International Journal of Nutrology
(Official Journal of the ABRAN - Brazilian Association of Nutrology)

ORIGINAL ARTICLE

DOI: 10.54448/ijn26402

Cross-sectional study on the work-related musculoskeletal disorders among secondary school teachers in Kirkuk City: prevalence, occupational risk factors, and nutritional status

Marwah Ali Khalaf[1,*], Omed HamaRasheed Mehammed-Ameen[1], Jenan Akbar Shakoor[1], Faeza Fakhradeen Basas[2], Darea Yaseen Mostafa[2], Nashwan Nadhem Hasan[1], Soad Mohamed Habeeb[2]

[1] University of Kirkuk. College of Nursing. Community Health Nursing Department, Kirkuk, Iraq.
[2] University of Kirkuk. College of Nursing. Maternity and child Health Nursing Department, Kirkuk, Iraq.

*Corresponding author: Marwah Ali Khalaf.
University of Kirkuk. College of Nursing. Community Health Nursing Department, Kirkuk, Iraq.
E-mail: marwaalik@uokirkuk.edu.iq
DOI: https://doi.org/10.54448/ijn26402
Received: 06-15-2026; Revised: 08-24-2026; Accepted: 09-11-2026; Published: 09-25-2026; IJN-id: e26402

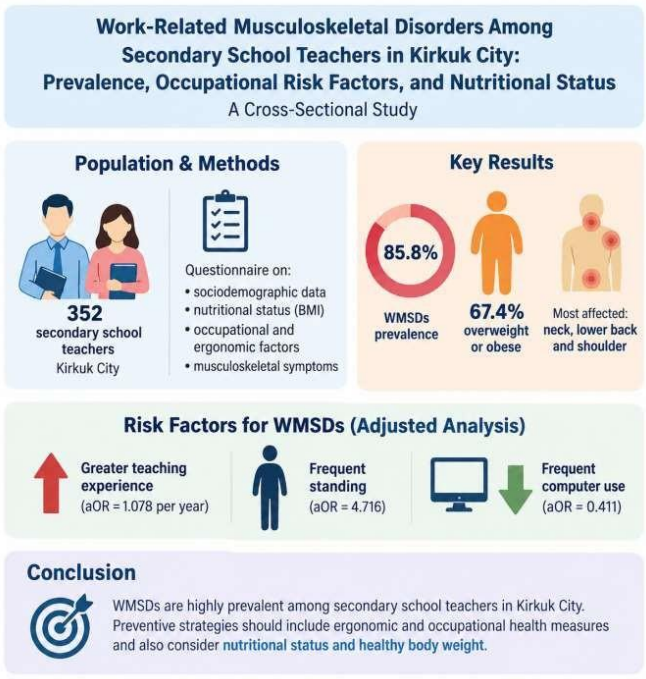
Editor: Dr. Luis Alberto Moreno Aznar, MD, Ph.D.

Abstract

Introduction: Work-related musculoskeletal disorders (WMSDs) represent a major occupational health concern among teachers globally; however, evidence from Iraq remains limited. This study aimed to estimate the 12-month prevalence of WMSDs and determine the occupational, ergonomic, and nutritional-status-related factors associated with these disorders among secondary school teachers in Kirkuk City. **Methods:** A cross-sectional descriptive-analytical study was conducted among 352 teachers working in public secondary schools in Kirkuk City. Data were obtained through a structured, self-administered questionnaire assessing socio-demographic characteristics, and anthropometric and nutritional status indicators, occupational and ergonomic factors, musculoskeletal symptoms affecting nine anatomical regions. Statistical analysis was performed using SPSS version 27. Associations were examined using the Mann-Whitney U test, chi-square or Fisher's exact test, and multivariable binary logistic regression. Statistical significance was established at $p<0.05$. **Results:** The overall 12-month prevalence of WMSDs was 85.8%. Overall, 67.4% of teachers were overweight or obese. The neck (69.3%), lower back (65.1%), and shoulder (64.8%) were the most frequently affected anatomical regions. Female teachers had a significantly higher prevalence than male teachers (91.0% vs 81.6%, p=0.012). In the adjusted regression model, greater teaching experience (aOR=1.078 per year) and frequent standing during teaching (aOR=4.716) were independently associated with higher odds of WMSDs. In contrast, frequent computer use was associated with reduced odds (aOR = 0.411). Despite the high prevalence of symptoms, only 43.7% of affected teachers sought medical care, and 23.6% had received ergonomic training. **Conclusion:** WMSDs are highly prevalent among secondary school teachers in Kirkuk City, with women experiencing a disproportionate burden. The findings suggest that cumulative occupational exposure and prolonged standing are important contributors to WMSDs, highlighting the need for improved ergonomic training and occupational health support and integrated health-promotion strategies that also consider nutritional status and healthy body weight within the education sector.

Keywords: Musculoskeletal Diseases. Nutritional Status. Body Mass Index. Occupational Health. Teachers. Risk Factors.

Graphical Abstract



Source: Own authorship.

Introduction

Musculoskeletal disorders (MSDs) are a major source of disability worldwide and affect multiple structures of the musculoskeletal system, including muscles, joints, ligaments, tendons, bones, and nerves. These disorders commonly develop progressively following repeated exposure to biomechanical and psychosocial demands in the workplace **[1,2]**. Recent findings from the Global Burden of Disease Study estimated that 1.686 billion people were living with MSDs globally in 2021, representing a 95% increase compared with 1990, with the number projected to reach 2.161 billion by 2035 **[3]**. Teachers are considered an occupational group at considerable risk because teaching frequently involves prolonged standing, sustained neck flexion, awkward trunk positions, computer use, grading, overhead writing on boards, and repetitive upper-limb movements, all of which may place considerable static and dynamic stress on the spine and upper extremities **[4,5]**.

Evidence from the teacher-specific literature demonstrates a substantial but heterogeneous burden of work-related musculoskeletal disorders (WMSDs). Previous research has estimated the prevalence of self-reported WMSDs among school teachers to range from 39% to 95% **[6]**. In a systematic review and meta-analysis involving 44 studies and 15,972 teachers, the pooled prevalence of WMSDs was estimated at 68%, with the neck and lower back each reported in 47% of teachers and the shoulder in 44% **[7]**. However, individual studies have reported considerably higher prevalence levels. For example, 66.77% of teachers in Cairo, Egypt, reported WMSDs during the preceding 12 months, with the neck, shoulders, lower back, and knees being the most frequently affected areas **[2]**. Studies among secondary school teachers in Hail, Saudi Arabia reported prevalence rates of 87.3% and 93.63%, with lower back and shoulder symptoms particularly common and multisite complaints frequently observed **[1,5]**. Comparable high levels of WMSDs have also been documented among teachers in Douala, Cameroon and Damascus, Syria, where the lower back, neck, and shoulder were among the principal sites of symptoms **[8,9]**.

The development of WMSDs among teachers is multifactorial, influenced by physical, ergonomic, individual, and psychosocial factors. Common occupational and ergonomic exposures include awkward or prolonged static postures, elevated arm positions, extended periods of standing or sitting, repetitive movements, and inappropriate furniture or workstation design. These conditions may increase mechanical loading and contribute to adverse biomechanical changes over time **[4,7]**. Individual characteristics also appear to influence risk. Female teachers have consistently demonstrated a higher prevalence of WMSDs **[1,9]**, while age, body mass index, years of professional experience, and longer working hours have also been associated with increased risk in several studies **[7,8]**. Nutritional status, particularly BMI, may also influence musculoskeletal health and WMSDs. Other factors may vary across educational contexts and include smoking, large class sizes, heavy teaching workloads, and inadequate physical activity **[2,9]**.

In addition to physical and ergonomic exposures, psychosocial working conditions may further contribute to musculoskeletal problems. Among teachers, inadequate supervisory support and unfavourable psychosocial work environments have been linked to WMSDs **[10]**. More broadly, longitudinal evidence across occupational groups indicates that job demands, degree of job control, and workplace social support are significantly associated with the development and progression of MSDs **[11]**. These findings suggest that effective prevention may require interventions that address not only ergonomic hazards but also organizational and psychosocial aspects of the work environment.

Despite the growing international evidence, significant gaps remain in the literature. The available research is geographically uneven, with teacher-focused studies conducted in countries such as Saudi Arabia, Egypt, Syria, and Cameroon. At the same time,

reliable occupational health evidence remains limited across much of the Middle East and North Africa (MENA) region. Weak population-based health information systems and the limited availability of context-specific occupational research further restrict understanding of the problem **[12]**. In Iraq, in particular, research on musculoskeletal health among teachers appears to be very limited. Existing studies in Iraq and the Kurdistan Region have predominantly examined healthcare workers rather than educational professionals, including research on governmental hospital staff in Duhok Governorate **[13]**. Consequently, the occupational musculoskeletal health of teachers remains insufficiently investigated.

Another important issue is the variation in the anatomical distribution of WMSDs across different settings. Although the neck and lower back are consistently identified as the most commonly affected regions in meta-analytic research, individual studies have reported different dominant symptom sites. In some settings, lower back disorders predominate, whereas in others, neck complaints are more frequent **[7,8]**. Such differences may reflect variations in school environments, teaching practices, workload, classroom design, and other contextual factors. Therefore, findings from other countries cannot necessarily be assumed to apply directly to teachers working in Iraq.

These knowledge gaps provide a strong rationale for investigating WMSDs among secondary school teachers in Kirkuk City. From a scientific perspective, the study can provide setting-specific evidence from an under-researched Iraqi population and contribute to the limited occupational musculoskeletal data available in the region. From an occupational perspective, teachers are fundamental to the education system, yet WMSDs may negatively influence work performance, increase absenteeism, and contribute to premature withdrawal from the teaching profession **[1,5]**. From a clinical and social perspective, musculoskeletal symptoms may adversely affect both physical and mental quality of life, as demonstrated among teachers in Cairo **[2]**. The high prevalence reported across different settings therefore supports the need to shift from a predominantly reactive approach toward preventive occupational health strategies **[7]**.

Identifying the determinants of WMSDs in Kirkuk may also provide a basis for targeted interventions. If the identified risk factors are consistent with those reported internationally, they could support measures such as ergonomic modifications, a review of workload and teaching practices, occupational health screening, and health-promotion interventions addressing obesity, smoking, and insufficient physical activity **[11,12]**. Conversely, if locally specific risk factors are identified, the findings could provide important evidence to inform the design of interventions better adapted to the Iraqi educational context.

Accordingly, this study seeks to answer three main research questions: **[1]** What is the 12-month prevalence of WMSDs among secondary school teachers in Kirkuk City, both overall and according to anatomical region? **[2]** Which sociodemographic, nutritional-status-related, occupational, and ergonomic characteristics are significantly associated with WMSDs in this population? **[3]** Which factors remain independently associated with WMSDs after adjustment for potential confounding variables through multivariable analysis?

The study hypothesizes that WMSDs are highly prevalent among secondary school teachers in Kirkuk City, particularly affecting the neck, lower back, and shoulder, and that occupational and ergonomic exposures—such as longer teaching experience, frequent standing during teaching, and computer use—are associated with the likelihood of experiencing WMSDs, independent of sociodemographic characteristics. Determining whether the observed risk pattern in Kirkuk is consistent with findings from other regional settings or reflects context-specific determinants is therefore a central aim of this study.

Methodology

Design, Setting, and Period of the Study

This study employed a descriptive, analytical, cross-sectional design, according to STROBE guidelines, to estimate the prevalence of, and identify risk factors associated with, work-related musculoskeletal disorders (WMSDs) among secondary school teachers. The study was conducted in public secondary schools in Kirkuk City, Kirkuk Governorate, Iraq. The study took place from January 2026 to July 2026, with data collection over two months, from February 2026 to April 2026.

Study Population

The target population comprised all teachers employed in public secondary schools in Kirkuk City during the study period. Kirkuk City has approximately 210 governmental secondary schools employing an estimated 4300 teachers, which constituted the accessible population for this study. Inclusion criteria: teachers who (a) were currently employed and actively teaching in a public secondary school in Kirkuk City at the time of data collection, and (b) provided informed consent to participate.

Exclusion criteria: teachers who (a) were on

extended leave (e.g., sick or maternity leave) during data collection, (b) held purely administrative duties without direct teaching responsibilities, or (c) submitted incomplete questionnaires with more than 20% of items missing. A total of 352 teachers met the eligibility criteria and completed the questionnaire, forming the final analytic sample for this study. All participating teachers were drawn from public secondary schools; no private secondary school teachers were represented in the final dataset.

Sampling

A multistage cluster sampling approach with convenience sampling at the final stage was used. In the first stage, Kirkuk City was divided into four geographical areas (north, south, east, and west). Sixteen of the 210 public secondary schools were selected using simple random sampling, with four schools chosen from each geographical area. In the second stage, all eligible teachers in the selected schools were invited to participate using convenience sampling. The required sample size was determined a priori using G*Power version 3.1.9.7 for a two-tailed logistic regression analysis, assuming an odds ratio of 1.5, a significance level of 0.05, 90% power, and $R^2 = 0.20$ for other predictors. The analysis indicated a minimum required sample of 348 participants. A total of 370 questionnaires were distributed, of which 352 were completed and included in the analysis, yielding a response rate of 95%.

Tools and data collection of the Study

Data were collected using a structured, self-administered questionnaire comprising seven sections developed for this study. Section 4 follows the format of the Standardised Nordic Musculoskeletal Questionnaire (NMQ) **[14]**. NMQ is a valid, reliable, responsive, and widely used tool for occupational musculoskeletal symptom surveillance **[15, 16]**. The sections include:

- Section 1 – Sociodemographic, anthropometric and nutritional status characteristics (9 items): age, sex, marital status, educational level, body weight, height, smoking status, and performing regular exercise. Body mass index (BMI) was calculated from self-reported weight and height (kg/m^2) and categorised per standard WHO cut-offs.
- Section 2 – Occupational characteristics (10 items): school type, total teaching experience, weekly working hours, number of classes per week, average students per class, main subject(s) taught, posture while teaching (standing/sitting frequency on a 4-point scale: Always/Often/Sometimes/Rarely), computer/ laptop use and daily duration, and carrying of school materials between home and school.
- Section 3 – Work-related posture and ergonomic factors (6 items): rated on a 5-point frequency scale (Never to Always), covering prolonged neck flexion, back bending/twisting, prolonged standing (>30 minutes), prolonged unsupported sitting, lifting/carrying heavy materials, and classroom furniture comfort/adjustability.
- Section 4 – Musculoskeletal symptoms in the past 12 months: presence of pain, discomfort, numbness, or stiffness across nine anatomical regions (neck, shoulder, upper back, lower back, elbow, wrist/hand, hip/thigh, knee, and ankle/foot), each followed by items on activity limitation (yes/no) and symptom frequency (occasional/weekly/daily).
- Section 5 – Pain characteristics: average pain intensity rated on an 11-point (0–10) numeric rating scale, duration of symptoms (<1 week, 1–4 weeks, 1–3 months, >3 months), healthcare-seeking behaviour, and sick leave taken due to musculoskeletal pain in the past year.
- Section 6 – Perceived contributing factors: a multiple-response checklist of eight potential contributors (prolonged standing, prolonged sitting, poor furniture design, carrying heavy materials, stress/workload pressure, lack of physical activity, inadequate breaks, and an open "other" option).
- Section 7 – Coping and prevention: whether teachers took stretch/rest breaks during teaching hours, had received ergonomic or posture training, and which pain-management strategy they used (rest, medication, physiotherapy, or exercise).

The questionnaire was piloted on a small sample before full data collection. It was translated into Arabic and Kurdish Sorani and back-translated**.** Data were collected using two complementary methods. The questionnaires were distributed in person to teachers at their schools, who completed and returned them on-site. For both modes of administration, participants were informed of the study's purpose and provided informed consent before completing the questionnaire.

Ethical consideration

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of the College of Nursing, University of Kirkuk, under approval reference number **[1]**, dated 19/1/2026. Official permission to conduct the study in participating schools was also obtained from the Kirkuk Directorate of Education under approval

reference number 61698, dated 8/12/2025. Participation was entirely voluntary. Before completing the questionnaire, all participants were informed of the study's purpose, procedures, expected duration, and their right to withdraw at any stage without affecting their professional standing. Written informed consent was obtained from teachers completing the paper-based questionnaire.

No personally identifying information (e.g., name, national ID, or school-specific identifiers) was collected on the questionnaire, and responses were anonymised prior to data entry. Data were stored on a password-protected device accessible only to the research team and used exclusively for this study. Participants were not exposed to any physical, psychological, or occupational risks beyond those associated with completing a standard self-report survey.

Data Analysis

Data were entered and analysed using IBM SPSS Statistics (version 27). Continuous variables were assessed for normality using the Shapiro-Wilk test; because age, body mass index, teaching experience, working hours per week, and pain intensity all deviated significantly from normality, these variables were summarised as medians (interquartile ranges) and compared using non-parametric tests. In contrast, categorical variables were summarised as frequencies and percentages.

The 12-month prevalence of WMSDs, overall and by anatomical region, was estimated with 95% confidence intervals calculated using the Wilson score method. Bivariate associations between WMSD status and sociodemographic, occupational, and ergonomic variables were assessed using the Mann-Whitney U test for continuous variables and the chi-square test for categorical variables, with Fisher's exact test used when expected cell counts were below 5. Sparse categories (e.g., divorced and widowed marital status) were collapsed prior to testing to reduce cell sparsity.

Variables reaching statistical or borderline significance in bivariate analysis ($p<0.20$) were entered into a multivariable binary logistic regression model to identify factors independently associated with WMSD status, with results reported as adjusted odds ratios (aOR) with 95% confidence intervals. A p-value of less than 0.05 was considered statistically significant for all analyses.

Results

Sociodemographic and Nutritional Status Characteristics

The study sample comprised 352 secondary school teachers, with a slightly higher proportion of males (55.7%) than females (44.3%). The mean age of participants was 41.30 ± 8.36 years, indicating a predominantly middle-aged workforce. The majority of respondents were married (73.0%), while the rest were single, divorced, and widowed. Most participants held a bachelor's degree (76.4%), with smaller proportions holding diplomas, master's degrees, or doctoral degrees. With respect to nutritional status as assessed by BMI, the mean body mass index (BMI) was 26.89 ± 3.93 kg/m², placing the average participant in the overweight range. Notably, 48.6% of teachers were classified as overweight and a further 18.8% as obese indicating that 67.4% of the study population had excess body weight. Approximately one-third of teachers reported current smoking (31.0%), and only 34.7% engaged in regular exercise (≥3 times/week) (Table 1).

Table 1. Sociodemographic and Nutritional Status Characteristics of the Sample (n=352).

Variable/	Category	n (%)
Sex	Male	196 (55.7%)
	Female	156 (44.3%)
Age (years)	Mean± SD	41.30 ± 8.36
Marital status	Single	62 (17.6%)
	Married	257 (73.0%)
	Divorced/ Widowed	33 (9.4%)
Educational level*	Diploma	16 (4.5%)
	Bachelor's	269 (76.4%)
	Master's	55 (15.6%)
	PhD	12 (3.4%)
Body weight (kg)	Mean± SD	75.59 ± 11.19
Height (cm)	Mean± SD	167.83 ± 8.10
BMI category	Underweight	2 (0.6%)
	Normal	113 (32.1%)
	Overweight	171 (48.6%)
	Obese	66 (18.8%)
	Mean± SD	26.89 ± 3.93
Smoking	Yes	109 (31.0%)
	No	243 (69.0%)
Regular exercise (≥3×/week)	Yes	122 (34.7%)
	No	230 (65.3%)

Source: Own authorship.

Occupational Characteristics of the sample

Teachers' years of teaching experience mean was 16.12 ± 8.21, with the largest proportion (40.6%) falling within the 11–20-year band. The mean working time was 21.70 ± 5.81 hours per week, with almost three-quarters of teachers (73.0%) working between 20 and 29 hours weekly. Two occupational exposures stand out as particularly informative. First, the overwhelming majority of teachers (88.6%) reported carrying school materials between home and school. Second, posture during teaching was markedly asymmetric: 82.4% of teachers reported standing

"Always" while teaching, whereas only 2.6% reported sitting "Always," with 79.0% sitting "Rarely.". Additionally, 71.9% of teachers reported frequent use of a computer or laptop for work (Table 2).

Table 2 Occupational Characteristics of the sample (n=352).

Variable	Category	n (%)
Teaching experience (years)	1-10	111 (31.5%)
	11-20	143 (40.6%)
	21-30	82 (23.3%)
	31-40	16 (4.5%)
	Mean ± SD	16.12 ± 8.21
Working hours per week	10-19	68 (19.3%)
	20-29	257 (73.0%)
	30-39	22 (6.3%)
	40-49	5 (1.4%)
	Mean ± SD	21.70 ± 5.81
Carries school materials	Yes	312 (88.6%)
	No	40 (11.4%)
Stands while teaching	Always	290 (82.4%)
	Often	36 (10.2%)
	Sometimes	16 (4.5%)
	Rarely	10 (2.8%)
Sits while teaching	Always	9 (2.6%)
	Often	15 (4.3%)
	Sometimes	50 (14.2%)
	Rarely	278 (79.0%)
Uses computer/laptop for work frequently	Yes	253 (71.9%)
	No	99 (28.1%)

Source: Own authorship.

Twelve-Month Prevalence of Work-Related Musculoskeletal Symptoms by Anatomical Region and Sex

The overall 12-month prevalence of WMSD symptoms in at least one body region was 85.8% (302/352). Prevalence was significantly higher among female teachers (91.0%, 142/156) than male teachers (81.6%, 160/196) (p = 0.012). Across all nine body regions, female teachers reported higher prevalence than male teachers without exception. The neck was the most commonly affected region overall (69.3%), followed by the lower back (65.1%) and shoulder (64.8%), while the elbow was the least affected (35.2%).

The sex difference reached statistical significance for six of the nine regions: shoulder (56.6% in males vs. 75.0% in females, p < 0.001), hand/wrist (37.8% vs. 56.4%, p < 0.001), knees (52.0% vs. 66.0%, p = 0.008), ankles/feet (45.4% vs. 59.6%, p = 0.008), neck (64.3% vs. 75.6%, p = 0.022), and hip/thigh (34.7% vs. 46.8%, p = 0.021). The difference did not reach statistical significance for upper back (46.4% vs. 56.4%, p = 0.064), lower back (61.2% vs. 69.9%, p = 0.075), or elbow(s) (32.1% vs. 39.1%, p = 0.174), although female teachers still showed a numerically higher prevalence in each of these three regions as well (Table 3).

Table 3. Twelve-Month Prevalence of Work-Related Musculoskeletal Symptoms by Anatomical Region and Sex (N = 352).

Body region	Male *n* (%)	Female *n* (%)	Total *n* (%)	*P* Value
Neck	126 (64.3)	118 (75.6)	244 (69.3)	0.022
Lower back	120 (61.2)	109 (69.9)	229 (65.1)	0.075
Shoulder	111 (56.6)	117 (75.0)	228 (64.8)	< 0.001
Knees	102 (52.0)	103 (66.0)	205 (58.2)	0.008
Ankles/Feet	89 (45.4)	93 (59.6)	182 (51.7)	0.008
Upper back	91 (46.4)	88 (56.4)	179 (50.9)	0.064
Hand/Wrist	74 (37.8)	88 (56.4)	162 (46)	< 0.001
Hip/Thigh	68 (34.7)	73 (46.8)	141 (40.1)	0.021
Elbow(s)	63 (32.1)	61 (39.1)	124 (35.2)	0.174
Overall (≥1 region)	**160 (81.6)**	**142 (91)**	**302 (85.8)**	**0.012**

* *P* value obtained from chi-square test. Source: Own authorship.

Pain Characteristics Among Symptomatic Teachers

Among the 302 symptomatic teachers, pain intensity was generally high: 47.0% rated their average pain as severe (7–10 on a 0–10 numeric scale) and a further 40.4% rated it as moderate (4–6), meaning that nearly nine in ten symptomatic teachers experienced at least moderate pain. Symptom chronicity was also notable: 28.1% of symptomatic teachers reported symptoms persisting for more than one year, while 46.7% reported a more recent onset (<1 month). Healthcare-seeking behavior was comparatively limited only 43.7% of symptomatic teachers reported having sought medical care, while 31.1% had taken sick leave specifically due to musculoskeletal pain (Table 4).

Table 4. Pain Characteristics Among Symptomatic Teachers (n=302).

Category	n	%
Pain Intensity (0–10 scale),		
No pain (0)	4	1.3%
Mild (1–3)	34	11.3%
Moderate (4–6)	122	40.4%
Severe (7–10)	142	47.0%
Mean ± SD	6.0 (5.0–8.0)	
Duration of symptoms		
<1 month	141	46.7%
1–6 months	50	16.6%
6–12 months	23	7.6%
>1 year (chronic)	85	28.1%
Healthcare-seeking behavior		
Sought medical care — Yes	132	43.7%
Sought medical care — No	168	55.6%
Took sick leave due to WMSDs pain		
Yes	94	31.1%
No	204	67.5%

Source: Own authorship.

Perceived Contributing Factors to WMSDs

When asked to identify perceived contributors to their musculoskeletal symptoms (multiple selections permitted), teachers most frequently cited prolonged standing (73.6%) and stress or workload pressure (61.1%), followed by inadequate breaks during work (40.1%). Prolonged sitting (28.7%) and lack of physical activity (27.8%) were reported less frequently; while carrying heavy teaching materials (19.3%) and poor classroom furniture design (17.4%) were the least commonly cited factors (Table 5).

Table 5. Perceived Contributing Factors (multi-select, n=352).

Factor	n	%
Prolonged standing	259	73.6%
Stress or workload pressure	215	61.1%
Inadequate breaks during work	141	40.1%
Prolonged sitting	101	28.7%
Lack of physical activity	98	27.8%
Carrying heavy teaching materials	68	19.3%
Poor classroom furniture design	61	17.4%

Source: Own authorship.

Preventive Behavior and Coping Strategies to Manage WMSDs Pain

Preventive and self-management behaviors were limited across the sample. Only 24.1% of teachers reported taking regular breaks to stretch or rest during teaching hours, and a similarly low proportion (23.6%) had received any form of ergonomic or posture training. Regarding pain management once symptoms occur, medication was the most commonly used strategy (51.1%), followed by rest (42.0%), while more evidence-based rehabilitative approaches exercise (22.7%) and physiotherapy (16.8%) were used considerably less often (Table 6).

Table 6. Preventive Behavior & Coping Strategies to manage pain.

Strategy	n	%
Takes breaks to stretch/rest during teaching		
Yes	85	24.1%
No	254	72.2%
Received ergonomic/posture training		
Yes	83	23.6%
No	258	73.3%
Pain management strategies used		
Medication	180	51.1%
Rest	148	42.0%
Exercise	80	22.7%
Physiotherapy	59	16.8%

Source: Own authorship.

Comparison between teachers with (n=302) and without (n=50) WMSD symptoms identified several statistically significant associations. Teachers with WMSD were significantly older (median 40.0 vs. 38.0 years, $p<0.001$) and had significantly more years of teaching experience (median 17.0 vs. 12.5 years, $p<0.001$). Sex was also significantly associated with WMSD status ($p=0.019$), while posture-related variables showed the strongest associations of all: both standing posture ($p<0.001$) and sitting posture ($p<0.001$) while teaching were highly significantly related to WMSD status, and frequency of computer use was also significant ($p=0.005$). BMI category approached significance ($p=0.060$), as did smoking status ($p=0.098$) and working hours per week ($p=0.090$). Variables such as marital status, educational level, regular exercise, and carrying school materials, showed no significant bivariate association with WMSD status in this sample (Table 7).

Table 7. Bivariate Risk Factor Comparison WMSD (n=302) vs. No WMSD (n=50).

Variable	WMSD group	No WMSD group	Test	p-value
Age (years), median (IQR)	40.0 (35.0–49.0)	38.0 (32.0–40.0)	Mann-Whitney U	0.0001
Teaching experience (years), median (IQR)	17.0 (9.0–23.0)	12.5 (5.0–17.0)	Mann-Whitney U	0.0001
BMI (kg/m²), median (IQR)	26.6 (24.2–29.4)	25.8 (23.5–27.7)	Mann-Whitney U	0.053
Working hours/week, median (IQR)	22.0 (20.0–25.0)	20.0 (15.0–25.0)	Mann-Whitney U	0.090
Classes/week, median (IQR)	14.0 (10.0–20.0)	17.0 (10.0–20.0)	Mann-Whitney U	0.145
Students/class, median (IQR)	42.0 (40.0–49.0)	40.0 (36.2–48.8)	Mann-Whitney U	0.739
Sex (n)	302	50	Chi-square	0.019
Stands while teaching (n)	302	50	Fisher's exact	<0.001
Sits while teaching (n)	302	50	Fisher's exact	<0.001
Uses computer for work (n)	302	50	Fisher's exact	0.005
BMI category (n)	302	50	Fisher's exact	0.060
Smoking (n)	302	50	Chi-square	0.098
Educational level (n)	302	50	Fisher's exact	0.183
Marital status (combined) (n)	302	50	Fisher's exact	0.431
Regular exercise (n)	302	50	Chi-square	0.486
Carries school materials (n)	302	50	Chi-square	0.382

Source: Own authorship.

After adjusting for the other covariates in the model, three variables remained independently and significantly associated with WMSD status. Teaching experience remained significant (adjusted OR = 1.078, 95% CI: 1.029–1.130, $p=0.0015$), indicating that each additional year of teaching experience was associated with an approximate 8% increase in the odds of reporting WMSD symptoms. Frequent standing while teaching emerged as the strongest independent predictor (adjusted OR = 4.716, 95% CI: 1.499–14.842, $p=0.0080$), with teachers who stood frequently having almost five times the odds of WMSD compared with those who stood less often. Counterintuitively, frequent computer/laptop use was associated with

significantly lower odds of WMSD after adjustment (adjusted OR = 0.411, 95% CI: 0.210–0.803, p=0.0093). Frequent sitting while teaching showed a similarly large point estimate to standing (adjusted OR = 4.365) but did not reach statistical significance (95% CI: 0.805–23.683, p=0.088), most likely reflecting the small number of teachers who reported frequent sitting (limited statistical power for this comparison) rather than a true absence of effect. BMI, working hours, sex, and smoking status were not independently associated with WMSD after adjustment. The model demonstrated modest explanatory power (McFadden's pseudo-R^2 = 0.136) and 87.0% classification accuracy, though this accuracy figure is influenced by the high baseline prevalence of WMSD in the sample and should be interpreted alongside the pseudo-R^2 rather than in isolation (Table 8).

Table 8. Multivariable Logistic Regression of Independent Risk Factors for WMSDs.

Predictor	Adjusted OR	95% CI	p-value
Teaching experience (per year)	1.078	1.029–1.130	0.0015
Frequent standing while teaching	4.716	1.499–14.842	0.0080
Uses computer/laptop for work	0.411	0.210–0.803	0.0093
Frequent sitting while teaching	4.365	0.805–23.683	0.088
BMI (per unit)	1.056	0.959–1.164	0.269
Working hours/week	1.021	0.969–1.076	0.440
Sex (Female vs. Male)	1.553	0.722–3.342	0.260
Smoker (vs. non-smoker)	0.755	0.364–1.563	0.449

Model fit: McFadden's pseudo-R^2 = 0.136 · Classification accuracy = 87.0% (cutoff 0.5). Source: Own authorship.

Discussion

The overall 12-month prevalence of WMSDs in this study (85.8%) was at the upper end of the range reported internationally. A meta-analysis of 44 studies involving approximately 16,000 teachers estimated a pooled prevalence of 68%, with the neck and lower back each affected in 47% of teachers and the shoulder in 44% (7). More broadly, reviews focusing on teachers have reported prevalence estimates ranging from 48.7% to 73.7%, while some special-education teacher populations have reported rates approaching 94% **[4].** The current finding is also comparable with evidence from the Middle East and North Africa (MENA), where prevalence among secondary schoolteachers in Hail, Saudi Arabia, ranged from 87.3% to 93.6% **[1,5]**, and where recent studies reported prevalence rates of 87.3% among primary-school teachers and 77.9% among special-education teachers **[17,18]**. These findings support evidence that the MENA region has a substantial and potentially underrecognized burden of musculoskeletal disorders, partly due to limited surveillance systems **[12]**.

The neck (69.3%), lower back (65.1%), and shoulder (64.8%) were the most commonly affected body regions, whereas the elbow (35.2%) was least affected. This pattern is broadly consistent with the meta-analysis by Tahernejad, Hejazi **[7]** and with studies conducted among teachers in Hail, Cameroon, and Damascus **[1,8,9]**. The similarity across different geographical settings suggests that common occupational exposures may contribute to this pattern, including prolonged neck flexion during writing and grading, sustained lumbar loading while standing, and repetitive shoulder elevation during board writing.

Female teachers had a significantly higher prevalence of WMSDs than male teachers (91.0% vs 81.6%, p = .012), with higher female prevalence observed in six of the nine body regions and no region showing a male predominance. This finding is consistent with previous evidence of greater musculoskeletal pain among women **[19-21]** and with findings from Hail, Saudi Arabia, where female teachers had 2.46- and 2.51-fold greater odds of shoulder and neck disorders, respectively **[1]**. However, sex was no longer significant following multivariable adjustment, suggesting that the observed crude difference may partly reflect differences in occupational or other exposures. This interpretation is plausible because biological sex and gender can influence symptom reporting through distinct biological and psychosocial pathways **[22]**.

Biological explanations include differences in muscle mass, tendon and ligament laxity, and hormonal influences on musculoskeletal tissues **[19]**, while gender-related occupational and domestic responsibilities may also contribute but were not assessed in the present study. Almost nine in ten symptomatic teachers reported at least moderate pain, while 28.1% had experienced symptoms for more than one year. Nevertheless, only 43.7% had sought medical care and 31.1% had taken sick leave. This combination of substantial symptom burden and limited healthcare utilisation is consistent with recent evidence on presenteeism among Egyptian public-school teachers, where musculoskeletal and respiratory problems were important contributors **[23].** Teachers may face barriers to seeking care due to staffing shortages, the normalisation of work-related pain, or limited awareness of available occupational health services.

Teaching experience remained an independent predictor of WMSD status after adjustment (adjusted OR = 1.078 per year, 95% CI: 1.029–1.130), representing an approximately 8% increase in the odds of WMSDs for each additional year of teaching. This finding is compatible with a cumulative exposure model in which repeated occupational loading over time

contributes to musculoskeletal problems and is consistent with associations reported in previous studies [24,25].

Frequent standing was the strongest independent predictor of WMSDs (adjusted OR = 4.716, 95% CI: 1.499–14.842), indicating nearly fivefold higher odds among teachers who stood frequently compared with those who stood infrequently. Prolonged static standing can increase intramuscular pressure, impair venous return, and modify spinal loading patterns [26] This is consistent with teacher-specific evidence linking standing for more than two hours with back and lower-limb symptoms [17,18]. Standing was also the most frequently reported perceived contributor (73.6%), followed by stress or workload pressure (61.1%) and inadequate breaks. The agreement between perceived and statistically identified risk strengthens the interpretation of standing as an important occupational exposure. Although the confidence interval was relatively wide, likely because only 26 teachers reported infrequent standing, the lower confidence limit still indicates a meaningful association.

In contrast, frequent computer or laptop use was independently associated with lower odds of WMSDs (adjusted OR = 0.411, 95% CI: 0.210–0.803). This finding differs from much of the existing literature, which generally identifies prolonged computer use as a musculoskeletal risk factor, with reported prevalence among computer users ranging from 33.8% to 95.3% across different settings [27, 28]. One possible explanation is a substitution effect: teachers who spend more time using computers for lesson preparation, grading, and administrative tasks may spend less time standing, writing on the board, or carrying teaching materials. Thus, computer use may have replaced other, more physically demanding teaching activities rather than simply adding another exposure.

Frequent sitting produced a point estimate similar to that of frequent standing (adjusted OR = 4.365), but the association was not statistically significant (95% CI: 0.805–23.683, p = .088). Given that only 24 teachers reported frequent sitting, the lack of statistical significance may partly reflect limited statistical power rather than the absence of an association. This interpretation is supported by previous research linking prolonged sitting with neck, shoulder, and back symptoms [28, 29]. Similarly, BMI, working hours, smoking status, and sex were significant or borderline-significant in bivariate analyses but did not remain independently significant after adjustment. This may indicate confounding by factors such as age and teaching experience rather than a genuine absence of effect. The modest pseudo-R^2 also suggests that additional unmeasured factors, including workstation design, task variation, and psychosocial stress, may contribute to WMSD risk [4,18].

The high prevalence of overweight and obesity (67.4%) highlights the importance of considering nutritional status alongside occupational factors in WMSDs [30]. Despite teachers identifying standing and stress as important contributors, only 24.1% reported taking regular breaks for stretching or rest, and only 23.6% had received ergonomic or posture-related training. Self-management was more common than professional treatment, with 51.1% reporting medication use compared with 16.8% who used physiotherapy. Evidence from other settings indicates that structured ergonomic interventions can improve prevention practices. For example, a Health Belief Model-based intervention improved neck-pain prevention behaviours among junior high school teachers in Tehran [31], while participatory ergonomics and educational interventions have demonstrated sustained reductions in neck, shoulder, and back symptoms. These findings support the need for ergonomic improvements, scheduled work-rest periods, greater variation in posture and tasks, structured occupational health surveillance, and sex-sensitive prevention strategies. Policies regarding sick leave and staffing should also avoid creating barriers for teachers who require medical care [23,32].

Limitations

This study has several limitations. First, its cross-sectional design prevents causal conclusions, particularly regarding the unexpected inverse association between computer use and WMSDs, for which the direction and temporal sequence cannot be determined. Second, both exposures and outcomes were self-reported and were not clinically verified, creating the possibility of recall and reporting bias. Third, participants were recruited exclusively from public secondary schools in one city, which limits the generalizability of the findings to private schools, primary or tertiary educators, and teachers in other regions of Iraq. Finally, the questionnaire did not assess non-occupational physical demands, such as domestic and caregiving responsibilities. Nutritional status was assessed by BMI; dietary intake was not evaluated. Consequently, the factors underlying the observed sex difference cannot be fully explained.

Conclusion

WMSDs are highly prevalent among secondary school teachers in Kirkuk City, with women disproportionately affected and the neck, lower back,

and shoulder representing the most commonly affected regions. Teaching experience and frequent standing were independent predictors of WMSD status, supporting the importance of cumulative occupational exposure and prolonged static postures. Conversely, the unexpected inverse association between computer use and WMSDs suggests that occupational exposures may substitute for one another rather than accumulate. Despite the high symptom burden, healthcare-seeking and preventive practices remain limited. There is therefore a clear need for ergonomic education, scheduled recovery periods, greater task and posture variation, and stronger occupational health support within the education sector. Nutritional status should also be considered in WMSD prevention strategies. Future longitudinal and intervention studies should examine causal pathways, distinguish biological sex effects from gender-related exposure patterns, and directly evaluate whether reducing prolonged standing can decrease WMSDs among teachers.

CRediT

Author contributions: **Conceptualization-** All authors; **Investigation-** All authors. **Methodology-** All authors; **Project administration-** All authors; **Supervision-**All authors; **Writing - original draft-** All authors; **Writing-review & editing-** All authors.

Acknowledgment

Not applicable.

Ethical Approval

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of the College of Nursing, University of Kirkuk, under approval reference number **[1]**, dated 19/1/2026. Official permission to conduct the study in participating schools was also obtained from the Kirkuk Directorate of Education under approval reference number 61698, dated 8/12/2025. Participation was entirely voluntary. Before completing the questionnaire, all participants were informed of the study's purpose, procedures, expected duration, and their right to withdraw at any stage without affecting their professional standing. Written informed consent was obtained from teachers completing the paper-based questionnaire.

Informed Consent

It was applicable.

Funding

Not applicable.

Data Sharing Statement

No additional data are available.

Publication Statement

All authors have agreed to the publication of this article.

Conflict of Interest

The authors declare no conflict of interest.

Similarity Check

It was applied by Ithenticate@.

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

References

1. Althomali OW. Long-Term Prevalence and Risk Factors of Musculoskeletal Disorders among the Schoolteachers in Hail, Saudi Arabia: A Cross-Sectional Study. BioMed Research International. 2022;2022(1):3610196.
2. Fahmy VF, Momen MAMT, Mostafa NS, Elawady MY. Prevalence, risk factors and quality of life impact of work-related musculoskeletal disorders among school teachers in Cairo, Egypt. BMC Public Health. 2022;22(1):2257.
3. Liu M, Rong J, An X, Li Y, Min Y, Yuan G, et al. Global, regional, and national burden of musculoskeletal disorders, 1990–2021: an analysis of the global burden of disease study 2021 and forecast to 2035. Frontiers in Public Health. 2025;Volume 13 - 2025.
4. Abdul Rahim AA, Jeffree MS, Ag Daud DM, Pang N, Sazali MF. Factors Associated with Musculoskeletal Disorders among Regular and Special Education Teachers: A Narrative Review. International Journal of Environmental Research and Public Health. 2022;19(18):11704.

5. Althomali OW, Amin J, Alghamdi W, Shaik DH. Prevalence and Factors Associated with Musculoskeletal Disorders among Secondary Schoolteachers in Hail, Saudi Arabia: A Cross-Sectional Survey. International Journal of Environmental Research and Public Health. 2021;18(12):6632.
6. Erick PN, Smith DR. A systematic review of musculoskeletal disorders among school teachers. BMC Musculoskeletal Disorders. 2011;12(1):260.
7. Tahernejad S, Hejazi A, Rezaei E, Makki F, Sahebi A, Zangiabadi Z. Musculoskeletal disorders among teachers: a systematic review and meta-analysis. Frontiers in Public Health. 2024;Volume 12 - 2024.
8. Al Khoder H, Mohamadi S, Abdollahi I, Karimi N, Zaadeh SH. Prevalence of Musculoskeletal Disorders and Related Risk Factors Among Female School Teachers in Damascus City, Syria. Archives of Rehabilitation. 2024;25(4):804-23.
9. Mekoulou Ndongo J, Bika Lele EC, Guessogo WR, Meche LP, Ayina Ayina CN, Guyot J, et al. Musculoskeletal disorders among secondary school teachers in Douala, Cameroon: The effect of the practice of physical activities. Frontiers in Rehabilitation Sciences. 2022;Volume 3 - 2022.
10. Temesgen MH, Belay GJ, Gelaw AY, Janakiraman B, Animut Y. Burden of shoulder and/neck pain among school teachers in Ethiopia. BMC Musculoskeletal Disorders. 2019;20(1):18.
11. Bezzina A, Austin E, Nguyen H, James C. Workplace psychosocial factors and their association with musculoskeletal disorders: a systematic review of longitudinal studies. Workplace health & safety. 2023;71(12):578-88.
12. Al-Ajlouni YA, Al Ta'ani O, Mushasha R, Lee JL, Capoor J, Kapadia MR, Alejandro R. The burden of musculoskeletal disorders in the Middle East and North Africa (MENA) region: a longitudinal analysis from the global burden of disease dataset 1990—2019. BMC Musculoskeletal Disorders. 2023;24(1):439.
13. Masood A. A, Omran A. J. Musculoskeletal Disorders among Healthcare Workers of Governmental Hospitals in Duhok Governorate. History of Medicine. 2023;9(1).
14. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, Jørgensen K. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Applied Ergonomics. 1987;18(3):233-7.
15. Crawford JO. The Nordic Musculoskeletal Questionnaire. Occupational Medicine. 2007;57(4):300-1.
16. Pugh JD, Gelder L, Williams AM, Twigg DE, Wilkinson AM, Blazevich AJ. Validity and reliability of an online extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E2) to measure nurses' fitness. Journal of Clinical Nursing. 2015;24(23-24):3550-63.
17. Aly HM, Fahim AE. Factors Affecting Musculoskeletal Disorders among Primary School Teachers in Ismailia, Egypt. The Egyptian Journal of Community Medicine. 2024;42(4):250-6.
18. Jeffree MS, Abdul Rahim AA, Daud DMA, Pang N, Sazali MF, Sudi S, et al. Predictors of musculoskeletal disorders among special education teachers in Sabah, Malaysia. Heliyon. 2024;10(10):e30873.
19. Hart DA. Sex differences in musculoskeletal injury and disease risks across the lifespan: Are there unique subsets of females at higher risk than males for these conditions at distinct stages of the life cycle? Frontiers in Physiology. 2023;Volume 14 - 2023.
20. Overstreet DS, Strath LJ, Jordan M, Jordan IA, Hobson JM, Owens MA, et al. A Brief Overview: Sex Differences in Prevalent Chronic Musculoskeletal Conditions. International Journal of Environmental Research and Public Health. 2023;20(5):4521.
21. Tosi LL, Templeton K, Pennington AM, Reid KA, Boyan BD. Influence of Sex and Gender on Musculoskeletal Conditions and How They Are Reported. J Bone Joint Surg Am. 2024;106(16):1512-9.
22. Ballering AV, Bonvanie IJ, Olde Hartman TC, Monden R, Rosmalen JGM. Gender and sex independently associate with common somatic symptoms and lifetime prevalence of chronic disease. Social Science & Medicine. 2020;253:112968.
23. Serya H, El-Gilany AH. Presenteeism and Its Associated Factors Among Teachers. Med Lav. 2025;116(2):16010.
24. Krishnan KS, Raju G, Shawkataly O. Prevalence of Work-Related Musculoskeletal Disorders: Psychological and Physical Risk Factors. International Journal of Environmental Research and Public Health. 2021;18(17):9361.
25. Popova MS, Nikolova SP, Filkova SI. Demographic and Occupational Determinants of Work-Related Musculoskeletal Disorders: A Cross-Sectional Study. Journal of Functional Morphology and Kinesiology. 2025;10(2):137.

26. Coenen P, Parry S, Willenberg L, Shi JW, Romero L, Blackwood DM, et al. Associations of prolonged standing with musculoskeletal symptoms—A systematic review of laboratory studies. Gait & Posture. 2017;58:310-8.

27. Demissie B, Bayih ET, Demmelash AA. A systematic review of work-related musculoskeletal disorders and risk factors among computer users. Heliyon. 2024;10(3).

28. Yang F, Di N, Guo W-w, Ding W-b, Jia N, Zhang H, et al. The prevalence and risk factors of work related musculoskeletal disorders among electronics manufacturing workers: a cross-sectional analytical study in China. BMC Public Health. 2023;23(1):10.

29. Ding X, Guan Z, Liu N, Bi M, Ji F, Wang H, et al. Prevalence and risk factors of work-related musculoskeletal disorders among emerging manufacturing workers in Beijing, China. Frontiers in Medicine. 2023;Volume 10 - 2023.

30. Garcia-Salgado S, et al. Adults with excess weight or obesity, but not with overweight, report greater pain intensities than individuals with normal weight: a systematic review and meta-analysis. *Nutr Rev.* 2024.

31. Moradi Z, Tavafian SS, Kazemi SS. Educational intervention program based on health belief model and neck pain prevention behaviors in school teachers in Tehran. BMC Public Health. 2022;22(1):1501.

32. Mamaye Y, Yenealem DG, Fentanew M, Abebaw T, Melaku C, Bezie AE, et al. Prevalence of sickness presenteeism and associated factors among primary school teachers in Gondar city, northwest Ethiopia. Frontiers in Public Health. 2024;Volume 12 - 2024.