifa Tameer-e-Millat University in Pakistan to identify postural conditions associated with computer use and the factors that may contribute to the accumulation of this discomfort. Participants were students from 17 to 25 years of age at the same university who had to take the SS-CMDQ. It which has two versions, one for male and one for female students, participants are asked whether they have presented pain or discomfort in any area of the body in the last week. If so, they have to state how many times a week/day and show in a diagram where the discomfort is. At the end of the study, students indicated that the musculoskeletal areas with the most significant ailments and discomfort were neck (75.5%), lumbar area (62.5%), and cervical area (58.8%). They were also asked how many hours a day they spent in front of a computer, and the average result was between 2.5 and 3 hours (approximately 5 hours a week).[31]

Table 2. Risk of bias assessment.

	Authors	Aims/ objectives clear	Study design appropiate for the aims	Sample size justified	Target population defined	Sample appropiate to represent the target population	Selection process of participants likely to represent the target population	Measures undertaken to adress non responders	Risk factors and outcome variables measured appropiatly to the aims	Clear statistical significance defined
1	AlShayhan and Saadeddin [39]	YES	YES	NO	YES	YES	YES	NO	YES	YES
2	Bubric and Hedge [21]	YES	YES	NO	YES	YES	YES	No non responders	YES	YES
3	Bueno et al. [35]	YES	YES	NO	YES	YES	YES	No non responders	YES	YES
4	Hosteng et al. [26]	YES	YES	NO	YES	NO	YES	No non responders	YES	YES
5	Hough and Nel [32]	YES	YES	NO	YES	NO	YES	No non responders	YES	YES
6	Kamal et al. [21]	YES	YES	NO	YES	YES	YES	No non responders	YES	YES
7	Nahar and Sayed [36]	YES	YES	NO	YES	YES	YES	No non responders	YES	YES
8	Osama, Ali and Malik [31]	YES	YES	YES	YES	YES	YES	No non responders	YES	YES
9	Penkala, El-Debal and Coxon [37]	YES	YES	NO	YES	YES	YES	NO	YES	YES
10	Rambhad, Pande and Radke [27]	YES	YES	NO	YES	YES	YES	No non responders	YES	YES
11	Weleslassie et al. [40]	YES	YES	YES	YES	YES	YES	NO	YES	YES
12	Woo, White and Lai [33]	YES	YES	NO	YES	NO	YES	NO	YES	YES
13	Nadeem et al. [22]	YES	YES	NO	YES	YES	YES	No non responders	YES	YES
14	Zafar and Almosa [28]	YES	YES	NO	YES	YES	YES	NO	YES	YES
15	Caromano et al. [24]	YES	YES	NO	YES	YES	NO	No non responders	YES	YES
16	Kim et al. [25]	YES	YES	NO	YES	YES	YES	No non responders	YES	NO
17	Hashim et al. [38]	YES	YES	NO	YES	YES	YES	NO	YES	YES
18	Haroon et al. [4]	YES	YES	YES	YES	NO	YES	NO	YES	YES
19	Ekşioğlu [19]	YES	YES	NO	YES	YES	YES	No non responders	YES	YES
20	Dockrell, Bennet and Culleton-Quinn [20]	YES	YES	NO	YES	YES	YES	NO	YES	YES
21	Rodríguez et al [29]	YES	YES	YES	YES	YES	YES	No non responders	YES	YES
22	Alsalameh et al [30]	NO	YES	YES	NO	YES	NO	No non responders	YES	YES

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Table 2. Risk of bias assessment (*continuation*).

	Methods described sufficiently to be repeated	Basic data described	Response rate described	If appropiate, information about non responders described	Results internally consistent	Presence of results for the analyses described	Discussion and conclusions justified	Limitations discussed	Funding or conflict of interests that could affect results	Ethical approval or informed consent attained
1	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
2	YES	YES	YES	No non responders	YES	YES	YES	YES	NO	YES
3	YES	YES	YES	No non responders	YES	YES	YES	YES	NO	YES
4	YES	YES	YES	No non responders	YES	YES	YES	YES	NO	YES
5	YES	YES	YES	No non responders	YES	YES	YES	YES	NO	YES
6	YES	YES	YES	No non responders	YES	YES	YES	YES	NO	YES
7	NO	YES	YES	No non responders	YES	YES	YES	NO	NO	NO
8	YES	YES	YES	No non responders	YES	YES	YES	YES	NO	YES
9	YES	YES	YES	NO	YES	YES	YES	YES	NO	YES
10	NO	NO	YES	No non responders	YES	YES	YES	NO	NO	NO
11	YES	YES	YES	NO	YES	YES	YES	YES	NO	YES
12	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES
13	YES	YES	YES	No non responders	YES	YES	YES	NO	NO	YES
14	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
15	YES	YES	YES	No non responders	YES	YES	YES	NO	NO	YES
16	NO	YES	YES	No non responders	YES	YES	YES	NO	NO	YES
17	YES	YES	YES	YES	YES	YES	YES	NO	NO	YES
18	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
19	YES	YES	YES	No non responders	YES	YES	YES	YES	NO	NO
20	YES	YES	YES	YES	YES	YES	YES	YES	NO	YES
21	YES	YES	YES	No non responders	YES	YES	YES	YES	NO	YES
22	YES	YES	YES	No non responders	YES	YES	YES	NO	NO	YES

The World Health Organization (WHO) indicates that a sedentary lifestyle affects at least 60% of the world's population. This negative impact increases the likelihood of chronic illness, muscle pain, poor posture, and ergonomic problems. Less physical activity, as sitting in one position or having no activity at all, can lead to a loss in nitrogen and calcium in the musculoskeletal system as well as a decrease in heart muscle (up to 11%) and oxygen intake (28%), which can mean that the muscles will not have the required oxygen consumption, making them more prone to injury.[34, 48]

In this review, the most reported pain sites are neck, lower and upper back, and shoulders; some participants have also reported pain in wrists, hands, and buttocks or hips. The time spent continuously sitting, the number of breaks, head position while working at a desk, and physical activity are all musculoskeletal pain determinant.[49] Forward neck posture is not associated with pain in adolescents[50] nor is neck flexion while using a smartphone device (text neck).[51] Casas et al. analyzed different sittings categories and how each type affects posture. They determined that, in chairs with armrests, sitting with a rounded back with the feet supported on another chair and sitting with a rounded back with the legs crossed were identified as significant and associated with both acute and chronic neck pain.[52] There is a direct link between lower back pain and sitting on a chair. Lumbar lordosis with chest kyphosis must be maintained to reduce the risk of muscle tensions and allow the upper limbs to have a free range of motion but simultaneously support the elbow joints-forearm on the armrest.[53, 54] A sitting position is defined by a variety of factors, like workplace setting, characteristics of chair and desk, job specifications, environmental factors (room temperature and lighting), human anatomical characteristics, and sitting time during school/study hours.[42,53] When using computers (or electronic devices) to study, 31.5% of students sit with posterior pelvic tilt and neck flexion, 18% slump (collapsed trunk), and 10% are in a prone position or lateral position over a flat surface. However, there has been an increase in laptop use (77% of students), which could benefit the student from maintaining the same position for extended times.[33] Maintaining a low position for a long time can lead to changes in posture that may develop into musculoskeletal disorders. Being seated for long periods and in an inadequate position generates alterations in postural balance and can trigger long-term muscle overloads on anatomical structures.[42]

Some authors report differences in pain intensity and prevalence between females and males, with males having a higher prevalence of lifetime lower back pain[39] and females having a higher prevalence of neck and shoulder discomfort,[23] upper body musculoskeletal disorders, shoulder discomfort,[33] and pain or numbness in wrists[32] This is in line with what has been previously reported. Women have a higher prevalence of upper extremity musculoskeletal disorders with factors ranging from job-related (work stress, architecture), psychological and psychosocial (social support, conflicting schedules), and cultural (housework, pain complaints), to biological (hormones, muscle fiber type) as potential candidates as to why there is such difference.[55] In a nationwide prospective cohort study covering five years in the Dutch population, females had higher rates of disability pension due to musculoskeletal problems like back and shoulder problems and neck symptoms.[56] A study done in 2015 by Vafadar, Coté, and Archambault shows that when asked to reproduce a shoulder angle, women immediately tend to overestimate the angle leading to an increased shoulder flexion, while men tend to both overestimate and underestimate the angle.[57] It could be argued that female college students overestimate the angle needed to do everyday tasks, and as a result, they produce a greater shoulder flexion that leads to increased muscle activation and eventual discomfort.

In our review, participants in several studies are dental students in a preclinical setting, and in one case, students in a laboratory setting. The analysis of pain and posture must be different as the settings in these populations are not those of the rest of the population (sitting in front of a desk vs. dental or laboratory workstations). Among dental professionals, the most reported pain sites are neck, back, and shoulders. Awkward postures and the number of working hours without breaks are risk factors for developing musculoskeletal pain[14] and pain in more than one site was associated with decreased work quality and quantity.[8-10] Among laboratory technicians, the most affected pain sites are trunk and knees, with awkward posture identified in neck, trunk, wrists, forearms, and shoulders.[58] Taken all together, it seems that posture per se does not cause musculoskeletal pain, but rather the time spent in that posture.

Several strategies to treat musculoskeletal problems due to posture have been proposed. Ergonomic interventions have not been effective in reducing the intensity and frequency of neck and lower back pain in the short and long term.[59] Among dental workers, ergonomic chairs, magnification lenses, broader and lighter instruments, ergonomics training courses, and prismatic glasses reduce musculoskeletal pain frequency and severity.[54, 60] Having 5-minute work breaks consisting of standing and stretching every 30–45 minutes effectively reduces musculoskeletal discomfort and muscle tension.[56] The most effective strategy to prevent and treat musculoskeletal pain appears to be physical activity. People with chronic musculoskeletal pain already exhibit low physical activity levels.[61] Physical activity is effective in reducing pain in the wrists, shoulder, cervical and lumbar spine,[1] and preventing episodes of neck pain[62]; it is also a good treatment for chronic neck pain.[63] Ten minutes of daily resistance exercise effectively reduce shoulder and neck pain.[64] Exercise treats and prevents upper extremity musculoskeletal pain.[65] Exercise plus education prevents[66] and treats episodes of lower back pain and work absence.[67] Between workplace modifications, the

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use of technologies or devices, and educational or behavioral interventions, only exercise and its combination with education effectively treat lower back pain in a workplace environment.[68] Exercise combined with cognitive intervention aimed at pain and movement effectively reduces chronic musculoskeletal pain in laboratory technicians.[69] Furthermore, physical activity levels can predict a return to work and subjective employability at one year of disability leave.[70] The promotion of physical activity and an active lifestyle can be especially beneficial to college students as it can carry over to the professional field as healthy lifestyle habits and behaviors. However, all these interventions must be taken with caution as their effectiveness has been measured in a professional setting (workplace, laboratory, or dental clinic) with professionals (office workers, laboratory workers, or dental professionals) and not college students as the study population.

Strengths

To the authors' knowledge, this is the first systematic review of musculoskeletal pain with college students as the study population. Second, the studies included in the analysis were done in different countries with different types of sub-populations (medical students, dental students, general students) and in different settings (classroom, dental clinic, laboratory), meaning that this is a widespread phenomenon not exclusive to one population or setting.

Limitations

An important limitation of this review is the lack of a meta-analysis. Mixed subpopulations and different settings made a meta-analysis not suitable for this review. Another limitation noted by the authors was the different types of instruments used to measure musculoskeletal pain, ranging from validated instruments to self-made questionnaires and simple yes or no questions. The majority of the studies did not have a justified sample, which may have biased their results or limited the extent to which their results can be generalized.

CONCLUSIONS

The most-reported pain sites were neck, lower and upper back, and shoulders. A particular interest must be taken in college students as previous pain episodes can be a risk factor for recurrent pain, so they may start to develop musculoskeletal pain at a young age. It is crucial to see posture from a global and holistic point of view to make recommendations that can be applied in universities to promote a healthy lifestyle, reduce the risk of musculoskeletal problems, and prevent the early onset of chronic diseases.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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REFERENCES

1. Rodrigues EV, Gomes ARS, Tanhoffer AIP, Leite N. Effects of exercise on pain of musculoskeletal disorders: a systematic review. Acta ortopedica brasileira. 2014;22(6):334-8.
   https://doi.org/10.1089/tmj.2018.0231
2. Obembe AO, Johnson OE, Tanimowo TO, Onigbinde AT, Emechete AA. Musculoskeletal pain among undergraduate laptop users in a Nigerian University. Journal of back and musculoskeletal rehabilitation. 2013;26(4):389-95.
   https://doi.org/10.3233/bmr-130397
3. Kanchanomai S, Janwantanakul P, Pensri P, Jiamjarasrangsi W. Prevalence of and factors associated with musculoskeletal symptoms in the spine attributed to computer use in undergraduate students. Work. 2012;43(4):497-506.
   https://doi.org/10.3233/wor-2012-1387
4. Haroon H, Mehmood S, Imtiaz F, Ali SA, Sarfraz M. Musculoskeletal pain and its associated risk factors among medical students of a public sector University in Karachi, Pakistan. JPMA The Journal of the Pakistan Medical Association. 2018;68(4):682-8.
5. Pública SdE. Características educativas de la población México2015.
   Available from: https://sinegi.page.link/ZPm2
   Available from: https://www.inegi.org.mx/temas/educacion/
6. Øiestad BE, Hilde G, Tveter AT, Peat GG, Thomas MJ, Dunn KM, et al. Risk factors for episodes of back pain in emerging adults. A systematic review. European Journal of Pain. 2020;24(1):19-38.
   https://doi.org/10.1002/ejp.1474
7. Saavedra-Hernández M, Castro-Sánchez AM, Cuesta-Vargas AI, Cleland JA, Fernández-de-las-Peñas C, Arroyo-Morales M. The contribution of previous episodes of pain, pain intensity, physical impairment, and pain-related fear to disability in patients with chronic mechanical neck pain. American journal of physical medicine & rehabilitation. 2012;91(12):1070-6.
   https://doi.org/10.1097/PHM.0b013e31827449a5
8. Hallman DM, Holtermann A, Björklund M, Gupta N, Rasmussen CDN. Sick leave due to musculoskeletal

pain: determinants of distinct trajectories over 1 year. International archives of occupational and environmental health. 2019;92(8):1099-108.

https://doi.org/10.1007/s00420-019-01447-y

9. Marklund S, Mienna CS, Wahlström J, Englund E, Wiesinger B. Work ability and productivity among dentists: associations with musculoskeletal pain, stress, and sleep. International archives of occupational and environmental health. 2020;93(2):271-8.

https://doi.org/10.1007/s00420-019-01478-5

10. Lallukka T, Hiilamo A, Oakman J, Mänty M, Pietiläinen O, Rahkonen O, et al. Recurrent pain and work disability: a record linkage study. International archives of occupational and environmental health. 2020;93(4):421-32.

https://link.springer.com/article/10.1007/s00420-019-01494-5

11. Melkevik O, Clausen T, Pedersen J, Garde AH, Holtermann A, Rugulies R. Comorbid symptoms of depression and musculoskeletal pain and risk of long term sickness absence. BMC public health. 2018;18(1):1-9.

https://doi.org/10.1186/s12889-018-5740-y

12. Demou E, Smith S, Bhaskar A, Mackay DF, Brown J, Hunt K, et al. Evaluating sickness absence duration by musculoskeletal and mental health issues: a retrospective cohort study of Scottish healthcare workers. BMJ open. 2018;8(1):e018085.

http://orcid.org/0000-0001-8616-525X

13. Hanvold TN, Kines P, Nykänen M, Thomée S, Holte KA, Vuori J, et al. Occupational safety and health among young workers in the nordic countries: a systematic literature review. Safety and health at work. 2019;10(1):3-20.

https://doi.org/10.1016/j.shaw.2018.12.003

14. Lietz J, Kozak A, Nienhaus A. Prevalence and occupational risk factors of musculoskeletal diseases and pain among dental professionals in Western countries: A systematic literature review and meta-analysis. PloS one. 2018;13(12):e0208628.

https://doi.org/10.1371/journal.pone.0208628

15. Jun D, Zoe M, Johnston V, O'Leary S. Physical risk factors for developing non-specific neck pain in office workers: a systematic review and meta-analysis. International archives of occupational and environmental health. 2017;90(5):373-410.

https://doi.org/10.1007/s00420-017-1205-3

16. Asante BO, Trask C, Adebayo O, Bath B. Prevalence and risk factors of low back disorders among waste collection workers: A systematic review. Work. 2019;64(1):33-42.

https://doi.org/10.3233/wor-192977

17. Khan MI, Bath B, Boden C, Adebayo O, Trask C. The association between awkward working posture and low back disorders in farmers: a systematic review. Journal of agromedicine. 2019;24(1):74-89.

https://doi.org/10.1080/1059924x.2018.1538918

18. Munn Z, Moola S, Lisy K, Riitano D, Tufanaru C. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. International journal of evidence-based healthcare. 2015;13(3):147-53.

https://doi.org/10.1097/xeb.0000000000000054

19. Ekşioğlu M. Musculoskeletal and visual symptoms among undergraduate students: Individual and computer-use-related risk factors and interference with academic performance. International Journal of Industrial Ergonomics. 2017;60:26-34.

http://dx.doi.org/10.1016/j.ergon.2015.11.011

20. Dockrell S, Bennett K, Culleton-Quinn E. Computer use and musculoskeletal symptoms among undergraduate university students. Computers & Education. 2015;85:102-9.

https://doi.org/10.1016/j.compedu.2015.02.001

21. Kamal AM, Ahmed DR, Habib SF, Al-Mohareb RA. Ergonomics of preclinical dental students and potential musculoskeletal disorders. Journal of Dental Education. 2020;84(12):1438-46.

https://doi.org/10.1002/jdd.12369

22. Nadeem K, Mehdi Z, Sadiq S, Asim HM. Musculoskeletal Pain Among Undergraduate Physical Therapy Students: Single Centered Survey.

https://doi.org/10.36283/PJMD8-4/018

23. Bubric K, Hedge A. Differential patterns of laptop use and associated musculoskeletal discomfort in male and female college students. Work. 2016;55(3):663-71.

https://doi.org/10.3233/wor-162419

24. Caromano FA, de Amorim CAP, de Fátima Rebelo C, Contesini AM, Fávero FM, Frutuoso JRC, et al. Prolonged sitting and physical discomfort in university students. CEP. 2015;5360:000.

http://dx.doi.org/10.5935/0104-7795.20150034

25. Kim J, Raval N, Joglekar P, Patil. A. Comparative Study Of The prevalence Of Musculoskeletal Disorders In Dental Undergraduate And Postgraduate Students. International Journal of Approximate Reasoning. 2016;4:888-95.

http://dx.doi.org/10.21474/IJAR01/1557

26. Hosteng KR, Reichter AP, Simmering JE, Carr LJ. Uninterrupted classroom sitting is associated with increased discomfort and sleepiness among college students. International journal of environmental research and public health. 2019;16(14):2498.

https://dx.doi.org/10.3390%2Fijerph16142498

27. Rambhad C, Pande N, Radke U. Assessment of knowledge of ergonomics among preclinical undergraduate students:

https://doi.org/10.36105/psrua.2021v1n2.04

A cross-sectional study. Journal of the International Clinical Dental Research Organization. 2018;10(2):65.

10.4103/jicdro.jicdro_12_18

28. Zafar H, Almosa N. Prevalence of work-related musculoskeletal disorders among dental students of King Saud University, Riyadh, kingdom of Saudi Arabia. J Contemp Dent Pract. 2019;20:449-53.

http://dx.doi.org/10.5005/jp-journals-10024-2537

29. Leirós-Rodríguez R, Rodríguez-Nogueira Ó, Pinto-Carral A, Álvarez-Álvarez M, Galán-Martín MÁ, Montero-Cuadrado F, et al. Musculoskeletal Pain and Non-Classroom Teaching in Times of the COVID-19 Pandemic: Analysis of the Impact on Students from Two Spanish Universities. Journal of Clinical Medicine. 2020;9(12):4053.

https://doi.org/10.3390/jcm9124053

30. Alsalameh AM, Harisi MJ, Alduayji MA, Almutham AA, Mahmood FM. Evaluating the relationship between smartphone addiction/overuse and musculoskeletal pain among medical students at Qassim University. Journal of family medicine and primary care. 2019;8(9):2953.

https://doi.org/10.4103/jfmpc.jfmpc_665_19

31. Osama M, Ali S, Malik RJ. Posture related musculoskeletal discomfort and its association with computer use among university students. J Pak Med Assoc. 2018;68:639-41.

32. Hough PA, Nel M. Postural risks and musculoskeletal discomfort of three preferred positions during laptop use amongst students. South African Journal of Occupational Therapy. 2017;47(1):3-8.

http://dx.doi.org/10.17159/2310-3833/2017/v47n1a2

33. Woo EH, White P, Lai CW. Musculoskeletal impact of the use of various types of electronic devices on university students in Hong Kong: An evaluation by means of self-reported questionnaire. Manual therapy. 2016;26:47-53.

https://doi.org/10.1016/j.math.2016.07.004

34. Narici M, De Vito G, Franchi M, Paoli A, Moro T, Marcolin G, et al. Impact of sedentarism due to the COVID-19 home confinement on neuromuscular, cardiovascular and metabolic health: Physiological and pathophysiological implications and recommendations for physical and nutritional countermeasures. European Journal of Sport Science. 2020:1-22.

https://doi.org/10.1080/17461391.2020.1761076

35. Regiani Bueno G, Garcia LF, Marques Gomes Bertolini SM, Rodrigues Lucena TF. The Head Down Generation: Musculoskeletal Symptoms and the Use of Smartphones Among Young University Students. Telemedicine and e-Health. 2019;25(11):1049-56.

https://doi.org/10.1089/tmj.2018.0231

36. Nahar S, Sayed A. Prevalence of musculoskeletal dysfunction in computer science students and analysis of workstation characteristics-an explorative study. International Journal of Advanced Research in Computer Science. 2018;9(2).

https://doi.org/10.26483/ijarcs.v9i2.5570

37. Penkala S, El-Deba l H, Coxon K. Work-related musculoskeletal problems related to laboratory training in university medical science students: a cross sectional survey. BMC public health. 2018;18(1):1208.

https://doi.org/10.1186/s12889-018-6125-y

38. Hashim R, Salah A, Mayahi F, Haidary S. Prevalence of postural musculoskeletal symptoms among dental students in United Arab Emirates. BMC Musculoskeletal Disorders. 2021;22(1):1-5.

https://doi.org/10.1186/s12891-020-03887-x

39. AlShayhan FA, Saadeddin M. Prevalence of low back pain among health sciences students. European Journal of Orthopaedic Surgery & Traumatology. 2018;28(2):165-70.

https://doi.org/10.1007/s00590-017-2034-5

40. Weleslassie GG, Meles HG, Haile TG, Hagos GK. Burden of neck pain among medical students in Ethiopia. BMC musculoskeletal disorders. 2020;21(1):1-9.

https://doi.org/10.1186/s12891-019-3018-x

41. Woo E, White P, Lai C. Ergonomics standards and guidelines for computer workstation design and the impact on users' health–a review. Ergonomics. 2016;59(3):464-75.

https://doi.org/10.1080/00140139.2015.1076528

42. Gerardo M-MG. Diagnóstico de lumbalgia en estudiantes universitarios del área de salud en Tepic, Nayarit.

www.binasss.sa.cr/ojssalud/index.php/mlcr/article/view/110

43. Saeidifard F, Medina-Inojosa JR, Supervia M, Olson TP, Somers VK, Erwin PJ, et al. Differences of energy expenditure while sitting versus standing: A systematic review and meta-analysis. European journal of preventive cardiology. 2018;25(5):522-38.

https://doi.org/10.1177/2047487317752186

44. Owari Y, Miyatake N. Long-Term Relationship between Psychological Distress and Continuous Sedentary Behavior in Healthy Older Adults: A Three Panel Study. Medicina. 2019;55(9):555.

https://doi.org/10.3390/medicina55090555

45. Bowden Davies KA, Pickles S, Sprung VS, Kemp GJ, Alam U, Moore DR, et al. Reduced physical activity in young and older adults: metabolic and musculoskeletal implications. Therapeutic advances in endocrinology and metabolism. 2019;10:2042018819888824.

https://doi.org/10.1177%2F2042018819888824

46. Medina C, Tolentino-Mayo L, López-Ridaura R, Barquera S. Evidence of increasing sedentarism in Mexico City during the last decade: Sitting time prevalence, trends,

and associations with obesity and diabetes. PloS one. 2017;12(12):e0188518.

https://doi.org/10.1371/journal.pone.0188518

47. Dempsey PC, Blankenship JM, Larsen RN, Sacre JW, Sethi P, Straznicky NE, et al. Interrupting prolonged sitting in type 2 diabetes: nocturnal persistence of improved glycaemic control. Diabetologia. 2017;60(3):499-507.

https://doi.org/10.1007/s00125-016-4169-z

48. Narici MV, Monti E, Franchi M, Reggiani C, Toniolo L, Giacomello E, et al. Early biomarkers of muscle atrophy and of neuromuscular alterations during 10-day bed rest. The FASEB Journal. 2020;34(S1):1-.

https://doi.org/10.1096/fasebj.2020.34.s1.09027

49. Çelik S, Dirimeşe E, Taşdemir N, Çelik K, Arık T, Büyükkara İ. Determination of pain in muscoloskeletal system reported by office workers and the pain risk factors. 2018.

https://doi.org/10.13075/ijomeh.1896.00901

50. Mahmoud NF, Hassan KA, Abdelmajeed SF, Moustafa IM, Silva AG. The relationship between forward head posture and neck pain: a systematic review and meta-analysis. Current reviews in musculoskeletal medicine. 2019;12(4):562-77.

https://doi.org/10.1007/s12178-019-09594-y

51. Damasceno GM, Ferreira AS, Nogueira LAC, Reis FJJ, Andrade ICS, Meziat-Filho N. Text neck and neck pain in 18–21-year-old young adults. European Spine Journal. 2018;27(6):1249-54.

https://doi.org/10.1007/s00586-017-5444-5

52. Casas AS, Patiño MS, Camargo DM. Association between the sitting posture and back pain in college students. Revista de la Universidad Industrial de Santander Salud. 2016;48(4):446-54.

http://dx.doi.org/10.18273/revsal.v48n4-2016003

53. Ming Z, Närhi M, Siivola J. Neck and shoulder pain related to computer use. Pathophysiology. 2004;11(1):51-6.

https://doi.org/10.1016/j.pathophys.2004.03.001

54. Lietz J, Ulusoy N, Nienhaus A. Prevention of musculoskeletal diseases and pain among dental professionals through ergonomic interventions: a systematic literature review. International journal of environmental research and public health. 2020;17(10):3482.

https://doi.org/10.3390/ijerph17103482

55. Treaster DE, Burr D. Gender differences in prevalence of upper extremity musculoskeletal disorders. Ergonomics. 2004;47(5):495-526.

https://doi.org/10.1080/00140130310001638171

56. Gjesdal S, Bratberg E, Mæland JG. Gender differences in disability after sickness absence with musculoskeletal disorders: five-year prospective study of 37,942 women and 26,307 men. BMC musculoskeletal disorders. 2011;12(1):1-9.

https://doi.org/10.1186/1471-2474-12-37

57. Vafadar AK, Côté JN, Archambault PS. Sex differences in the shoulder joint position sense acuity: a cross-sectional study. BMC musculoskeletal disorders. 2015;16(1):1-7.

https://doi.org/10.1186/s12891-015-0731-y

58. Maulik S, Iqbal R, De A, Chandra AM. Evaluation of the working posture and prevalence of musculoskeletal symptoms among medical laboratory technicians. Journal of back and musculoskeletal rehabilitation. 2014;27(4):453-61.

https://doi.org/10.3233/BMR-140466

59. Driessen MT, Proper KI, van Tulder MW, Anema JR, Bongers PM, van der Beek AJ. The effectiveness of physical and organisational ergonomic interventions on low back pain and neck pain: a systematic review. Occupational and environmental medicine. 2010;67(4):277-85.

https://doi.org/10.1136/oem.2009.047548

60. Romero-Blanco C, Rodríguez-Almagro J, Onieva-Zafra MD, Parra-Fernández ML, Prado-Laguna MDC, Hernández-Martínez A. Physical activity and sedentary lifestyle in university students: Changes during confinement due to the Covid-19 pandemic. International Journal of Environmental Research and Public Health. 2020;17(18):6567.

https://doi.org/10.3390/ijerph17186567

61. Ding Y, Cao Y, Duffy VG, Zhang X. It is Time to Have Rest: How do Break Types Affect Muscular Activity and Perceived Discomfort During Prolonged Sitting Work. Safety and Health at Work. 2020;11(2):207-14.

https://dx.doi.org/10.1016%2Fj.shaw.2020.03.008

62. de Campos TF, Maher CG, Steffens D, Fuller JT, Hancock MJ. Exercise programs may be effective in preventing a new episode of neck pain: a systematic review and meta-analysis. Journal of physiotherapy. 2018;64(3):159-65.

https://doi.org/10.1016/j.jphys.2018.05.003

63. de Zoete RM, Brown L, Oliveira K, Penglaze L, Rex R, Sawtell B, et al. The effectiveness of general physical exercise for individuals with chronic neck pain: a systematic review of randomised controlled trials. European Journal of Physiotherapy. 2020;22(3):141-7.

https://doi.org/10.1080/21679169.2018.1561942

64. Saeterbakken AH, Makrygiannis P, Stien N, Solstad TEJ, Shaw M, Andersen V, et al. Dose-response of resistance training for neck-and shoulder pain relief: a workplace intervention study. BMC Sports Science, Medicine and Rehabilitation. 2020;12:1-8.

https://dx.doi.org/10.1186%2Fs13102-020-0158-0

65. Van Eerd D, Munhall C, Irvin E, Rempel D, Brewer S, Van Der Beek A, et al. Effectiveness of workplace interventions in the

https://doi.org/10.36105/psrua.2021v1n2.04

prevention of upper extremity musculoskeletal disorders and symptoms: an update of the evidence. Occupational and Environmental Medicine. 2016;73(1):62-70.

https://doi.org/10.1136/oemed-2015-102992

66. Steffens D, Maher CG, Pereira LS, Stevens ML, Oliveira VC, Chapple M, et al. Prevention of low back pain: a systematic review and meta-analysis. JAMA internal medicine. 2016;176(2):199-208.

https://doi.org/10.1001/jamainternmed.2015.7431

67. Huang R, Ning J, Chuter VH, Taylor JB, Christophe D, Meng Z, et al. Exercise alone and exercise combined with education both prevent episodes of low back pain and related absenteeism: systematic review and network meta-analysis of randomised controlled trials (RCTs) aimed at preventing back pain. British journal of sports medicine. 2020;54(13):766-70.

https://doi.org/10.1136/bjsports-2018-100035

68. Sowah D, Boyko R, Antle D, Miller L, Zakhary M, Straube S. Occupational interventions for the prevention of back pain: Overview of systematic reviews. Journal of safety research. 2018;66:39-59.

https://doi.org/10.1016/j.jsr.2018.05.007

69. Jay K, Brandt M, Hansen K, Sundstrup E, Jakobsen MD, Schraefel M, et al. Effect of individually tailored biopsychosocial workplace interventions on chronic musculoskeletal pain and stress among laboratory technicians: randomized controlled trial. Pain Physician. 2015;18(5):459-71.

http://dx.doi.org/10.1186/1471-2474-15-444

70. Storm V, Paech J, Ziegelmann JP, Lippke S. Physical exercise, sickness absence and subjective employability: an 8-year longitudinal observational study among musculoskeletal patients. Journal of rehabilitation medicine. 2016;48(6):541-6.

https://doi.org/10.2340/16501977-2103