Lifestyle Behaviours and Future Healthcare Utilisation for Musculoskeletal Pain in Young Adults: A Cohort Study of Norwegian University Students With Three-Year Follow-Up.

SMEDBRÅTEN, Kaja <http://orcid.org/0000-0002-9036-0709>, GROTLE, Margreth, HAGEN, Milada, SIVERTSEN, Børge, JAHRE, Henriette, RICHARDSEN, Kåre Rønn, PEAT, George <http://orcid.org/0000-0002-9008-0184>, SKILLGATE, Eva and ØIESTAD, Britt Elin

Lifestyle behaviours and future healthcare utilisation for musculoskeletal pain in young adults: A cohort study of Norwegian university students with three-year follow-up

Kaja Smedbråten[1], Margreth Grotle[2,3], Milada Hagen[4], Børge Sivertsen[5,6], Henriette Jahre[2], Kåre Rønn Richardsen[2], George Peat[7], Eva Skillgate[8,9], Britt Elin Øiestad[1]

[1] Department of Rehabilitation Science and Health Technology, Faculty of Health Sciences, Oslo Metropolitan University, Oslo, Norway;

[2] Centre for Intelligent Musculoskeletal Health, Department of Rehabilitation Science and Health Technology, Oslo Metropolitan University, Oslo, Norway

[3] Department of Research and Innovation, Division of Clinical Neuroscience, Oslo University Hospital, Oslo, Norway

[4] Department of Nursing and Health Promotion, Faculty of Health Sciences, Oslo Metropolitan University, Oslo, Norway

[5] Department of Health Promotion, Norwegian Institute of Public Health, Bergen, Norway

[6] Department of Research and Innovation, Helse Fonna HF, Haugesund, Norway

[7] Centre for Applied Health & Social Care Research, Sheffield Hallam University, Sheffield, United Kingdom

[8] Musculoskeletal & Sports Injury Epidemiology Center, Department of Health Promoting Science, Sophiahemmet University, Stockholm, Sweden

[9] Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden

Corresponding author:

Kaja Smedbråten, PT, PhD
Department of Rehabilitation Science and Health Technology, Faculty of Health Sciences
Oslo Metropolitan University

Phone: +47 91153536
E-mail: kasm@oslomet.no

ABSTRACT

Background: It is unclear whether lifestyle behaviours influence use of healthcare for musculoskeletal pain in young adults. This study examined if lifestyle behaviours among college/university students were associated with future healthcare utilisation for musculoskeletal pain.

Methods: Data from the Students' Health and Wellbeing Study (SHoT2018) were linked with the Norwegian Registry for Primary Health Care, comprising 31,358 college/university students. We analysed associations of physical activity level, sleep duration, alcohol consumption, smoking, illicit drug use, and cumulative adverse lifestyle behaviours, with healthcare utilisation for musculoskeletal pain over the following 3 years, including 'any use', 'high use' and for back and neck pain specifically.

Results: High physical activity levels, compared to recommended levels, were associated with higher risk of 'any' healthcare utilisation for musculoskeletal pain (females: RR 1.14, 99%CI [1.04-1.25]; males: RR 1.20, 99%CI [1.07-1.36]); below recommended physical activity levels were associated with lower risk (females: RR 0.90, 99%CI [0.85-0.96]; males: RR 0.84, 99%CI [0.76-0.93]). Illicit drug use was associated with lower risk of healthcare utilisation for neck pain in females (RR 0.77, 99%CI [0.62-0.97]). Four or more adverse lifestyle behaviours, compared to ≤1, were associated with lower risk of high healthcare utilisation for musculoskeletal pain (females: RR 0.66, 99%CI [0.48-0.90]; males: RR 0.68, 99%CI [0.48-0.97]) and healthcare utilisation for neck pain in females (RR 0.63, 99%CI [0.41-0.97]).

Conclusion: Associations between college/university students' lifestyle behaviours and healthcare utilisation for musculoskeletal pain were identified, but with some unexpected patterns. Future research should explore long-term effects of these behaviours on healthcare utilisation for musculoskeletal pain.

INTRODUCTION

Musculoskeletal pain is a major contributor to disability worldwide (Ferrari et al., 2024). Musculoskeletal conditions account for a significant proportion of healthcare utilisation (Finley et al., 2018) and substantial societal costs (Kinge et al., 2017; Power et al., 2022). Reporting musculoskeletal pain is common among university students (Parto et al., 2023; Wong et al., 2021), and among 20-29-year-olds in general, a Norwegian study indicated that over a quarter annually contact primary healthcare for musculoskeletal conditions (Kinge et al., 2015). University students with chronic pain have more academic, psychological, and social challenges compared to students without chronic pain (Serbic et al., 2023). Moreover, young people who suffer from musculoskeletal pain are more likely to experience future pain (Smedbråten et al., 2022b; Øiestad et al., 2020). Given the extensive burden of musculoskeletal pain for individuals and healthcare systems, it is essential to identify risk factors for musculoskeletal pain at young ages, to inform preventive strategies.

The impact of adverse lifestyle behaviours violating health recommendations (e.g. physical inactivity, smoking) on musculoskeletal pain is of interest, given their importance as modifiable risk factors for other health complaints (IHME, 2024). Systematic reviews of musculoskeletal pain in young adults have reported inconsistent findings concerning physical activity level, smoking and body mass index (BMI) as risk factors for back pain (Øiestad et al., 2020), while neither BMI nor physical activity were identified as risk factors for neck pain (Jahre et al., 2020). However, the latter review included only six studies and revealed a paucity of high-quality studies on risk factors for neck pain in young adults (Jahre et al., 2020). Moreover, few longitudinal studies have explored the impact of lifestyle behaviours among young adults on healthcare utilisation for musculoskeletal pain.

Reviews on other chronic diseases report a strong association with health outcomes when a combination of lifestyle behaviours are examined (Tsai et al., 2020; Zhang et al., 2020a; Zhang et al., 2020b). In a prior study, we showed that the presence of four or more adverse lifestyle behaviours in adolescents with musculoskeletal pain was associated with the subsequent persistence of musculoskeletal pain into young adulthood (Smedbråten et al., 2022b). To our knowledge, no previous longitudinal studies have examined associations of cumulative adverse lifestyle behaviours, including factors such as physical inactivity, insufficient sleep, risky alcohol consumption, smoking and drug use, among young adults, with future healthcare utilisation for musculoskeletal pain.

Potential risk factors, such as physical activity level, may be differently associated with musculoskeletal pain, depending on the pain site (Rhim et al., 2022). Thus, it is relevant to examine different pain sites individually, such as the prevalent back and neck pain (Parto et al., 2023), alongside musculoskeletal pain in general.

The aim of this study was to examine if lifestyle behaviours among male and female college/university students were associated with future healthcare utilisation for musculoskeletal pain in general, back pain or neck pain. Lifestyle behaviours included physical activity level, sleep duration, alcohol consumption, smoking, illicit drug use, as well as cumulative adverse lifestyle behaviours.

METHODS

Study design and sample

In this cohort study with three-year follow-up, data from the Students` Health and Wellbeing study (the SHoT study) (Sivertsen et al., 2019), were linked with registry data on healthcare

utilisation from the Norwegian Registry for Primary Health Care (NRPHC). The SHoT study is a large national health survey of students in higher education in Norway, conducted every fourth year. In the current study we have used data from the SHoT2018 study (conducted from February 6th to April 5th in 2018). Detailed information about the survey has been published elsewhere (Sivertsen et al., 2019). Briefly, all fulltime Norwegian college and university students aged between 18 and 35 years were invited to participate in the survey. The data collection consisted of a comprehensive electronic questionnaire, including questions on sociodemographic factors, lifestyle behaviours and health. Data from SHoT2018 were merged with official healthcare utilisation records from the NRPHC, using the 11-digit national identify number assigned to Norwegian citizens at birth. The NRPHC contains data on public primary healthcare utilisation through reimbursements claims sent to the government by primary healthcare providers. In this study, we have included healthcare contacts with general practitioners, out-of-our services (emergency room), chiropractors and physiotherapists. Registered diagnoses follow the International Classification of Primary Care (ICPC-2) coding system. In Norway, all residents are entitled to use the public healthcare system. The costs for healthcare utilisation are strongly subsidised, with free healthcare provided once an annual cost limit is reached, which was EUR 242 as of 2021. Since a referral from a primary healthcare provider is required to be treated in specialist healthcare unless emergency care is needed, most new cases of healthcare utilisation for musculoskeletal pain in both primary and specialist healthcare in Norway are recorded in the primary healthcare registry. Healthcare delivered by private practicing healthcare providers without the right to claim reimbursement from the government are not included in the registry.

Of 162,512 students invited to the SHOT2018 Study, 50,054 completed the online questionnaire (30.8 %). Of these, 42,853 consented to merging data with registry data for

research purposes, yielding an overall response rate of 26.4%. To focus on new cases of healthcare utilisation and minimize the potential for reverse causation (i.e., musculoskeletal pain in need of healthcare leading to adverse lifestyle behaviours), individuals with recent healthcare utilisation for musculoskeletal pain were excluded. Recent healthcare utilisation for musculoskeletal pain were defined as healthcare for musculoskeletal pain diagnoses during the 12 months prior to the exposure assessment or during the 2 months of baseline data collection, leading to exclusion of 9,244 respondents. Moreover, a group of 1,449 respondents were excluded from the sample because they were studying abroad, which likely influenced their use of healthcare services in Norway, and 39 respondents due to missing information on study location. Finally, as the invited study population was students between 18 and 35 years of age, 308 respondents were excluded because they were above 35 years of age at baseline, as well as 455 students due to missing information on age. The final sample consisted of 31,358 college/university students (Figure 1).

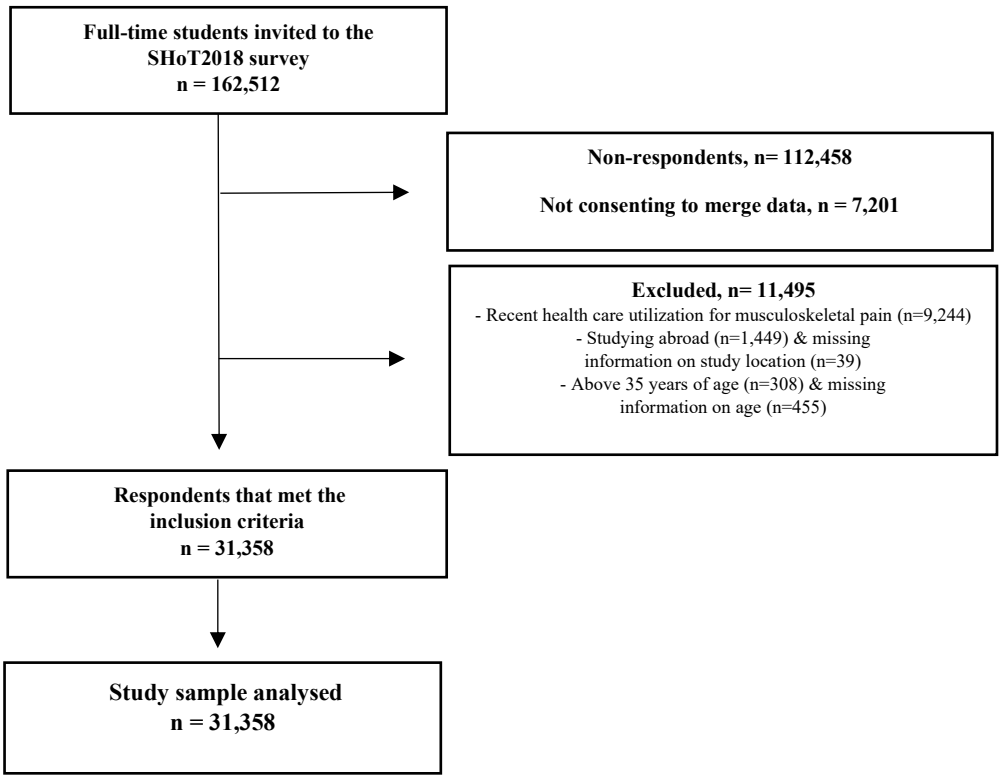

Figure 1: Flowchart of the study sample

Participation was voluntary and based on written informed consent. The study was approved by the Regional Committee for Medical and Health Research Ethics in Norway (251771/REK sør-øst C) and the Norwegian Centre for Research Data (353552). The study protocol was published at clinicaltrials.gov (NCT06157112). The article follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (von Elm et al., 2008).

Outcome

The primary outcome was any healthcare utilisation for musculoskeletal pain in primary healthcare during 3 years of follow-up, between April 6th in 2018 and April 5th in 2021. The variable was generated using data from NRPHC, utilising healthcare contacts with selected diagnosis within the musculoskeletal (L) section in the ICPC-2 coding system. We included diagnoses which reflect musculoskeletal pain and symptoms. Identifiable inflammatory conditions, osteoarthritis, osteochondrosis, tumours, injuries (sprains/strains, fractures), deformity or other diagnoses not reflecting pain and symptoms were not included in the outcome variable. An overview of the included diagnoses is presented in Table 1. The outcome was used as a binary variable. A cut-off of ≥1 healthcare contact (seeking healthcare for a musculoskeletal pain diagnosis at least once during follow-up vs. not seeking healthcare for a musculoskeletal pain diagnosis) was used, representing males and females at or above the 75th percentile of the number of healthcare contacts, compared to the other participants.

Table 1: Diagnoses included in the outcome variables

Musculoskeletal pain	Back pain	Neck pain
(L01) neck symptom/complaint		(L01) neck symptom/complaint
(L02) back symptom/complaint	(L02) back symptom/complaint	
(L03) low back symptom/complaint	(L03) low back symptom/complaint	
(L04) chest symptom/complaint		
(L05) flank/axilla symptom/complaint		
(L07) jaw symptom/complaint		
(L08) shoulder symptom/complaint		
(L09) arm symptom/complaint		
(L10) elbow symptom/complaint		
(L11) wrist symptom/complaint		
(L12) hand/finger symptom/complaint		
(L13) hip symptom/complaint		
(L14) thigh/shin symptom/complaint		
(L15) knee symptom/complaint		
(L16) ankle symptom/complaint		
(L17) foot/toe symptom/complaint		
(L18) widespread muscle pain/fibromyalgia		
(L19) muscle symptom/complaint		
(L20) joint symptom/complaint		
(L29) musculoskeletal symptom/complaint		
(L83) neck syndrome		(L83) neck syndrome
(L84) back syndrome without radiation	(L84) back syndrome without radiation	
(L86) back syndrome with radiation	(L86) back syndrome with radiation	
(L87) bursitis/ tendinitis/ synovitis		
(L92) shoulder syndrome		
(L93) lateral epicondylitis		

Diagnoses following the International Classification of Primary Care (ICPC-2) coding system

A secondary outcome was high healthcare utilisation for musculoskeletal pain. We defined individuals with high healthcare utilisation as those at or above the 90th percentile of the number of healthcare contacts with a musculoskeletal pain diagnosis (Reichard et al., 2015). Hence, a cut-off of ≥ 3 and ≥ 5 healthcare contacts in primary healthcare with a musculoskeletal pain diagnosis during 3-year follow-up were used for males and females, respectively. Individuals with high healthcare utilisation were in the analyses compared to individuals who did not seek care for musculoskeletal pain at all. When multiple contacts with the same category of healthcare provider (e.g. physiotherapist) were reported within a single day, these were classified as a single healthcare contact.

Another secondary outcome was healthcare utilisation for back pain, in terms of healthcare contacts in primary healthcare with a back pain diagnosis during 3-year follow-up. Included

diagnoses are presented in Table 1. A cut-off of ≥1 healthcare contact for a back pain diagnosis during follow-up was used and compared to those who did not seek healthcare for back pain.

A final secondary outcome was healthcare utilisation for neck pain, in terms of healthcare contacts in primary healthcare with a neck pain diagnosis during 3-year follow-up. Included diagnoses are presented in Table 1. A cut-off of ≥1 healthcare contact for a neck pain diagnosis during follow-up was used and compared to those who did not seek healthcare for neck pain. The two outcomes representing healthcare utilisation for back pain and neck pain are not mutually exclusive, as participants might have consulted healthcare providers for several diagnoses during the follow-up period. Also, back- and neck pain diagnoses were included in the outcomes of musculoskeletal pain diagnoses in general, in addition to be examined isolated.

Exposures

Physical activity was assessed by three questions concerning average frequency, intensity and duration of exercise (Kurtze et al., 2008). A brief definition of exercise was presented to the students ahead of the questions: "With exercise we mean that you, for example, go for a walk, go skiing, swim or take part in a sport". Question 1: "How frequently do you exercise?" ("never", "less than once per week", "once per week", "two to three times per week", "almost every day"). Question 2: "If you do such exercise as frequently as once or more times a week: How hard do you push yourself?" ("I take it easy without breaking into a sweat or losing my breath", "I push myself so hard that I lose my breath and break into a sweat", "I push myself to near exhaustion"). Question 3: "How long does each session last?" ("less than 15 minutes", "15-29 minutes", "30 minutes to 1 hour", "more than 1 hour"). This 3-item questionnaire has

demonstrated good test-retest reliability and correlates with direct measurements of maximal oxygen uptake (r= 0.43 [frequency], r= 0.40 [intensity] and r=0.31 [duration]) among young adult men (Kurtze et al., 2008). In accordance with previous research in which similar questions have been used (Moholdt et al., 2014), we constructed a four-level index to match with current recommendations of physical activity. The recommendations by the World Health Organisation (WHO) are at least 150-300 minutes of activity with moderate intensity or 75-150 minutes of vigorous-intensity activity a week, or a combination (Bull et al., 2020). The intensity of "lose my breath and break into a sweat" was interpreted as moderate intensity and "near exhaustion" as vigorous intensity. Reporting no physical activity and physical activity below the recommendations were classified as "inactive" and "physical activity levels below recommendations", respectively. In the analyses, these two groups were merged. Those who reported physical activity corresponding to the recommendations were classified as "recommended level", while reporting more physical activity than the minimum recommendations was classified as "high physical activity level". The recommended level of physical activity was used as the reference category, due to a potential U-shaped association between physical activity and pain (Heneweer et al., 2009).

Sleep duration was assessed by questions on the participants` usual bedtime, rise time, sleep-onset latency (SOL) and wake after sleep onset (WASO). Data was reported separately for weekdays and weekends. Average sleep duration was calculated in hours and minutes and defined as time in bed (time between bedtime and rise time), minus SOL and WASO (Hysing et al., 2015). According to sleep duration recommendations for young adults and adults of 7 to 9 hours a day (Hirshkowitz et al., 2015), three categories were used: "recommended sleep duration" (7-9 hours), "above recommendation" (> 9 hours) and "below recommendation" (< 7 hours).

Smoking was assessed by the question "Do you smoke?" with the response alternatives "yes", "sometimes" and "no". Those answering "yes" or "sometimes" were defined as smokers.

Alcohol use was assessed by the Alcohol Use Disorder Identification Test (AUDIT), developed by the WHO for identifying risky or harmful alcohol use (Babor et al., 2001; Saunders et al., 1993). The questionnaire consists of 10 items and includes questions of consumption patterns (frequency, typical amount, and episodic heavy drinking frequency), alcohol dependence symptoms and harmful consequences of drinking during the last year. Each item was scored from 0 (never) to 4 (daily / almost daily). The scores were summarized, yielding a total score from 0 to 40. To indicate risky alcohol consumption, a cut-off of ≥ 8 was used (Babor et al., 2001).

Illicit drug use was measured by the question "Have you ever tried other drugs [than alcohol] (e.g., narcotic drugs or medication causing an intoxicating effect)?" followed by questions on frequency of use of several prespecified types of illicit drugs, the last 12 months. The prespecified drug types included cannabis (hash/marihuana), amphetamine or methamphetamine, benzodiazepines without prescription (Sobril, Valium etc.), ecstasy, gamma-hydroksybutyrate (GHB), heroin, cocaine, lysergic acid diethylamide (LSD) or psilocybin, methylenedioxymethamphetamine (MDMA), Ritalin without prescription, synthetic cannabinoids (spice) and other illegal drugs. Illicit drug use was in this study defined as any illicit drug use ≥ 1 during the last 12 months.

Number of adverse lifestyle behaviours (cumulative adverse lifestyle behaviours*)* was computed with five dichotomised lifestyle variables: physical activity levels below

recommendations, sleep duration below recommendations, risky alcohol consumption, smoking and illicit drug use. Each of the factors had been categorised beforehand, as previously described, and encoded as follows: 1 for adverse and 0 for healthy. For physical activity and sleep duration which were originally assessed as 3-level ordinal variables, below recommendations were coded as 1 and the recommended levels coded as 0, while those with high physical activity level or sleep duration above recommendation were excluded from the analyses when this variable was examined, to keep the same reference category across the different analyses. The number of adverse lifestyle behaviours was categorised as ≤ 1, 2, 3 and ≥ 4.

Potential confounders

Based on previous literature and assumed theoretical associations; age, financial difficulties (Beenackers et al., 2018; Bøe et al., 2021), chronic diseases (Ferreira et al., 2013; Smedbråten et al., 2022a; Suris et al., 2005), depression/anxiety (Beynon et al., 2020; Fluharty et al., 2017; Ning et al., 2020) and BMI (Sagelv et al., 2021; Su et al., 2018; Taylor et al., 2019), were considered as potential confounders for the associations between lifestyle behaviour and future healthcare utilisation for musculoskeletal pain, back pain and neck pain. Furthermore, all single lifestyle behaviours were considered potential confounders for each other, and all associations were examined stratified by sex. Information on *age* was obtained from the questionnaire, and information on *sex* was obtained from the questionnaire and the NRPHC. *Financial difficulties* were measured by a question of whether the participants had experienced difficulties the last 12 months affording costs of living (such as for food, transportation and/or accommodation). The response alternatives "never" and "seldom" were merged and "sometimes" and "often" were merged. *Chronic diseases* were assessed using questions about pre-defined present conditions. Those confirming ≥ 1 of the following

complaints were categorised as having chronic diseases; allergy/intolerance, asthma, cerebral palsy, diabetes, eczema, epilepsy, heart disease, irritable bowel, cancer, chronic fatigue syndrome, rheumatoid arthritis, migraine, multiple sclerosis and/or other diseases. *Depression and/or anxiety* were, like the chronic diseases, measured by a question of present health complaints. Participants who confirmed to have mental disorders in the pre-defined list, were asked to indicate the specific type of disorder in a second pre-defined list, with "depression" and "anxiety disorder" as two of the response options. *BMI* (kg/m^2) was calculated based on self-reported height and weight. All analyses were additionally adjusted for *healthcare utilisation for other causes* [than musculoskeletal pain], the last 12 months before the exposure assessment, categorised as the number of months in which the participants had consulted a primary care provider (0-12). This variable was used to adjust for differences in health care seeking behaviour and the information was obtained from the NRPHC.

Other descriptive variables

Musculoskeletal pain, back pain and neck pain at baseline were assumed to be on the causal pathway between exposures and outcomes. Therefore, they were not adjusted for in the analyses but were used in the description of the sample. These conditions were assessed with the question "to what extent have you, during the last 7 days, been bothered by the following problems?", with neck pain, back pain and pain in arms, legs and joints as three of the options. Those who reported "some", "pretty much" or "very much" back pain or neck pain were categorised as having back or neck pain, respectively, while those who reported "some", "pretty much" or "very much" pain from either the back, neck, or arms, legs or joints were categorised as having musculoskeletal pain.

Statistical analyses

All analyses were conducted with STATA statistical software system, version 18 (StataCorp., 2023). Categorical descriptive data of study participants were expressed as counts and percentages, while continuous data were described with median and interquartile range (IQR) due to their skewed distributions. Histograms were presented to illustrate the data distribution of the continuous variables. Sample characteristics are presented for the entire sample, separately for males and females, and separately for the different numbers of adverse lifestyle behaviours.

Poisson regression with robust standard errors (SE) was used to estimate the strength of association between lifestyle behaviours and the different outcomes (Zou, 2004). First, we examined crude and adjusted associations between single lifestyle behaviours (physical activity level, sleep duration, alcohol use, smoking and illicit drug use) and each outcome (any healthcare utilisation for musculoskeletal pain, high healthcare utilisation for musculoskeletal pain, back pain and neck pain) in separate models. Second, we estimated crude and adjusted associations between the number of adverse lifestyle behaviours and each outcome. The analyses were adjusted for age, financial difficulties, chronic diseases, depression and/or anxiety, BMI and healthcare utilisation for other reasons. Additionally, the analyses of single lifestyle behaviours were adjusted for the other lifestyle behaviours. All analyses were stratified by sex. Due to the size of the sample, a conservative level of statistical significance was chosen, alpha = 0.01. The estimates from the regression analyses were reported with risk ratios (RRs) with 99% confidence intervals (CI). Missing values were in the regression analyses handled using listwise deletion.

Several sensitivity analyses were conducted to assess the robustness of the findings. First, we conducted analyses for individuals with and without baseline musculoskeletal pain separately. Second, sensitivity analyses limited to healthcare contacts preceding the Covid-19 pandemic (March 12th 2020), were performed. Third, to assess whether the associations were sensitive to inclusion of students > 30 years of age, as characteristics and behaviours might differ between young adult students and older students, sensitivity analyses restricted to students ≤ 30 years of age were conducted. Sensitivity analyses were conducted for the primary outcome only.

RESULTS

Sample characteristics

Baseline characteristics of the sample are shown in Table 2, and histograms which illustrate data distribution of continuous variables are presented in Figure 2. The sample consisted of two-thirds females, with a median (IQR) age of 22 (3) years. Among females and males, 66.9% and 57.7% were less physically active than recommended, respectively. For both males and females, about one in five reported having shorter sleep duration than recommended. Smoking was reported by 14.0% of males and 8.6% of females, with corresponding numbers for illicit drug use of 27.5% vs. 16.3% and for risky alcohol consumption of 53.4% vs. 41.4%. In males, 41.7% reported ≤ 1 adverse lifestyle behaviour, while 10.6% reported ≥ 4. In females, 49.9% reported ≤ 1 adverse lifestyle behaviour, while 6.0% reported ≥ 4.

Table 2: Baseline characteristics of the study sample

Characteristics	Females N= 21,055	Males N=10,294	Overall [a] N=31,358	Missing n (%)
Age, y, median (IQR)	22 (3)	23 (4)	22 (3)	
Financial difficulties, n (valid %)				56 (0.2)
Difficulties making ends meet	6,655 (31.7)	2,447 (23.8)	9,103 (29.1)	
Never / seldom difficulties	14,360 (68.3)	7,831 (76.2)	22,199 (70.9)	
Chronic diseases [b], yes, n (valid %)	10,954 (52.0)	4,311 (41.9)	15,270 (48.7)	
Depression and/or anxiety, yes, n (valid %)	3,225 (15.3)	996 (9.7)	4,225 (13.5)	
BMI (kg/m^2), median (IQR)	22.9 (4.6)	23.8 (4.3)	23.3 (4.5)	937 (3.0)
Healthcare utilisation for other causes [c], median (IQR)	2 (3)	1 (2)	2 (3)	
Musculoskeletal pain [d], yes, n (valid %)	12,162 (59.1)	3,661 (36.7)	15,827 (51.7)	773 (2.5)
Back pain [e], yes, n (valid %)	7,000 (34.0)	2,010 (20.1)	9,012 (29.5)	774 (2.5)
Neck pain [e], yes, n (valid %)	9,431 (45.7)	2,278 (22.7)	11,711 (38.1)	658 (2.1)
Physical activity level, n (valid %)				190 (0.6)
Inactive	826 (3.9)	647 (6.3)	1,473 (4.7)	
Below recommendations	13,204 (63.0)	5,249 (51.4)	18,459 (59.2)	
Recommended	4,969 (23.7)	2,590 (25.4)	7,561 (24.3)	
High physical activity level	1,947 (9.3)	1,727 (16.9)	3,675 (11.8)	
Sleep duration, n (valid %)				2,254 (7.2)
Below recommendations (< 7 hours)	4,235 (21.7)	2,121 (22.0)	6,358 (21.8)	
Recommended (7-9 hours)	12,922 (66.4)	6,589 (68.5)	19,517 (67.1)	
Above recommendation (> 9 hours)	2,315 (11.9)	914 (9.5)	3,229 (11.1)	
Smoking, yes, n (valid %)	1,776 (8.6)	1,408 (14.0)	3,184 (10.4)	658 (2.1)
Risky alcohol consumption [f], n (valid %)	8,449 (41.4)	5,327 (53.4)	13,776 (45.3)	978 (3.1)
Illicit drugs last 12 months, yes, n (valid %)	3,388 (16.3)	2,788 (27.5)	6,176 (19.9)	386 (1.2)
Number of adverse lifestyle behaviours [g] (valid %)				3,850 (12.3) [h]
0-1	7,332 (49.9)	2,861 (41.7)	10,200 (47.3)	
2	4,539 (30.9)	2,037 (29.7)	6,577 (30.5)	
3	1,933 (13.2)	1,232 (18.0)	3,165 (14.7)	
4-5	879 (6.0)	723 (10.6)	1,602 (7.4)	

Valid %: the percentages are calculated by considering the valid responses only

[a] 67.2% of the sample are females (9 unknown values for sex)

[b] Include allergy/intolerance, asthma, cerebral palsy, diabetes, eczema, epilepsy, heart disease, irritable bowel, cancer, chronic fatigue syndrome, rheumatoid arthritis, migraine, multiple sclerosis and/or other diseases

[c] The number of months in which the participants had consulted a primary health care provider for another cause than musculoskeletal pain, the last 12 months prior to baseline (0-12)

[d] Pain in one or more musculoskeletal pain site the last 7 days

[e] Pain last 7 days

[f] Alcohol Use Disorder Identification Test (AUDIT) (0-40) (Babor et al., 2001; Saunders et al., 1993), risky alcohol consumption ≥ 8

[g] Includes physical activity levels below recommendations, sleep duration below recommendations, smoking, risky alcohol consumption and illicit drug use.

[h] Additionally, n=5,964 (19.0%) were omitted from this variable as they were either highly physically active and/or reported sleep duration above recommendations

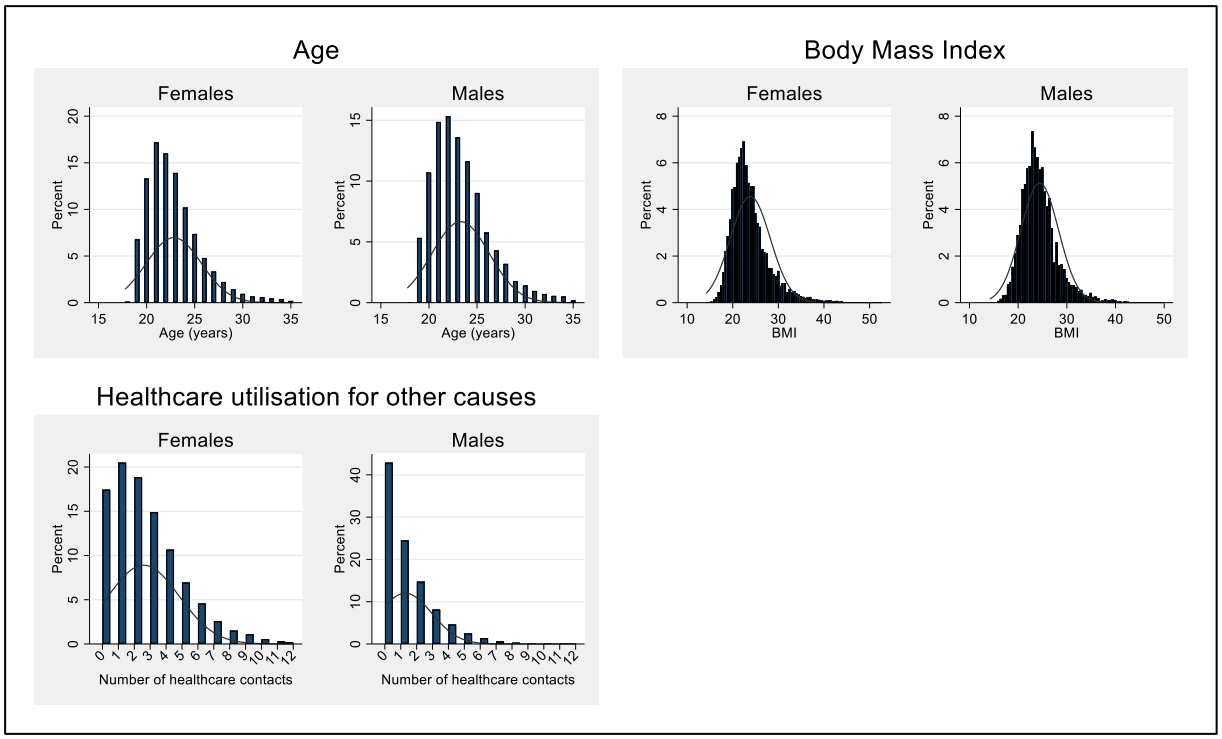

Figure 2: Data distribution of continuous variables

In males and females, 36.7% and 59.1% reported musculoskeletal pain at baseline, respectively. A higher prevalence of baseline musculoskeletal pain was reported among students with ≥ 4 adverse lifestyle behaviours (47.2% in males and 67.1% in females) than among students with ≤ 1 adverse lifestyle behaviour (32.3% in males and 55.7% in females). Also, among students with ≥ 4 adverse lifestyle behaviours, a higher proportion reported financial difficulties and depression/anxiety than those with ≤ 1 adverse lifestyle behaviour (Table 3).

Table 3: Baseline characteristics in relation to number of adverse lifestyle behaviours [a] in male and female college/university students

Characteristics	Females					Males				
	0-1 adverse lifestyle behaviours	**2**	**3**	**4 or more**	Missing	**0-1 adverse lifestyle behaviours**	**2**	**3**	**4 or more**	Missing
	N= 7,332	**N= 4,539**	**N=1,933**	**N= 879**	N (%)	**N= 2,861**	**N= 2,037**	**N=1,232**	**N=723**	N (%)
Age, y, median (IQR)	22 (3)	22 (3)	22 (4)	22 (3)		23 (4)	23 (4)	23 (4)	23 (4)	
Financial difficulties, n (valid %)										
Difficulties making ends meet	1,770 (24.2)	1,566 (34.5)	824 (42.7)	465 (52.9)	20 (0.1)	461 (16.1)	481 (23.6)	393 (32.0)	318 (44.0)	7 (0.1)
Never / seldom difficulties	5,547 (75.8)	2,969 (65.5)	1,108 (57.3)	414 (47.1)		2,397 (83.9)	1,554 (76.4)	837 (68.0)	405 (56.0)	
Chronic diseases [b], yes, n (valid %)	3,762 (51.3)	2,420 (53.3)	1,111 (57.5)	444 (50.5)		1,189 (41.6)	887 (43.5)	533 (43.3)	338 (46.7)	
Depression and/or anxiety, yes, n (valid %)	811 (11.1)	808 (17.8)	454 (23.5)	290 (33.0)		190 (6.6)	200 (9.8)	155 (12.6)	157 (21.7)	
BMI (kg/m^2), median (IQR)	22.8 (4.5)	23.3 (5.0)	23.1 (5.1)	23.1 (5.5)	404 (2.8)	23.6 (4.2)	23.9 (4.8)	23.7 (4.5)	23.8 (5.3)	126 (1.8)
Healthcare utilisation for other causes [c], median (IQR)	2 (3)	2 (3)	2 (3)	2 (3)		1 (2)	1 (2)	1 (2)	1 (2)	
Musculoskeletal pain [d], yes, n (valid %)	4,004 (55.7)	2,781 (62.5)	1,246 (65.4)	578 (67.1)	286 (1.9)	903 (32.3)	773 (38.8)	465 (38.8)	333 (47.2)	162 (2.4)
Back pain [e], yes, n (valid %)	2,180 (30.4)	1,675 (37.7)	768 (40.4)	394 (45.9)	305 (2.1)	480 (17.2)	430 (21.4)	274 (22.8)	197 (27.8)	139 (2.0)
Neck pain [e], yes, n (valid %)	3,036 (42.2)	2,200 (49.4)	1,010 (53.0)	474 (55.0)	258 (1.8)	584 (20.7)	478 (23.9)	300 (25.0)	232 (32.9)	128 (1.9)

The table describes participants with valid responses on the "number of adverse lifestyle behaviours" variable: Females, N= 14,683; Males, N=6,853.

[a] Includes physical activity levels below recommendations, sleep duration below recommendation, smoking, risky alcohol consumption and illicit drug use.

[b] Include allergy/intolerance, asthma, cerebral palsy, diabetes, eczema, epilepsy, heart disease, irritable bowel, cancer, chronic fatigue syndrome, rheumatoid arthritis, migraine, multiple sclerosis and other diseases

[c] The number of months in which the participants had consulted a primary health care provider for another cause than musculoskeletal pain, the last 12 months prior to baseline (0-12)

[d] Pain in one or more musculoskeletal pain site the last 7 days

[e] Pain last 7 days

Table 4: Healthcare utilisation for musculoskeletal pain [a] during 3-years follow-up

Healthcare utilisation	Musculoskeletal pain			Back pain			Neck pain		
	Females N=21,055	**Males** N=10,294	**Total** N=31,358 [b]	**Females** N=21,055	**Males** N=10,294	**Total** N=31,358 [b]	**Females** N=21,055	**Males** N=10,294	**Total** N=31,358 [b]
No healthcare contacts	13,581 (64.5)	7,326 (71.2)	20,915 (66.7)	18,426 (87.5)	9,405 (91.4)	27,840 (88.8)	19,634 (93.3)	9,925 (96.4)	29,568 (94.3)
At least *one* healthcare contact, n (%)	7,474 (35.5)	2,968 (28.8)	10,442 (33.3)	2,629 (12.5)	889 (8.6)	3,518 (11.2)	1,421 (6.7)	369 (3.6)	1,790 (5.7)
≥ 3 healthcare contacts, n (%)	3,715 (17.6)	1,240 (12.0)	4,956 (15.8)						
≥ 5 healthcare contacts, n (%)	2,419 (11.5)	709 (6.9)	3,128 (10.0)						

[a] Healthcare contacts with musculoskeletal pain diagnoses in primary healthcare (data obtained from the Norwegian Registry for Primary Health Care)
[b] Nine missing values on sex

Healthcare utilisation for musculoskeletal pain, back pain and neck pain

During the 3-year follow-up, one third (n=10,442) of the students (35.5% of the females and 28.8% of the males), consulted primary healthcare with a musculoskeletal pain diagnosis at least once (Table 4). Among females, 17.6% had ≥ 3 healthcare contacts and 11.5% had ≥ 5 healthcare contacts. Among males, 12.0% had ≥ 3 healthcare contacts and 6.9% had ≥ 5 healthcare contacts. Regarding healthcare utilisation for back pain during the 3-year follow-up, 12.5% of the females and 8.6% of the males had one or more healthcare contact. The corresponding numbers of healthcare utilisation for neck pain were 6.7% among females and 3.6% among males (Table 4).

Association between lifestyle behaviours and future healthcare utilisation for musculoskeletal pain, back pain, and neck pain

Physical activity below recommended levels was associated with lower risk of any healthcare utilisation for musculoskeletal pain and lower risk of high healthcare utilisation for musculoskeletal pain, in males and females, in adjusted analyses (Table 5 & 6). High levels of physical activity were associated with higher risk of any healthcare utilisation for musculoskeletal pain and higher risk of high healthcare utilisation for musculoskeletal pain in males and females, higher risk of healthcare utilisation for neck pain in females and for back pain in males. Physical activity level was not statistically significantly associated with any other outcomes in adjusted analyses (Table 5 & 6).

Illicit drug use was associated with lower risk of healthcare utilisation for neck pain in females (Table 5). Illicit drug use was not statistically significantly associated with any other outcomes in neither males nor females. Smoking, alcohol consumption and sleep duration

were not statistically significantly associated with any outcomes in adjusted models, in neither males nor females (Table 5 & 6).

Having ≥ 4 adverse lifestyle behaviours, compared to ≤ 1, was associated with lower risk of healthcare utilisation for neck pain in females, and lower risk of high healthcare utilisation for musculoskeletal pain in males and females. The number of adverse lifestyle behaviours was not statistically significantly associated with any other outcomes in adjusted models (Table 5 & 6).

Sensitivity analyses

Repeating the analyses for the primary outcome, separately for individuals with and without baseline musculoskeletal pain, revealed no substantial differences in point estimates compared to the main analyses (maximum differences in RRs of 0.1) (Table S1). Restricting the analyses to healthcare utilisation prior to Covid-19 did not produce any substantially differences compared to the main analyses. The maximum differences in RRs were 0.05 for females and 0.12 for males (Table S2). Analyses restricted to students ≤ 30 years of age produced similar findings as the main analyses (Table S3).

Table 5: Associations between lifestyle behaviours in *female* college/university students and healthcare utilisation for musculoskeletal pain during 3 years of follow-up

	Musculoskeletal pain [a] RR (99% CI)		Back pain [a] RR (99% CI))		Neck pain [a] RR (99% CI)		High healthcare utilisation for musculoskeletal pain [b] RR (99% CI)	
	Crude	Adjusted [c]	Crude	Adjusted [c]	Crude	Adjusted [c]	Crude	Adjusted [c]
Physical activity level								
Below recommendations	0.93 (0.88-0.99)	0.90 (0.85-0.96)	0.94 (0.84-1.05)	0.89 (0.79-1.01)	1.06 (0.90-1.25)	1.07 (0.89-1.28)	0.87 (0.77–0.97)	0.85 (0.75–0.96)
Recommended (ref.)	1	1	1	1	1	1	1	1
High physical activity level	1.11 (1.02-1.20)	1.14 (1.04- 1.25)	1.07 (0.90-1.27)	1.11 (0.92-1.35)	1.18 (0.92-1.51)	1.34 (1.03-1.75)	1.30 (1.11–1.53)	1.43 (1.20–1.71)
Sleep duration								
Below recommendations	1.10 (1.04-1.17)	1.03 (0.97-1.10)	1.17 (1.04-1.32)	1.06 (0.93-1.20)	1.14 (0.97-1.34)	1.05 (0.88 – 1.26)	1.18 (1.04–1.33)	1.04 (0.92–1.18)
Recommended (ref.)	1	1	1	1	1	1	1	1
Above recommendations	1.03 (0.95-1.11)	1.04 (0.96-1.12)	1.13 (0.97-1.32)	1.16 (0.995-1.36)	0.98 (0.79-1.23)	1.01 (0.80 – 1.27)	1.11 (0.95 –1.30)	1.11 (0.95–1.30)
Risky alcohol consumption[d]								
Yes	0.98 (0.94-1.03)	0.99 (0.94-1.05)	0.99 (0.90-1.09)	1.02 (0.92-1.14)	0.91 (0.80-1.05)	0.96 (0.83-1.13)	0.92 (0.83–1.02)	0.98 (0.87–1.09)
No (ref)	1	1	1	1	1	1	1	1
Smoking								
Yes	1.02 (0.93-1.11)	0.98 (0.89-1.08)	1.03 (0.87-1.22)	1.01 (0.84-1.21)	0.94 (0.73-1.20)	0.92 (0.69-1.22)	0.92 (0.77–1.11)	0.98 (0.81–1.19)
No (ref)	1	1	1	1	1	1	1	1
Illicit drugs last 12 months								
Yes	1.02 (0.96-1.09)	1.01 (0.93-1.08)	1.06 (0.93-1.20)	1.01 (0.87-1.16)	0.84 (0.69-1.02)	0.77 (0.62-0.97)	0.93 (0.81–1.06)	0.88 (0.75–1.03)
No (ref)	1	1	1	1	1	1	1	1
Number of adverse lifestyle behaviours [e]								
0-1 (ref)	1	1	1	1	1	1	1	1
2	1.04 (0.97-1.11)	1.0 (0.93–1.07)	1.01 (0.88-1.15)	0.94 (0.82-1.08)	1.07 (0.89-1.28)	1.01 (0.84-1.21)	1.02 (0.89–1.17)	0.95 (0.83–1.09)
3	1.07 (0.98-1.17)	1.01 (0.93–1.11)	1.12 (0.94-1.33)	1.03 (0.87-1.23)	1.01 (0.79-1.29)	0.92 (0.72-1.18)	1.11 (0.93–1.33)	1.02 (0.86–1.22)
4 or more	0.97 (0.85-1.10)	0.90 (0.79–1.03)	1.10 (0.87-1.40)	0.97 (0.76-1.25)	0.67 (0.44-1.03)	0.63 (0.41-0.97)	0.72 (0.53–0.99)	0.66 (0.48–0.90)

Abbreviations: CI, confidence interval; RR, risk ratio.

[a] ≥ 1 healthcare contact vs. 0

[b] ≥ 5 healthcare contacts vs. 0

[c] Adjusted for: age, financial difficulties, anxiety/depression, chronic diseases, BMI, frequency of healthcare contacts prior to baseline, and other lifestyle behaviours (the latter in analyses of single lifestyle behaviours only)

[d] Alcohol Use Disorder Identification Test (AUDIT) (0-40) (Babor et al., 2001; Saunders et al., 1993), risky alcohol consumption ≥ 8

[e] Includes physical activity levels below recommendations, sleep duration below recommendations, smoking, risky alcohol consumption and illicit drug use

Data was obtained from the the Students` Health and Wellbeing study (SHoT2018) and the Norwegian Registry for Primary Health Care

Table 6: Associations between lifestyle behaviours in *male* college/university students and healthcare utilisation for musculoskeletal pain during 3 years of follow-up

	Musculoskeletal pain [a] RR (99% CI)		Back pain [a] RR (99% CI))		Neck pain [a] RR (99% CI)		High healthcare utilisation for musculoskeletal pain [b] RR (99% CI)	
	Crude	Adjusted [c]	Crude	Adjusted [c]	Crude	Adjusted [c]	Crude	Adjusted [c]
Physical activity level								
Below recommendations	0.84 (0.76–0.92)	0.84 (0.76–0.93)	0.86 (0.70–1.05)	0.86 (0.69–1.07)	0.81 (0.60–1.11)	0.78 (0.55–1.09)	0.71 (0.61–0.84)	0.70 (0.59–0.83)
Recommended (ref.)	1	1	1	1	1	1	1	1
High physical activity level	1.18 (1.06–1.32)	1.20 (1.07–1.36)	1.33 (1.05–1.68)	1.36 (1.05–1.77)	1.06 (0.72–1.56)	1.07 (0.70–1.64)	1.32 (1.10–1.58)	1.32 (1.08–1.61)
Sleep duration								
Below recommendations	1.07 (0.97–1.18)	1.03 (0.93–1.14)	1.18 (0.97–1.45)	1.07 (0.86–1.33)	1.31 (0.95–1.79)	1.21 (0.86–1.69)	1.09 (0.92–1.29)	1.01 (0.85–1.21)
Recommended (ref.)	1	1	1	1	1	1	1	1
Above recommendations	1.02 (0.88–1.17)	1.03 (0.89–1.20)	0.93 (0.68–1.28)	0.96 (0.69–1.33)	1.10 (0.69–1.77)	1.10 (0.66–1.81)	1.03 (0.80–1.31)	1.08 (0.84–1.38)
Risky alcohol consumption[d]								
Yes	1.10 (1.01–1.19)	1.08 (0.98-1.18)	1.17 (0.99–1.39)	1.08 (0.89–1.30)	0.89 (0.68–1.16)	0.88 (0.65–1.19)	1.11 (0.96–1.27)	1.07 (0.92–1.25)
No (ref)	1	1	1	1	1	1	1	1
Smoking								
Yes	0.98 (0.87–1.11)	0.97 (0.85–1.11)	1.13 (0.90–1.43)	1.07 (0.81–1.40)	0.99 (0.67–1.45)	1.0 (0.62-1.60)	0.84 (0.68–1.04)	0.88 (0.69–1.13)
No (ref)	1	1	1	1	1	1	1	1
Illicit drugs last 12 months								
Yes	1.03 (0.94–1.13)	0.99 (0.89–1.10)	1.11 (0.92–1.33)	1.03 (0.83–1.28)	0.89 (0.66–1.21)	0.90 (0.62–1.30)	0.94 (0.80–1.10)	0.92 (0.77–1.10)
No (ref)	1	1	1	1	1	1	1	1
Number of adverse lifestyle behaviours [e]								
0-1 (ref)	1	1	1	1	1	1	1	1
2	1.05 (0.93–1.19)	1.02 (0.91–1.16)	1.02 (0.78–1.32)	0.99 (0.76–1.29)	1.02 (0.69–1.52)	0.97 (0.65–1.46)	0.95 (0.77–1.17)	0.90 (0.73–1.12)
3	1.14 (0.995–1.31)	1.09 (0.95–1.25)	1.32 (0.997–1.75)	1.23 (0.93–1.63)	1.04 (0.65–1.66)	0.95 (0.58–1.53)	1.05 (0.82–1.34)	0.95 (0.74–1.21)
4 or more	1.04 (0.87–1.25)	0.96 (0.80–1.16)	1.04 (0.72–1.51)	0.93 (0.63–1.37)	0.95 (0.53–1.71)	0.78 (0.41–1.47)	0.79 (0.56–1.11)	0.68 (0.48–0.97)

Abbreviations: CI, confidence interval; RR, risk ratio.

[a] ≥ 1 healthcare contact vs. 0

[b] ≥ 3 healthcare contacts vs. 0

[c] Adjusted for: age, financial difficulties, anxiety/depression, chronic diseases, BMI, frequency of healthcare contacts prior to baseline, and other lifestyle behaviours (the latter in analyses of single lifestyle behaviours only)

[d] Alcohol Use Disorder Identification Test (AUDIT) (0-40) (Babor et al., 2001; Saunders et al., 1993), risky alcohol consumption ≥ 8

[e] Includes physical activity levels below recommendations, sleep duration below recommendations, smoking, risky alcohol consumption and illicit drug use

Data was obtained from the the Students` Health and Wellbeing study (SHoT2018) and the Norwegian Registry for Primary Health Care

4.0 DISCUSSION

This cohort study of Norwegian college and university students investigated if lifestyle behaviours were associated with future healthcare utilisation for musculoskeletal pain. The results showed that high levels of physical activity were associated with greater risk of seeking healthcare for musculoskeletal pain within the following three years. Other single lifestyle behaviours were not clearly and consistently associated with healthcare utilisation for musculoskeletal pain, although illicit drug use appeared to be associated with lower risk of healthcare utilisation for neck pain in females. Despite a higher prevalence of baseline musculoskeletal pain among students with four or more adverse lifestyle behaviours than students with one or less, the presence of four or more adverse lifestyle behaviours appeared to be associated with lower risk of healthcare utilisation for musculoskeletal pain, particularly healthcare contacts for neck pain in females and repeated healthcare contacts for musculoskeletal pain in general.

Few cohort studies have investigated the associations between young adults' lifestyle behaviours and later healthcare utilisation for musculoskeletal pain using medical records. One such study from Finland found no association between exercise frequency and consultations for back pain (Suikkanen et al., 2023). However, that study was conducted on young male conscripts. As lifestyle behaviours may change when entering military service, these findings are not directly comparable with ours. Previous longitudinal studies on self-reported musculoskeletal pain in young adults have found an association between high physical activity levels and pain (Mitchell et al., 2010), between low physical activity level and pain (Jahre et al., 2021b; Lindell et al., 2022) or no significant association with physical activity level (Lunde et al., 2015; Smith et al., 2009). Traumatic onset has been found as a determinant of seeking care for knee pain in adolescent girls (Rathleff et al., 2013), and

physical trauma and overuse pathology as the most common pain aetiology in children with musculoskeletal pain seeking healthcare (Inocencio, 2004). As trauma and overuse are probably more common in highly active individuals, this might explain the increased healthcare utilisation in physically active individuals in our study. Also, highly active students may more often seek healthcare due to musculoskeletal pain obstructing their usual exercise routine. Besides, participants of organised sports might have easier access to healthcare providers through their team connections.

Illicit drug use seemed to be associated with lower risk of healthcare utilisation for neck pain in females. There is a paucity of longitudinal studies on illicit drug use and musculoskeletal pain in young adults, and the reason behind the identified association is not known. One potential explanation might be that illicit drugs have been used as self-medication for pain (Alford et al., 2016), instead of seeking medical care. However, the relationship between substance use and healthcare utilisation for pain in young adults is probably complex. According to Andersen`s behavioural model of health services use, an individual's use of healthcare depends on a comprehensive set of predisposing-, enabling- and need factors, which encompass both individual and contextual elements (Andersen et al., 2001).

Sleep duration, alcohol consumption and smoking were not associated with healthcare utilisation for musculoskeletal pain in this study. Existing literature has shown conflicting evidence on associations of sleep (Bonvanie et al., 2016; Jahre et al., 2021b; Lindell et al., 2022), alcohol consumption (Hestbaek et al., 2006; Puroila et al., 2015; Smith et al., 2017) and smoking (Øiestad et al., 2020) with future musculoskeletal pain in young adults.

Surprisingly, an accumulation of four or more adverse lifestyle behaviours was associated with lower risk of high healthcare utilisation for musculoskeletal pain in both sexes and lower risk of healthcare utilisation for neck pain in females. To the best of our knowledge, no previous longitudinal studies have examined associations between cumulative adverse lifestyle behaviours among young adults and future healthcare utilisation for musculoskeletal pain. The current finding might have several explanations. As individuals with many adverse lifestyle behaviours had lower healthcare utilisation despite a higher prevalence of self-reported musculoskeletal pain at baseline, the finding is probably connected to healthcare utilisation itself, and not solely to pain status. Use of healthcare when needed can be interpreted as health-promoting behaviour similarly to being physically active or avoid substance use. As health-promoting behaviours often cluster (Noble et al., 2015), this might explain why individuals with healthy lifestyles used more healthcare, while those with many adverse lifestyle behaviours had lower healthcare utilisation for musculoskeletal pain, despite a higher prevalence of baseline pain. An association between adverse lifestyle behaviours and lower healthcare utilisation was also found in a previous study on adults with physical discomfort, in which individuals who were physically inactive, smoked or consumed alcohol regularly, had lower probability of seeking healthcare (Li et al., 2022). Factors such as cost barriers or limited access to healthcare providers might also have obstructed certain students from seeking healthcare in our study. Moreover, in a young population, negative effects of adverse behaviours might not yet have appeared, emphasizing the importance of examining risk factors for pain in younger populations isolated.

Strengths and limitations

The main strengths of this study are the large sample size and the prospective design, allowing for analyses of the temporal relationship between exposures and future outcomes.

Furthermore, using registry-based data as outcomes limited the occurrence of reporting bias from the participants, and provided data for the entire temporal frame, compared to studies where data are collected solely at fixed points in time.

The main limitation of the study is the modest participation rate (30.8% participated, 26.4 % consented linkage to register data). Therefore, care should be taken when generalising the findings. Compared to the group invited to the survey (58.1% females, 41.9% males), the sample consisted of 67.2% females and 32.8% males. The age distribution of the attendees of SHoT2018 was, on the other hand, almost identical to that of invited students (Sivertsen et al., 2019). A second limitation concerns the registrations of healthcare utilisation. Healthcare providers are only obliged to report *one* diagnosis on each patient to receive reimbursement. As co-occurrence of musculoskeletal pain and other health complaints, such as mental health complaints (Jahre et al., 2021a), and other pain problems (e.g. headache) (Jahre et al., 2021a; Swain et al., 2014) are common, musculoskeletal pain diagnoses might have been underreported in the register, leading to potential misclassifications of the outcome. Moreover, consultations with primary practicing healthcare providers without the right to claim reimbursement from the government are not included in the registry. A third limitation is the use of binary lifestyle variables to establish the number of adverse lifestyle behaviour variable, which might have led to loss of exposure information. Also, dichotomising the outcome variable of high healthcare utilisation for musculoskeletal pain based on percentiles might have led to an arbitrary categorisation. Fourth, while logistic regression, as applied in this study, is a common and appropriate method for investigating associations between a binary dependent variable and a selection of possible predictive factors, it assumes correct model specification and may not fully capture the complexity of the data. We did not assess model predictive performance, as our objective was not to develop a predictive model where

model testing would be a natural next step. Nevertheless, this implies that the results reflect our model specifications, e.g. our choice and availability of possible predictive factors. Finally, we conducted multiple comparisons. We used a conservative p-value (0.01), but no other corrections for multiple comparisons were conducted. Hence, the findings should be interpreted with caution and the study replicated by other.

Implications

Although physical activity levels below the level recommended by WHO were associated with reduced risk of healthcare utilisation for musculoskeletal pain, and high physical activity levels were associated with higher risk, we emphasize that the recommendations should be maintained. However, optimal type, dose, and intensity of physical activity to promote musculoskeletal health in young adults, should be further assessed. Our finding of lower healthcare utilisation for musculoskeletal pain in students with four or more adverse lifestyle behaviours also requires further investigation. Given that these students had less healthcare utilisation for musculoskeletal pain despite a higher prevalence of baseline pain, it underscores the need to investigate whether students with multiple adverse lifestyle behaviours are at risk of negative musculoskeletal pain outcomes and higher use of healthcare in the long-term.

CONCLUSION

In this study, associations between college/university students' lifestyle behaviours and future healthcare utilisation for musculoskeletal pain were identified, but with some unexpected patterns. Future research should explore long-term effects of these behaviours on healthcare utilisation for musculoskeletal pain.

Acknowledgements:

We would like to thank all students participating in the study, and the three largest student welfare organisations in Norway (SiO, Sammen and SiT) which initiated the SHoT study. We would also like to thank the Norwegian Institute of Public Health for their cooperation. Data form the Norwegian Registry for Primary Health Care has been used in this publication. The interpretation and reporting of these data are the sole responsibility of the authors, and no endorsement by the Norwegian Registry for Primary Health Care is intended nor should be inferred.

Author contribution:

KS: originated the idea, contributed to designing the study, conducted the analyses, interpreted the results and wrote the first and subsequent drafts of the manuscript. BEØ: principal investigator, contributed to the conception and design of the study, interpreted the results and critically revised the manuscript for important intellectual content. BS: acquired the data, contributed to the conception and design of the study, interpreted the results and critically revised the manuscript for important intellectual content. MG, MH, HJ, KRR, GP, ES: contributed to the conception and design of the study, interpreted the results and critically revised the manuscript for important intellectual content. All authors approved the submitted version of the manuscript.

Alford, D. P., German, J. S., Samet, J. H., Cheng, D. M., Lloyd-Travaglini, C. A., & Saitz, R. (2016). Primary Care Patients with Drug Use Report Chronic Pain and Self-Medicate with Alcohol and Other Drugs. *Journal of General Internal Medicine*, *31*(5), 486-491. https://doi.org/10.1007/s11606-016-3586-5

Andersen, R. M., & Davidson, P. L. (2001). Improving Access to Care in America: Individual and Contextual Indicators. In R. M. Andersen, R. T. H, & K. E.F (Eds.), *Changing the U.S. Health Care System: Key issues in Health Services Policy and Management* (pp. 3-31). Jossey-Bass.

Babor, T. F., Higgins-Biddle, J., Saunders, J. B., & Monteiro, M. (2001). AUDIT-The Alcohol Use Disorders Identification Test: Guidelines for Use in Primary Heath Care. Second Edition. *WHO.*, 1-40.

Beenackers, M. A., Oude Groeniger, J., van Lenthe, F. J., & Kamphuis, C. B. M. (2018). The role of financial strain and self-control in explaining health behaviours: the GLOBE study. *Eur J Public Health*, *28*(4), 597-603. https://doi.org/10.1093/eurpub/ckx212

Beynon, A. M., Hebert, J. J., Hodgetts, C. J., Boulos, L. M., & Walker, B. F. (2020). Chronic physical illnesses, mental health disorders, and psychological features as potential risk factors for back pain from childhood to young adulthood: a systematic review with meta-analysis. *European Spine Journal*, *29*(3), 480-496. https://doi.org/10.1007/s00586-019-06278-6

Bonvanie, I. J., Oldehinkel, A. J., Rosmalen, J. G. M., & Janssens, K. A. M. (2016). Sleep problems and pain: a longitudinal cohort study in emerging adults. *Pain*, *157*(4), 957-963. https://doi.org/10.1097/j.pain.0000000000000466

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., Carty, C., Chaput, J. P., Chastin, S., Chou, R., Dempsey, P. C., DiPietro, L., Ekelund, U., Firth, J., Friedenreich, C. M., Garcia, L., Gichu, M., Jago, R., Katzmarzyk, P. T., Lambert, E., Leitzmann, M., Milton, K., Ortega, F. B., Ranasinghe, C., Stamatakis, E., Tiedemann, A., Troiano, R. P., van der Ploeg, H. P., Wari, V., & Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*, *54*(24), 1451-1462. https://doi.org/10.1136/bjsports-2020-102955

Bøe, T., Hysing, M., Lønning, K. J., & Sivertsen, B. (2021). Financial difficulties and student health: Results from a National Cross-Sectional Survey of Norwegian college and university students. *Mental Health & Prevention*, *21*, 200196. https://doi.org/10.1016/j.mhp.2020.200196

Ferrari, A. J., Santomauro, D. F., Aali, A., Abate, Y. H., Abbafati, C., Abbastabar, H., Abd ElHafeez, S., Abdelmasseh, M., Abd-Elsalam, S., Abdollahi, A., Abdullahi, A., Abegaz, K. H., Abeldaño Zuñiga, R. A., Aboagye, R. G., Abolhassani, H., Abreu, L. G., Abualruz, H., Abu-Gharbieh, E., Abu-Rmeileh, N. M. E., Ackerman, I. N., Addo, I. Y., Addolorato, G., Adebiyi, A. O., Adepoju, A. V., Adewuyi, H. O., Afyouni, S., Afzal, S., Afzal, S., Agodi, A., Ahmad, A., Ahmad, D., Ahmad, F., Ahmad, S., Ahmed, A., Ahmed, L. A., Ahmed, M. B., Ajami, M., Akinosoglou, K., Akkaif, M. A., Al Hasan, S. M., Alalalmeh, S. O., Al-Aly, Z., Albashtawy, M., Aldridge, R. W., Alemu, M. D., Alemu, Y. M., Alene, K. A., Al-Gheethi, A. A. S., Alharrasi, M., Alhassan, R. K., Ali, M. U., Ali, R., Ali, S. S. S., Alif, S. M., Aljunid, S. M., Al-Marwani, S., Almazan, J. U., Alomari, M. A., Al-Omari, B., Altaany, Z., Alvis-Guzman, N., Alvis-Zakzuk, N. J., Alwafi, H., Al-Wardat, M. S., Al-Worafi, Y. M., Aly, S., Alzoubi, K. H., Amare, A. T., Amegbor, P. M., Ameyaw, E. K., Amin, T. T., Amindarolzarbi, A., Amiri, S., Amugsi, D. A., Ancuceanu, R., Anderlini, D., Anderson, D. B., Andrade, P. P., Andrei, C. L., Ansari, H., Antony, C. M., Anwar, S., Anwar, S. L., Anwer, R., Anyanwu, P. E., Arab, J. P., Arabloo, J., Arafat, M., Araki, D. T., Aravkin, A. Y., Arkew, M., Armocida, B., Arndt, M. B., Arooj, M., Artamonov, A. A., Aruleba, R. T., Arumugam, A., Ashbaugh, C., Ashemo, M. Y., Ashraf, M., Asika, M. O., Askari, E., Astell-Burt, T., Athari, S. S., Atorkey, P., Atout, M. M. d. W., Atreya, A., Aujayeb, A., Ausloos, M., Avan, A., Awotidebe, A. W., Awuviry-Newton, K., Ayala Quintanilla, B. P., Ayuso-Mateos, J. L., Azadnajafabad, S., Azevedo, R. M. S., Babu, A. S., Badar, M., Badiye, A. D., Baghdadi, S., Bagheri, N., Bah, S., Bai, R., Baker, J. L., Bakkannavar, S. M., Bako, A. T., Balakrishnan, S., Bam, K., Banik, P. C., Barchitta, M., Bardhan, M., Bardideh, E., Barker-Collo, S. L., Barqawi, H. J., Barrow, A., Barteit, S., Barua, L., Bashiri Aliabadi, S., Basiru, A., Basu, S., Basu, S., Bathini, P. P., Batra, K., Baune, B.

T., Bayileyegn, N. S., Behnam, B., Behnoush, A. H., Beiranvand, M., Bejarano Ramirez, D. F., Bell, M. L., Bello, O. O., Beloukas, A., Bensenor, I. M., Berezvai, Z., Bernabe, E., Bernstein, R. S., Bettencourt, P. J. G., Bhagavathula, A. S., Bhala, N., Bhandari, D., Bhargava, A., Bhaskar, S., Bhat, V., Bhatti, G. K., Bhatti, J. S., Bhatti, M. S., Bhatti, R., Bhutta, Z. A., Bikbov, B., Bishai, J. D., Bisignano, C., Bitra, V. R., Bjørge, T., Bodolica, V., Bodunrin, A. O., Bogale, E. K., Bonakdar Hashemi, M., Bonny, A., Bora Basara, B., Borhany, H., Boxe, C., Brady, O. J., Bragazzi, N. L., Braithwaite, D., Brant, L. C., Brauer, M., Breitner, S., Brenner, H., Brown, J., Brugha, T., Bulamu, N. B., Buonsenso, D., Burkart, K., Burns, R. A., Busse, R., Bustanji, Y., Butt, Z. A., Byun, J., Caetano dos Santos, F. L., Calina, D., Cámera, L. A., Campos-Nonato, I. R., Cao, C., Capodici, A., Carr, S., Carreras, G., Carugno, A., Carvalho, M., Castaldelli-Maia, J. M., Castañeda-Orjuela, C. A., Castelpietra, G., Catapano, A. L., Cattaruzza, M. S., Caye, A., Cegolon, L., Cembranel, F., Cenderadewi, M., Cerin, E., Chakraborty, P. A., Chan, J. S. K., Chan, R. N. C., Chandika, R. M., Chandrasekar, E. K., Charalampous, P., Chattu, V. K., Chatzimavridou-Grigoriadou, V., Chen, A. W., Chen, A.-T., Chen, C. S., Chen, H., Chen, N. M., Cheng, E. T. W., Chimed-Ochir, O., Chimoriya, R., Ching, P. R., Cho, W. C. S., Choi, S., Chong, B., Chong, Y. Y., Choudhari, S. G., Chowdhury, R., Christensen, S. W. M., Chu, D.-T., Chukwu, I. S., Chung, E., Chung, E., Chutiyami, M., Claassens, M. M., Cogen, R. M., Columbus, A., Conde, J., Cortesi, P. A., Cousin, E., Criqui, M. H., Cruz-Martins, N., Dadras, O., Dai, S., Dai, X., Dai, Z., Dalaba, M. A., Damiani, G., Das, J. K., Das, S., Dashti, M., Dávila-Cervantes, C. A., Davletov, K., De Leo, D., Debele, A. T., Debopadhaya, S., DeCleene, N. K., Deeba, F., Degenhardt, L., Del Bo, C., Delgado-Enciso, I., Demetriades, A. K., Denova-Gutiérrez, E., Dervenis, N., Desai, H. D., Desai, R., Deuba, K., Dhama, K., Dharmaratne, S. D., Dhingra, S., Dias da Silva, D., Diaz, D., Diaz, L. A., Diaz, M. J., Dima, A., Ding, D. D., Dirac, M. A., Do, T. H. P., do Prado, C. B., Dohare, S., Dominguez, R.-M. V., Dong, W., Dongarwar, D., D'Oria, M., Dorsey, E. R., Doshmangir, L., Dowou, R. K., Driscoll, T. R., Dsouza, H. L., Dsouza, V., Dube, J., Dumith, S. C., Duncan, B. B., Duraes, A. R., Duraisamy, S., Durojaiye, O. C., Dzianach, P. A., Dziedzic, A. M., Eboreime, E., Ebrahimi, A., Edinur, H. A., Edvardsson, D., Eikemo, T. A., Eini, E., Ekholuenetale, M., Ekundayo, T. C., El Sayed, I., El Tantawi, M., Elbarazi, I., Elemam, N. M., ElGohary, G. M. T., Elhadi, M., Elmeligy, O. A. A., Elnahas, G., Elshaer, M., Elsohaby, I., Engelbert Bain, L., Erkhembayar, R., Eshrati, B., Estep, K., Fabin, N., Fagbamigbe, A. F., Falzone, L., Fareed, M., Farinha, C. S. e. S., Faris, M. E. M., Faro, A., Farrokhi, P., Fatehizadeh, A., Fauk, N. K., Feigin, V. L., Feng, X., Fereshtehnejad, S.-M., Feroze, A. H., Ferreira, N., Ferreira, P. H., Fischer, F., Flavel, J., Flood, D., Flor, L. S., Foigt, N. A., Folayan, M. O., Force, L. M., Fortuna, D., Foschi, M., Franklin, R. C., Freitas, A., Fukumoto, T., Furtado, J. M., Gaal, P. A., Gadanya, M. A., Gaidhane, A. M., Gaihre, S., Galali, Y., Ganbat, M., Gandhi, A. P., Ganesan, B., Ganie, M. A., Ganiyani, M. A., Gardner, W. M., Gebi, T. G., Gebregergis, M. W., Gebrehiwot, M., Gebremariam, T. B. B., Gebremeskel, T. G., Gela, Y. Y., Georgescu, S. R., Getachew Obsa, A., Gething, P. W., Getie, M., Ghadiri, K., Ghadirian, F., Ghailan, K. Y., Ghajar, A., Ghasemi, M., Ghasempour Dabaghi, G., Ghasemzadeh, A., Ghazy, R. M., Gholamrezanezhad, A., Ghorbani, M., Ghotbi, E., Gibson, R. M., Gill, T. K., Ginindza, T. G., Girmay, A., Glasbey, J. C., Göbölös, L., Godinho, M. A., Goharinezhad, S., Goldust, M., Golechha, M., Goleij, P., Gona, P. N., Gorini, G., Goulart, A. C., Grada, A., Grivna, M., Guan, S.-Y., Guarducci, G., Gubari, M. I. M., Gudeta, M. D., Guha, A., Guicciardi, S., Gulati, S., Gulisashvili, D., Gunawardane, D. A., Guo, C., Gupta, A. K., Gupta, B., Gupta, I., Gupta, M., Gupta, R., Gupta, V. B., Gupta, V. K., Gupta, V. K., Gutiérrez, R. A., Habibzadeh, F., Habibzadeh, P., Haddadi, R., Hadi, N. R., Haep, N., Hafezi-Nejad, N., Hafiz, A., Hagins, H., Halboub, E. S., Halimi, A., Haller, S., Halwani, R., Hamilton, E. B., Hankey, G. J., Hannan, M. A., Haque, M. N., Harapan, H., Haro, J. M., Hartvigsen, J., Hasaballah, A. I., Hasan, I., Hasanian, M., Hasnain, M. S., Hassan, A., Haubold, J., Havmoeller, R. J., Hay, S. I., Hayat, K., Hebert, J. J., Hegazi, O. E., Heidari, G., Helfer, B., Hemmati, M., Hendrie, D., Henson, C. A., Hezam, K., Hiraike, Y., Hoan, N. Q., Holla, R., Hon, J., Hossain, M. M., Hosseinzadeh, H., Hosseinzadeh, M., Hostiuc, M., Hostiuc, S., Hsu, J. M., Huang, J., Hugo, F. N., Hushmandi, K., Hussain, J., Hussein, N. R., Huynh, C. K., Huynh, H.-H., Hwang, B.-F.,

Iannucci, V. C., Ihler, A. L., Ikiroma, A. I., Ikuta, K. S., Ilesanmi, O. S., Ilic, I. M., Ilic, M. D., Imam, M. T., Immurana, M., Irham, L. M., Islam, M. R., Islam, S. M. S., Islami, F., Ismail, F., Ismail, N. E., Isola, G., Iwagami, M., Iwu, C. C. D., Iyer, M., Jaafari, J., Jacobsen, K. H., Jadidi-Niaragh, F., Jafarinia, M., Jaggi, K., Jahankhani, K., Jahanmehr, N., Jahrami, H., Jain, A., Jain, N., Jairoun, A. A., Jaiswal, A., Jakovljevic, M., Jatau, A. I., Javadov, S., Javaheri, T., Jayapal, S. K., Jayaram, S., Jee, S. H., Jeganathan, J., Jeyakumar, A., Jha, A. K., Jiang, H., Jin, Y., Jonas, J. B., Joo, T., Joseph, A., Joseph, N., Joshua, C. E., Jozwiak, J. J., Jürisson, M., K, V., Kaambwa, B., Kabir, A., Kabir, Z., Kadashetti, V., Kalani, R., Kalankesh, L. R., Kaliyadan, F., Kalra, S., Kamenov, K., Kamyari, N., Kanagasabai, T., Kandel, H., Kanmanthareddy, A. R., Kanmodi, K. K., Kantar, R. S., Karaye, I. M., Karim, A., Karimi, S. E., Karimi, Y., Kasraei, H., Kassel, M. B., Kauppila, J. H., Kawakami, N., Kayode, G. A., Kazemi, F., Kazemian, S., Keikavoosi-Arani, L., Keller, C., Kempen, J. H., Kerr, J. A., Keshtkar, K., Kesse-Guyot, E., Keykhaei, M., Khajuria, H., Khalaji, A., Khalid, A., Khalid, N., Khalilian, A., Khamesipour, F., Khan, A., Khan, I., Khan, M., Khan, M. A. B., Khanmohammadi, S., Khatab, K., Khatami, F., Khatatbeh, M. M., Khater, A. M., Khayat Kashani, H. R., Khidri, F. F., Khodadoust, E., Khormali, M., Khorrami, Z., Kifle, Z. D., Kim, M. S., Kimokoti, R. W., Kisa, A., Kisa, S., Knudsen, A. K. S., Kocarnik, J. M., Kochhar, S., Koh, H. Y., Kolahi, A.-A., Kompani, F., Koren, G., Korzh, O., Kosen, S., Koulmane Laxminarayana, S. L., Krishan, K., Krishna, V., Krishnamoorthy, V., Kuate Defo, B., Kuddus, M. A., Kuddus, M., Kuitunen, I., Kulkarni, V., Kumar, M., Kumar, N., Kumar, R., Kurmi, O. P., Kusuma, D., Kyu, H. H., La Vecchia, C., Lacey, B., Ladan, M. A., Laflamme, L., Lafranconi, A., Lahariya, C., Lai, D. T. C., Lal, D. K., Lalloo, R., Lallukka, T., Lám, J., Lan, Q., Lan, T., Landires, I., Lanfranchi, F., Langguth, B., Laplante-Lévesque, A., Larijani, B., Larsson, A. O., Lasrado, S., Lauriola, P., Le, H.-H., Le, L. K. D., Le, N. H. H., Le, T. D. T., Leasher, J. L., Ledda, C., Lee, M., Lee, P. H., Lee, S.-w., Lee, S. W., Lee, W.-C., Lee, Y. H., LeGrand, K. E., Lenzi, J., Leong, E., Leung, J., Li, M.-C., Li, W., Li, X., Li, Y., Li, Y., Lim, L.-L., Lim, S. S., Lindstrom, M., Linn, S., Liu, G., Liu, R., Liu, S., Liu, W., Liu, X., Liu, X., Llanaj, E., Lo, C.-H., López-Bueno, R., Loreche, A. M., Lorenzovici, L., Lozano, R., Lubinda, J., Lucchetti, G., Lunevicius, R., Lusk, J. B., lv, h., Ma, Z. F., Machairas, N., Madureira-Carvalho, Á. M., Magaña Gómez, J. A., Maghazachi, A. A., Maharjan, P., Mahasha, P. W., Maheri, M., Mahjoub, S., Mahmoud, M. A., Mahmoudi, E., Majeed, A., Makris, K. C., Malakan Rad, E., Malhotra, K., Malik, A. A., Malik, I., Malta, D. C., Manla, Y., Mansour, A., Mansouri, P., Mansournia, M. A., Mantilla Herrera, A. M., Mantovani, L. G., Manu, E., Marateb, H. R., Mardi, P., Martinez, G., Martinez-Piedra, R., Martini, D., Martins-Melo, F. R., Martorell, M., Marx, W., Maryam, S., Marzo, R. R., Mathangasinghe, Y., Mathieson, S., Mathioudakis, A. G., Mattumpuram, J., Maugeri, A., Mayeli, M., Mazidi, M., Mazzotti, A., McGrath, J. J., McKee, M., McKowen, A. L. W., McPhail, M. A., Mehrabani-Zeinabad, K., Mehrabi Nasab, E., Mekene Meto, T., Mendoza, W., Menezes, R. G., Mensah, G. A., Mentis, A.-F. A., Meo, S. A., Meresa, H. A., Meretoja, A., Meretoja, T. J., Mersha, A. M., Mestrovic, T., Mettananda, K. C. D., Mettananda, S., Michalek, I. M., Miller, P. A., Miller, T. R., Mills, E. J., Minh, L. H. N., Mirijello, A., Mirrakhimov, E. M., Mirutse, M. K., Mirza-Aghazadeh-Attari, M., Mirzaei, M., Mirzaei, R., Misganaw, A., Mishra, A. K., Mitchell, P. B., Mittal, C., Moazen, B., Moberg, M. E., Mohamed, J., Mohamed, M. F. H., Mohamed, N. S., Mohammadi, E., Mohammadi, S., Mohammed, H., Mohammed, S., Mohammed, S., Mohr, R. M., Mokdad, A. H., Molinaro, S., Momtazmanesh, S., Monasta, L., Mondello, S., Moodi Ghalibaf, A., Moradi, M., Moradi, Y., Moradi-Lakeh, M., Moraga, P., Morawska, L., Moreira, R. S., Morovatdar, N., Morrison, S. D., Morze, J., Mosapour, A., Mosser, J. F., Mossialos, E., Motappa, R., Mougin, V., Mouodi, S., Mrejen, M., Msherghi, A., Mubarik, S., Mueller, U. O., Mulita, F., Munjal, K., Murillo-Zamora, E., Murlimanju, B. V., Mustafa, G., Muthu, S., Muzaffar, M., Myung, W., Nagarajan, A. J., Naghavi, P., Naik, G. R., Nainu, F., Nair, S., Najmuldeen, H. H. R., Nangia, V., Naqvi, A. A., Narayana, A. I., Nargus, S., Nascimento, G. G., Nashwan, A. J., Nasrollahizadeh, A., Nasrollahizadeh, A., Natto, Z. S., Nayak, B. P., Nayak, V. C., Nduaguba, S. O., Negash, H., Negoi, I., Negoi, R. I., Nejadghaderi, S. A., Nesbit, O. D., Netsere, H. B., Ng, M., Nguefack-Tsague, G., Ngunjiri, J. W., Nguyen, D. H., Nguyen, H. Q.,

Niazi, R. K., Nikolouzakis, T. K., Nikoobar, A., Nikoomanesh, F., Nikpoor, A. R., Nnaji, C. A., Nnyanzi, L. A., Noman, E. A., Nomura, S., Norrving, B., Nri-Ezedi, C. A., Ntaios, G., Ntsekhe, M., Nurrika, D., Nzoputam, C. I., Nzoputam, O. J., Oancea, B., Odetokun, I. A., O'Donnell, M. J., Oguntade, A. S., Oguta, J. O., Okati-Aliabad, H., Okeke, S. R., Okekunle, A. P., Okonji, O. C., Olagunju, A. T., Olasupo, O. O., Olatubi, M. I., Oliveira, G. M. M., Olufadewa, I. I., Olusanya, B. O., Olusanya, J. O., Omar, H. A., Omer, G. L., Omonisi, A. E. E., Onie, S., Onwujekwe, O. E., Ordak, M., Orish, V. N., Ortega-Altamirano, D. V., Ortiz, A., Ortiz-Brizuela, E., Osman, W. M. S., Ostroff, S. M., Osuagwu, U. L., Otoiu, A., Otstavnov, N., Otstavnov, S. S., Ouyahia, A., Ouyang, G., Owolabi, M. O., P A, M. P., Padron-Monedero, A., Padubidri, J. R., Palicz, T., Palladino, C., Pan, F., Pandi-Perumal, S. R., Pangaribuan, H. U., Panos, G. D., Panos, L. D., Pantea Stoian, A. M., Pardhan, S., Parikh, R. R., Pashaei, A., Pasovic, M., Passera, R., Patel, J., Patel, S. K., Patil, S., Patoulias, D., Patthipati, V. S., Pawar, S., Pazoki Toroudi, H., Pease, S. A., Peden, A. E., Pedersini, P., Peng, M., Pensato, U., Pepito, V. C. F., Peprah, E. K., Peprah, P., Perdigão, J., Pereira, M. O., Perianayagam, A., Perico, N., Pesudovs, K., Petermann-Rocha, F. E., Petri, W. A., Pham, H. T., Philip, A. K., Phillips, M. R., Pigeolet, M., Pigott, D. M., Pillay, J. D., Piracha, Z. Z., Pirouzpanah, S., Plass, D., Plotnikov, E., Poddighe, D., Polinder, S., Postma, M. J., Pourtaheri, N., Prada, S. I., Pradhan, P. M. S., Prakash, V., Prasad, M., Prates, E. J. S., Priscilla, T., Pritchett, N., Puri, P., Puvvula, J., Qasim, N. H., Qattea, I., Qazi, A. S., Qian, G., Rabiee Rad, M., Radhakrishnan, R. A., Radhakrishnan, V., Raeisi Shahraki, H., Rafferty, Q., Raggi, A., Raghav, P. R., Rahim, M. J., Rahman, M. M., Rahman, M. H. U., Rahman, M., Rahman, M. A., Rahmani, S., Rahmanian, M., Rahmawaty, S., Rajaa, S., Ramadan, M. M., Ramasamy, S. K., Ramasubramani, P., Ramazanu, S., Rana, K., Ranabhat, C. L., Rancic, N., Rane, A., Rao, C. R., Rao, K., Rao, M., Rao, S. J., Rashidi, M.-M., Rathnaiah Babu, G., Rauniyar, S. K., Rawaf, D. L., Rawaf, S., Razo, C., Reddy, M. M. R. K., Redwan, E. M. M., Reifels, L., Reiner Jr, R. C., Remuzzi, G., Renzaho, A. M. N., Reshmi, B., Reyes, L. F., Rezaei, N., Rezaei, N., Rezaei, N., Rezaei Hachesu, P., Rezaeian, M., Rickard, J., Rodrigues, C. F., Rodriguez, J. A. B., Roever, L., Ronfani, L., Roshandel, G., Rotimi, K., Rout, H. S., Roy, B., Roy, N., Roy, P., Rubagotti, E., S N, C., Saad, A. M. A., Saber-Ayad, M. M., Sabour, S., Sacco, S., Sachdev, P. S., Saddik, B., Saddler, A., Sadee, B. A., Sadeghi, E., Sadeghi, M., Saeb, M. R., Saeed, U., Safi, S. Z., Sagar, R., Sagoe, D., Saif, Z., Sajid, M. R., Sakshaug, J. W., Salam, N., Salami, A. A., Salaroli, L. B., Saleh, M. A., Salem, M. R., Salem, M. Z. Y., Sallam, M., Samadzadeh, S., Samargandy, S., Samodra, Y. L., Samy, A. M., Sanabria, J., Sanna, F., Santos, I. S., Santric-Milicevic, M. M., Sarasmita, M. A., Sarikhani, Y., Sarmiento-Suárez, R., Sarode, G. S., Sarode, S. C., Sarveazad, A., Sathian, B., Sathyanarayan, A., Satpathy, M., Sawhney, M., Scarmeas, N., Schaarschmidt, B. M., Schmidt, M. I., Schneider, I. J. C., Schumacher, A. E., Schwebel, D. C., Schwendicke, F., Sedighi, M., Senapati, S., Senthilkumaran, S., Sepanlou, S. G., Sethi, Y., Setoguchi, S., Seylani, A., Shadid, J., Shafie, M., Shah, H., Shah, N. S., Shah, P. A., Shahbandi, A., Shahid, S., Shahid, W., Shahwan, M. J., Shaikh, M. A., Shakeri, A., Shalash, A. S., Sham, S., Shamim, M. A., Shamshirgaran, M. A., Shamsi, M. A., Shanawaz, M., Shankar, A., Shannawaz, M., Sharath, M., Sharifan, A., Sharifi-Rad, J., Sharma, M., Sharma, R., Sharma, S., Sharma, U., Sharma, V., Shastry, R. P., Shavandi, A., Shayan, A. M., Shayan, M., Shehabeldine, A. M. E., Shetty, P. H., Shibuya, K., Shifa, J. E., Shiferaw, D., Shiferaw, W. S., Shigematsu, M., Shiri, R., Shitaye, N. A., Shittu, A., Shivakumar, K. M., Shivarov, V., Shokati Eshkiki, Z., Shool, S., Shrestha, S., Shuval, K., Sibhat, M. M., Siddig, E. E., Sigfusdottir, I. D., Silva, D. A. S., Silva, J. P., Silva, L. M. L. R., Silva, S., Simpson, C. R., Singal, A., Singh, A., Singh, B. B., Singh, H., Singh, J. A., Singh, M., Singh, P., Skou, S. T., Sleet, D. A., Slepak, E. L. N., Solanki, R., Soliman, S. S. M., Song, S., Song, Y., Sorensen, R. J. D., Soriano, J. B., Soyiri, I. N., Spartalis, M., Sreeramareddy, C. T., Stark, B. A., Starodubova, A. V., Stein, C., Stein, D. J., Steiner, C., Steiner, T. J., Steinmetz, J. D., Steiropoulos, P., Stockfelt, L., Stokes, M. A., Subedi, N. S., Subramaniyan, V., Suemoto, C. K., Suleman, M., Suliankatchi Abdulkader, R., Sultana, A., Sundström, J., Swain, C. K., Szarpak, L., Tabaee Damavandi, P., Tabarés-Seisdedos, R., Tabatabaei Malazy, O., Tabatabaeizadeh, S.-A., Tabatabai, S., Tabche, C., Tabish, M., Tadakamadla, S. K., Taheri Abkenar, Y., Taheri

Soodejani, M., Taherkhani, A., Taiba, J., Talaat, I. M., Talukder, A., Tampa, M., Tamuzi, J. L., Tan, K.-K., Tandukar, S., Tang, H., Tavakoli Oliaee, R., Tavangar, S. M., Teimoori, M., Temsah, M.-H., Teramoto, M., Thangaraju, P., Thankappan, K. R., Thapar, R., Thayakaran, R., Thirunavukkarasu, S., Thomas, N., Thomas, N. K., Thum, C. C. C., Tichopad, A., Ticoalu, J. H. V., Tillawi, T., Tiruye, T. Y., Tobe-Gai, R., Tonelli, M., Topor-Madry, R., Torre, A. E., Touvier, M., Tovani-Palone, M. R., Tran, J. T., Tran, M. T. N., Tran, N. M., Tran, N.-H., Trico, D., Tromans, S. J., Truyen, T. T. T. T., Tsatsakis, A., Tsegay, G. M., Tsermpini, E. E., Tumurkhuu, M., Tyrovolas, S., Udoh, A., Umair, M., Umakanthan, S., Umar, T. P., Undurraga, E. A., Unim, B., Unnikrishnan, B., Unsworth, C. A., Upadhyay, E., Urso, D., Usman, J. S., Vahabi, S. M., Vaithinathan, A. G., Van den Eynde, J., Varga, O., Varma, R. P., Vart, P., Vasankari, T. J., Vasic, M., Vaziri, S., Vellingiri, B., Venketasubramanian, N., Veroux, M., Verras, G.-I., Vervoort, D., Villafañe, J. H., Violante, F. S., Vlassov, V., Vollset, S. E., Volovat, S. R., Vongpradith, A., Waheed, Y., Wang, C., Wang, F., Wang, N., Wang, S., Wang, Y., Wang, Y.-P., Ward, P., Wassie, E. G., Weaver, M. R., Weerakoon, K. G., Weintraub, R. G., Weiss, D. J., Weldemariam, A. H., Wells, K. M., Wen, Y. F., Whisnant, J. L., Whiteford, H. A., Wiangkham, T., Wickramasinghe, D. P., Wickramasinghe, N. D., Wilandika, A., Wilkerson, C., Willeit, P., Wimo, A., Woldegebreal, D. H., Wolf, A. W., Wong, Y. J., Woolf, A. D., Wu, C., Wu, F., Wu, X., Wu, Z., Wulf Hanson, S., Xia, Y., Xiao, H., Xu, X., Xu, Y. Y., Yadav, L., Yadollahpour, A., Yaghoubi, S., Yamagishi, K., Yang, L., Yano, Y., Yao, Y., Yaribeygi, H., Yazdanpanah, M. H., Ye, P., Yehualashet, S. S., Yesuf, S. A., Yezli, S., Yiğit, A., Yiğit, V., Yigzaw, Z. A., Yismaw, Y., Yon, D. K., Yonemoto, N., Younis, M. Z., Yu, C., Yu, Y., Yusuf, H., Zahid, M. H., Zakham, F., Zaki, L., Zaki, N., Zaman, B. A., Zamora, N., Zand, R., Zandieh, G. G. Z., Zar, H. J., Zarrintan, A., Zastrozhin, M. S., Zhang, H., Zhang, N., Zhang, Y., Zhao, H., Zhong, C., Zhong, P., Zhou, J., Zhu, Z., Ziafati, M., Zielińska, M., Zimsen, S. R. M., Zoladl, M., Zumla, A., Zyoud, S. H., Vos, T., & Murray, C. J. L. (2024). Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. *The Lancet*, *403*(10440), 2133-2161. https://doi.org/10.1016/S0140-6736(24)00757-8

Ferreira, P. H., Beckenkamp, P., Maher, C. G., Hopper, J. L., & Ferreira, M. L. (2013). Nature or nurture in low back pain? Results of a systematic review of studies based on twin samples. *European Journal of Pain*, *17*(7), 957-971. https://doi.org/10.1002/j.1532-2149.2012.00277.x

Finley, C. R., Chan, D. S., Garrison, S., Korownyk, C., Kolber, M. R., Campbell, S., Eurich, D. T., Lindblad, A. J., Vandermeer, B., & Allan, G. M. (2018). What are the most common conditions in primary care? Systematic review. *Can Fam Physician*, *64*(11), 832-840.

Fluharty, M., Taylor, A. E., Grabski, M., & Munafò, M. R. (2017). The Association of Cigarette Smoking With Depression and Anxiety: A Systematic Review. *Nicotine Tob Res*, *19*(1), 3-13. https://doi.org/10.1093/ntr/ntw140

Heneweer, H., Vanhees, L., & Picavet, S. J. H. (2009). Physical activity and low back pain: A U-shaped relation? *Pain*, *143*(1), 21-25. https://doi.org/10.1016/j.pain.2008.12.033

Hestbaek, L., Leboeuf-Yde, C., & Kyvik, K. O. (2006). Are lifestyle-factors in adolescence predictors for adult low back pain? A cross-sectional and prospective study of young twins [journal article]. *BMC Musculoskeletal Disorders*, *7*(1), 27. https://doi.org/10.1186/1471-2474-7-27

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Hazen, N., Herman, J., Adams Hillard, P. J., Katz, E. S., Kheirandish-Gozal, L., Neubauer, D. N., O'Donnell, A. E., Ohayon, M., Peever, J., Rawding, R., Sachdeva, R. C., Setters, B., Vitiello, M. V., & Ware, J. C. (2015). National Sleep Foundation's updated sleep duration recommendations: final report. *Sleep Health: Journal of the National Sleep Foundation*, *1*(4), 233-243. https://doi.org/10.1016/j.sleh.2015.10.004

Hysing, M., Pallesen, S., Stormark, K. M., Jakobsen, R., Lundervold, A. J., & Sivertsen, B. (2015). Sleep and use of electronic devices in adolescence: results from a large population-based study. *BMJ Open*, *5*(1), e006748. https://doi.org/10.1136/bmjopen-2014-006748

IHME. (2024). *GBD Results 2021*. Seattle, WA: Institute for Health Metrics and Evaluation, University of Washington Retrieved from https://vizhub.healthdata.org/gbd-results/
Inocencio, J. D. (2004). Epidemiology of musculoskeletal pain in primary care. *Arch Dis Child*, *89*(5), 431-434. https://doi.org/10.1136/adc.2003.028860
Jahre, H., Grotle, M., Smedbråten, K., Dunn, K. M., & Øiestad, B. E. (2020). Risk factors for non-specific neck pain in young adults. A systematic review. *BMC Musculoskeletal Disorders*, *21*(1), 366-366. https://doi.org/10.1186/s12891-020-03379-y
Jahre, H., Grotle, M., Smedbråten, K., Richardsen, K. R., Bakken, A., & Øiestad, B. E. (2021a). Neck and shoulder pain in adolescents seldom occur alone: Results from the Norwegian Ungdata Survey. *European Journal of Pain*, *25*(8), 1751-1759. https://doi.org/10.1002/ejp.1785
Jahre, H., Grotle, M., Småstuen, M., Guddal, M. H., Smedbråten, K., Richardsen, K. R., Stensland, S., Storheim, K., & Øiestad, B. E. (2021b). Risk factors and risk profiles for neck pain in young adults: Prospective analyses from adolescence to young adulthood—The North-Trøndelag Health Study. *PLOS ONE*, *16*(8), e0256006. https://doi.org/10.1371/journal.pone.0256006
Kinge, J. M., Knudsen, A. K., Skirbekk, V., & Vollset, S. E. (2015). Musculoskeletal disorders in Norway: prevalence of chronicity and use of primary and specialist health care services. *BMC Musculoskelet Disord*, *16*, 75. https://doi.org/10.1186/s12891-015-0536-z
Kinge, J. M., Sælensminde, K., Dieleman, J., Vollset, S. E., & Norheim, O. F. (2017). Economic losses and burden of disease by medical conditions in Norway. *Health Policy*, *121*(6), 691-698. https://doi.org/10.1016/j.healthpol.2017.03.020
Kurtze, N., Rangul, V., Hustvedt, B.-E., & Flanders, W. D. (2008). Reliability and validity of self-reported physical activity in the Nord-Trøndelag Health Study — HUNT 1. *Scandinavian Journal of Public Health*, *36*(1), 52-61. https://doi.org/10.1177/1403494807085373
Li, C., & Sun, J. (2022). The impact of current smoking, regular drinking, and physical inactivity on health care-seeking behavior in China. *BMC Health Services Research*, *22*(1), 52. https://doi.org/10.1186/s12913-022-07462-z
Lindell, M., & Grimby-Ekman, A. (2022). Stress, non-restorative sleep, and physical inactivity as risk factors for chronic pain in young adults: A cohort study. *PLOS ONE*, *17*(1), e0262601. https://doi.org/10.1371/journal.pone.0262601
Lunde, L.-K., Koch, M., Hanvold, T. N., Wærsted, M., & Veiersted, K. B. (2015). Low back pain and physical activity – A 6.5 year follow-up among young adults in their transition from school to working life. *BMC Public Health*, *15*(1), 1115. https://doi.org/10.1186/s12889-015-2446-2
Mitchell, T., O'Sullivan, P. B., Burnett, A., Straker, L., Smith, A., Thornton, J., & Rudd, C. J. (2010). Identification of modifiable personal factors that predict new-onset low back pain: a prospective study of female nursing students. *Clin J Pain*, *26*(4), 275-283. https://doi.org/10.1097/AJP.0b013e3181cd16e1
Moholdt, T., Wisløff, U., Lydersen, S., & Nauman, J. (2014). Current physical activity guidelines for health are insufficient to mitigate long-term weight gain: more data in the fitness versus fatness debate (The HUNT study, Norway). *Br J Sports Med*, *48*(20), 1489-1496. https://doi.org/10.1136/bjsports-2014-093416
Ning, K., Gondek, D., Patalay, P., & Ploubidis, G. B. (2020). The association between early life mental health and alcohol use behaviours in adulthood: A systematic review. *PLOS ONE*, *15*(2), e0228667. https://doi.org/10.1371/journal.pone.0228667
Noble, N., Paul, C., Turon, H., & Oldmeadow, C. (2015). Which modifiable health risk behaviours are related? A systematic review of the clustering of Smoking, Nutrition, Alcohol and Physical activity ('SNAP') health risk factors. *Prev Med*, *81*, 16-41. https://doi.org/10.1016/j.ypmed.2015.07.003
Parto, D. N., Wong, A. Y. L., & Macedo, L. (2023). Prevalence of musculoskeletal disorders and associated risk factors in canadian university students. *BMC Musculoskeletal Disorders*, *24*(1), 501. https://doi.org/10.1186/s12891-023-06630-4
Power, J. D., Perruccio, A. V., Paterson, J. M., Canizares, M., Veillette, C., Coyte, P. C., Badley, E. M., Mahomed, N. N., & Rampersaud, Y. R. (2022). Healthcare utilization and costs for

musculoskeletal disorders in Ontario, Canada. *J Rheumatol*, *49*(7), 740-747. https://doi.org/10.3899/jrheum.210938

Puroila, A., Paananen, M., Taimela, S., Jarvelin, M. R., & Karppinen, J. (2015). Lifestyle-factors in adolescence as predictors of number of musculoskeletal pain sites in adulthood: a 17-year follow-up study of a birth cohort. *Pain Medicine*, *16*(6), 1177-1185. https://doi.org/10.1111/pme.12697

Rathleff, M. S., Skuldbøl, S. K., Rasch, M. N. B., Roos, E. M., Rasmussen, S., & Olesen, J. L. (2013). Care-seeking behaviour of adolescents with knee pain: a population-based study among 504 adolescents. *BMC Musculoskeletal Disorders*, *14*(1), 225. https://doi.org/10.1186/1471-2474-14-225

Reichard, A., Gulley, S. P., Rasch, E. K., & Chan, L. (2015). Diagnosis isn't enough: Understanding the connections between high health care utilization, chronic conditions and disabilities among U.S. working age adults. *Disabil Health J*, *8*(4), 535-546. https://doi.org/10.1016/j.dhjo.2015.04.006

Rhim, H. C., Tenforde, A., Mohr, L., Hollander, K., Vogt, L., Groneberg, D. A., & Wilke, J. (2022). Association between physical activity and musculoskeletal pain: an analysis of international data from the ASAP survey. *BMJ Open*, *12*(9), e059525. https://doi.org/10.1136/bmjopen-2021-059525

Sagelv, E. H., Ekelund, U., Hopstock, L. A., Fimland, M. S., Løvsletten, O., Wilsgaard, T., & Morseth, B. (2021). The bidirectional associations between leisure time physical activity change and body mass index gain. The Tromsø Study 1974–2016. *International Journal of Obesity*, *45*(8), 1830-1843. https://doi.org/10.1038/s41366-021-00853-y

Saunders, J. B., Aasland, O. G., Babor, T. F., de la Fuente, J. R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption--II. *Addiction*, *88*(6), 791-804. https://doi.org/10.1111/j.1360-0443.1993.tb02093.x

Serbic, D., Friedrich, C., & Murray, R. (2023). Psychological, social and academic functioning in university students with chronic pain: A systematic review. *Journal of American College Health*, *71*(9), 2894-2908. https://doi.org/10.1080/07448481.2021.2006199

Sivertsen, B., Råkil, H., Munkvik, E., & Lønning, K. J. (2019). Cohort profile: the SHoT-study, a national health and well-being survey of Norwegian university students. *BMJ Open*, *9*(1), e025200. https://doi.org/10.1136/bmjopen-2018-025200

Smedbråten, K., Grotle, M., Jahre, H., Richardsen, K. R., Côté, P., A., S. Ó., Storheim, K., Nielsen, C. S., & Øiestad, B. E. (2022a). Accumulation of health complaints is associated with persistent musculoskeletal pain two years later in adolescents: The Fit Futures study. *PLOS ONE*, *17*(12), e0278906. https://doi.org/10.1371/journal.pone.0278906

Smedbråten, K., Grotle, M., Jahre, H., Richardsen, K. R., Småstuen, M. C., Skillgate, E., & Øiestad, B. E. (2022b). Lifestyle behaviour in adolescence and musculoskeletal pain 11 years later: The Trøndelag Health Study. *European Journal of Pain*, *26*(9), 1910-1922. https://doi.org/10.1002/ejp.2012

Smith, A., Beales, D., O'Sullivan, P., Bear, N., & Straker, L. (2017). Low Back Pain With Impact at 17 Years of Age Is Predicted by Early Adolescent Risk Factors From Multiple Domains: Analysis of the Western Australian Pregnancy Cohort (Raine) Study. *J Orthop Sports Phys Ther*, *47*(10), 752-762. https://doi.org/10.2519/jospt.2017.7464

Smith, M. D., Russell, A., & Hodges, P. W. (2009). Do incontinence, breathing difficulties, and gastrointestinal symptoms increase the risk of future back pain? *The Journal of Pain*, *10*(8), 876-886. https://doi.org/10.1016/j.jpain.2009.03.003

StataCorp. (2023). *Stata Statistical Software: Release 18.* . StataCorp LLC.

Su, C. A., Kusin, D. J., Li, S. Q., Ahn, U. M., & Ahn, N. U. (2018). The Association Between Body Mass Index and the Prevalence, Severity, and Frequency of Low Back Pain: Data From the Osteoarthritis Initiative. *Spine*, *43*(12), 848-852. https://doi.org/10.1097/brs.0000000000002601

Suikkanen, S., Pihlajamaki, H., Parviainen, M., Kautiainen, H., & Kiviranta, I. (2023). Prevalence of and Risk Factors for Back Pain Among Young Male Conscripts During Compulsory Finnish Military Service. *Military Medicine*, *188*(3-4), e739-e744. https://doi.org/10.1093/milmed/usab375

Suris, J.-C., & Parera, N. (2005). Sex, drugs and chronic illness: health behaviours among chronically ill youth. *European Journal of Public Health*, *15*(5), 484-488. https://doi.org/10.1093/eurpub/cki001

Swain, M. S., Henschke, N., Kamper, S. J., Gobina, I., Ottová-Jordan, V., & Maher, C. G. (2014). An international survey of pain in adolescents. *BMC Public Health*, *14*(1), 447. https://doi.org/10.1186/1471-2458-14-447

Taylor, A. E., Richmond, R. C., Palviainen, T., Loukola, A., Wootton, R. E., Kaprio, J., Relton, C. L., Davey Smith, G., & Munafò, M. R. (2019). The effect of body mass index on smoking behaviour and nicotine metabolism: a Mendelian randomization study. *Hum Mol Genet*, *28*(8), 1322-1330. https://doi.org/10.1093/hmg/ddy434

Tsai, M.-C., Lee, C.-C., Liu, S.-C., Tseng, P.-J., & Chien, K.-L. (2020). Combined healthy lifestyle factors are more beneficial in reducing cardiovascular disease in younger adults: a meta-analysis of prospective cohort studies. *Scientific Reports*, *10*(1), 18165. https://doi.org/10.1038/s41598-020-75314-z

von Elm, E., Altman, D. G., Egger, M., Pocock, S. J., Gøtzsche, P. C., & Vandenbroucke, J. P. (2008). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *J Clin Epidemiol*, *61*(4), 344-349. https://doi.org/10.1016/j.jclinepi.2007.11.008

Wong, A. Y. L., Chan, L. L. Y., Lo, C. W. T., Chan, W. W. Y., Lam, K. C. K., Bao, J. C. H., Ferreira, M. L., & Armijo-Olivo, S. (2021). Prevalence/Incidence of Low Back Pain and Associated Risk Factors Among Nursing and Medical Students: A Systematic Review and Meta-Analysis. *Pm r*, *13*(11), 1266-1280. https://doi.org/10.1002/pmrj.12560

Zhang, Y., Pan, X.-F., Chen, J., Xia, L., Cao, A., Zhang, Y., Wang, J., Li, H., Yang, K., Guo, K., He, M., & Pan, A. (2020a). Combined lifestyle factors and risk of incident type 2 diabetes and prognosis among individuals with type 2 diabetes: a systematic review and meta-analysis of prospective cohort studies. *Diabetologia*, *63*(1), 21-33. https://doi.org/10.1007/s00125-019-04985-9

Zhang, Y. B., Pan, X. F., Chen, J., Cao, A., Zhang, Y. G., Xia, L., Wang, J., Li, H., Liu, G., & Pan, A. (2020b). Combined lifestyle factors, incident cancer, and cancer mortality: a systematic review and meta-analysis of prospective cohort studies. *British Journal of Cancer*, *122*(7), 1085-1093. https://doi.org/10.1038/s41416-020-0741-x

Zou, G. (2004). A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol*, *159*(7), 702-706. https://doi.org/10.1093/aje/kwh090

Øiestad, B. E., Hilde, G., Tveter, A. T., Peat, G. G., Thomas, M. J., Dunn, K. M., & Grotle, M. (2020). Risk factors for episodes of back pain in emerging adults. A systematic review. *European Journal of Pain*, *24*(1), 19-38. https://doi.org/10.1002/ejp.1474