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Musculoskeletal pain in medical laboratory personnel: a cross-sectional study

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Abstract

Objectives: To estimate the prevalence of musculoskeletal pain among the laboratory workforce in the United States.

Methods: An electronic survey was used to gather data from laboratory workers between October 2021 and February 2022. The instrument included the Standardized Nordic Musculoskeletal Questionnaire, as well as personal and work-related questions. A summary of descriptive statistics and a multivariable analysis using self-reported musculoskeletal pain in the past 7 days were performed.

Results: Of 518 medical laboratory professionals in the study, 94% reported musculoskeletal pain in at least 1 body site in the past 12 months, with many experiencing pain in the past 7 days. The sites where musculoskeletal pain was most often reported in the past week included lower back (39%), neck (38%), and shoulders (34%). Sex, race and ethnicity, time in the profession, job title, and organization type were associated with recent musculoskeletal pain.

Conclusions: A high prevalence of musculoskeletal pain was documented among medical laboratory personnel. Characterizing musculoskeletal pain in this population can help researchers understand the physiologic impacts of long-term exposure to laboratory work, as well as implement and evaluate prevention and risk reduction measures.

KEY POINTS

- This research identifies and characterizes the incidence of musculoskeletal pain in medical laboratory personnel in the United States.
- Most medical laboratory personnel who reported musculoskeletal pain in at least 1 of the assessed body sites in the past year (lower back, neck, and shoulders) had the highest prevalence of pain.
- Pain in the past week was reported by 75% of medical laboratory professionals. Increased efforts to reduce the risk of experiencing musculoskeletal disorders while at work are needed.

Key words

medical laboratory personnel; musculoskeletal pain; work environment; safety management

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INTRODUCTION

Medical laboratory personnel (MLPs) are technical specialists who staff and operate laboratories in health care institutions, such as hospitals and clinics, as well as research and commercial facilities.[1] In 2023, there were 482 480 MLP, including phlebotomists, pathologists, and clinical laboratory technologists and technicians, working in the United States.[2-4] Medical laboratory personnel work in many areas of clinical testing, and their labor provides evidence that is vital to patient care, research, and the protection of public health. This group of health professionals has been identified by the Occupational Safety and Health Administration as being at risk of developing work-related pain and injury due to repetitive motions from pipetting and using cell counters; remaining too long in uncomfortable, static positions from standing at work stations; looking into microscopes; and working inside biosafety cabinets, among other factors.[5] Some health problems are acute and resolve promptly, whereas others can lead to chronic pain and musculoskeletal disorders.

Musculoskeletal disorders (MSDs) are injuries to multiple body systems or tissues (eg, muscular, nervous, cartilaginous) and can occur due to the work environment in a single interaction or with the performance of work over a period of time.[6] The World Health Organization estimated that 1.71 billion people experience MSDs worldwide, with low back pain being widely reported by 570 million cases, followed by osteoarthritis (528 million), fractures (440 million), and neck pain (222 million).[7] As of 2023, in the United States, 2.37 million nonfatal work-related injuries and illnesses were reported by private employers to the Bureau of Labor Statistics (BLS), with a rate of 2.2 injury cases per 100 full-time equivalent workers.[8] In fact, injuries occurring in health care and social assistance industries increased from 443 800 to 471 600 between 2022 and 2023, with 6900 of these injuries reported by medical and diagnostic laboratories.[8,9] These numbers are likely a lower bound for injuries as only certain types of injuries (eg, those requiring days away from work, transfer, or medical attention beyond first aid) are reported.[10]

In the United States, a 1996 study of pain symptoms among cytotechnologists reported a high prevalence of neck, hand and wrist, and lower back pain.[11] A 1995 study of histology professionals reported that 15% of them experienced chronic pain related to overuse due to their work environment.[12] In addition, in 2020, the BLS *Injuries, Illnesses, and Fatalities* database suggested that 6500 clinical laboratory technologists and technicians (SOC 29-2010), 260 pathologists (SOC 29-1222), and 2520 phlebotomists (SOC 31-9097) reported experiencing occupational injuries and illnesses involving days away from work.[13] Injury among clinical laboratory technologists and technicians included 830 reports for upper limbs such as shoulder, arms, hands, and wrists; 620 for trunk, including upper and lower back; and 290 for lower limbs such as knees, ankles, and feet.[13] In phlebotomists, there were 580 reports for trunk, 270 for lower limb, and 210 for upper limb injury.[13] Site-specific data for pathologists were unavailable. To our knowledge, there have been no other in-depth investigations into MSDs among MLPs in the United States using standardized methods beyond the general reports associated with injuries severe enough to merit days away from work.

Moreover, the COVID-19 pandemic demonstrated deleterious impacts on the well-being of MLPs, as workers during this period were tasked with implementing high volumes of testing for a new disease, and routines for other types of testing were disrupted. Both anecdotal and empirical evidence indicated high levels of stress, burnout, personnel shortages, and increased work demands.[14,15] Interviews with MLPs working during this time suggested that adapting existing instruments and onboarding of new testing equipment and technology to perform COVID-19 tests were physically taxing, increasing the workload and causing MLPs to perform additional work activities.[15] The goal of this research was to document the prevalence of self-reported musculoskeletal pain experienced by MLPs in the United States and to characterize their associations of pain with work and personal factors during the COVID-19 pandemic.

METHODS

Study design and sample

A cross-sectional online survey of MLPs was conducted between October 2021 and February 2022. We initially included volunteer respondents from a random sample of 10 000 members of the American Society for Clinical Pathology (ASCP group). Incentives for the ASCP group included a drawing to receive 1 of 70 $100 gift cards for those who completed the survey. Due to low response rates from this initial data collection, a second round of recruitment targeted users of social media (eg, Facebook, LinkedIn) and other professional societies related to laboratory medicine (hereafter referred to as the SM group). No incentives were given to respondents in the SM group.

Inclusion criteria required all respondents to self-identify as MLPs (eg, medical laboratory scientist/technologist or technician, phlebotomist/phlebotomy technician, pathologist, pathologists' assistant, Doctor of Clinical Laboratory Science, and others, including those in supervisory and management roles). A further screening question required respondents to self-identify as being employed full-time or part-time within the past 3 years working in the diagnostic laboratory process by performing medical tests and providing results using human samples. Implied consent was obtained by respondents continuing to the survey portion after reading the research and rights description. The Institutional Review Board of the University of Kansas Medical Center reviewed and approved this study in accordance with the Declaration of Helsinki.

Variables

Musculoskeletal symptoms were assessed with the Standardized Nordic Questionnaire (SNQ).[16] The SNQ assessed self-reported pain in 9 areas of the body (neck, shoulders, upper back, elbows, lower back, wrists/hands, hips/thighs, knees, and ankles/feet) in the past 12 months. Response categories for the SNQ were restricted to "yes" or "no." Additional pain questions with similar response options were presented using branching logic; only when participants indicated they experienced an ache, pain, or discomfort in a particular body site at any time during the past 12 months would they be directed to provide an answer for subsequent questions regarding that specific body site. Follow-up questions included if the body site–specific pain had prevented them from working normally in the past year, if they had received care for the indicated body site in the past year, total length of time experiencing pain, and if they had experienced the body site–specific pain in the past 7 days. We generated a set of binary dependent variables, including (1) any musculoskeletal pain in the past 7 days and (2) pain in the past 7 days by body region, including neck and trunk (ie, upper and lower back), lower limbs (ie, hips, thighs, knees, ankles, feet), and upper limbs (ie, shoulders, elbows, wrists, hands).

We also captured demographic information, including sex assigned at birth, gender identity, age, and race and ethnicity. Because the laboratory profession has historically comprised individuals who identify as White, and to examine similarities or differences between those belonging to racial or ethnic minority groups based on the dependent variable of interest during analyses, the race and ethnicity variable was recoded into 5 categories (non-Hispanic White, Black or African American, Asian, Hispanic or Latinx, all others). The number of years working in the laboratory profession was captured as a continuous variable and recoded into a categorical value. To assess self-reported health status, we included a question asking, “Would you say your health in general is excellent, very good, good, fair, or poor?” Additional items included asking, “Are you predominantly right-handed or left-handed?” and “Did you take any pain medication yesterday, such as Aspirin, Ibuprofen or prescription pain medication?”

Other work environment characteristics included employment status (eg, full-time, permanent, part-time), tenure at current job in years, job title (eg, staff, lead, manager, director), health insurance coverage (ie, government or employer sponsored), and if they received paid leave, including sick leave (eg, complete, mostly, somewhat, or not at all). Organization type and size were captured using a comprehensive list of typical medical laboratory settings and recoded into 4 categories (nonhospital laboratory, large ≥500-bed hospital laboratory, medium 100- to 499-bed hospital laboratory, <100-bed hospital laboratory). Organization location was captured using state and county drop-down options, which were recoded into categories based on the rural-urban continuum codes and into regions following the Federal Emergency Management Agency and Department of Health and Human Services groupings from 1 to 10.[17]

Statistical analyses

Data cleaning and analysis were done using STATA version 17 statistical software.[18] Among responses, some items were missing. An analysis using STATA’s *miss table* command was conducted to determine whether there were identifiable patterns of missing data. Observations with missing answers to the SNQ questions were removed from analysis. Summary statistics for demographic and work-related responses, as well as information regarding pain in the last year, were calculated thereafter. Pain results were summarized using diagrams to illustrate pain locations and prevalence.

The relationship between any pain in the past 7 days and personal and workplace characteristics was analyzed using the Pearson χ^2 test. Due to the data collection taking place from 2 separate recruitment groups, we performed χ^2 analyses to determine if there were any statistically significant recruitment group (ASCP vs SM) differences in personal or work-related variables to determine if group needed to be controlled for in the model. Additionally, multivariable logistic regressions were undertaken for the binary dependent variables. Clustering for upper and lower limb sites followed the BLS injury reporting data.[13] Covariates of interest (sex, race and ethnicity, years in the laboratory profession, job title, tenure in their current job, access to leave benefits, and type of laboratory setting) with associations exhibiting a *P* value of <.05 were considered statistically significant.

In this analysis, we used self-reported years working in the laboratory profession instead of age, as the former was originally captured in years, whereas the latter used categorical values. The variable “years of practice” is also better at providing for potential exposure to the clinical laboratory work environment over time. There was a strong positive association between age group and years of practice variables ($\gamma = 0.86$, Asymptotic Standard Error = 0.025, $P < .001$).

RESULTS

Participation and sample description

The process for recruitment of the ASCP group started in October 2021 with data received between November 15, 2021, and January 15, 2022. A total of 8574 individuals were contacted via email, 846 opened the survey, 412 initiated the consent process, and 192 individuals completed the questionnaire. This resulted in a completion rate of 46.6%. During preliminary analysis of the ASCP group data, 2 observations were dropped due to lack of responses to the SNQ portion of the survey. To increase our sample size, we conducted additional recruitment using social media. The SM group recruitment took place between January 18, 2022, and February 16, 2022. A total of 467 people initiated the survey, and 328 completed the instrument, for a completion rate of 70.3%. All respondents in the SM group provided answers to the SNQ portion of the survey. For initial analysis, variables of interest were tested by combining both groups as well as performing analysis in each group individually.

Table 1 shows findings for all respondents for personal characteristics of participants. Female sex assigned at birth and female gender identity were the most prevalent in the sample (N = 518). Most survey respondents identified as White (78.6%). The largest age group represented was between 45 and 64 years, and the plurality of respondents reported having worked in the profession for 31 years or more. Most (92.5%) respondents indicated they were predominantly right-handed, and 83.4% indicated they were in excellent to good general health at the time of the survey. However, almost half of the sample reported taking pain medication, either over the counter or prescription, on the preceding day.

Regarding work characteristics, the combined results shown in Table 2 indicate that almost half of the respondents reported working in technical or staff roles. Over 85% of all respondents said they worked in full-time, permanent positions, and almost 75% responded that their workplace was in a metropolitan area. Figure 1 shows the distribution of respondents by Department of Health and Human Services region. Of those respondents who provided the state where their employer was located, over 52.8% were in regions 3, 4, and 5. Over one-fourth of respondents indicated that they worked at a nonhospital clinical laboratory facility (27.4%). Regarding time in their current laboratory position, 45.2% of respondents indicated that they had been employed for 5 or fewer years. In terms of employment benefits, 63.7% of respondents reported that their employer provided complete paid leave benefits, including sick leave. Most (84.8%) MLPs reported that they received health insurance coverage solely through their employer.

Chi-square analyses were conducted to determine any differences between the 2 recruitment groups for person-level and work-related variables. Across nearly all demographic and job-related variables, the ASCP-recruited respondents and the SM respondents differed significantly ($P = .0000$). The SM group was more female (69% vs 31%) and younger, with 88% younger than 29 years compared with 13% in the ASCP group. Racial and ethnic composition also differed, with the SM group being predominantly White (71% vs 30%). The ASCP group had more respondents with 31 years or more in the profession (54% vs 46%)

Table 1 Personal Characteristics of Medical Laboratory Personnel (N = 518)

Variable	No. (%)
Sex assigned at birth	
Female	434 (83.8)
Male	81 (15.6)
Prefer not to answer/missing	3 (0.6)
Gender identity	
Female	429 (82.8)
Male	82 (15.8)
Other (eg, nonbinary, transgender, prefer not to answer)	4 (0.8)
Missing	3 (0.6)
Age, y	
18 to 29	48 (9.3)
30 to 44	176 (33.9)
45 to 64	238 (46.0)
≥65	56 (10.8)
Race and ethnicity	
White	407 (78.6)
Black or African American	36 (6.9)
Asian	29 (5.6)
Hispanic or Latino, no specified racial identity	17 (3.2)
Hispanic or Latino, also identifies as White	7 (1.4)
American Indian, Alaska Native, Native Hawaiian, or Pacific Islander	7 (1.4)
Two or more racial groups	7 (1.4)
International (no other race or ethnicity reported)	3 (0.6)
Missing	5 (0.9)
Time in the profession, y	
5 or less	65 (12.6)
6 to 10	76 (14.7)
11 to 15	68 (13.1)
16 to 20	43 (8.3)
21 to 25	55 (10.6)
26 to 30	49 (9.5)
31 or more	154 (29.7)
Missing	8 (1.5)
Predominant hand dexterity	
Right-handed	479 (92.5)
Left-handed	39 (7.5)
General health	
Excellent/very good/good	432 (83.4)
Fair/poor	86 (16.6)
Reports taking pain medication yesterday, prescription or nonprescription	
No	263 (50.8)
Yes	255 (49.2)

and more individuals in administrative, managerial, or director roles (58% vs 42%). Differences were also observed in health status, reporting intake of medication yesterday, employment status, type of laboratory, geographic location of laboratory, job tenure, and insurance type. Only handedness and leave benefits did not differ significantly between groups. **Tables S1** and **S2** show the results of these comparisons.

Table 2 Work-Related Characteristics of Medical Laboratory Personnel (N = 518)

Variable	No. (%)
Job title	
Staff	233 (45.0)
Manager, administrator, or director	106 (20.5)
Supervisor or technical supervisor	97 (18.7)
Lead or coordinator	80 (15.4)
Missing	2 (0.4)
Employment status	
Full-time, permanent	449 (86.7)
Full-time, temporary (ie, traveling, subcontract, independent)	20 (3.8)
Part-time	34 (6.6)
Per diem	6 (1.2)
PRN, on call, as needed	8 (1.5)
Missing	1 (0.2)
Type and size of the organization	
Large hospital ≥500 beds	109 (21.0)
Medium hospital 100-499 beds	173 (33.4)
Small hospital <100 beds	87 (16.8)
Nonhospital laboratory[a]	142 (27.4)
Missing	7 (1.4)
Organization geographic location based on RUCC status	
1-3 Counties IMA of fewer than 250 000 to 1 million population or more	386 (74.5)
4-9 Urban population of fewer than 5000 NAM to 20 000 or more AM	92 (17.8)
Missing	40 (7.7)
Time in current job, y	
≤5	234 (45.2)
6-10	102 (19.7)
11-20	73 (14.1)
21-25	38 (7.3)
≥26	65 (12.5)
Missing	6 (1.2)
Receive paid leave benefits, including sick leave	
Completely	330 (63.7)
Mostly	79 (15.3)
Somewhat	69 (13.3)
Not at all	40 (7.7)
Insurance type	
Employer-based insurance	439 (84.8)
Employer-based insurance and government insurance[b]	29 (5.6)
Government insurance[b]	27 (5.2)
No insurance	18 (3.5)
Does not know	5 (0.9)

Abbreviations: AM, adjacent to metro; IMA, in metro areas; NAM, not adjacent to metro; PRN, pro re nata, employed as the circumstance arises; RUCC, Rural-Urban Continuum Codes 2013.[18]
[a]Included military, public health, tribal clinic laboratories, reference laboratories, industry, outpatient, retail, or other small laboratories.
[b]Included Medicare, Medicaid, military, or Indian Health Services.

Frequency of musculoskeletal pain in the past year

In the past 12 months, 94% of respondents in the combined sample reported experiencing pain in at least 1 body area in the preceding year, with most participating MLPs indicating problems with 1 or both

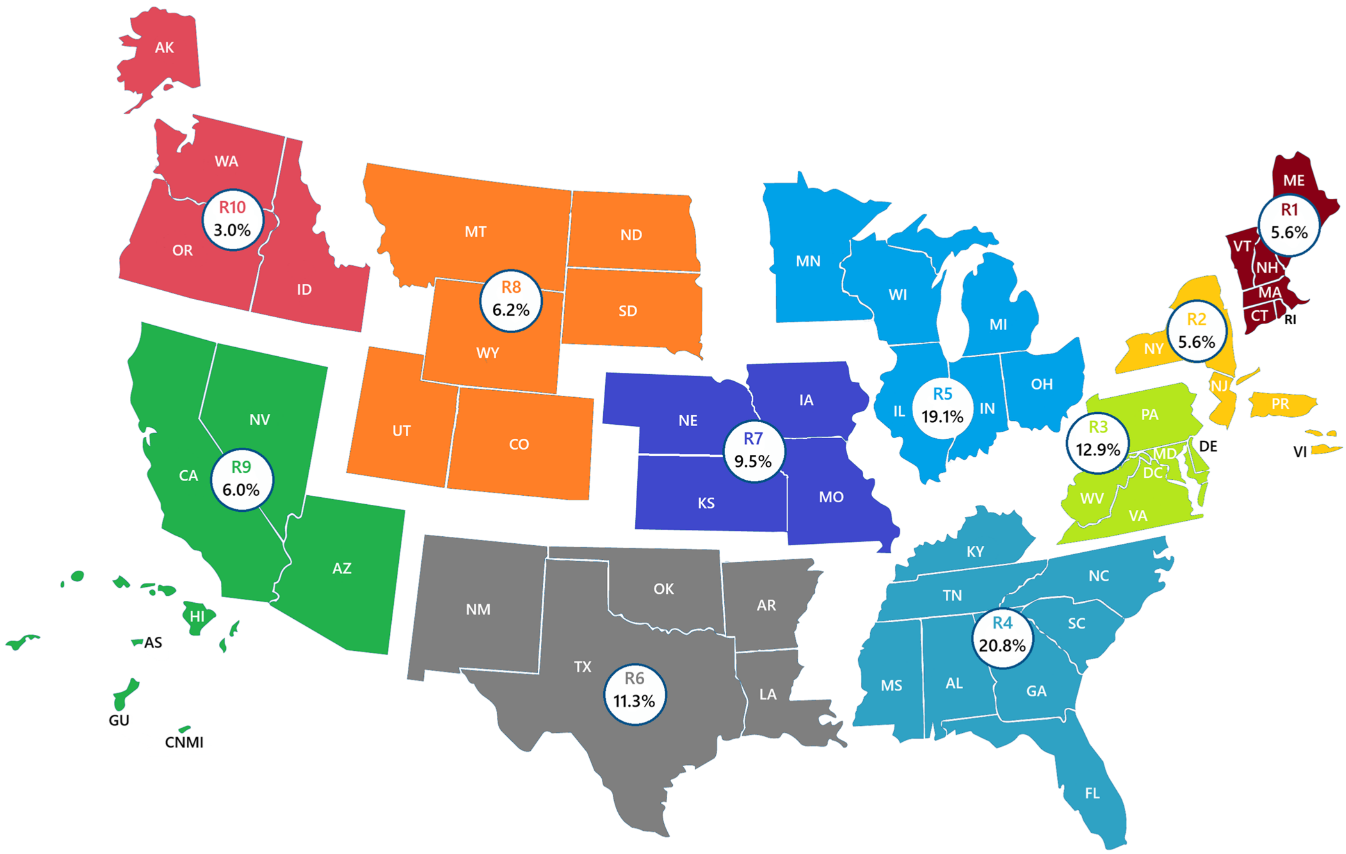

Figure 1 Geographic distribution of medical laboratory personnel. Proportions of medical laboratory personnel who indicated the geographic location of their workplace by Department of Health and Human Services region in the United States, October 2021 to February 2022 (n = 503). Original image altered for use in this figure is licensed under CC-BY-SA-4.0. Modifications include colors of regions, format of region numbers, and inclusion of percentages.[19]

shoulders (71%), lower back (69%), or neck (68%) and the fewest problems with pain in their elbows (22%). In fact, 33% reported pain in at least 1 body part every day, and 52% indicated they sought care for musculoskeletal pain from a health care provider. More than one-third (36%) reported being unable to work due to musculoskeletal pain in at least 1 body site in the past year. Specifically, 26% reported that they stopped work due to pain in the neck, trunk, or both; 17% due to pain in lower limbs; and 17% due to upper limb pain.

Figure 2 illustrates the frequency with which MLPs reported pain by body site in the past year, as well as those who indicated experiencing pain in each body site every day, those for whom MSDs prevented normal work, and those who sought care for their pain. On average, 10% of respondents reported experiencing pain every day. Although the pain reported did not prevent most of them from working, fewer than one-third of MLPs, on average, sought the care of a trained health care professional to address pain in the specific body site.

Musculoskeletal pain in the past 7 days

Among the MLPs who responded to the pain questions, 75% indicated that they experienced pain in at least 1 body site in the immediately preceding week. The proportion of respondents experiencing pain by body region was 58% in the neck and trunk, 52% in the upper limbs, and 47% in the lower limbs. Like the results for pain in the past 12 months by body site, most respondents with musculoskeletal symptoms in the past 7 days indicated problems associated with their lower back (39%), neck (38%), and shoulders (34%) and the least problems with elbows (9%) in the past 7 days. Figure 3 shows the distribution of musculoskeletal pain by body site in the past 7 days.

Relationship between pain in the past 7 days and personal and workplace characteristics

Using χ^2 tests, we found statistically significant differences in MSD reports by sex, racial or ethnic identity, job category, and recruitment group in the past 7 days. These analyses are available in **Tables S3** and **S4**. No other personal or work environment variables held a relationship for pain in the past week.

Greater proportions of women reported that they experienced pain in the past week in at least 1 body site compared with men ($\chi^2 = 7.64$, $P = .0057$). Within each of the 3 body regions examined, the proportion of female respondents who reported pain was higher than for respondents who indicated they were male (neck and trunk, $\chi^2 = 13.89$, $P = .0002$; lower limbs, $\chi^2 = 6.80$, $P = .0091$; upper limbs, $\chi^2 = 3.90$, $P = .0483$). In general, more respondents who identified as White reported experiencing pain ($\chi^2 = 17.87$, $P = .0013$) than people who

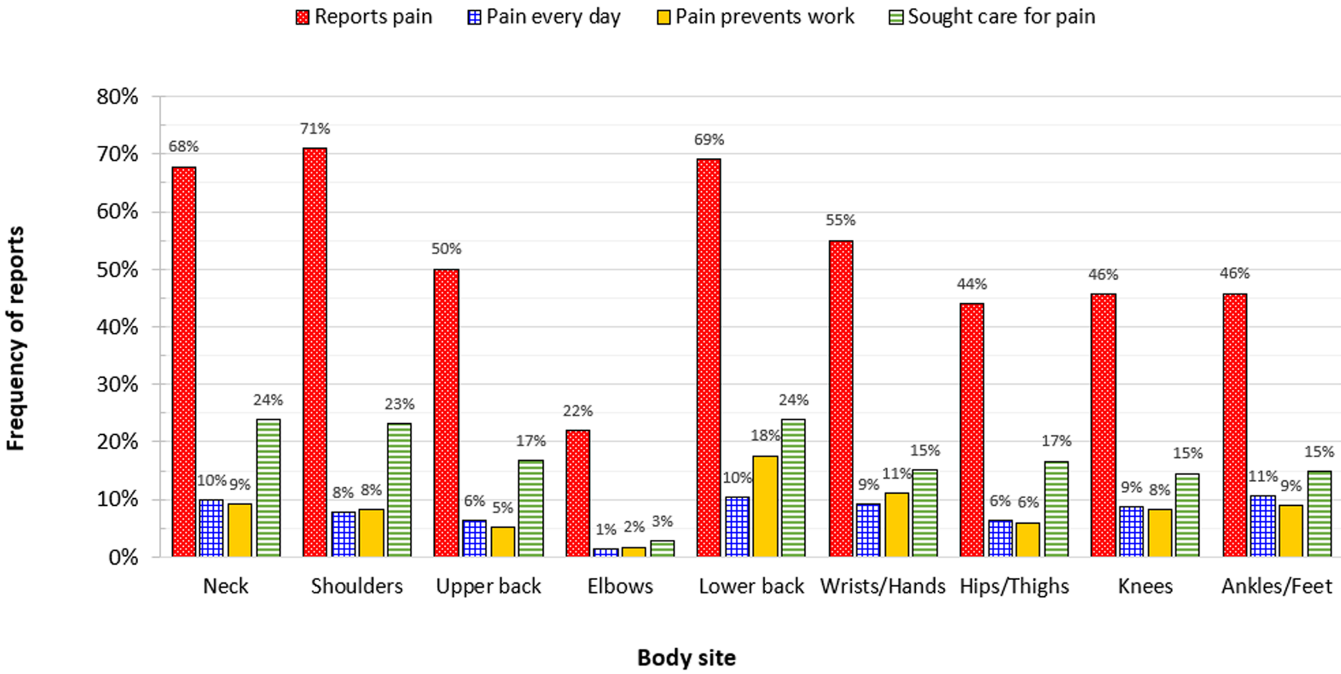

Figure 2 Proportion of self-reported musculoskeletal pain in the past year. The proportion of medical laboratory personnel who self-reported musculoskeletal pain by body site, indicating any pain in the past 12 months, whether they experienced pain every day, if pain severity prevented normal work, and if they sought treatment for their pain, October 2021 to February 2022 (N = 518).

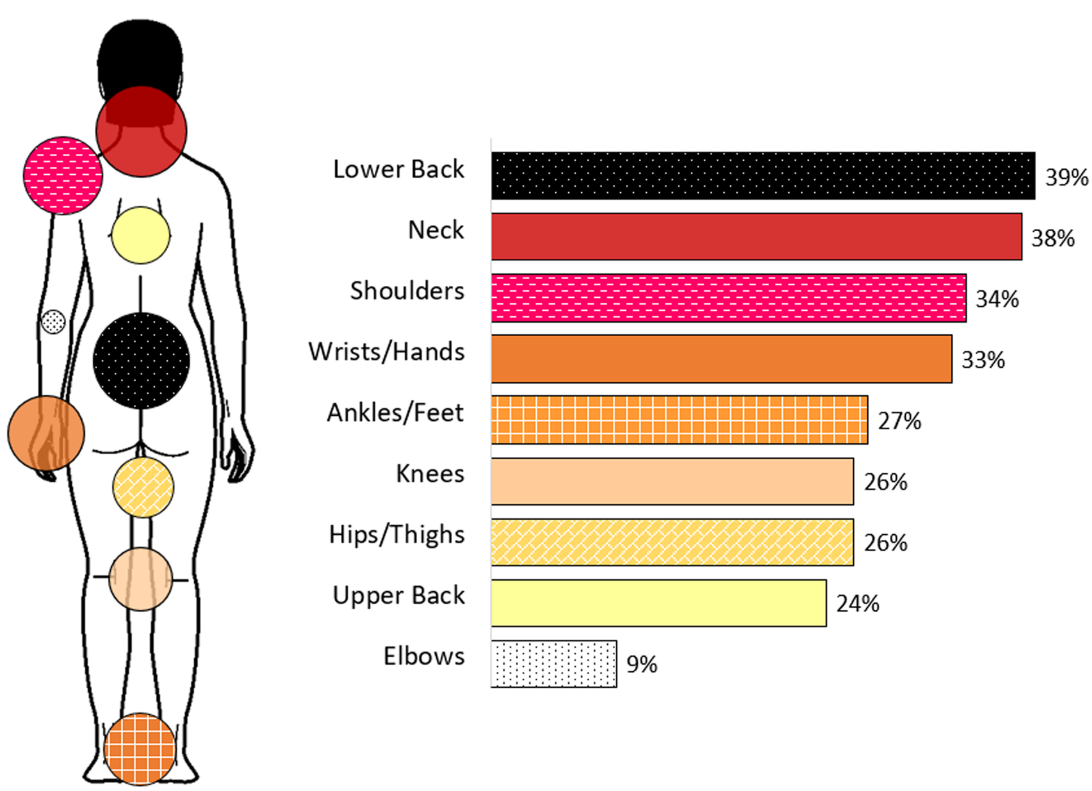

Figure 3 Representation of the proportion of self-reported musculoskeletal pain in the past 7 days. The proportion of laboratory personnel who self-reported musculoskeletal pain in the past 7 days by body site, October 2021 to February 2022 (N = 518). Original image altered for use in this figure is licensed under CC BY-SA 3.0. Modifications include overlay of multicolored circles on top of female figure and a bar chart with text and data.[20]

identified with other racial or ethnic groups, as well as in the neck and trunk ($\chi^2 = 12.93$, $P = .0116$), lower limbs ($\chi^2 = 19.02$, $P = .0008$), and upper limbs ($\chi^2 = 14.43$, $P = .0060$).

There were proportionally more staff, leads, coordinators, or supervisors who reported pain in the past 7 days ($\chi^2 = 6.98$, $P = .0082$) than managers, administrators, or directors who reported experiencing any pain. The trend of significantly higher reports of pain in the neck and trunk ($\chi^2 = 7.52$, $P = .0061$) and lower limbs ($\chi^2 = 6.10$, $P = .0135$) by staff and technical workers followed that of pain in any site compared with those in administrator roles.

Significantly more participants recruited in the SM group reported experiencing MSD-related pain in the past 7 days ($\chi^2 = 6.07$, $P = .0138$) compared with those in the ASCP group. This tendency remained when looking at each body region, where significantly higher proportions of SM group respondents said they experienced pain in neck and trunk ($\chi^2 = 22.04$, $P = .0000$), lower limbs ($\chi^2 = 8.89$, $P = .0027$), and upper limbs ($\chi^2 = 7.16$, $P = .0074$), suggesting a potential sample selection effect.

To evaluate the relationships of person-level and work characteristics with reports of pain in the past 7 days, we performed multivariable logistic regression models with pain in the past 7 days as the dependent variable using robust standard errors. There were 4 separate dependent variables: any pain, pain in neck and trunk, pain in lower limbs, and pain in upper limbs. Resulting odds ratios (ORs) with 95% confidence intervals can be found in Table 3.

Pain in any area in the past 7 days was higher for staff and others in technical roles (OR = 1.88; 95% CI, 1.09-3.27; $P = .024$) compared with administrators or others in leadership roles but appeared lower for MLPs who self-identified as Asian (OR = 0.4; 95% CI, 0.17-0.95; $P = .038$) compared with non-Hispanic White respondents. Female (vs male) respondents (OR = 1.91; 95% CI, 1.10-3.33; $P = .022$) and SM (vs ASCP) respondents had higher odds (OR = 1.96; 95% CI, 1.25-3.08; $P = .004$) of reporting neck and back pain.

For lower limb pain, self-identifying as Asian (OR = 0.3; 95% CI, 0.11-0.8; $P = .016$) or Black/African American (OR = 0.4; 95% CI, 0.17-0.98; $P = .044$) compared with those who identified as non-Hispanic White, time in practice in the clinical laboratory between 11 and 20 years (OR = 0.45; 95% CI, 0.26-0.79; $P = .005$) compared with having worked in the laboratory 31 years or more, and working in a large hospital (OR = 0.54; 95% CI, 0.31-0.93; $P = .027$) compared with

Table 3 Multivariate Analysis for Musculoskeletal Pain in at Least 1 Body Site, Neck and Trunk, Upper Limbs, and Lower Limbs, in the Past 7 Days (N = 494)[a]

	At least 1 body site	Neck and trunk	Lower limbs	Upper limbs
Covariate	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Sex				
Female	1.24 (0.67-2.28)	1.91 (1.10-3.33*)	1.09 (0.61-1.94)	1.03 (0.59-1.80)
Self-identifies as non-Hispanic White				
Black or African American	0.51 (0.22-1.19)	0.65 (0.29-1.49)	0.40 (0.17-0.98*)	0.42 (0.19-0.95*)
Asian	0.40 (0.17-0.95*)	0.56 (0.23-1.34)	0.30 (0.11-0.80*)	0.68 (0.30-1.59)
Hispanic or Latinx[b]	0.78 (0.30-2.06)	2.01 (0.72-5.62)	0.59 (0.22-1.55)	0.67 (0.27-1.65)
Other[c]	1.48 (0.38-5.77)	2.04 (0.69-6.05)	0.85 (0.31-2.36)	1.02 (0.38-2.76)
Time in practice				
10 years or less	0.54 (0.27-1.09)	1.13 (0.62-2.06	0.75 (0.42-1.34)	0.77 (0.43-1.37)
11-20 years	0.59 (0.31-1.11)	0.91 (0.52-1.59)	0.45 (0.26-0.79**)	0.65 (0.38-1.12)
21-30 years	1.10 (0.57-2.14)	1.22 (0.71-2.10	1.15 (0.67-1.97)	1.37 (0.80-2.33)
Job category				
Staff/lead/coordinator/supervisor	1.88 (1.09-3.27*)	1.33 (0.82-2.16)	1.77 (1.08-2.90*)	1.43 (0.88-2.34)
Time in current job				
6 years or more	0.82 (0.51-1.33)	1.13 (0.74-1.73)	1.23 (0.81-1.88)	0.88 (0.58-1.35)
Received complete paid leave				
No	1.46 (0.90-2.34)	1.33 (0.89-2.01)	0.98 (0.66-1.46)	1.20 (0.80-1.78)
Organization type				
Large hospital (≥500 beds)	0.78 (0.42-1.46)	0.88 (0.50-1.53)	0.54 (0.31-0.93*)	1.15 (0.68-1.95)
Medium hospital (100-499 beds)	0.76 (0.43-1.35)	0.76 (0.47-1.23)	0.70 (0.43-1.15)	1.00 (0.62-1.61)
Small hospital (<100 beds)	0.95 (0.47-1.94)	1.09 (0.60-1.98)	1.04 (0.57-1.89)	1.08 (0.61-1.92)
Recruited group				
Social media	1.34 (0.80-2.25)	1.96 (1.25-3.08**)	1.66 (1.04-2.65*)	1.34 (0.87-2.09)

Abbreviation: OR, odds ratio; CI, confidence interval.
[a]Reference: sex = male; self-identify as non-Hispanic White = yes; time in practice = 31 years or more; job = manager/administrator/director; time in current job = 5 years or less; received complete paid leave = yes; organization type = nonhospital laboratory; recruitment = ASCP group.
[b]Recoded variable race/ethnicity was modified by combining the “White and non-White Hispanic/Latinx” categories to “Hispanic or Latinx.”
[c]Recoded variable race/ethnicity includes all categories except those listed specifically into the “Other” category. See Table 1 for original categories.
*$P < .05$.
**$P < 0.01$.

working in a nonhospital clinical laboratory were associated with lower odds of reporting pain. In contrast, job category as staff, lead, coordinator, or supervisor (OR = 1.77; 95% CI, 1.08-2.9; P = .023) compared with role in management and recruitment into the SM group (OR = 1.66; 95% CI, 1.04-2.65; P = .033) compared with recruitment into the ASCP group were associated with higher odds of reporting lower limb pain. Lastly, those self-identifying as Black or African American had lower odds (OR = 0.42; 95% CI, 0.19-0.95; P = .038) of reporting pain in the upper limbs than MLPs who identified as non-Hispanic White. All other comparisons were not statistically significant.

DISCUSSION

This study characterizes the nature of work-related pain and musculoskeletal problems among MLPs in the United States. Musculoskeletal disorders afflicting at least 1 body site in the past 12 months were reported by 94% of respondents. Lower back, neck, and shoulders were the body sites with the greatest reported prevalence of pain in the past year and in the past 7 days. These proportions of musculoskeletal pain were similar to or greater than those identified by researchers studying medical laboratory workers outside of the United States.[21-24] This may be attributed to the timing of the data collection, which took place in the year after the start of the COVID-19 pandemic. Past studies that include other health professionals from the United States indicate high rates of musculoskeletal pain in the past 12 months. Franasiak and colleagues[25] measured pain using the SNQ in physicians performing robotic surgery and found reports of neck (73%), shoulders (53%), and lower back (42%) pain, and Sembajwe and colleagues[26] found nurses in their study indicated pain in the lower back (58%), shoulders (34%), and neck (30%). While the proportions differ, the sites where musculoskeletal strain was reported were similar to those in our sample of MLPs.

The frequencies of reported MSDs among MLPs by body site were much higher than data published by the BLS.[27] In 2020, the BLS data on nonfatal occupational injuries and illnesses involving days away from work in the private industry estimated that 13.3% of all injuries reported by clinical laboratory technologists and technicians and phlebotomists were in the trunk, 11.5% in the upper limbs, and 6.2% in the lower limbs.[13] Our study found self-reported pain in these body regions that prevented participants from normal work was 26%, 17%, and 17%, respectively, by body region. This suggests that musculoskeletal pain among MLPs that prevents them from working may be underreported in official US statistics.

However, the current study is consistent with other research on MLPs reporting MSDs. One study of cytotechnologists reported a prevalence of pain symptoms in the past 7 days as 62% in the neck, 56% in hand and wrist, and 42% in lower back.[11] Another studied the occurrence of cumulative trauma disorder among histology technologists and technicians; 62% of respondents described some type of pain, and 9% reported a diagnosis of carpal tunnel syndrome, which is a soft tissue injury of the upper limbs that develops over time due to repetitive movements.[12]

Differences between recruitment groups

We found systematic differences between the ASCP and SM recruitment groups, which indicated that each method reached a distinct segment of the laboratory workforce. The SM group reflected a younger, predominantly female, early-career population with higher reported pain levels, whereas the ASCP group captured a more experienced and diverse workforce with greater representation in supervisory roles. Bethel and colleagues[28] examined several strategies of survey recruitment using social media, which indicated advantages such as increased responses in shorter data collection windows but raised concerns about the generalizability of the data collected. We observed a similar phenomenon, in which two-thirds of our responses originated from recruiting using social media, and these were collected in a shorter period of time.

Other research has indicated that traditional means of recruitment, such as newspaper advertisements or posters placed in spaces where individuals in the targeted group might see them, provide either higher conversion rates from recruitment to completion or a more diverse participant population.[29,30] Recruiting MLPs using a database from ASCP facilitated conversion of a more diverse group, and respondents may have been more trusting of the source of the survey. In our study, recruitment source was intertwined with multiple demographic and occupational characteristics, and thus group membership was inherently confounded with these factors, which is why we included group origin in the model to measure the impact of this covariate.

Our models suggested that individuals in the SM group reported experiencing pain in the neck and trunk, as well as in the lower limbs, at higher rates than those in the ASCP group, and these associations were statistically significant. We hypothesize that, while controlling for group did not ultimately change many of the original associations observed, the patterns observed underscored the importance of adjusting for covariates in multivariable models and highlighted how recruitment strategies can shape the composition of survey data.

Personal characteristics associated with MSDs

Our study suggests that statistically significant associations exist between reporting musculoskeletal pain in the past 7 days in at least 1 body site, as well as by body region, and personal-level characteristics. A salient personal factor was sex, with MLPs of female sex having almost double the likelihood of reporting neck and trunk pain in the past 7 days than males. This was consistent with other literature.[22,31] As with other health professions, women predominantly staff clinical laboratories, and these workers experience a high incidence of musculoskeletal pain related to their occupation. Particular attention should be given to women in nonsupervisory positions who may be exposed to chronic pain over prolonged periods of time, as suggested by the results. Accordingly, this highlights the need for interventions that consider postural and physiologic characteristics of the female body, as well as potential social reasons why women may be more at risk for pain.

Time in the profession was another person-level characteristic that showed a relationship with MSD pain. The probability of experiencing pain in the lower limbs in the preceding week was less among MLPs who had worked in the laboratory for 11 to 20 years compared with those who had been in the profession for 31 years or more. Other studies suggest that workers tend to experience an increased likelihood of reporting work-related musculoskeletal pain with more time in the clinical practice.[22,32,33] López-González and colleagues[22] also reported that the probability of experiencing pain in the neck, shoulder, and wrists or hands in the past 7 days was higher among laboratory personnel with more years of work experience than among those with fewer years in the profession. However, the relationship between musculoskeletal pain in certain body sites and years in the profession may be affected by the type of work MLPs are currently performing, as well as other environmental variables, and not only be influenced by their personal characteristics.

Our results also suggest that racial or ethnic identity was a protective factor for MSDs among MLPs. The likelihood of reporting pain in general, as well as in the lower limbs, was less than half for MLPs identifying as Asian compared with their non-Hispanic White counterparts. Similarly, MLPs who identified as Black or African American were less likely to report pain in both upper and lower limbs compared with non-Hispanic White MLPs.

An explanation for this association may be related to pain perception, beliefs, and practices attributable to individuals' racial and ethnic background, whereas people from racial or ethnic minority groups experience pain that is not consistently documented. For example, a study of self-reported and physiologic measurements of pain identified that race and ethnicity may influence reported pain experiences in a simulated clinical setting.[34] Another explanation may be that, due to social and cultural beliefs related to race or ethnicity, people manage and report their experiences of pain differently. A systematic review of the literature of pain beliefs among individuals with chronic musculoskeletal pain identified moderate evidence of differences in the types of pain-coping strategies between racial and ethnic groups.[35]

It is also likely that our survey inadequately documented experiences of MSDs based on race and ethnicity due to our recruitment strategy. In comparing the demographic makeup of our sample with officially published research, both the ASCP group and the combined population of respondents differed in racial and ethnic composition from those who participated in the biannual ASCP wage survey. For instance, the ASCP group had higher proportions of Black or African American, Asian, and Hispanic or Latinx respondents than those who participated in the ASCP wage survey in 2021 (13.8 vs 7.6%, 10.1% vs 8.2%, and 7.5% vs 6.1%, respectively) and a lower proportion of non-Hispanic White respondents (63.8 vs 74.5%).[36]

Although MLPs, like many other health professionals, predominantly identify as non-Hispanic White, changes in the demographic composition of this professional group indicate that the laboratory is becoming more diverse.[37] More research is needed to identify if and how experiences of pain and having certain pain-related beliefs, cognitions, and behaviors are related to workers' self-reports of pain, so that accurate data that inform interventions to reduce the risk of MSDs can be implemented.

Work-related factors associated with MSDs

Medical laboratory personnel whose job category was staff, lead, coordinator, or supervisor experienced pain in at least 1 body site and in the lower limbs in the past week to a higher degree than did MLPs whose roles were those of manager, administrator, or director. This may be explained by the differences in tasks that individuals perform as staff or technical personnel as opposed to those in an administrative or managerial role.[38] A literature review of risk for MSDs suggested that the type of tasks involved in work (eg, wrist bending), rather than personal characteristics (eg, age of the worker), is a better criterion to determine if the work is likely to increase risk of this type of pain.[39] While our comparison of those in technical roles in management showed lower odds of the latter experiencing pain, 18% of administrators still reported experiencing some pain in the past week. Research shows that administrative tasks expose laboratory workers to ergonomic risks, including prolonged time at computer stations and adoption of uncomfortable or unsupported body postures.[32] These risks could be compounded in managers by concurrent or prior work performing technical tasks in the clinical laboratory setting. Additional efforts to advocate for ergonomic workstations in both clinical and administrative laboratory areas, as well as more research on the relationship between job tasks, knowledge of ergonomics practices, and their effects on workers, are warranted.

Finally, this study indicated a positive association between work-related pain in the lower limbs in the past 7 days among MLPs working in nonhospital laboratories compared with those working in large hospitals. In anecdotal reports from hospital-based laboratories during the first weeks and months of the COVID-19 pandemic, informants described the growth in testing capacity, from 20 to 1400 tests daily, within a matter of weeks.[40] Labor shortages and lack of adequate personnel training are major issues in the clinical laboratory workforce, with these problems being more acute in small hospitals and rural laboratories.[36] But there is not enough evidence on how these trends affect nonhospital clinical laboratory services specifically. With approximately 1 of every 5 clinical laboratory technologists and technicians and 1 of every 3 phlebotomists working in nonhospital medical and diagnostic laboratories in the United States, assessing the impact of ergonomic safety in these work environments is crucial, and further research is necessary.[2,3]

Implications and additional considerations

Practice in the clinical laboratory demands that workers operate in high-stress environments while performing repetitive tasks and maintaining potentially harmful postures for prolonged periods of time. Although some recommended ergonomic controls can help curtail or reduce the risks to MLPs, most of these controls address individual training of workers rather than through higher-level administrative and engineering controls.[5,41] Research by Caskey[42] identifies ergonomic programs specific to clinical laboratories that can help design workplaces that decrease risk of injury, and Jahan and colleagues[43] have proposed the Plan, Do, Check, Act cycle as an intervention that can reduce risk factors for MSDs in this workforce. In both cases, implementing plans for ergonomic improvement and additional training of staff were key to increasing overall ergonomic safety. A systematic review of nurses looking at the effectiveness of ergonomic interventions and work-related MSDs found that when compared with education alone, interventions including incorporating neck exercises and workstation ergonomic adjustments were more effective in reducing absenteeism due to MSDs.[44] More work related to the effectiveness of ergonomic interventions and longitudinal measures, such as sickness due to MSD or changes in work performance, is still needed in the laboratory workforce.

With clinical test volumes projected to increase in response to the higher need for health care and the aging of the US population, additional research on how the work environment affects laboratory personnel's risk for acute and chronic injury due to their professional activity is urgent. There is a need to implement best practices, such as the Total Worker Health program, to address the needs of MLPs.[45] Recommendations informed by consistent monitoring, leading to policy and program changes that optimize worker activity while addressing musculoskeletal problems, are also needed. In addition, design solutions and optimized ergonomic practices can reduce MSD risk and promote safe and healthy work in clinical laboratories.

A final consideration regarding the current study sample was that it included many participants who had been at their current job for 5 years or less, and a similarly substantial number of MLPs indicated they had worked in this profession for 31 years or more. These numbers suggest potential for turnover, which may affect knowledge and use of ergonomic controls based on the type of work the MLP performs and the risk factors they encounter. Understanding why US MLPs change jobs and if this turnover is associated with musculoskeletal pain requires further inquiry.

Limitations

This research was subject to several limitations. First, the cross-sectional nature of the study did not allow for causal modeling, particularly as this study took place during the COVID-19 pandemic, which is a once-in-a-generation phenomenon. However, it does provide evidence that suggests the degree and direction of the associations between MSDs and personal and work-related predictors. Also, it provided a better understanding of the prevalence of pain in a population of health professionals during times of increased workload. Second, participants did not answer every question, which led to missing data, and although there were no detectable patterns of nonresponse encountered, this may be a source of bias.

This study was subject to recruitment-related limitations and selection bias. The ASCP and social media strategies reached systematically different segments of the laboratory workforce, resulting in substantial demographic and occupational differences between groups. Because these differences were large and consistent across variables, the analytic sample is not a random or demographically balanced cross section of the profession. Although covariate adjustment mitigates confounding in the regression models, residual bias may remain if unmeasured characteristics also varied by recruitment source. These limitations should be considered when interpreting prevalence estimates and comparing subgroup patterns.

Another limitation stemming from the use of an electronic survey was the lack of information about nonrespondents, which led to an inability to assess response bias. It is possible that individuals experiencing pain are more likely to respond to the survey. This also limited researchers' ability to conduct adequate follow-up with individuals who may have been qualified as respondents. It is also possible that the heightened awareness of COVID-related work changes influenced both the selection of the respondents and the responses to the survey. Although we are unable to address the specific consequences of the pandemic environment, it seems likely that pain would be increased over periods of shortages and heightened stressors, suggesting an ongoing need for addressing pain among this population.

CONCLUSION

This study indicates a high prevalence of work-related pain and musculoskeletal problems among MLPs in the United States. It also documents relationships between personal characteristics and work-related factors that are associated with MSD. This research suggests that MLPs experience MSDs that can affect their work, which is a concern for potential acute and chronic pain due to the workers' environment. Medical laboratory personnel in the United States are essential members of the workforce, and as such, it is crucial to document and address experiences of musculoskeletal pain and injury.

Despite technological changes and the implementation of ergonomic controls in the medical laboratory, musculoskeletal pain among MLPs appears to be inadequately addressed. It is important to analyze other influences on well-being for this population, such as updating ergonomic observations and comparing pain with psychosocial factors at work. The results of this study can be used to identify areas of concern for MLPs regarding MSDs and serve as a foundation for further investigations and potential preventive or treatment interventions.

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Author Contributions

L.C.N. contributed to study design, data analysis, and interpretation, and wrote the first draft of the manuscript with J.A.W. revising drafts iteratively and assisting with analysis and interpretation; J.M.S. and E.A. contributed to study design, data curation, and manuscript revisions; all authors reviewed and approved the final draft of the manuscript.

Supplementary material

Supplementary material is available at *American Journal of Clinical Pathology* online.

Conflicts of Interest

None declared.

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Data Availability

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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