A Survey Study of Musculoskeletal Disorders Among Eye Care Physicians Compared with Family Medicine Physicians

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Purpose: To evaluate the prevalence of musculoskeletal disorders among eye care physicians compared with family medicine physicians.

Design: Case control study.

Participants and Controls: Ophthalmologists and optometrists at the University of Iowa and Mayo Clinic (participants) and family medicine physicians at the University of Iowa and Mayo Clinic (controls).

Methods: An electronic survey was e-mailed to all subjects.

Main Outcome Measures: The prevalence of musculoskeletal symptoms between eye care providers and family medicine physicians (control group).

Results: One hundred eight-six surveys were completed by 94 eye care physicians and 92 family medicine physicians with a response rate of 99% and 80%, respectively. There were no significant differences between the 2 groups with regard to mean age, gender, body mass index, years with current employer, or years in practice. Eye care providers, compared with their family medicine colleagues, reported a higher prevalence of neck (46% vs 21%; $P<0.01$), hand/wrist pain (17% vs 7%; $P = 0.03$), and lower back pain (26% vs 9%; $P<0.01$). A greater proportion of eye care physicians classified their job as a high-strain job (high demand, low control; 31% vs 20%) and a lower proportion classified their job as an active job (high demand, high control; 24% vs 47%; $p = 0.01$). Several job factors reported by eye care providers to contribute to musculoskeletal symptoms included performing the same task repeatedly, working in awkward/cramped positions, working in the same position for long periods, and bending/twisting the back (all $P<0.01$).

Conclusions: In this survey, the study group, composed of ophthalmologists and optometrists, had a higher prevalence of neck, hand/wrist, and lower back pain compared with family medicine physicians; repetitive tasks, prolonged or awkward/cramped positions, and bending/twisting were contributory factors. Given the ramifications of these findings, future efforts should concentrate on modifications to the eye care providers' work environment to prevent or alleviate musculoskeletal disorders and their personal and socioeconomic burden.

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Musculoskeletal disorders (MSDs) are among the most common occupational injuries and illnesses. Many epidemiologic studies report associations between physical risk factors (e.g., forceful exertions, static or awkward postures, repetitive motion) and MSDs or musculoskeletal symptoms among occupational groups in the health care sector, including registered nurses,[1] dental hygienists,[2] and custodial workers.[3,4]

An emerging literature is also available documenting MSDs or musculoskeletal symptoms among surgeons.[5–8] In a recent study, 90% of surgeons across multiple specialties, including general surgery, otorhinolaryngology, plastic surgery, orthopedics, and trauma surgery, reported experiencing musculoskeletal pain while performing operative procedures and 43% reported pain of sufficient intensity to necessitate rest breaks during surgery.[9] In another example, 73% of laparoscopic surgeons reported musculoskeletal symptoms in ≥1 body region during or after surgery.[10] Despite this evidence, most surgeons do not receive formal education about physical risk factors for MSDs and are unaware of guidelines for minimizing exposures to physical risk factors during surgery.[11]

Anecdotally, many ophthalmologists and optometrists have experienced MSDs themselves or know colleagues who have suffered from MSDs. Recent reports in *EyeNet*, an ophthalmology professional trade publication, drew attention to practitioners for the need to consider ergonomic factors in the design of ophthalmology examination and surgical equipment.[12,13]

Few previous studies have examined the prevalence of musculoskeletal symptoms among ophthalmologists (Desai UR, Abdulhak MM, Bhatti R. Occupational back and neck

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problems in vitreoretinal surgeons. Paper presented at American Society of Retina Specialists Meeting, August 2004; San Diego).[14–17] The reported prevalence of musculoskeletal symptoms ranged from 52% to 94% in these studies, which seems to substantiate the anecdotal evidence. However, none of the previous studies included a reference group and the response rates were generally low. Moreover, no information was obtained about job factors related to musculoskeletal symptoms. Consequently, it is unclear whether the prevalence of musculoskeletal symptoms among ophthalmologists is comparable with other groups of physicians and whether job factors may contribute to symptoms.

The objectives of this study were to compare the prevalence of musculoskeletal symptoms between eye care physicians and family medicine physicians (control group) and to examine relationships between job factors and musculoskeletal symptoms in both groups.

Methods

Study Population

We conducted a cross-sectional study of musculoskeletal symptoms among eye care physicians (ophthalmology residents, ophthalmology fellows, ophthalmology staff, and optometrists) and family medicine physicians (residents and staff) employed at the University of Iowa Hospitals and Clinics (Iowa City, IA) and the Mayo Clinic (Rochester, MN). Family medicine was chosen as a reference group because it is a nonsurgical specialty and does not require microscopelike equipment. All eye care physicians and family medicine physicians identified from the employment rosters at the respective hospitals were eligible to participate and contacted by e-mail. The e-mail included information about the study and an invitation to complete an anonymous, self-administered, on-line questionnaire. Multiple e-mail reminders and a gift certificate to a local coffeehouse (sent upon completion of the questionnaire) were used to encourage participation. The Institutional Review Boards and the ophthalmology and family medicine research committees at both the University of Iowa and The Mayo Clinic reviewed and approved the study procedures.

Questionnaire

The online questionnaire collected information about participant demographics, personal health, musculoskeletal symptoms, potentially contributing job factors, and occupational psychosocial stress (Appendix 1, available at http://aaojournal.org).

Demographics and Personal Health. Demographic information included age, gender, height, weight, and job history (employer, level of training, years in practice, and the average number of patients treated per day). Personal health information included exercise frequency, tobacco use, and prior diagnoses of specific MSDs (epicondylitis, rotator cuff tendonitis, and idiopathic low back pain, among others).

Musculoskeletal Symptoms. Musculoskeletal symptom status was addressed with standard questions about symptom quality and severity during the 30-day period before questionnaire completion. A positive symptom response was defined as a report of ache, pain, or discomfort (1) of intensity ≥"3" on a 0- to 10-point visual analog scale and not resulting from acute trauma, or (2) not resulting from acute trauma but requiring the use of medication regardless of symptom intensity. Visual analog scales are widely considered sensitive, accurate, and responsive metrics of pain.[18] Separate scales were included to assess symptoms of the neck, shoulder, elbows, hands/wrists, upper back, and lower back. Symptom laterality was not considered.

Job Factors. Participants indicated their perception of the contribution of each of 15 job factors to musculoskeletal symptoms. The job factor questions (with slight variations) have good test–retest reliability[19] and have been used in previous studies of musculoskeletal symptoms among workers in a variety of industries.[20–22] The job factor rating scales were anchored at "0" (indicating no contribution to symptoms) and "10" (indicating major contribution to symptoms). Specific job factors included "working very fast," "working in the same position for long periods," "bending or twisting your back," and "working in awkward or cramped positions."

Occupational Psychosocial Stress. Exposure to occupational psychosocial stress was assessed the widely used Job Content Questionnaire.[23] Specifically, the psychological job demand and decision latitude scales of the Job Content Questionnaire were used to estimate psychosocial job strain. The medians of the job demand and decision latitude (job control) scale responses were used to assign each participant into 1 of 4 psychosocial job strain categories (low-strain job = low demand and high control; passive job = low demand and low control; active job = high demand and high control; high-strain job = high demand and low control).

Statistical Analyses

Descriptive statistics were computed for the demographic and personal health variables from the questionnaire, with percentages for categorical variables and mean and standard deviation or median and interquartile range (IQR) for continuous variables. Responses of eye care providers and family medicine physicians were compared using Pearson chi square tests or Fisher exact test for the categorical variables, the Wilcoxon rank-sum test for the ordinal variables, and the 2-sample *t* test for the continuous variables. Thirty-day period prevalence of musculoskeletal symptoms for each body area within each group was estimated by dividing the number of positive symptom responses by the total number of participants in the group and then compared between the groups using Pearson chi square test.

Job factors were dichotomized as 0 to 5 (no problem/minor problem) or 6 to 10 (moderate problem/major problem) for comparison between groups. The Cochran–Armitage trend test was used to assess the association of the prevalence of musculoskeletal symptoms with the level of psychosocial job strain among the combined participant pool (not considering medical specialty in the analysis).

Because of small numbers of positive musculoskeletal symptom responses, logistic regression modeling to examine the association of symptoms with medical specialty adjusted for other relevant covariates was performed only for neck and/or shoulder symptoms. Two initial models were constructed. In the first, positive neck or shoulder symptoms was the dependent variable. In the second, positive neck symptoms only was the dependent variable. Each initial model included medical specialty as the independent variable and a set of covariates including gender, exercise frequency, the average number of patients seen per day, prior diagnosis of rotator cuff tendonitis, and psychosocial job strain category. These initial covariates were selected based on strength of association with medical specialty in the bivariate analyses described, and in the case of rotator cuff tendonitis, biomechanical reasoning. For the purposes of the logistic regression modeling, psychosocial job strain was dichotomized as "high strain" or

"other," and exercise frequency was categorized as "less than once per week," "1 to 2 days per week," or "≥3 days per week." The average number of patients per day was analyzed as a continuous variable. A backward elimination process was then used to construct final models for each dependent variable, retaining the independent variable and removing covariates with P values $>$ 0.20 one at a time. From the final fitted logistic model, the adjusted symptom odds ratio (OR), with 95% confidence intervals (CI), for eye care physicians relative to family medicine physicians was computed, as well as symptom OR for the covariates. All statistical analyses were performed using SAS, version 9.2 (SAS Inc., Cary, NC).

Results

Response Rates

A total of 95 eye care physicians and 115 family medicine physicians were invited to participate in this study; 187 questionnaires were completed. One participant was excluded because the question regarding medical specialty was unanswered. Of the 186 remaining participants, 94 (50.5%) were eye care physicians and 92 (49.5%) were family medicine physicians. The response rates were 99% for the eye care physician group and 80% for the family medicine physician group. In the eye care physician group, there were 39 residents/fellows and 52 staff in the eye care physician group; 3 participants did not answer this question. In the family medicine group, there were 29 residents and 58 staff; 5 participants did not answer this question.

Demographic, Job History, and Personal Health Characteristics

Results from the demographic, job history, and personal health sections of the questionnaire are shown in Table 1. The mean age and body mass index of the eye care physician and family medicine physician groups were similar. The proportion of males in the eye care physician group (67%) was greater than in the family medicine group (54%), although the difference was not significant.

Neither the median number of years employed at the current hospital nor the median number of years in practice were significantly different when comparing the eye care physicians with the family medicine physicians. However, the eye care physicians reported seeing a greater number of patients per day (median, 25; IQR, 16–30) than the family medicine physicians (median, 16; IQR, 10–20; $P<0.01$).

Table 1. Demographic, Job History, and Personal Health Characteristics, by Group

Variable	Eye Care Physicians		Family Medicine Physicians		
	Mean (SD)	*N (%)*	*Mean (SD)*	*N (%)*	***P***
Age	41.5 (10.9)		42.4 (11.4)		0.55
Male (n = 93, 91)		62 (67)		49 (54)	0.08
Race (n = 90, 91)					0.02
Caucasian		72 (80)		83 (91)	
African American		3 (3)		0 (0)	
Hispanic		1 (1)		3 (3)	
Asian		14 (16)		5 (5)	
BMI (kg/m^2) (n = 89, 91)	24.5 (4.0)		24.8 (4.5)		0.64
Employer (n = 92, 90)					0.78
UIHC		51 (55)		48 (53)	
Mayo		41 (45)		42 (47)	
Years with employer (n = 61, 60), median (IQR)	5.0 (1.9–13.8)		7.3 (0.9–28.8)		0.56*
Years in practice (n = 51, 46), median (IQR)	11.8 (1.0–23.7)		11.6 (2.9–23.9)		0.88*
Patients per day (n = 90, 90), median (IQR)	25 (16–30)		16 (10–20)		<0.01*
Exercise frequency (days per week)	0.05				
<1		22 (23)		17 (18)	
1		10 (11)		4 (4)	
2		12 (13)		13 (14)	
3		19 (20)		13 (14)	
4		9 (10)		12 (13)	
≥5		22 (23)		33 (36)	
Ever smoked tobacco		6 (6)		6 (7)	0.97
Prior musculoskeletal diagnoses					
Epicondylitis		6/93 (6)		18/91(20)	<0.01
Rotator cuff tendonitis		11/93 (12)		16/90 (18)	0.26
Biceps tendonitis		0/93 (0)		5/90 (6)	0.03
Carpal tunnel syndrome		6/92 (7)		8/90 (9)	0.55
Dequervain's syndrome		2/93 (2)		5/90 (6)	0.23
Slipped/ruptured cervical disc		12/93 (13)		14/90 (16)	0.61
Idiopathic low back pain		22/94 (23)		23/91 (25)	0.77
Other spine disorders		13/93 (14)		10/86 (12)	0.64

BMI = body mass index; Mayo = Mayo Clinic, Rochester, Minnesota; IQR = interquartile range; SD = standard deviation; UIHC = University of Iowa Hospitals and Clinics.
Sample sizes are 94 eye care physicians and 92 family medicine physicians unless otherwise noted.
*Wilcoxon rank-sum test used to compare results between groups.

Table 2. Participants Reporting Musculoskeletal Symptoms during the Previous 30 Days, by Body Region and Group

Body Region	Eye Care Physicians, n (%)	Family Medicine Physicians, n (%)	*P*-Value
Neck	(n = 93) 43 (46)	(n = 90) 19 (21)	<0.01
Shoulder	10 (11)	10 (11)	0.96
Elbow	1 (1)	(n = 91) 3 (3)	0.36*
Hand/wrist	(n = 93) 16 (17)	6 (7)	0.03
Upper back	(n = 93) 18 (19)	11 (12)	0.17
Lower back	(n = 93) 24 (26)	8 (9)	<0.01

Sample sizes are 94 eye care physicians and 92 family medicine physicians unless otherwise noted.
*Fisher's exact test used to compare groups

Musculoskeletal Symptoms

The 30-day prevalence of neck, hand/wrist, and low back musculoskeletal symptoms were significantly different between the groups (Table 2). In all cases, the prevalence among the eye care physicians was greater than among the family medicine physicians (neck, 46% vs 21%, respectively [$P<0.01$]; hand/wrist, 17% vs 7% [$P = 0.03$]; low back, 26% vs 9% [$P<0.01$]). Differences in the prevalence of shoulder, elbow, and upper back symptoms were not observed. There was no association between cervical disc disorders and neck pain ($P = 0.25$).

Occupational Psychosocial Stress

The JQR results are shown in Table 3. The slightly smaller sample sizes available for analyses of occupational psychosocial stress reflect missing data for some participants and the removal of 1 obvious outlier with a very low score identified in the distribution of decision latitude scores. Family medicine physicians reported a greater level of decision latitude (median, 76; IQR, 70–82) than eye care physicians (median, 72; IQR, 66–78; $P<0.01$). No difference in psychosocial job demands was observed between the groups.

A significant difference was observed between the groups in the distribution of the proportion of participants categorized into the 4 levels of psychosocial job strain ($P = 0.01$). Among the eye care physicians, 31% were in the high job strain category (high demands and low control), compared with 20% of the family medicine physicians. Moreover, a substantially greater proportion of family medicine physicians (47%) were observed in the active job category (high demands and high control) compared with 24% of the eye care physicians.

Job Factors

Eye care physicians more often reported that job factors moderately to greatly contributed (>5 on a 0 to 10 scale) to musculoskeletal symptoms compared with family medicine physicians (Table 4). Other than 4 job factors ("continuing to work when injured/hurt," "carrying, lifting, moving materials/equipment," "work scheduling," and "training"), in which similar percentages were reported, eye care physicians reported higher rates in all 11 other categories than family medicine physicians regarding their working environment as a contributing factor to musculoskeletal symptoms. The greatest differences were observed for the job factors "performing the same task repeatedly" (45% vs 22%; $P<0.01$), "working in awkward or cramped positions" (57% vs 15%; $P<0.01$), "working in the same position for long periods" (55% vs 18%; $P<0.01$), and "bending or twisting the back" (35% vs 5%; $P<0.01$).

Logistic Regression Models

Adjusted for gender, exercise frequency, rotator cuff tendonitis, high job strain, and patients seen per day, the data suggested, although not statistically significant, that eye care physicians relative to family medicine physicians were more likely to have positive neck *or* shoulder symptoms (OR, 1.95; 95% CI, 0.86–4.43; $P = 0.11$). A similar result was seen in the final model with an OR of 1.96 (95% CI, 0.90–4.27; $P = 0.09$; Table 5, available at http://aaojournal.org). In the final model, those who exercise <1 day per week relative to those who exercise ≥3 days per week were more likely to have positive neck or shoulder symptoms (OR, 2.57; 95% CI, 1.09–6.05; $P = 0.03$).

Table 3. Occupational Psychosocial Job Demands, Decision Latitude, and Job Strain among Study Participants

	Eye Care Physicians	Family Medicine Physicians	*P*-Value
Decision latitude	(n = 90) 72.0 (66.0–78.0)	(n = 91) 76.0 (70.0–82.0)	<0.01*
Psychosocial job demands	(n = 90) 26.0 (24.0–28.3)	(n = 90) 27.0 (25.0–29.0)	0.23*
Job strain	(n = 89)	(n = 90)	0.01†
Low strain job	22 (25)	18 (20)	
Passive job	18 (20)	12 (13)	
Active job	21 (24)	42 (47)	
High strain job	28 (31)	18 (20)	

Psychosocial job demands and decision latitude results reported as median (interquartile range), job strain results reported as number (%) within each category.
*Wilcoxon rank-sum test used to compare groups.
†Chi-square test used to compare distribution of job strain category proportions between groups.

Table 4. Participants Reporting ≥6 Level of Job Factor Contribution to Musculoskeletal Symptoms, by Group

Job Factor	Eye Care Physicians	Family Medicine Physicians	*P*-Value
Performing same task repeatedly	42 (45)	(n = 91) 20 (22)	<0.01
Working very fast	(n = 93) 24 (26)	22 (24)	0.77
Handling/grasping small objects	(n = 93) 16 (18)	6 (7)	0.02
Insufficient breaks	36 (38)	(n = 90) 24 (27)	0.09
Working in awkward/cramped positions	54 (57)	14 (15)	<0.01
Working in same position for long periods	52 (55)	17 (18)	<0.01
Bending/twisting the back	33 (35)	(n = 91) 5 (5)	<0.01
Working at/near physical limits	(n = 93) 13 (14)	8 (9)	0.26
Reaching/working overhead/away from body	17 (18)	7 (8)	0.03
Hot, cold, humid, or wet conditions	6 (6)	2 (2)	0.28
Continuing to work when injured/hurt	(n = 91) 15 (16)	(n = 91) 15 (16)	1.00
Carrying, lifting, moving materials/equipment	(n = 93) 3 (3)	2 (2)	1.00
Work scheduling	(n = 93) 30 (32)	32 (35)	0.72
Tool use (e.g., design, weight, vibration)	(n = 93) 10 (11)	2 (2)	0.02
Training	(n = 92) 4 (4)	2 (2)	0.68

Sample sizes are 94 eye care physicians and 92 family medicine physicians unless otherwise noted.

Restricting the logistic regression analyses to neck symptoms only as the health outcome produced different results (Table 6, available at http://aaojournal.org). In the final model, adjusted for gender, exercise frequency, and patients per day, eye care physicians relative to the control group were more likely to have positive neck symptoms (OR, 2.41; 95% CI, 1.10–5.30; $P<0.03$). In addition, the average number of patients seen per day was positively associated with neck symptoms (OR, 1.05; 95% CI, 1.00–1.09; $P<0.04$). Because the average number of patients seen per day was included in the model as a continuous variable, the OR is interpreted as a 5% increase in the odds of reporting neck pain per patient. The association between exercise frequency and neck symptoms was not significant.

Discussion

Among ophthalmologists, previous studies have reported the prevalence of neck symptoms to range from 32.6% to 69%, upper extremity/shoulder symptoms to range from 26.7% to 32.9%, and low back symptoms to range from 29.8% to 79.6%.[14–17] The observed prevalence of neck symptoms among eye care physicians in this study (46%) agrees with previous studies. However, the observed prevalence of shoulder symptoms (11%) and low back symptoms (26%) was somewhat lower.

The lower prevalence of musculoskeletal symptoms in this study compared with previous studies may have resulted in part from the use of a 30-day recall period. A higher prevalence of self-reported musculoskeletal pain is expected for longer recall periods (e.g., 12-months or ever during career). Dhimitri et al[14] also used a 30-day recall period, and their results are on the lower end of the range of reported musculoskeletal symptoms prevalence. Our use of a more restrictive definition of symptoms (i.e., self-reported symptom severity >3 on a 0–10 scale) rather than a dichotomous yes/no response may have also contributed to the lower observed musculoskeletal symptom prevalence.

Forty-one percent of eye care physicians in this study were residents or fellows, resulting in a somewhat younger study population compared with other studies, in which trainees were not included (mean age, 42 vs 48[15,16] and 52 years[14]). The median years in practice was 12 years, which is less than 16[15,16] and 20[14] years in the other studies. Because MSDs and musculoskeletal symptoms are progressive problems caused or exacerbated by suboptimal ergonomic job conditions (rather than an acute injury), older and more experienced colleagues may suffer more from these issues compared with younger colleagues.[17]

Participants in this study included 94 ophthalmologists, compared with 130 ophthalmic plastic surgeons,[15] 697 ophthalmologists,[14] and 162 ophthalmologists[16] in previous studies. The relatively small sample size in our study limited our ability to perform more robust analyses of the available data, for example, by exploring relationships between job factors or professional status (i.e., residents, fellows, staff) and musculoskeletal symptoms among the ophthalmology group. However, our response rate was exceptional and decreased the potential for self-selection to introduce bias, positively affecting the study's internal validity.

The contributing role of the eye care physician's physical work environment, in both clinic and procedural settings, to the development of MSDs or musculoskeletal symptoms must be taken seriously. Eye care physicians in this study identified several job factors that contributed to musculoskeletal symptoms to a greater extent than the family medicine physicians. These factors included performing the same task repeatedly, working in awkward/cramped positions, working in the same positions for long periods, and bending/twisting the back. Occupational tasks specific to the eye care physician group and performed frequently in the office environment include the use of the slit-lamp biomicroscope (which often has limited adjustability of the oculars and controls), indirect ophthalmoscopy, and use of refracting equipment such as the phoropter. These devices and tasks may excessively expose eye care physicians to nonneutral postures and muscular exertions of neck, shoulders, trunk, and distal upper extremities. Procedures performed in the operating room or with lasers have similar positional re-

quirements, but also frequently involve prolonged, static postures. Prolonged visual focus is also required, often in postures dictated by limited adjustability of surgical and clinical instrumentation.

Associations between exposure to occupational psychosocial stress (as estimated with the Job Content Questionnaire) and musculoskeletal outcomes have been reported among workers in a variety of industries.[24–26] Increased exposure to physical work demands can lead to elevated psychosocial stress,[27] and the combination of high physical work demands and psychosocial stressors may increase the severity of self-reported pain.[28] A previous study of musculoskeletal outcomes among ophthalmologists observed positive associations between stress levels and the prevalence of neck, upper extremity, and lower back symptoms.[14] In this study, a greater proportion of eye care physicians were classified into the high strain job category (high demands and low control) compared with family medicine physicians. Inspection of the results reveals the difference to likely be a consequence of the lower decision latitude observed among the eye care physicians. Consistent with previous literature, increasing levels of job strain were associated with increased frequency of neck and low back pain among the overall study population.

Similar to the results of Dhimitri et al,[14] the average number of patients treated per day was associated with musculoskeletal symptoms of the neck. In addition, infrequent exercise (<1 day per week) was associated with neck or shoulder symptoms. The potential benefit of regular exercise in preventing musculoskeletal symptoms among eye care providers has been reported in other studies.[15,29] Eye care physicians were more likely to report musculoskeletal symptoms of the neck than family medicine physicians while controlling for the potential confounding effects of patient load and exercise frequency in the logistic regression models.

Ophthalmology shares many similarities with laparoscopic surgery, including reduced access to the patient, adoption of awkward working postures for prolonged periods, limited freedom to reposition instruments and the video camera, and the requirement to focus on a video monitor while simultaneously manipulating foot pedals.[30–32] As with ophthalmology, a substantial proportion of laparoscopic surgeons (87%) have reported musculoskeletal symptoms.[11] Unlike ophthalmology, research has been performed in the field of laparoscopic surgery to document suboptimal ergonomics and investigate alternative strategies, and recommendations are available for improving operating room ergonomics.[32] Research has focused on handheld instrument design, video monitor position, placement of foot pedals, operating room table height, surgeon body posture, and the ergonomics of robot-assisted surgical systems.[32–35] In pediatric laparoscopy, checklists have been published to educate surgeons on work practice methods to prevent musculoskeletal symptoms and disorders.[36] Similar research efforts are needed in the field of ophthalmology.

As in all cross-sectional studies, temporal relationships between exposure to risk factors (medical specialty and covariates) and health outcomes (musculoskeletal symptoms) cannot be established, precluding definitive statements about causality. Also, the reliance on self-reported information can lead to misclassification of exposure or health outcome. However, we have no evidence to suggest the presence of differential misclassification. Possible reporting bias was minimized through the use of an online, anonymous questionnaire format. The health outcomes of interest in this study were self-reported musculoskeletal symptoms rather than clinical diagnoses of specific MSDs. Finally, responses to the job factor section of the questionnaire reflect each participant's subjective assessment of work activities believed to contribute to musculoskeletal symptoms. The job factors are surrogates for physical risk factors (e.g., forceful exertion, static or awkward postures) and more detailed exposure assessment methods are needed to accurately and precisely quantify exposures.

Another limitation may have been the inclusion of optometrists in our study population in an effort to increase our sample size. Optometrists are subject to similar clinical environments, but are not exposed to ergonomic factors in the operating room or procedural setting. We were unable to perform a subgroup analysis, because the participants were not asked to distinguish themselves as optometrists versus ophthalmologists, and the contribution of performing surgery to musculoskeletal symptoms could not be assessed in this study. Similarly, this reduced the mean surgeries per week reported by the eye care physician group and number of procedures per week may be related to the frequency of MSDs.[14] Moreover, because this study was conducted in an academic setting and the study population included trainees, the results may not be generalizable to those in private practice. Procedures commonly require more time in teaching hospitals than in private practice. The relationship between musculoskeletal symptoms and the average operative procedure duration should be examined in future studies.

To the best of our knowledge, this is the first cross-sectional study comparing the prevalence of musculoskeletal among eye care physicians to a reference group. Hand/wrist, neck, and lower back pain occurred more commonly in a group of eye care physicians compared with family medicine physicians. Eye care physicians also reported that several job factors contributed to musculoskeletal symptoms. Although we did not attempt to quantify the personal and socioeconomic impact of our findings, the importance of this issue should be self-evident. In contrast with the field of laparoscopic surgery, in which more research has been conducted and recommendations for improving the work environment are available, recommendations, guidelines and improvements in the eye care ergonomic environment are relatively lacking. We were able to find only 3 published articles in the ophthalmology literature (only one of which is indexed in PubMed) that advise ophthalmologists on how to properly position themselves in the clinic and the operating room.[12,13,37] The ergonomic design of many of the instruments used by eye care physicians, such as the slit lamp, have changed very little since their

invention. Given the findings of this study and other survey studies of musculoskeletal symptoms among ophthalmologists, which do suggest a high prevalence of MSDs, we hope that these data will encourage additional research, innovation, and collaboration with industry to improve the work environment of ophthalmologists and optometrists.

References

1. Smedley J, Inskip H, Trevelyan F, et al. Risk factors for incident neck and shoulder pain in hospital nurses. Occup Environ Med 2003;60:864–9.
2. Hayes MJ, Cockrell D, Smith DR. A systematic review of musculoskeletal disorders among dental professionals. Int J Dent Hyg 2009;7:159–65.
3. Unge J, Ohlsson K, Nordander C, et al. Differences in physical workload, psychosocial factors and musculoskeletal disorders between two groups of female hospital cleaners with two diverse organizational models. Int Arch Occup Environ Health 2007;81:209–20.
4. Alamgir H, Yu S. Epidemiology of occupational injury among cleaners in the healthcare sector. Occup Med (Lond) 2008;58:393–9.
5. Gofrit ON, Mikhail AA, Zorn KC, et al. Surgeons' perceptions and injuries during and after urologic laparoscopic surgery. Urology 2008;71:404–7.
6. Szeto GP, Ho P, Ting AC, et al. Work-related musculoskeletal symptoms in surgeons. J Occup Rehabil 2009;19:175–84.
7. Capone AC, Parikh PM, Gatti ME, et al. Occupational injury in plastic surgeons. Plast Reconstr Surg 2010;125:1555–61.
8. Stomberg MW, Tronstad SE, Hedberg K, et al. Work-related musculoskeletal disorders when performing laparoscopic surgery. Surg Laparosc Endosc Percutan Tech 2010;20:49–53.
9. Soueid A, Oudit D, Thiagarajah S, Laitung G. The pain of surgery: pain experienced by surgeons while operating. Int J Surg 2010;8:118–20.
10. Sari V, Nieboer TE, Vierhout ME, et al. The operation room as a hostile environment for surgeons: physical complaints during and after laparoscopy. Minim Invasive Ther Allied Technol 2010;19:105–9.
11. Park A, Lee G, Seagull FJ, et al. Patients benefit while surgeons suffer: an impending epidemic. J Am Coll Surg 2010;210:306–13.
12. Roach L. Ergonomics, part one: Is the job you love a pain in the neck? EyeNet. July/August 2009:49–50. Available at: http://www.aao.org/publications/eyenet/200907/upload/July-2009-Practice-Perfect.pdf. Accessed June 5, 2011.
13. Roach L. Seven risk factors for injury, and seven solutions: ergonomics, part two. EyeNet. September 2009:45–6. Available at: http://www.aao.org/publications/eyenet/200909/upload/Sept-2009-Practice-Perfect.pdf. Accessed June 5, 2011.
14. Dhimitri KC, McGwin G Jr, McNeal SF, et al. Symptoms of musculoskeletal disorders in ophthalmologists. Am J Ophthalmol 2005;139:179–81.
15. Sivak-Callcott JA, Diaz SR, Ducatman AM, et al. A survey study of occupational pain and injury in ophthalmic plastic surgeons. Ophthal Plast Reconstr Surg 2010;27:28–32.
16. Chams H, Mohammadi SF, Moayyeri A. Frequency and assortment of self-reported occupational complaints among Iranian ophthalmologists: a preliminary survey. MedGenMed [serial online] 2004;6(4):1. Available at: http://www.medscape.com/viewarticle/493990. Accessed June 5, 2011.
17. Chatterjee A, Ryan WG, Rosen ES. Back pain in ophthalmologists. Eye (Lond) 1994;8:473–4.
18. McDowell I. Measuring Health: A Guide to Rating Scales and Questionnaires. Oxford, UK: Oxford University Press; 2006:477–81.
19. Rosecrance JC, Ketchen K, Merlino L, et al. Test-retest reliability of a self-administered musculoskeletal symptoms and job factors questionnaire used in ergonomics research. Appl Occup Environ Hyg 2002;17:613–21.
20. Merlino LA, Rosecrance JC, Anton D, Cook TM. Symptoms of musculoskeletal disorders among apprentice construction workers. Appl Occup Environ Hyg 2003;18:57–64.
21. Rosecrance J, Rodgers G, Merlino L. Low back pain and musculoskeletal symptoms among Kansas farmers. Am J Ind Med 2006;49:547–56.
22. Nonnenmann MW, Anton D, Gerr F, et al. Musculoskeletal symptoms of the neck and upper extremities among Iowa dairy farmers. Am J Ind Med 2008;51:443–51.
23. Karasek R, Brisson C, Kawakami N, et al. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. J Occup Health Psychol 1998;3:322–55.
24. Haukka E, Leino-Arjas P, Ojajärvi A, et al. Mental stress and psychosocial factors at work in relation to multiple-site musculoskeletal pain: a longitudinal study of kitchen workers. Eur J Pain 2011;15:432–8.
25. Campo MA, Weiser S, Koenig KL. Job strain in physical therapists. Phys Ther 2009;89:946–56.
26. Sjölander P, Daerga L, Edin-Liljegren A, Jacobsson L. Musculoskeletal symptoms and perceived work strain among reindeer herders in Sweden. Occup Med (Lond) 2008;58:572–9.
27. Kompier MAJ, van der Beek AJ. Psychosocial factors at work and musculoskeletal disorders. Scand J Work Environ Health 2008;34:323–5.
28. Johnston V, Jull G, Souvlis T, Jimmieson NL. Interactive effects from self-reported physical and psychosocial factors in the workplace on neck pain and disability in female office workers. Ergonomics 2010;53:502–13.
29. Andersen LL, Jorgensen MB, Blangsted AK, et al. A randomized controlled intervention trial to relieve and prevent neck/shoulder pain. Med Sci Sports Exerc 2008;40:983–90.
30. Berguer R, Forkey DL, Smith WD. Ergonomic problems associated with laparoscopic surgery. Surg Endosc 1999;13:466–8.
31. van Veelen MA, Jakimowicz JJ, Kazemier G. Improved physical ergonomics of laparoscopic surgery. Minim Invasive Ther Allied Technol 2004;13:161–6.
32. Matern U. Ergonomic deficiencies in the operating room: examples from minimally invasive surgery. Work 2009;33:165–8.
33. Trejo A, Jung MC, Oleynikov D, Hallbeck MS. Effect of handle design and target location on insertion and aim with a laparoscopic surgical tool. Appl Ergon 2007;38:745–53.
34. van der Schatte Olivier RH, van't Hullenaar CD, Ruurda JP, Broeders IA. Ergonomics, user comfort, and performance in standard and robot-assisted laparoscopic surgery. Surg Endosc 2009;23:1365–71.
35. Harper JD, Figueroa H, Ebrahimi K, Baldwin DD. Laparoscopic scissors: a subjective and objective comparison of three brands. J Endourol 2009;23:1359–63.
36. Lenoir C, Steinbrecher H. Ergonomics, surgeon comfort, and theater checklists in pediatric laparoscopy. J Laparoendosc Adv Surg Tech A 2010;20:281–91.
37. Marx JL, Wertz FD, Dhimitri KC. Work-related musculoskeletal disorders in ophthalmologists. Tech Ophthalmol 2005;3:54–61.

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