Research Square

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Individual characteristics associated with low back pain in chiropractic students: A cross-sectional study

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Research Article

Keywords: chiropractic, students, low back pain, occupations, cross-sectional studies

Posted Date: July 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10271470/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

LBP is common among chiropractic students; however, little is known about its etiology. Therefore, we explored the association between individual characteristics and low back pain (LBP) in chiropractic students at the Canadian Memorial Chiropractic College (CMCC).

Methods

We conducted a cross-sectional study of all CMCC students from September to November 2017. Eligible participants were students aged 18 years and older, enrolled in year 1–4 of the chiropractic program. Individual characteristics included sociodemographic, lifestyle behaviours, and health-related factors. The outcomes were: 1) self-reported LBP in the past week, and 2) LBP ≥3/10 on the 11-point Numeric Rating Scale. We used univariable modified Poisson regression to explore the association between characteristics and stated outcomes in the entire sample and stratified by gender.

Results

Our sample included 510 participants (67% response rate), with a mean age of 24.6 years (SD 2.8) and 60% women. Sixty-nine percent reported LBP in the past week and 47.4% had LBP ≥3/10 in intensity. Sociodemographic characteristics associated with LBP of any intensity included women, second year of studies, and the number of paid work hours per week. Lifestyle behaviours associated with LBP of any intensity included poor to fair sedentary behaviour and longer commute times to the college. Health-related factors associated with LBP of any intensity were symptoms of psychological distress, functional limitations related to psychological symptoms, neck pain, poor sleep quality, and low student satisfaction, with stronger associations observed with LBP ≥3/10. Gender-stratified analysis showed slight variations in these associations.

Conclusion

Our study provides preliminary evidence on factors associated with LBP in Canadian chiropractic students, informing future studies investigating LBP in this population.

BACKGROUND

Globally, low back pain (LBP) is the leading cause of years lived with disability, and it commonly affects younger adults [1]. In 2019, LBP ranked as the 7th leading cause of disability adjusted life years (DALYs) in people between the ages 10–24 years and the 4th leading cause in those between ages 25–49 years [2]. Post-secondary students in healthcare programs, such as health sciences, physiotherapy, medical,

and nursing report a high prevalence of LBP [3–5]. A systematic review found that nursing and medical students had a 12-month prevalence of 44% (95% CI 27–61%) and 53% (95% CI 44–62%), respectively [3]. The review identified moderate to strong quality evidence that final year of study, presence of anxiety or psychological distress, and female sex were associated with prevalent LBP [3]. Similarly, a cross-sectional study of physiotherapy students in Australia found that length of program of study (> two years), ages 20–21 years, sedentary behaviour, and treating patients were associated with prevalent LBP[4] Treating patients was also found to be a factor associated with LBP in physiotherapy students in Nigeria [6]. Overall, the evidence suggests that lifestyle behaviours, psychological, and sociodemographic factors are associated with LBP in these healthcare students. However, little is known about the epidemiology of LBP in chiropractic students.

Chiropractic students train to become healthcare professionals who manage musculoskeletal disorders [7]. A recent systematic review examining the epidemiology of LBP in chiropractors and chiropractic students found limited high-quality evidence addressing this population [8]. One high-quality cross-sectional study conducted among chiropractic students in Canada, found a one-week prevalence of LBP of 69%, with a higher prevalence observed in females [9]. These students commonly reported sedentary behaviour, poor sleep quality and symptoms of psychological distress [9, 10]. These findings underscore the burden of LBP in this population and highlight potential biopsychosocial factors such as health-related, sociodemographic, and lifestyle behaviour characteristics that could contribute to LBP. In this systematic review, nine studies were excluded from the synthesis due to high risk of bias [8]. Additionally, no studies were identified that investigated incidence, risk factors, or factors associated with LBP, highlighting an important gap in the literature [8].

Currently, there is limited evidence on the factors associated with LBP among chiropractic students. Therefore, we investigated whether a range of individual characteristics, including sociodemographic, lifestyle behaviours, and health-related factors are associated with self-reported LBP (any intensity, and ≥3/10 on the 11-point Numeric Rating Scale) among undergraduate students enrolled at the Canadian Memorial Chiropractic College (CMCC) in 2017. We also examined whether the associations differed by gender.

METHODS

Study Design

We conducted a secondary analysis of data from the CMCC / Ontario Tech University (OTU) (previously University of Ontario Institute of Technology) Mental Health and Wellness Study [10–12]. This cross-sectional study included chiropractic students enrolled at CMCC in the fall of 2017. The reporting of this study complies with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement for cross-sectional studies [13]. Our secondary analysis was approved by the Research Ethics Boards (REB) at CMCC (#232006) and at the University of Toronto (#45802). The OTU / CMCC Mental

Health and Wellness Study was originally approved by CMCC REB (#1709B03) and University of Ontario Institute of Technology REB (#14515) in 2017.

Study Setting

The CMCC program is a four-year second entry honours baccalaureate chiropractic degree program delivered in Toronto, Ontario [14]. This program is the only English-speaking chiropractic program in Canada, and as such, students from across the country attend CMCC [15]. Years I and II build foundational knowledge in basic sciences and provide hands-on training in chiropractic technique, diagnosis, and orthopedics. Year III integrates the acquired knowledge into case-based material while continuing to develop manual therapy and other techniques. Year IV is a 12-month clinical internship where interns provide patient care under the supervision of a licensed chiropractor, and complete laboratory and advanced imaging clerkships.

Study Sample

Undergraduate students aged 18 years and older enrolled at CMCC in 2017 were eligible to participate in the study. Participants were recruited via two different methods based on their year of study. Participants in Years I to III were recruited during mandatory classes between October 31 and November 2, 2017. Fourth year interns were recruited during clinic rounds between September 30 and October 4, 2017. Recruitment was augmented through Facebook posts, informational posters throughout the institution, and a post in the school newsletter. Students who missed class were able to participate until November 13, 2017.

Data Collection

Eligible students accessed the questionnaire and the informed consent form through their online course portal (KIRO) using an electronic device (laptop, cell phone, or tablet). Students were informed of the purpose of the study and potential risks and benefits of participating, and students were informed they could withdraw at any point in time. Prior to administering the questionnaire, an investigator explained the study to the students using a standardized script. Clinicians and course instructors were not present during the data collection. Participation was voluntary, and students were allowed to complete the survey in-class or outside of class. The survey was open until November 13, 2017. At the end of the survey, students were provided with the CMCC school counselor’s contact information if they felt they needed support.

Study Questionnaire and Characteristics of Interest

The study questionnaire included self-reported instruments on socio-demographics, comorbidities, psychological distress, physical activity and sedentary behaviour, food security, substance use, sleep quality, and neck and low back pain (see Additional File 1). The lead author (LE) linked all the instrument constructs to the International Classification of Functioning, Disability and Health (ICF) categories using the ICF Linking Rules (see Table 1) [16]. This was done to determine how the collected characteristics map onto the biopsychosocial model [17]. Neck pain, sleep quality, and symptoms of psychological distress were mapped to 'Body Functions'. Physical activity and sedentary behaviour, paid work hours, number of dependents, marital status, functional limitations related to psychological symptoms, and food security were mapped to 'Activities and Participation'. Commute time to university and social support were mapped to 'Environment'. Finally, student satisfaction, self-reported morbidity, substance use, age, gender, study year, personal/household annual income, and living arrangement were mapped to 'Personal Factors'.

Table 1
Questionnaire constructs linked to the ICF model using the ICF Linking Rules.

Questionnaires	Instrument Construct	ICF Code	ICF Category
Questions adapted from Statistics Canada [18]	Sociodemographic characteristics	PF; D7700; D7701; D850; D7600; E215	Personal factors; Activity and Participation; Environment
Question adapted from Statistics Canada, Canadian Community Health Survey [18]	Self-reported comorbidities	PF	Personal factors
Depression Anxiety Stress Scale-21 [19]	Psychological distress	B152	Body functions
Physical Activity and Sedentary Behaviour Questionnaire [23]	Physical activity and sedentary behaviour	D455; D920; D4153; D5701	Activities and Participation
Household Food Security Survey Model [26]	Food security	D6200	Activities and Participation
Alcohol, Smoking, and Substance Involvement Screening Test [28]	Substance use	PF	Personal factor
Pittsburgh Sleep Quality Index [30]	Sleep quality	B1343	Body functions
Numeric Rating Scale [38]	Pain intensity	B28013	Body functions
Social Provisions Scale [35]	Social Support	E310-E315; E320; E325	Environmental factor
Student University Satisfaction Scale [34]	Student Satisfaction	PF	Personal Factor
World Health Organization's Model Disability Survey [36]	Functional limitations with psychological symptoms	D240	Activities and Participation

Note. ICF, International Classification of Functioning; *PF*, personal factors; *B1343*, quality of sleep; *B152*, emotional functions; *B28013*, pain in back; *D240*, handling stress and other psychological demands; *D4153*, maintaining a sitting position; *D455*, moving around; *D5701*, managing diet and fitness; *D6200*, shopping; *D7600*, parent-child relationships; *D7700*, romantic relationships; *d7701*, spousal relationships; *D850*, remunerative employment; *D920*, recreation and leisure; *E215*: population; *E310*, immediate family; *E315*, extended family; *E320*, friends; *E325*, acquaintances, peers, colleagues, neighbours, and community members.

Sociodemographic characteristics and comorbidities. Socio-demographics and comorbidities were collected using questions developed by Statistics Canada for the Canadian Community Health Survey (CCHS) [18]. The CCHS collects information on health status, health care utilization, and health determinants from a nationally representative sample of Canadians aged 12 years and older living in

private dwellings in all provinces and territories. Information was collected on gender, age, marital status, living arrangement, number of dependents, year of study, self-reported medical conditions, personal annual income, commute time to university, and paid hours of work per week. A question on comorbidities from the CCHS was used to determine self-reported diagnosed health conditions (see Additional File 1). Participants were asked to indicate the gender they identify with, with response options including 'male', 'female', 'transgender male', 'transgender female', 'genderqueer (or gender fluid, or non-binary gender), or other. We acknowledge that use of terms 'male' and 'female' for gender from the original survey conflate sex and gender and is not inclusive. Therefore, hereafter, we use 'men' and 'women' when referring to 'male' and 'female', respectively.

Psychological distress. Psychological distress was measured using the Depression Anxiety Stress Scale-21 (DASS-21) [19]. This tool measures symptoms of anxiety, stress, and depression over the past week in non-clinical populations. Scores for depression, anxiety, and stress can be classified into normal, mild, moderate, severe, and extremely severe. For the purposes of this study, individuals were classified as follows: normal (depression: 0–9, anxiety: 0–7, stress: 0–14), mild-to-moderate (depression: 10–20, anxiety: 8–14, stress: 15–25), and severe-to-extremely severe (depression: ≥21, anxiety: ≥15, stress: ≥26). The DASS-21 has been found to have adequate psychometric properties in a variety of populations [20–22]. Specifically, it is reported that the tool has adequate reliability, internal consistency, and discriminative, concurrent and convergent validity in medical students in Nigeria [22].

Physical activity and sedentary behaviour. Physical activity and sedentary behaviour were measured by the Physical Activity and Sedentary Behaviour Questionnaire (PASB-Q) [23]. This instrument measures the average frequency and duration of moderate-to-vigorous aerobic training, strength training, and sedentary behaviour (time spent sitting) in one week. The PASB-Q is scored and separated into five categories: poor, fair, good, very good, and excellent [23]. For our purpose, we categorized responses into one of three categories for each of the three constructs (aerobic activity, sedentary behaviour, and strength activity): 1) 'poor to fair', 2) 'good', and 3) 'very good to excellent'. The PASB-Q has adequate reliability and validity for measuring aerobic activity in university students [24, 25].

Food security. Food security was measured using the short-form Household Food Security Survey Model (HFSSM) [26]. This tool includes six-items that measure food security status in the past 12-months. Participants can be classified into food secure, marginally food insecure, moderately food insecure and severely food insecure. Due to the low prevalence of food insecurity in this population, we categorized individuals as 'food secure (sum score 0 or 1)' and 'food insecure (sum score 2 to 6)'. The HFSSM has good validity and reliability when used in the United States and Canada to measure food insecurity [27].

Substance use. Substance use was measured with the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) [28]. The ASSIST collects information on lifetime and past 3-month use of tobacco, alcohol, cannabis, cocaine, amphetamine-type stimulants, inhalants, sedatives, hallucinogens, and opioids. This tool provides a score for each substance, which is categorized as low, moderate, and high risk of substance dependence. ASSIST has shown good psychometric properties in university

students [29]. In our study, we used the ASSIST to determine whether participants used alcohol, marijuana, and tobacco in the past three months. Those who reported 'never' were categorized as 'no', while those who reported responses ranging from 'once or twice' to 'daily' were categorized as 'yes'.

Sleep quality. Sleep quality was measured by the Pittsburgh Sleep Quality Index (PSQI) [30]. The PSQI measures seven self-reported constructs of sleep quality in the past month: sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The total PSQI score ranges from 0 (better quality) to 21 (worse quality) and participants who scored 0–5 were considered as having 'good sleep quality', while those scoring ≥6 had 'poor sleep quality' [30]. The PSQI has acceptable reliability and validity in university students [31, 32].

Neck pain. The neck region was defined using a body diagram that defined neck pain as pain between the superior nuchal line and the spine of the scapula [33]. Self-reported neck pain was identified from the question: "In the past 7 days, have you experienced any pain in your neck?", categorized as 'yes' or 'no'.

Satisfaction with learning environment and social support. Student satisfaction with the learning environment was measured using two questions from the Student University Satisfaction Scale: 1) "I find university's learning environment conducive" and 2) "I find academic policies of my university student friendly" with responses including never, sometimes, and always [34]. Social support was measured using two questions from the Social Provisions Scale: 1) "I have close relationships that make me feel good" and 2) "There is no one I feel comfortable talking about my problems with" with responses including strongly disagree, disagree, agree, and strongly agree [35]. In our analysis, these were categorized as 'strongly disagree/disagree' versus 'strongly agree/agree'.

Functional limitations related to psychological symptoms. Functional limitations related to psychological symptoms were measured using four questions from the World Health Organization's Model Disability Survey (WHO-MDS) [36]. Three questions asked participants how much of a problem they have with feelings of depression, anxiety, and stress during the last 30 days. One question asked participants how much of a problem is coping with their tasks during the last 30 days. Participants responded on a scale ranging from '1 = no problem' to '5 = extreme problem'. For our purpose, we categorized this as 'no problem', 'mild-to-moderate problem', and 'severe-to-extreme problem'.

Outcome

The outcomes were: 1) self-reported LBP in the past week (objective 1), and 2) self-reported LBP in the past week with ≥3/10 on the 11-point NRS (objective 2). The lower back was defined as the region between the lower costal margin and the buttock creases [37]. LBP intensity was assessed using the 11-point NRS [38], the scale ranging from 0 meaning no pain and 10 being worst pain imaginable. The 11-point NRS has good psychometric properties for measuring pain intensity in a variety of pain conditions [39]. The tool has been recommended as a single-item instrument to measure pain intensity in the low back [40, 41]. We chose a cut point of ≥3/10 for our secondary outcome because it is greater than the minimal important change of 2 for the 11-point NRS and is considered clinically important [42]. Self-

reported LBP was identified from the question: “In the past 7 days, have you experienced any pain in your low back?”. Individuals who reported yes to this question was classified as having LBP and these respondents were then asked to rate the intensity of their average LBP over the past 7 days on the 11-point NRS.

Data Analysis

The distributions of the variables used in this study were explored using descriptive statistics. Continuous variables were described as means and standard deviations (SD), while categorical variables were described as frequencies and percentages. The associations between the individual characteristics and self-reported LBP (or LBP ≥ 3/10 pain intensity) were assessed using univariable modified Poisson regression with robust error variance. We reported associations as prevalence ratios (PR) and 95% confidence intervals (CI). We emphasized associations with characteristics that had a crude PR < 0.91 or > 1.10. We selected this conservative cut off point based on the observation that as the crude PR for a variable approaches a PR of 1, it is more likely that biases and random error accounted for the computed PRs. We built univariable models to compute the bivariate associations between each covariate and any self-reported LBP or LBP rated as ≥3/10 pain intensity as separate models. All analyses were stratified by gender to explore the impact of these variables on the association between sociodemographic factors, lifestyle behaviours, and health-related factors and LBP. We did not use imputation for missing data, as missingness was minimal (< 3% for 7 variables), and full details are provided in the tables. SAS™ software (version 9.4, SAS Institute Inc. 2024. Cary, NC, USA) was used to conduct the statistical analysis.

Participation Bias

We used de-identified demographic data (age, gender, and year of study) routinely collected on all CMCC students upon entering their year of study to evaluate participation bias. We compared the proportions of each demographic variable by visually inspecting the respondents and comparing them to those of the source population to assess participation bias.

Sensitivity Analysis

We performed a sensitivity analysis with the univariable models for each outcome to assess if models were sensitive to potentially misclassified cases. There were five respondents who reported no LBP but responded to the 11-point NRS. We removed potentially misclassified cases from the sample and tested the crude associations. If no significant differences in the point estimates were seen, the potentially misclassified cases were kept in the sample.

Protocol Deviation

Our protocol proposed to conduct multivariable models and stratifying results by year of study. We instead reported only crude associations. This decision was made to avoid potential misinterpretation of

our findings and due to small cell sizes, that introduced greater uncertainty in the point estimates. Further details of the protocol deviation are provided in Additional File 2.

RESULTS

Sample Characteristics (Table 2 and Table 3)

Table 2
Sample characteristics of chiropractic students at the Canadian Memorial Chiropractic College in 2017 and characteristics of those with and without any LBP.

Characteristics, n (%)	**CMCC Student Population (N = 766)**	**Participants (n = 510)**	**Participants with LBP (n = 352)**	**Participants without LBP (n = 158)**
Sociodemographic				
Age, mean (SD)	25	24.6 (2.8)	24.6 (3.0)	24.4 (2.2)
Gender				
Woman	424 (55.4)	306 (60.0)	222 (63.1)	84 (53.2)
Man	-	203 (39.8)	130 (36.9)	73 (46.2)
Other	-	1 (0.2)	--	1 (0.6)
Study year				
1	199 (26.0)	131 (25.7)	82 (23.3)	49 (31.0)
2	190 (24.8)	137 (26.9)	102 (29.0)	35 (22.2)
3	186 (24.3)	149 (29.2)	106 (30.1)	43 (27.2)
4	191 (24.9)	93 (18.2)	62 (17.6)	31 (19.6)
Marital Status				
Single (single, separated, divorced, or widowed)		451 (88.4)	312 (88.6)	139 (88.0)
Married/common law		59 (11.6)	40 (11.4)	19 (12.0)
Personal annual income				
$0–4,999		311 (61.0)	212 (60.2)	99 (62.7)
$5,000–9,999		129 (25.3)	88 (25.0)	41 (25.9)
≥ $10,000		67 (13.1)	49 (13.9)	18 (11.4)
No response		3 (0.6)	3 (0.9)	0 (0)
Paid work hours per week				
0 hours		263 (51.6)	167 (47.4)	96 (60.8)
1–9 hours		171 (33.5)	132 (37.5)	39 (24.7)

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	CMCC Student Population (N = 766)	Participants (n = 510)	Participants with LBP (n = 352)	Participants without LBP (n = 158)
Sociodemographic				
≥ 10 hours		76 (14.9)	53 (15.1)	23 (14.6)
Number of dependents				
0		457 (89.6)	316 (89.8)	141 (89.2)
≥ 1		53 (10.4)	36 (10.2)	17 (10.8)
Food security				
Food secure		478 (93.7)	330 (93.8)	148 (93.7)
Food insecure		32 (6.3)	22 (6.3)	10 (6.3)
Living arrangement				
Living with relatives/partner		225 (44.1)	154 (43.8)	71 (44.9)
Living with non-relatives		210 (41.2)	143 (40.6)	67 (42.4)
Living alone		54 (10.6)	40 (11.4)	14 (8.9)
Multiple arrangements		21 (4.1)	15 (4.3)	6 (3.8)
Lifestyle Behaviours				
Commute time to college				
< 15 minutes		258 (50.6)	175 (49.7)	83 (52.5)
15–29 minutes		113 (22.2)	81 (23.0)	32 (20.3)
30 – 44 minutes		56 (11.0)	45 (12.8)	11 (7.0)
≥ 45 minutes		83 (16.3)	51 (14.5)	32 (20.3)
Aerobic physical activity				
Excellent to Very Good (≥ 225 min/week)		186 (36.5)	133 (37.8)	53 (33.5)
Good (150–224 min/week)		84 (16.5)	53 (15.1)	31 (19.6)
Poor to Fair (< 150 mins/week)		228 (44.7)	157 (44.6)	71 (44.9)

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	CMCC Student Population (N = 766)	Participants (n = 510)	Participants with LBP (n = 352)	Participants without LBP (n = 158)
Sociodemographic				
No response		12 (2.4)	9 (2.6)	3 (1.9)
Strengthening physical activity				
Excellent to Very Good (3-4x/week)		312 (61.2)	216 (61.4)	96 (60.8)
Good (2x/week)		93 (18.2)	58 (16.5)	35 (22.2)
Poor to Fair (0-1x/week)		102 (20.0)	76 (21.6)	26 (16.5)
No response		3 (0.6)	2 (0.6)	1 (0.6)
Sedentary behaviour				
Excellent to Very Good (0–4 hrs/day)		92 (18.0)	56 (16.2)	35 (22.2)
Good (5–6 hrs/day)		151 (29.6)	103 (29.3)	48 (30.4)
Poor to Fair (≥ 7 hrs/day)		267 (52.4)	192 (54.5)	75 (47.5)
Substance Use				
3-month tobacco use				
Yes		92 (18.0)	60 (17.0)	32 (20.3)
No		418 (82.0)	292 (83.0)	126 (79.7)
3-month alcohol use				
Yes		464 (91.0)	323 (91.8)	141 (89.2)
No		46 (9.0)	29 (8.2)	17 (10.8)
3-month marijuana use				
Yes		169 (33.1)	110 (31.3)	59 (37.3)
No		341 (66.9)	242 (68.8)	99 (62.7)
Health-related				

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	CMCC Student Population (N = 766)	Participants (n = 510)	Participants with LBP (n = 352)	Participants without LBP (n = 158)
Sociodemographic				
Diagnosed medical condition				
Yes		238 (46.7)	176 (50.0)	62 (39.2)
No		272 (53.3)	176 (50.0)	96 (60.8)
Neck pain				
Yes		390 (76.5)	286 (81.3)	104 (65.8)
No		120 (23.5)	66 (18.8)	54 (34.2)
Sleep quality				
Good		164 (32.2)	98 (27.8)	66 (41.8)
Poor		346 (67.8)	254 (72.2)	92 (58.2)
Symptoms of depression				
None		341 (66.9)	227 (64.5)	114 (72.2)
Mild-to-moderate		137 (26.9)	99 (28.1)	38 (24.1)
Severe-to-extremely severe		32 (6.3)	26 (7.4)	6 (3.8)
Symptoms of anxiety				
None		301 (59.0)	193 (54.8)	108 (68.4)
Mild-to-moderate		138 (27.1)	101 (28.7)	37 (23.4)
Severe-to-extremely severe		71 (13.9)	58 (16.5)	13 (8.2)
Symptoms of stress				
None		323 (63.3)	209 (59.4)	114 (72.2)
Mild-to-moderate		148 (29.0)	112 (31.8)	36 (22.8)
Severe-to-extremely severe		39 (7.6)	31 (8.8)	8 (5.1)
Problems related to symptoms of depression				
No		172 (33.7)	106 (30.1)	66 (41.8)

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	CMCC Student Population (N = 766)	Participants (n = 510)	Participants with LBP (n = 352)	Participants without LBP (n = 158)
Sociodemographic				
Mild-Moderate		266 (52.2)	195 (55.4)	71 (44.9)
Severe-Extreme		172 (33.7)	106 (30.1)	66 (41.8)
Missing		6 (1.2)	4 (1.1)	2 (1.3)
Problems related to symptoms of anxiety				
No		87 (17.1)	41 (11.6)	46 (29.1)
Mild-Moderate		290 (56.9)	212 (60.2)	78 (49.4)
Severe-Extreme		127 (24.9)	97 (27.6)	30 (19.0)
Missing		6 (1.2)	2 (0.6)	4 (2.5)
Problems related to symptoms of stress				
No		98 (19.2)	57 (16.2)	41 (25.9)
Mild-Moderate		325 (63.7)	235 (66.8)	90 (57.0)
Severe-Extreme		84 (16.5)	59 (16.8)	25 (15.8)
Missing		3 (0.6)	1 (0.3)	2 (1.3)
Problems with coping with tasks				
No		86 (16.9)	48 (13.6)	38 (24.1)
Mild-Moderate		333 (65.3)	234 (66.5)	99 (62.7)
Severe-Extreme		90 (17.6)	70 (19.9)	20 (12.7)
Missing		1 (0.2)	--	1 (0.6)
I have close relationships that make me feel good				
Strongly agree/agree		477 (93.5)	333 (94.6)	144 (91.1)
Strongly disagree/disagree		33 (6.5)	19 (5.4)	14 (8.9)

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	CMCC Student Population (N = 766)	Participants (n = 510)	Participants with LBP (n = 352)	Participants without LBP (n = 158)
Sociodemographic				
There is no one I feel comfortable talking about my problems with				
Strongly agree/agree		60 (11.8)	39 (11.1)	21 (13.3)
Strongly disagree/disagree		450 (88.2)	313 (88.9)	137 (86.7)
I found the learning environment conducive				
Never		16 (3.1)	10 (2.8)	6 (3.8)
Sometimes		348 (68.2)	247 (70.2)	101 (63.9)
Always		146 (28.6)	95 (27.0)	51 (32.3)
I find academic policies of my university student friendly				
Never		31 (6.1)	22 (6.3)	9 (5.7)
Sometimes		301 (59.0)	217 (61.6)	84 (53.2)
Always		178 (34.9)	113 (32.1)	65 (41.1)

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Table 3
Sample characteristics between participants with LBP ≥3/10 and without LBP ≥3/10 at the Canadian Memorial Chiropractic College in 2017.

Characteristics, n (%)	**Participants with LBP ≥3/10 (n = 242)**	**Participants without LBP ≥3/10 (n = 268)**
Sociodemographic		
Age, mean (SD)	24.6 (2.9)	24.5 (2.7)
Gender		
Woman	157 (64.9)	149 (55.6)
Man	85 (35.1)	118 (44.0)
Other	--	1 (0.4)
Study year		
1	64 (26.4)	67 (25.0)
2	70 (28.9)	67 (25.0)
3	70 (28.9)	79 (29.5)
4	38 (15.7)	55 (20.5)
Marital Status		
Single (single/separated/divorced)	219 (90.5)	232 (86.6)
Married/common law	23 (9.5)	36 (13.4)
Personal annual income		
$0–4,999	141 (58.3)	170 (63.4)
$5,000–9,999	65 (26.9)	64 (23.9)
≥ $10,000	34 (14.0)	33 (12.3)
No response	2 (0.8)	1 (0.4)
Paid work hours per week		
0 hours	113 (46.7)	150 (56.0)
1–9 hours	91 (37.6)	80 (29.9)
≥ 10 hours	38 (15.7)	38 (14.2)

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	Participants with LBP ≥3/10 (n = 242)	Participants without LBP ≥3/10 (n = 268)
Sociodemographic		
Number of dependents		
0	214 (88.4)	243 (90.7)
≥ 1	28 (11.6)	25 (9.3)
Food security		
Food secure	223 (92.1)	255 (95.1)
Food insecure	19 (7.9)	13 (4.9)
Living arrangement		
Living with relatives/partner	111 (45.9)	114 (42.5)
Living with non-relatives	95 (39.3)	115 (42.9)
Living alone	23 (9.5)	31 (11.6)
Multiple arrangements	13 (5.4)	8 (3.0)
Lifestyle Behaviours		
Commute time to college		
< 15 minutes	117 (48.3)	141 (52.6)
15–29 minutes	56 (23.1)	57 (21.3)
30 – 44 minutes	30 (12.4)	26 (9.7)
≥ 45 minutes	39 (16.1)	44 (16.4)
Aerobic physical activity		
Excellent to Very Good (≥ 225 min/week)	89 (36.8)	97 (36.2)
Good (150–224 min/week)	32 (13.2)	52 (19.4)
Fair to Poor (< 150 mins/week)	112 (46.3)	116 (43.3)
No response	9 (3.7)	3 (1.1)
Strengthening activity		

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	Participants with LBP ≥3/10 (n = 242)	Participants without LBP ≥3/10 (n = 268)
Sociodemographic		
Excellent to Very Good (3-4x/week)	146 (60.3)	166 (61.9)
Good (2x/week)	44 (18.2)	49 (18.3)
Poor to Fair (0-1x/week)	50 (20.7)	52 (19.4)
No response	2 (0.8)	1 (0.4)
Sedentary behaviour		
Excellent to Very Good (0–4 hrs/day)	38 (15.7)	54 (20.1)
Good (5–6 hrs/day)	66 (27.3)	85 (31.7)
Poor to Fair (≥ 7 hrs/day)	138 (57.0)	129 (48.1)
Substance Use		
3-month tobacco use		
Yes	40 (16.5)	52 (19.4)
No	202 (83.5)	216 (80.6)
3-month alcohol use		
Yes	215 (88.8)	249 (92.9)
No	27 (11.2)	19 (7.1)
3-month marijuana use		
Yes	77 (31.8)	92 (34.3)
No	165 (68.2)	176 (65.7)
Health-Related		
Diagnosed medical condition		
Yes	127 (52.5)	111 (41.4)
No	115 (47.5)	157 (58.6)

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	Participants with LBP ≥3/10 (n = 242)	Participants without LBP ≥3/10 (n = 268)
Sociodemographic		
Neck pain		
Yes	196 (81.0)	194 (72.4)
No	46 (19.0)	74 (27.6)
Sleep quality		
Good	59 (24.4)	105 (39.2)
Poor	183 (75.6)	163 (60.8)
Symptoms of depression		
None	148 (61.2)	193 (72.0)
Mild-to-moderate	71 (29.3)	66 (24.6)
Severe-to-extremely severe	23 (9.5)	9 (3.4)
Symptoms of anxiety		
None	122 (50.4)	179 (66.8)
Mild-to-moderate	74 (30.6)	64 (23.9)
Severe-to-extremely severe	46 (19.0)	25 (9.3)
Symptoms of stress		
None	131 (54.1)	192 (71.6)
Mild-to-moderate	85 (35.1)	63 (23.5)
Severe-to-extremely severe	26 (10.7)	13 (4.9)
Problems related to symptoms of depression		
No	68 (28.1)	104 (38.8)
Mild-Moderate	129 (53.3)	137 (51.1)
Severe-Extreme	41 (16.9)	25 (9.3)
Missing	4 (1.7)	2 (0.7)
Problems related to symptoms of anxiety		

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	Participants with LBP ≥3/10 (n = 242)	Participants without LBP ≥3/10 (n = 268)
Sociodemographic		
No	22 (9.1)	65 (24.3)
Mild-Moderate	140 (57.9)	150 (56.0)
Severe-Extreme	78 (32.2)	49 (18.3)
Missing	2 (0.8)	4 (1.5)
Problems related to symptoms of stress		
No	31 (12.8)	67 (25.0)
Mild-Moderate	163 (67.4)	162 (60.4)
Severe-Extreme	47 (19.4)	37 (13.8)
Missing	1 (0.4)	2 (0.7)
Problems with coping with tasks		
No	29 (12.0)	57 (21.3)
Mild-Moderate	155 (64.0)	178 (66.4)
Severe-Extreme	58 (24.0)	32 (11.9)
Missing	--	1 (0.4)
I have close relationships that make me feel good		
Strongly agree/agree	224 (92.6)	253 (94.4)
Strongly disagree/disagree	18 (7.4)	15 (5.6)
There is no one I feel comfortable talking about my problems with		
Strongly agree/agree	33 (13.6)	27 (10.1)
Strongly disagree/disagree	209 (86.4)	241 (89.9)
I found the learning environment conducive		
Never	9 (3.7)	7 (2.6)
Sometimes	168 (69.4)	180 (67.2)

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

Characteristics, n (%)	Participants with LBP ≥3/10 (n = 242)	Participants without LBP ≥3/10 (n = 268)
Sociodemographic		
Always	65 (26.9)	81 (30.2)
I find academic policies of my university student friendly		
Never	19 (7.9)	12 (4.5)
Sometimes	146 (60.3)	155 (57.8)
Always	77 (31.8)	101 (37.7)

SD, standard deviation; *N*, number; *CMCC*, Canadian Memorial Chiropractic College; *LBP*, low back pain

The participation rate was 67% and our analysis included 510 participants. The sample was generally representative of the source population in terms of age, gender, and year of study, except there were slightly more women (60% versus 55%) and less Year 4 students in our sample (18% versus 25%) (Table 2).

The mean age of the sample was 24.6 years (SD 2.8) and 60.0% were women. Most participants were single (88.4%), had no dependents (89.6%), and reported a personal annual income of $0–4,999 (61.0%). Most did not smoke tobacco (82.0%) or marijuana (66.9%), but 91% consumed alcohol in the past three months. Most participants did not work (51.6%), reported commute time < 15 minutes (50.6%), and were food secure (93.7%). Many students had ‘very good to excellent’ levels of strengthening activity (61.2%), while 52.4% had sedentary behaviour that was categorized as ‘poor-to-fair’. Most individuals did not report symptoms of depression (66.9%), anxiety (59.0%), or stress (63.3%), but poor sleep quality was common (67.8%). Finally, 46.7% reported a diagnosed medical condition and 76.5% reported neck pain in the past week. Differences in characteristics are observed when comparing students with LBP and without LBP (see Table 2) and those with LBP ≥3/10 and without LBP ≥3/10 (see Table 3). The one-week prevalence of any LBP was 69.0% (95% CI 64.8, 73.0), and 47.4% (95% CI 43.1, 51.8) for LBP rated as ≥3/10 in intensity (see Table 4). Table 4 presents the prevalence stratified by gender and year of study.

Table 4
One-week prevalence of LBP among chiropractic students at the Canadian Memorial Chiropractic College in 2017 overall, by gender, and by year of study.

	Any LBP % (95% CI)	**LBP ≥3/10% (95% CI)**
Subgroup		
Overall	69.0 (64.8, 73.0)	47.4 (43.1, 51.8)
Gender		
Woman	72.6 (67.6, 77.6)	51.3 (45.7, 56.9)
Man	64.0 (57.4, 70.6)	41.9 (35.1, 48.7)
Study year		
1	62.6 (54.3, 70.9)	48.9 (40.3, 57.4)
2	74.5 (67.2, 81.8)	51.1 (42.7, 59.5)
3	71.1 (63.9, 78.4)	47.0 (39.0, 55.0)
4	66.7 (57.1, 76.3)	40.9 (30.9, 50.9)

LBP, low back pain.

Factors Associated with Any Low Back Pain

Overall Sample (Table 5)

Table 5
Crude associations between individual factors and any LBP or LBP ≥3/10 pain intensity among chiropractic students at the Canadian Memorial Chiropractic College in 2017.

Independent Variables	**Any LBP**	**LBP ≥ 3/10**
	Prevalence Ratios (95% CI)	
Body Functions		
Symptoms of Depression		
None (Ref)	--	
Mild-to-moderate	1.09 (0.96, 1.23)	1.19 (0.98, 1.46)
Severe-to-extremely severe	1.22 (1.02, 1.46)	1.66 (1.29, 2.12)
Symptoms of Anxiety		
None (Ref)	--	
Mild-to-moderate	1.14 (1.00, 1.30)	1.32 (1.08, 1.63)
Severe-to-extremely severe	1.27 (1.11, 1.46)	1.60 (1.28, 1.99)
Symptoms of Stress		
None (Ref)	--	
Mild-to-moderate	1.17 (1.04, 1.32)	1.42 (1.17, 1.72)
Severe-to-extremely severe	1.23 (1.03, 1.47)	1.64 (1.27, 2.13)
Neck Pain		
Yes	1.34 (1.12, 1.58)	1.31 (1.02, 1.68)
No (Ref)	--	
Sleep quality		
Poor	1.23 (1.07, 1.41)	1.47 (1.17, 1.85)
Good (Ref)	--	
Activities and Participation		
Problems related to symptoms of depression[∂]		
No (Ref)		

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: [∂] 6 due to missing values; [Φ] 6 due to missing values; [Φ]3 due to missing values; [θ]1 due to missing values; * 12 due to missing values; [δ] 3 due to missing values; [τ] 1 case categorized as 'other', considered as missing due to small cell size; [υ] 3 due to missing values.

Independent Variables	Any LBP	LBP ≥ 3/10
	Prevalence Ratios (95% CI)	
Body Functions		
Mild-Moderate	1.19 (1.04, 1.37)	1.23 (0.98, 1.53)
Severe-Extreme	1.16 (0.95, 1.40)	1.57 (1.21, 2.05)
Problems related to symptoms of anxiety[φ]		
No (Ref)	--	
Mild-Moderate	1.55 (1.23, 1.96)	1.91 (1.31, 2.79)
Severe-Extreme	1.62 (1.27, 2.07)	2.43 (1.65, 3.58)
Problems related to symptoms of stress[Φ]		
No (Ref)	--	
Mild-Moderate	1.24 (1.04, 1.49)	1.59 (1.16, 2.16)
Severe-Extreme	1.21 (0.97, 1.50)	1.77 (1.25, 2.50)
Problems with coping with tasks[θ]		
No (Ref)		
Mild-Moderate	1.26 (1.03, 1.54)	1.38 (1.00, 1.90)
Severe-Extreme	1.39 (1.12, 1.73)	1.91 (1.37, 2.67)
Aerobic Activity[*]		
Poor to Fair	0.96 (0.85, 1.09)	1.03 (0.84, 1.25)
Good	0.88 (0.73, 1.06)	0.79 (0.58, 1.09)
Excellent to Very Good (Ref)	--	
Sedentary Behaviour		
Poor to Fair	1.16 (0.97, 1.39)	1.25 (0.96, 1.64)
Good	1.10 (0.91, 1.34)	1.06 (0.78, 1.43)
Excellent to Very Good (Ref)	--	

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: [∂] 6 due to missing values; [φ] 6 due to missing values; [Φ]3 due to missing values; [θ]1 due to missing values; * 12 due to missing values; [δ] 3 due to missing values; [τ] 1 case categorized as 'other', considered as missing due to small cell size; [υ] 3 due to missing values.

Independent Variables	Any LBP	LBP ≥ 3/10
	Prevalence Ratios (95% CI)	
Body Functions		
Strengthening[δ]		
Poor to Fair	1.08 (0.94, 1.23)	1.05 (0.83, 1.32)
Good	0.90 (0.76, 1.07)	1.01 (0.79, 1.29)
Excellent to Very Good (Ref)	--	
Number of Dependent		
0 (Ref)	--	
≥ 1	0.98 (0.81, 1.20)	1.13 (0.86, 1.48)
Marital Status		
Single	1.02 (0.85, 1.23)	1.25 (0.89, 1.74)
Married/common law (Ref)	--	
Paid Work Hours		
0 hours (Ref)	--	
1–9 hours	1.22 (1.07, 1.37)	1.24 (1.02, 1.51)
≥ 10 hours	1.10 (0.92, 1.31)	1.16 (0.89, 1.52)
Food security		
Food insecure	1.00 (0.78, 1.27)	1.27 (0.94, 1.72)
Food secure (Ref)	--	
Environmental Factors		
Commute time		
< 15 minutes (Ref)	--	
15–29 minutes	1.06 (0.92, 1.22)	1.09 (0.87, 1.37)
30–44 minutes	1.18 (1.02, 1.38)	1.18 (0.89, 1.56)

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: [∂] 6 due to missing values; [φ] 6 due to missing values; [Φ]3 due to missing values; [θ]1 due to missing values; * 12 due to missing values; [δ] 3 due to missing values; [τ] 1 case categorized as 'other', considered as missing due to small cell size; [υ] 3 due to missing values.

Independent Variables	Any LBP	LBP ≥ 3/10
	Prevalence Ratios (95% CI)	
Body Functions		
≥ 45 minutes	0.91 (0.75, 1.10)	1.04 (0.80, 1.35)
I have close relationships that make me feel good		
Strongly agree/agree (Ref)	--	
Strongly disagree/disagree	0.82 (0.61, 1.11)	1.16 (0.83, 1.61)
There is no one I feel comfortable talking about my problems with		
Strongly agree/agree	0.93 (0.77, 1.14)	1.18 (0.92, 1.52)
Strongly disagree/disagree (Ref)	--	
Personal Factors		
Age	1.01 (0.99, 1.03)	1.00 (0.97, 1.04)
Gender[τ]		
Woman	1.13 (1.00, 1.28)	1.23 (1.01, 1.49)
Man (Ref)		
Study Year		
Year 1 (Ref)	--	
Year 2	1.19 (1.01, 1.40)	1.05 (0.82, 1.33)
Year 3	1.14 (0.96, 1.34)	0.96 (0.75, 1.23)
Year 4	1.06 (0.87, 1.30)	0.84 (0.62, 1.13)
Morbidity		
Yes	1.14 (1.02, 1.28)	1.26 (1.05, 1.52)
No (Ref)	--	
Substance use		
Tobacco		

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: [∂] 6 due to missing values; [φ] 6 due to missing values; [Φ]3 due to missing values; [θ]1 due to missing values; * 12 due to missing values; [δ] 3 due to missing values; [τ] 1 case categorized as 'other', considered as missing due to small cell size; [υ] 3 due to missing values.

Independent Variables	Any LBP	LBP ≥ 3/10
	Prevalence Ratios (95% CI)	
Body Functions		
Yes	0.93 (0.79, 1.10)	0.90 (0.70, 1.16)
No (Ref)	--	
Alcohol		
Yes	1.10 (0.88, 1.39)	0.79 (0.61, 1.03)
No (Ref)	--	
Marijuana		
Yes	0.92 (0.81, 1.04)	0.94 (0.77, 1.15)
No (Ref)	--	
Annual Personal Income[υ]		
$0–4,999	0.93 (0.79, 1.10)	0.89 (0.69, 1.17)
$5,000–9,999	0.93 (0.77, 1.12)	0.99 (0.74, 1.33)
≥$10,000 (Ref)	--	
Living Arrangement		
Non-Relative	0.99 (0.88, 1.13)	0.92 (0.75, 1.12)
Alone	1.08 (0.90, 1.30)	0.86 (0.62, 1.21)
Multiple Arrangements	1.04 (0.78, 1.39)	1.25 (0.87, 1.80)
Relative/Partner (Ref)	--	
I find academic policies of my university student friendly		
Never	1.12 (0.87, 1.44)	1.42 (1.02, 1.96)
Sometimes	1.14 (0.99, 1.30)	1.12 (0.91, 1.38)
Always (Ref)	--	
I find university's learning environment conducive		

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: [∂] 6 due to missing values; [φ] 6 due to missing values; [Φ]3 due to missing values; [θ]1 due to missing values; * 12 due to missing values; [δ] 3 due to missing values; [τ] 1 case categorized as 'other', considered as missing due to small cell size; [υ] 3 due to missing values.

Independent Variables	Any LBP	LBP ≥ 3/10
	Prevalence Ratios (95% CI)	
Body Functions		
Never	0.96 (0.65, 1.43)	1.26 (0.79, 2.02)
Sometimes	1.09 (0.95, 1.25)	1.08 (0.88, 1.34)
Always (Ref)	--	

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: [∂] 6 due to missing values; [Φ] 6 due to missing values; [Φ]3 due to missing values; [θ]1 due to missing values; * 12 due to missing values; [δ] 3 due to missing values; [τ] 1 case categorized as 'other', considered as missing due to small cell size; [υ] 3 due to missing values.

Body Functions

Based on univariable models, students who reported neck pain were more likely to report LBP. Students with poor sleep quality were more likely to report LBP compared to those with good sleep quality. For symptoms of depression, anxiety, or stress, there was a mild gradient of prevalence across categories with the highest PR seen in those with severe-to-extremely severe anxiety.

Activities and Participation

Students who reported functional problems related to depression, anxiety, stress, or coping with tasks, were more likely to report any LBP, with the highest PR among those with problems with anxiety. For physical activity levels, individuals with 'poor to fair' sedentary behaviour or strengthening activity were more likely to report LBP compared to those with 'very good to excellent'. Individuals with 'good' levels of aerobic or strengthening activity had a slightly lower prevalence of LBP compared to those with 'very good to excellent' levels. There was a mild gradient of prevalence across categories of sedentary behaviour, with the highest in those reporting 'poor to fair' levels of sedentary behaviour. Compared to no paid work hours, individuals who reported working were more likely to report LBP, with the highest PR seen in those working 1–9 hours per week.

Contextual Factors (environmental and personal factors)

Women were more likely to report LBP compared to men. For year of study, students in Year 2 reported the highest prevalence of LBP compared to students in Year 1. Compared to no self-reported morbidity, individuals who reported morbidity were more likely to report LBP. For substance-use, consumers of alcohol were more likely to report LBP compared to those who did not report consuming alcohol. For student satisfaction, those 'never' or 'sometimes' satisfied with academic policies were more likely to report LBP compared to those 'always' satisfied, with a higher PR in those reporting 'sometimes' satisfied. For social support, those who did not report close relationships that make them feel good were

less likely to have LBP compared to those who did report close relationships. Students who commuted 30–44 minutes to the college were more likely to report LBP compared to those who commute < 15 minutes. Gender-specific analyses showed slight differences in these associations (see Table 6).

Table 6
Crude associations for any LBP and LBP ≥3/10, stratified by gender among chiropractic students at the Canadian Memorial Chiropractic College in 2017.

	Any LBP		LBP ≥3/10	
	Women	Men	Women	Man
Independent Variables			**Prevalence Ratios (95% CI)**	
Body Functions				
Symptoms of Depression				
None (Ref)	--			
Mild-to-moderate	1.13 (0.97, 1.31)	1.01 (0.80, 1.27)	1.19 (0.93, 1.51)	1.21 (0.85, 1.72)
Severe-to-extremely severe	1.31 (1.10, 1.56)	1.05 (0.69, 1.59)	1.71 (1.31, 2.22)	1.51 (0.90, 2.56)
Symptoms of Anxiety				
None (Ref)	--			
Mild-to-moderate	1.07 (0.91, 1.26)	1.25 (1.00, 1.56)	1.14 (0.89, 1.48)	1.66 (1.17, 2.36)
Severe-to-extremely severe	1.23 (1.05, 1.44)	1.30 (1.00, 1.70)	1.46 (1.13, 1.89)	1.81 (1.21, 2.72)
Symptoms of Stress				
None (Ref)	--			
Mild-to-moderate	1.14 (0.99, 1.32)	1.17 (0.94, 1.46)	1.37 (1.08, 1.73)	1.43 (1.02, 2.01)
Severe-to-extremely severe	1.21 (1.21, 1.47)	1.20 (0.81, 1.76)	1.64 (1.23, 2.19)	1.47 (0.82, 2.63)
Neck Pain				
Yes	1.21 (0.95, 1.53)	1.38 (1.08, 1.77)	1.18 (0.84, 1.65)	1.32 (0.91, 1.90)
No (Ref)	--			
Sleep quality				

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: 1 case as excluded from stratified analysis, 'other' due to cell count of 1; ∂ 6 due to missing values; φ 6 due to missing values; Φ3 due to missing values; θ1 due to missing values; * 12 due to missing values; δ 3 due to missing values; υ 3 due to missing values.

	Any LBP		LBP ≥3/10	
	Women	Men	Women	Man
Independent Variables		Prevalence Ratios (95% CI)		
Poor	1.14 (0.97, 1.35)	1.34 (1.05, 1.73)	1.39 (1.06, 1.82)	1.57 (1.05, 2.34)
Good (Ref)	--			
Activities and Participation				
Problems related to symptoms of depression[∂]				
No (Ref)				
Mild-Moderate	1.10 (0.93, 1.30)	1.30 (1.03, 1.64)	0.98 (0.75, 1.27)	1.68 (1.14, 2.48)
Severe-Extreme	1.11 (0.88, 1.39)	1.18 (0.84, 1.66)	1.37 (1.01, 1.85)	1.83 (1.13, 2.97)
Problems related to symptoms of anxiety[φ]				
No (Ref)				
Mild-Moderate	1.30 (0.95, 1.75)	1.79 (1.26, 2.54)	1.48 (0.92, 2.40)	2.32 (1.28, 4.20)
Severe-Extreme	1.37 (1.00, 1.86)	1.79 (1.21, 2.63)	1.76 (1.08, 2.87)	3.32 (1.80, 6.11)
Problems related to symptoms of stress[Φ]				
No (Ref)				
Mild-Moderate	1.15 (0.90, 1.48)	1.26 (0.97, 1.64)	1.51 (0.96, 2.39)	1.54 (0.99, 2.37)
Severe-Extreme	1.10 (0.82, 1.46)	1.26 (0.88, 1.79)	1.59 (0.97, 2.61)	1.90 (1.13, 3.19)
Problems with coping with tasks[θ]				
No (Ref)				

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: 1 case as excluded from stratified analysis, 'other' due to cell count of 1; [∂] 6 due to missing values; [φ] 6 due to missing values; [Φ]3 due to missing values; [θ]1 due to missing values; * 12 due to missing values; [δ] 3 due to missing values; [υ] 3 due to missing values.

	Any LBP		LBP ≥3/10	
	Women	Men	Women	Man
Independent Variables		Prevalence Ratios (95% CI)		
Mild-Moderate	1.22 (0.92, 1.62)	1.24 (0.93, 1.65)	1.47 (0.91, 2.36)	1.22 (0.79, 1.90)
Severe-Extreme	1.30 (0.95, 1.75)	1.47 (1.06, 2.04)	1.90 (1.16, 3.11)	1.89 (1.16, 3.07)
Aerobic Activity *				
Poor to Fair	1.00 (0.86, 1.17)	0.88 (0.71, 1.09)	1.06 (0.83, 1.37)	0.94 (0.68, 1.31)
Good	0.97 (0.79, 1.20)	0.70 (0.48, 1.03)	0.98 (0.70, 1.38)	0.43 (0.20, 0.90)
Excellent-Very Good (Ref)	--			
Sedentary Behaviour				
Poor to Fair	1.06 (0.86, 1.31)	1.13 (0.84, 1.51)	1.07 (0.76, 1.49)	1.31 (0.84, 2.03)
Good	0.91 (0.71, 1.16)	1.30 (0.98, 1.72)	0.86 (0.59, 1.27)	1.24 (0.78, 1.98)
Excellent-Very Good (Ref)	--			
Strengthening$^{\delta}$				
Poor to Fair	1.07 (0.91, 1.25)	1.05 (0.81, 1.36)	1.01 (0.77, 1.32)	1.06 (0.69, 1.61)
Good	0.87 (0.71, 1.07)	0.90 (0.63, 1.28)	0.95 (0.72, 1.26)	1.04 (0.63, 1.69)
Excellent-Very Good (Ref)	--			
Number of Dependents				
0 (Ref)	--			
≥ 1	1.04 (0.80, 1.35)	0.99 (0.75, 1.32)	1.40 (1.03, 1.91)	1.02 (0.66, 1.57)
Marital Status				

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: 1 case as excluded from stratified analysis, 'other' due to cell count of 1; $^{\partial}$ 6 due to missing values; $^{\varphi}$ 6 due to missing values; $^{\Phi}$3 due to missing values; $^{\theta}$1 due to missing values; * 12 due to missing values; $^{\delta}$ 3 due to missing values; $^{\upsilon}$ 3 due to missing values.

	Any LBP		LBP ≥3/10	
	Women	Men	Women	Man
Independent Variables		Prevalence Ratios (95% CI)		
Single	1.00 (0.80, 1.24)	1.05 (0.76, 1.45)	1.14 (0.77, 1.69)	1.41 (0.78, 2.58)
Married/Common Law (Ref)	--			
Paid Work Hours				
0 hours (Ref)	--			
1–9 hours	1.09 (0.94, 1.27)	1.44 (1.16, 1.79)	1.13 (0.89, 1.43)	1.45 (1.03, 2.05)
≥ 10 hours	0.99 (0.81, 1.22)	1.29 (0.94, 1.76)	1.07 (0.78, 1.46)	1.32 (0.81, 2.16)
Food security				
Food insecure	0.86 (0.61, 1.23)	1.22 (0.89, 1.67)	1.25 (0.87, 1.80)	1.31 (0.77, 2.23)
Food secure (Ref)	--			
Environmental Factors				
Commute time				
< 15 minutes (Ref)	--			
15–29 minutes	1.03 (0.86, 1.22)	1.10 (0.86, 1.40)	1.09 (0.83, 1.46)	1.07 (0.72, 1.58)
30–44 minutes	1.18 (0.98, 1.42)	1.19 (0.92, 1.56)	1.31 (0.95, 1.81)	1.01 (0.62, 1.66)
≥ 45 minutes	0.99 (0.80, 1.22)	0.79 (0.55, 1.13)	1.27 (0.95, 1.70)	0.70 (0.41, 1.21)
I have close relationships that make me feel good				
Strongly agree/agree (Ref)	--			
Strongly disagree/disagree	1.04 (0.77, 1.39)	0.62 (0.35, 1.11)	1.50 (1.11, 2.04)	0.83 (0.43, 1.62)

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: 1 case as excluded from stratified analysis, 'other' due to cell count of 1; [∂] 6 due to missing values; [Φ] 6 due to missing values; [Φ]3 due to missing values; [θ]1 due to missing values; * 12 due to missing values; [δ] 3 due to missing values; [υ] 3 due to missing values.

	Any LBP		LBP ≥3/10	
	Women	Men	Women	Man
Independent Variables		Prevalence Ratios (95% CI)		
There is no one I feel comfortable talking about my problems with				
Strongly agree/agree	0.91 (0.69, 1.20)	0.99 (1.75, 1.32)	1.17 (0.84, 1.64)	1.29 (0.88, 1.88)
Strongly disagree/disagree (Ref)	--			
Personal Factors				
Age	1.01 (0.99, 1.03)	1.01 (0.99, 1.03)	1.01 (0.98, 1.04)	0.98 (0.92, 1.05)
Study Year				
Year 1 (Ref)	--			
Year 2	1.15 (0.94, 1.40)	1.26 (0.95, 1.67)	0.86 (0.64, 1.16)	1.43 (0.95, 2.15)
Year 3	1.18 (0.97, 1.43)	1.07 (0.79, 1.46)	0.96 (0.73, 1.27)	0.95 (0.59, 1.53)
Year 4	1.02 (0.80, 1.30)	1.15 (0.83, 1.59)	0.81 (0.57, 1.16)	0.88 (0.51, 1.53)
Morbidity				
Yes	1.07 (0.93, 1.23)	1.25 (1.02, 1.53)	1.23 (0.98, 1.53)	1.28 (0.93, 1.76)
No (Ref)	--			
Substance use				
Tobacco				
Yes	0.95 (0.73, 1.24)	0.99 (0.79, 1.24)	1.05 (0.73, 1.53)	0.91 (0.64, 1.31)
No (Ref)	--			
Alcohol				

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: 1 case as excluded from stratified analysis, 'other' due to cell count of 1; ∂ 6 due to missing values; φ 6 due to missing values; Φ3 due to missing values; θ1 due to missing values; * 12 due to missing values; δ 3 due to missing values; υ 3 due to missing values.

	Any LBP		LBP ≥3/10	
	Women	Men	Women	Man
Independent Variables		Prevalence Ratios (95% CI)		
Yes	1.06 (0.82, 1.36)	1.23 (0.78, 1.95)	0.76 (0.57, 1.02)	0.88 (0.52, 1.50)
No (Ref)	--			
Marijuana				
Yes	1.00 (0.85, 1.17)	0.85 (0.69, 1.06)	1.10 (0.87, 1.39)	0.81 (0.58, 1.14)
No (Ref)	--			
Good (Ref)	--			
Annual Personal Income [υ]				
$0–4,999	0.87 (0.73, 1.03)	1.00 (0.74, 1.36)	0.73 (0.55, 0.96)	1.21 (0.72, 2.05)
$5,000–9,999	0.83 (0.67, 1.03)	1.09 (0.79, 1.50)	0.81 (0.59, 1.12)	1.35 (0.78, 2.35)
≥$10,000 (Ref)	--			
Living Arrangement				
Non-Relative	0.95 (0.81, 1.10)	1.06 (0.85, 1.33)	0.79 (0.62, 1.01)	1.17 (0.83, 1.65)
Alone	0.97 (0.76, 1.23)	1.27 (0.96, 1.68)	0.77 (0.51, 1.17)	1.05 (0.60, 1.84)
Multiple Arrangements	1.03 (0.78, 1.37)	0.82 (0.30, 2.22)	1.24 (0.88, 1.75)	0.64 (0.11, 3.56)
Relative/Partner (Ref)	--			
I find academic policies of my university student friendly				
Never	1.04 (0.76, 1.42)	1.26 (0.83, 1.92)	1.58 (1.11, 2.25)	1.16 (0.61, 2.23)

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: 1 case as excluded from stratified analysis, 'other' due to cell count of 1; [∂] 6 due to missing values; [Φ] 6 due to missing values; [Φ]3 due to missing values; [θ]1 due to missing values; * 12 due to missing values; [δ] 3 due to missing values; [υ] 3 due to missing values.

	Any LBP		LBP ≥3/10	
	Women	Men	Women	Man
Independent Variables			**Prevalence Ratios (95% CI)**	
Sometimes	1.07 (0.92, 1.25)	1.26 (0.99, 1.61)	1.15 (0.89, 1.47)	1.08 (0.76, 1.53)
Always (Ref)	--			
I find university's learning environment conducive				
Never	0.98 (0.60, 1.59)	0.93 (0.48, 1.82)	1.60 (0.94, 2.71)	0.90 (0.37, 2.19)
Sometimes	1.09 (0.92, 1.29)	1.08 (0.86, 1.35)	1.30 (0.97, 1.73)	0.81 (0.58, 1.13)
Always (Ref)	--			

LBP, low back pain; *Ref*, reference variable; *CI*, confidence interval. Missing cases: 1 case as excluded from stratified analysis, 'other' due to cell count of 1; ∂ 6 due to missing values; φ 6 due to missing values; Φ3 due to missing values; θ1 due to missing values; * 12 due to missing values; δ 3 due to missing values; υ 3 due to missing values.

Factors Associated with Low Back Pain ≥3/10

Overall Sample (Table 5)

Body Functions

Similar to the results for any LBP, those with neck pain had a higher prevalence of LBP ≥3/10; however, the magnitude of the association was larger than for any LBP. Students with poor sleep quality were more likely to report LBP ≥3/10, with a higher PR than for any LBP. Symptoms of depression, anxiety, and stress had a mild gradient of prevalence across categories with the highest PR in those with severe-to-extremely severe symptoms of depression.

Activities and Participation

Similar findings were found among functional limitations related to depression, anxiety, stress, and coping with tasks, with the highest PR in those with severe to extreme problems with anxiety. For physical activity, students with 'poor to fair' sedentary behaviours were more likely to report clinically important LBP compared to those with 'very good to excellent'. Compared to those with no dependents or who were married, those with ≥1 dependent or who were single were more likely to report LBP. Similar

to any LBP, those working were more likely to report LBP ≥3/10 with higher PRs. Students who reported food insecurity had a higher prevalence compared to those reporting food security.

Contextual Factors (environmental and personal factors)

Women were more likely to report LBP ≥3/10 compared to men. Students in Year 4 were less likely to report prevalence compared to those in Year 1. Similar to the results for any LBP, those with morbidity had a higher prevalence of LBP ≥3/10; however, the magnitude of the association was larger than for any LBP. Students who consumed alcohol and tobacco were less likely to report clinically important LBP. For annual personal income, those with a low income ($0–4,999) had a slightly lower prevalence compared to those ≥$10,000. Those with multiple arrangements were more likely to report LBP, compared to those living with their relative and/or partners, while those living alone were less likely to report LBP. For student satisfaction, those 'never' or 'sometimes' satisfied were more likely to report clinically important LBP with the highest PR among those 'never' satisfied with academic policies. Those indicating poor social support were more likely to report prevalence of LBP ≥3/10. Compared to those commuting < 15 minutes, students with longer commute times were more likely to report prevalent LBP ≥3/10 with the highest PR for those commuting 30–44 minutes. Gender-stratified analyses showed slight variations in these associations (see Table 6).

Results of the Sensitivity Analysis

The inclusion of potentially misclassified cases (n = 5) did not alter the results of the univariable associations (see Additional File 3). Therefore, we included them in the analysis as individuals with no LBP, as identified by the response to the LBP question.

DISCUSSION

Summary of Key Results

We identified lifestyle behaviour, sociodemographic, and health-related factors associated with LBP and LBP that was ≥3/10 on the 11-point NRS in chiropractic students in Canada. Women, students in Year 2, those with paid work hours, poor to fair sedentary behaviour, commute times between 30–44 minutes, symptoms or functional limitations due to psychological distress, neck pain, poor sleep quality, and low student satisfaction had the strongest associations with LBP regardless of intensity. Gender-stratified analysis showed slight differences, with symptoms of anxiety being the most strongly associated with LBP in both men and women.

Our findings align with results from previous studies on healthcare students, where female medical students were more likely to report LBP [3]. Gender-stratified results showed slight variations in associations, highlighting potential differences in etiology that warrant further investigation. Unlike prior studies on nursing, medical, and physiotherapy students where the final year of study was a risk factor for LBP [3, 4], we found second-year students more affected. This difference could be attributed to the

lower representation of fourth year students in our sample. However, a study reported that second year students at CMCC had the highest one-week prevalence of symptoms of anxiety and depression [10], indicating a need for further investigations into why second-year chiropractic students may experience higher LBP prevalence.

Our findings on sedentary behaviour and LBP are consistent with a study on physiotherapy students [4], reinforcing the known association between low physical activity levels and poorer general health and the higher risk for LBP chronicity [43, 44]. However, chiropractic students with good levels of aerobic activity were less likely to report LBP compared to those with very good or excellent levels. This finding aligns with a systematic review that found limited evidence that medical students who engage in regular exercise reported a higher 12-month LBP prevalence compared to those who did not engage in exercise [3]. Future cohort studies on chiropractic students investigating the incidence and risk factors of LBP could clarify the relationship between physical activity levels and LBP.

Consistent with a systematic review in nursing and medical students [3], psychological distress was strongly associated with LBP in our sample. Severe-to-extremely-severe symptoms of depression, anxiety, and stress, as well as functional limitations due to psychological symptoms, had the highest PRs associated with clinically important LBP. Academic demands, personal challenges (e.g., living alone, working side jobs), social isolation, and an unhealthy lifestyle (e.g., lack of sleep) may lead to symptoms of psychological distress, burnout, or emotional exhaustion in healthcare students [45–47]. CMCC students face similar stressors, such as poor sleep quality and working side jobs, that could contribute to symptoms of psychological distress, potentially also contributing to LBP. Further evaluation of the association between psychological distress and LBP in this population is warranted.

Our study highlights the multifactorial nature of LBP in chiropractic students. Our results provide preliminary insights into how body functions (e.g., psychological distress, sleep quality, neck pain), activities and participation (e.g., functional limitations related to psychological symptoms, sedentary behaviour, paid work hours), environmental factors (e.g., commute time to college and social support), and personal factors (e.g., age, gender, year of study) are associated with LBP in this population [17]. These biopsychosocial factors can influence chiropractic students' daily functioning with LBP and should be considered when developing future studies on mitigation strategies. However, as our analyses do not consider potential confounders, future research is needed to better understand the independent effects of these factors on LBP.

Strengths and Limitations

This study has strengths. First, the survey included instruments with good reliability and validity, thereby reducing measurement error and bias. Second, we used a standardized definition for our outcome, LBP, reducing misclassification bias. Third, we linked the instruments to the ICF to demonstrate that our survey captures functioning from a biopsychosocial perspective. Finally, the participation rate was moderately high at 67%, and the sample was generally representative of the source population in terms

of age, gender, and year of study, with the exception of women and fourth year students. This reduces, but does not eliminate, the likelihood of selection bias.

This study has limitations, which must be taken into consideration. Misclassification bias may have been present in this study as some respondents who identified no LBP responded to the 11-point NRS. However, sensitivity analyses revealed that the point estimates did not differ whether they were classified as having no LBP or excluding these cases (see Additional File 3). Second, a self-administered questionnaire can result in misinterpretation of questions introducing measurement error and bias. However, our questionnaire had good reliability and validity, which helps to reduce this bias. Additionally, respondents may have provided answers they perceived as socially acceptable introducing social desirability bias, potentially underrepresenting 'bad' behaviours and overrepresenting 'good' behaviours. Third, despite a 67% participation rate, our findings indicate that our sample might be less representative of fourth year students, which may contribute to an underestimation of LBP. Fourth year students at external clinics were not recruited in-person due to feasibility issues. However, they were recruited via the online recruitment methods. Furthermore, there was a slightly higher proportion of women participants, which may contribute to an overestimation of LBP. Finally, our study was cross-sectional in nature, and therefore, cannot infer a cause-and-effect relationship.

Implications and Future Research

This study identified certain sociodemographic characteristics, lifestyle behaviours, and health-related factors associated with LBP among chiropractic students, providing a preliminary understanding of the etiology of LBP in this student population. The findings may help CMCC administrators better understand the burden of LBP and affected groups of students. Higher-risk groups may include those with paid work hours per week, neck pain, morbidity, poor sleep quality, low satisfaction, and symptoms of psychological distress. These factors warrant close attention in future investigations. Future cohort studies should explore the incidence and risk factors of LBP in this population. Furthermore, our study provides evidence to generate hypotheses for future studies aiming to investigate prevention strategies for LBP in chiropractic students.

CONCLUSION

Our study provides preliminary findings to advance the study of the epidemiology of LBP in chiropractic students. We found that certain sociodemographic characteristics, lifestyle behaviours, and health-related factors were associated with LBP and LBP ≥3/10 on the 11-point NRS in chiropractic students. Based on our exploratory analysis, paid work hours, commute time to the college, neck pain, symptoms of psychological distress, and problems related to psychological symptoms had the strongest associations with any LBP. For LBP ≥3/10, associations were strongest among students reporting food insecurity, poor to fair sedentary behaviour, poor sleep quality, symptoms of psychological distress, and problems related to psychological symptoms. These findings can be used to inform future hypotheses for studies investigating risk factors of LBP in this population.

Abbreviations

ASSIST, Alcohol, Smoking, and Substance Involvement Screening Test

CCHS, Canadian Community Health Survey

CI, Confidence interval

CMCC, Canadian Memorial Chiropractic College

DALY, Disability adjusted life years

DASS-21, Depression Anxiety Stress Scale-21

HFSSM, Household Food Security Survey Model

ICF, International Classification of Functioning, Disability and Health

LBP, Low back pain

NRS, Numeric rating scale

OTU, Ontario Tech University

PASB-Q, Physical Activity and Sedentary Behaviour Questionnaire

PR, Prevalence ratio

PSQI, Pittsburgh Sleep Quality Index

REB, Research Ethics Board

SD, Standard deviation

STROBE, Strengthening the Reporting of Observational Studies in Epidemiology

WHO-MDS, World Health Organization's Model Disability Survey

Declarations

Ethics approval and consent to participate

The study was approved by the Research Ethics Boards at CMCC (#232006) and at the University of Toronto (#45802). The OTU / CMCC Mental Health and Wellness Study was originally approved by CMCC REB (#1709B03) and University of Ontario Institute of Technology REB (#14515) in 2017. Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Data Availability

The datasets generated and analyzed during the current study are not publicly available due to ethical restrictions but are available from the corresponding author on reasonable request.

Competing Interests

All authors declare that they have no competing interests.

Funding

This work was part of Lauren Ead's Master's thesis. She was supported by the Canada Graduate Scholarship – Master's from the Canadian Institutes of Health Research (CIHR) and a residency fellowship award from the Canadian Memorial Chiropractic College. Pierre Côté is supported by the Hann-Kelly Family Chair in Disability and Rehabilitation Research and the Ontario Tech University Research Excellence Chair in Musculoskeletal Rehabilitation. Jessica Wong is supported by a CIHR Research Excellence, Diversity, and Independence Early Career Transition Award. The funding organizations were not involved in the design, conduct, interpretation, or final review of the research project.

Author Contributions

LE, PC, JW, SHJ, and SM were involved in the conceptualization of the research question and methodology. The data analysis was completed by LE with support from SHJ. The interpretation was completed by LE, PC, JW, SHJ, and SM. The original draft of the manuscript was written by LE. All authors contributed to reviewing and editing the manuscript. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Acknowledgements

The authors are grateful for the residency fellowship award funded by the Canadian Memorial Chiropractic College, Ontario, Canada, to Dr. Lauren Ead. We would also like to thank the postsecondary students at CMCC for their support and participation in the study.

References

1. Wu A, March L, Zheng X, Huang J, Wang X, Zhao J, et al. Global low back pain prevalence and years lived with disability from 1990 to 2017: estimates from the Global Burden of Disease Study 2017. Ann Transl Med. 2020;8:299.

2. Vos T, Lim SS, Abbafati C, Abbas KM, Abbasi M, Abbasifard M, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet. 2020;396:1204–22.
3. Wong AYL, Chan LLY, Lo CWT, Chan WWY, Lam KCK, Bao JCH, et al. Prevalence/Incidence of Low Back Pain and Associated Risk Factors Among Nursing and Medical Students: A Systematic Review and Meta-Analysis. PM R. 2021;13:1266–80.
4. Nyland LJ, Grimmer KA. Is undergraduate physiotherapy study a risk factor for low back pain? A prevalence study of LBP in physiotherapy students. BMC Musculoskelet Disord. 2003;4:22.
5. AlShayhan FA, Saadeddin M. Prevalence of low back pain among health sciences students. Eur J Orthop Surg Traumatol. 2018;28:165–70.
6. Vincent-Onabajo GO, Nweze E, Kachalla Gujba F, Masta A, Ali MU, Modu AA et al. Prevalence of Low Back Pain among Undergraduate Physiotherapy Students in Nigeria. 2016; Available from: http://dx.doi.org/10.1155/2016/1230384
7. World Federation of Chiropractic. Definition of Chiropractic [Internet]. 2001. Available from: https://www.wfc.org/website/index.php?option=com_content&view=article&id=90&Itemid=110⟨=en
8. Ead L, Wong J, Hogg-Johnson S, Mior S, Plener J, Côté P. The epidemiology of low back pain in chiropractors and chiropractic students: a systematic review of the literature. Chiropr Man Th. 2024;32:36.
9. Campbell A, Wang D, Martin K, Côté P. The one-week prevalence of neck pain and low back pain in post-secondary students at two Canadian institutions. Chiropr Man Th. 2023;31:1–8.
10. Meckamalil C, Brodie L, Hogg-Johnson S, Carroll LJ, Jacobs C, Côté P. The prevalence of anxiety, stress and depressive symptoms in undergraduate students at the Canadian Memorial Chiropractic College. Journal of American College Health. 2022;70:371–6. Available from: https://doi.org/10.1080/07448481.2020.1751173
11. Hattangadi N, Vogel E, Carroll LJ, Côté P. Is Food Insecurity Associated with Psychological Distress in Undergraduate University Students? A Cross Sectional Study. J Hunger Environ Nutr. 2021;16:133–48. Available from: https://doi.org/10.1080/19320248.2019.1658679
12. Short M, Martin K, Livingston L, Côté P. Physical activity, sedentary behaviour and symptoms of anxiety in post-secondary students: A cross-sectional study of two faculties. Psychiatry Res Commun. 2021;1:100007.
13. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet. 2007;370:1453–7.
14. Canadian Memorial Chiropractic College. Doctor of Chiropractic Program [Internet]. 2022. Available from: https://cmcc.ca/academic-programs/doctor-of-chiropractic-program
15. Canadian Memorial Chiropractic College. About CMCC (Values, Vision, Educational Position) [Internet]. 2022. Available from: https://cmcc.ca/about-cmcc/about-cmcc

16. Cieza A, Fayed N, Bickenbach J, Prodinger B. Refinements of the ICF Linking Rules to strengthen their potential for establishing comparability of health information. Disabil Rehabil. 2019;41:574–83.
17. Üstün TB, Chatterji S, Bickenbach J, Kostanjsek N, Schneider M. The International Classification of Functioning, Disability and Health: a new tool for understanding disability and health. Disabil Rehabil. 2003;25:565–71.
18. Statistics Canada. Canadian Community Health Survey (CCHS) [Internet], Ottawa O. 2015. Available from: https://www23.statcan.gc.ca/imdb/p3Instr.pl?Function=assembleInstr&Item_Id=238890
19. Lovibond SH, Lovibond PF. Manual for the depression anxiety stress scales. 2nd ed. Sydney: Psychology Foundation of Australia; 1995.
20. Lee J, Lee EH, Moon SH. Systematic review of the measurement properties of the Depression Anxiety Stress Scales–21 by applying updated COSMIN methodology. Quality of Life Research. 2019;28:2325–39. Available from: https://doi.org/10.1007/s11136-019-02177-x
21. Gloster AT, Rhoades HM, Novy D, Klotsche J, Senior A, Kunik M, et al. Psychometric properties of the Depression Anxiety and Stress Scale-21 in older primary care patients. J Affect Disord. 2008;110:248–59.
22. Coker AO, Coker OO, Sanni D. Psychometric properties of the 21-item Depression Anxiety Stress Scale (DASS-21). Afr Res Rev. 2018;12:135.
23. Canadian Society for Exercise Physiology. Canadian society for exercise physiology-physical activity training for health (CSEP-PATH). 2013; Available from: https://scholar.google.com/scholar_lookup?title=Canadian Society for Exercise Physiology – Physical Activity Training for Health (CSEP-PATH)&author=Canadian Society of Exercise Physiology&publication_year = 2013.
24. Fowles JR, O'Brien MW, Wojcik WR, D'Entremont L, Shields CA. A pilot study: Validity and reliability of the CSEP-PATH PASB-Q and a new leisure time physical activity questionnaire to assess physical activity and sedentary behaviours. Appl Physiol Nutr Metab. 2017;42:677–80.
25. Sattler MC, Jaunig J, Tösch C, Watson ED, Mokkink LB, Dietz P, et al. Current Evidence of Measurement Properties of Physical Activity Questionnaires for Older Adults: An Updated Systematic Review. Sports Med. 2020;50:1271–315.
26. Bickel G, Nord M, Price C, Hamilton W, Cook J. Measuring Food Security in the United States Guide to Measuring Household Food Security Revised 2000. Available from: http://www.fns.usda.gov/oane
27. Marques ES, Reichenheim ME, de Moraes CL, Antunes MML, Salles-Costa R. Household food insecurity: a systematic review of the measuring instruments used in epidemiological studies. Public Health Nutr. 2015;18:877–92.
28. Humeniuk R, Ali R, Poznyak V, Monteiro M. The Alcohol Smoking and Substance Involvement Screening Test (ASSIST) Manual for use in Primary Care. World Health Organization. Geneva; 2010.
29. Tiburcio Sainz M, Rosete-Mohedano MG, Natera Rey G, Martínez Vélez NA, Carreño García S. Pérez Cisneros D. Validity and Reliability of the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) in University Students. Adicciones. 2016;28:19–27.

30. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28:193–213.
31. Manzar MD, Moiz JA, Zannat W, Spence DW, Pandi-Perumal SR, Bahammam AS, et al. Validity of the Pittsburgh sleep quality index in Indian university students. Oman Med J. 2015;30:193–202.
32. Dietch JR, Taylor DJ, Sethi K, Kelly K, Bramoweth AD, Roane BM. Psychometric evaluation of the PSQI in U.S. college students. J Clin Sleep Med. 2016;12:1121–9.
33. Guzman J, Hurwitz EL, Carroll LJ, Haldeman S, Côté P, Carragee EJ, et al. A new conceptual model of neck pain: Linking onset, course, and care: The Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders. Spine (Phila Pa 1976). 2008;33:14–23.
34. Hussain N, Bhamani S. Development of the Student University Satisfaction Scale: Reliability and Validity. Interdisciplinary J Contemp Res Bus. 2012;4:332–41.
35. Cutrona CE, Russell D. The provisions of social relationships and adaptation to stress. Adv Personal Relationships. 1987;37–67.
36. World Health Organization. World Bank. Model Disability Survey (MDS) survey manual. 2017.
37. Dionne CE, Dunn KM, Croft PR, Nachemson AL, Buchbinder R, Walker BF, et al. A consensus approach toward the standardization of back pain definitions for use in prevalence studies. Spine (Phila Pa 1976). 2008;33:95–103.
38. Downie WW, Leatham PA, Rhind VM, Wright V, Branco JA, Anderson JA. Studies with pain rating scales. Ann Rheum Dis. 1978;37:378–81.
39. Hjermstad MJ, Fayers PM, Haugen DF, Caraceni A, Hanks GW, Loge JH, et al. Studies comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for assessment of pain intensity in adults: a systematic literature review. J Pain Symptom Manage. 2011;41:1073–93.
40. Chiarotto A, Boers M, Deyo RA, Buchbinder R, Corbin TP, Costa LOP, et al. Core outcome measurement instruments for clinical trials in nonspecific low back pain. Pain. 2018;159:481–95.
41. Modarresi S, Lukacs MJ, Ghodrati M, Salim S, MacDermid JC, Walton DM, et al. A Systematic Review and Synthesis of Psychometric Properties of the Numeric Pain Rating Scale and the Visual Analog Scale for Use in People With Neck Pain. Clin J Pain. 2021;38:132–48.
42. Ostelo RWJG, Deyo RA, Stratford P, Waddell G, Croft P, Von Korff M, et al. Interpreting change scores for pain and functional status in low back pain: Towards international consensus regarding minimal important change. Spine (Phila Pa 1976). 2008;33:90–4.
43. Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, et al. What low back pain is and why we need to pay attention. Lancet. 2018;391:2356–67.
44. Shiri R, Falah-Hassani K. Does leisure time physical activity protect against low back pain? Systematic review and meta-analysis of 36 prospective cohort studies. Br J Sports Med. 2017;51:1410–8.
45. Dyrbye LN, Thomas MR, Huntington JL, Lawson KL, Novotny PJ, Sloan JA, et al. Personal life events and medical student burnout: a multicenter study. Acad Med. 2006;81:374–84.

46. Goebert D, Thompson D, Takeshita J, Beach C, Bryson P, Ephgrave K, et al. Depressive symptoms in medical students and residents: a multischool study. Acad Med. 2009;84:236–41.
47. Bergmann C, Muth T, Loerbroks A. Medical students' perceptions of stress due to academic studies and its interrelationships with other domains of life: a qualitative study. Med Educ Online. 2019;24:1603526.

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