Original Article

Digital Survey Assessment of Individual and Occupational Factors Associated with Musculoskeletal Disorders among Indian Ophthalmologists

Roshni Robert[1], Mahesh Babu[1], N.A. Sudhakar[1], B. Sumanth[1]

[1]Department of Ophthalmology, KVG Medical College and Hospital, Sullia, Karnataka, India

Abstract

Purpose: To study the prevalence of musculoskeletal disorder (MSD) and the associated occupational risk factors among Indian ophthalmologists, including residents and fellows.

Methods: A cross-sectional survey was conducted among ophthalmologists in India using a semi-structured questionnaire in a web-based survey. The questionnaire was prepared in English after extensive literature research and consulting with subject experts. It was pretested on ten ophthalmologists and after confirming that there were no ambiguities, the questionnaire was circulated. After providing informed consent online and ensuring the confidentiality of information, respondents could fill out the questionnaire containing questions to assess demographic details, risk factors, and musculoskeletal symptoms.

Results: We received 551 valid responses, out of which 74.77% reported musculoskeletal symptoms since starting practice in ophthalmology. We found a statistically significant association of work-related MSD with greater hours of practice, a higher number of hours of surgery, and a larger patient load. The self-reported symptoms were maximum in lower back (56.55%), followed by neck (49.03%), upper back (38.59%), and shoulder (23.79%). As a remedial measure, 58.98% resorted to rest while only 8.98% consulted orthopedist. Only 46% were aware of good ergonomic practices. Surgery (74.5%), indirect ophthalmoscopy (51.69%), and slit-lamp examination (50.73%) were reported as the major culprits. Respondents declared an interference with personal life (39.56%), with work (33.74%) as well as having caused psychological stress (43.2%) due to work-related MSD.

Conclusion: A vast majority of our respondents reported work-related MSD. Major risk factors were hours of practice, hours of surgery, higher body mass index, sedentary lifestyle, and higher patient load. The awareness of ergonomic practices was low.

Keywords: Back pain, Ergonomics, Musculoskeletal disorders, Neck pain, Ophthalmic practice, Ophthalmologist

Address for correspondence: Mahesh Babu, Quarter No. B-26, KVG Doctors' Apartment, Kurunjibhag, Sullia - 574 327, Karnataka, India.
E-mail: maheshbabu.oph@gmail.com
Submitted: 21-Feb-2023; **Revised:** 19-Aug-2023; **Accepted:** 29-Sep-2023; **Published:** 29-Mar-2024

Introduction

Musculoskeletal disorders (MSDs) have been described by the Centers for Disease Control and Prevention as soft-tissue injuries occurring due to sudden or sustained exposure to repetitive motion, force, vibration, and positions, affecting soft tissues, joints, and nerves.[1] Worldwide, MSDs in adults constitute a common cause of disability and there has been an increase in the global prevalence by 25% based on the World Health Organization report on global disease burden.[2,3] Healthcare workers, especially specialists in various fields are at risk of continuously strained postures and repetitive movements which strain the osteoarticular system invariably affecting muscles and joints.[4-6] While most doctors

Access this article online

Quick Response Code:

Website: https://journals.lww.com/joco

DOI: 10.4103/joco.joco_46_23

How to cite this article: Robert R, Babu M, Sudhakar NA, Sumanth B. Digital survey assessment of individual and occupational factors associated with musculoskeletal disorders among Indian ophthalmologists. J Curr Ophthalmol 2023;35:281-6.

experience some form of MSD during their practice, the prevalence of symptoms is markedly higher among surgeons due to their positioning during operation, operating table positions, instrument handling, and repetitive wrist and neck motions.[7,8] Recent studies have shown a high percentage of ophthalmologists reporting work-related MSD symptoms.[9] Globally, despite having over 200,000 ophthalmologists, developing countries still face a significant shortfall of ophthalmologists posing an increased work demand on existing ophthalmologists, which further translates to increased physical load placing stress on their musculoskeletal system.[10] Ophthalmologists reported various musculoskeletal symptoms associated with repeated slit-lamp examination, operating room procedures, and indirect ophthalmoscope examinations.[9,11-14] There is a lack of comprehensive studies on MSDs and their risk factors among ophthalmologists in India. With ophthalmologists at risk of ergonomic hazards translating to MSDs, there is little training on good ergonomic practices. We hence studied the MSDs among ophthalmologists and their relation to associated risk factors ophthalmologists starting from their residency.

Methods

We conducted a cross-sectional survey among currently practicing ophthalmologists and ophthalmology residents in India using a semi-structured questionnaire in a web-based survey over 2 months, which was sent through e-mail, text message, and other social media platforms to ophthalmologists across India. The questionnaire was prepared in English after extensive literature research and consulting with experts in this subject. It was pretested on ten ophthalmologists and after confirming that there were no ambiguities, the questionnaire was circulated. After providing informed consent online and ensuring the confidentiality of information, respondents could fill out the questionnaire containing questions to assess demographic details, risk factors, and musculoskeletal symptoms. Ophthalmologists who are currently practicing in India for at least 2 years, including ophthalmology residents, fellows, and consultants who give consent to the study, were considered for the study. Ophthalmologists with previous history of musculoskeletal surgeries (due to trauma or other conditions unrelated to work), history of musculoskeletal pain, history of congenital MSDs before starting the ophthalmic practice, or currently not practicing in the last 6 months were excluded from the study. All experimental protocols and procedures were approved by the institutional review board and complied with the tenets of the Declaration of Helsinki. Data were analyzed using IBM SPSS software version 27 (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, version 27.0. Armonk, NY, USA: IBM Corp). Descriptive and inferential statistics were carried out. Shapiro–Wilk test was done to look for the normality of data. Logistic regression analysis was done to investigate the multivariate effect of parameters. Chi-square test and Pearson's correlation test were done, and odds ratio was calculated appropriately. The statistical significance was determined at $P < 0.05$ in all analyses.

Results

In our study, we analyzed responses from ophthalmologists from across India, including residents and fellows. We received 575 responses, out of which 551 were valid and considered for the study. The mean age of our study population was 40.82 ± 8.8 years (interquartile range [IQR] = 35–48). The age of respondents ranged from 25 years to 59 years. Females comprised 346 (62.79%) and males comprised 205 (37.21%). In our study, 74.77% (n = 412) reported some form of musculoskeletal complaints related to their ophthalmology practice. We found that 81.46% (n = 167) of males and 70.81% (n = 245) of females reported some form of MSDs related to work. This gender predilection was statistically significant; $\chi^2 = 7.192$, $P = 0.007323$ (with Yates correction). The mean body mass index (BMI) was 25.67 ± 3.29 kg/m^2; IQR = 23.69–27.77. Table 1 shows the association of BMI with work-related MSD.

We used multivariate linear regression analysis to find the effect of parameters such as age, gender, BMI, and years of practice on MSD complaints and also to overcome the probable effects of confounding factors such as age and gender.

It was found that BMI and years of practice can significantly predict MSD ($P = 0.043$, $P = 0.027$, respectively). Detailed findings from the MSD-related multiple regressions are included in Table 2.

In our study, among respondents who were obese (i.e., BMI ≥ 30), musculoskeletal symptoms were reported by 81.55% of them. The presence of musculoskeletal complaints was significantly

Table 1: Body mass index and musculoskeletal complaints in ophthalmologists

BMI	Respondents with MSD	Percentage of respondents with MSD (%)	Respondents without MSD
18.5–24.9 (normal)	236	70.87	97
25–29.9 (overweight)	92	80.0	23
≥30 (obese)	84	81.55	19

MSD: Musculoskeletal disorder, BMI: Body mass index

Table 2: Linear regressions testing associations between demographics and musculoskeletal disorder

Variables	OR	*P*	R^2	95% CI	
				Lower	Upper
Age	0.058	0.038	0.005	0.913	1.407
Gender	2.056	0.044	0.026	0.051	2.770
BMI	0.726	0.043	0.006	0.090	1.543
Years of practice	0.583	0.027	0.004	0.737	1.150

OR: Odds ratio, R^2: Coefficient of determination, CI: Confidence interval, BMI: Body mass index

associated with higher BMI, $P = 0.032$. The majority of the participants who reported musculoskeletal discomfort had a general ophthalmology practice [Figure 1].

The number of individuals with MSD was greater in those with more than 10 years of experience ($n = 221$), but this was not statistically significant; $P = 0.363$. With the increase in the number of patients seen per week (>300), more than 20 h of surgery per week, and more than 50 h of practice per week there were increased odds of having MSD in the ophthalmologists in our survey. The same is explained in Table 3.

Only 46.46% ($n = 256$) of the total 551 participants were aware of good ergonomic practices, out of which 184 (71.88%) had musculoskeletal symptoms. The percentage of respondents with MSD was higher at 77.29% ($n = 228$) among ophthalmologists who had no awareness regarding good ergonomic practices ($n = 295$). Having awareness about ergonomic practices showed a lower prevalence of MSD; however, this was not statistically significant; $\chi^2 = 1.8518$, $P = 0.1736$. However, only 70 of those with good awareness were regularly practicing ergonomic postures, of which only 37 had musculoskeletal pains. There was statistical significance between the presence of MSD and those not practicing ergonomic postures among respondents who declared they were aware of good ergonomic practices ($P = 0.0009$). Of the respondents, 539 (97.81%) stated that they never received training regarding good ergonomic practices and all respondents ($n = 551$) believe it will be helpful if the same is imparted during residency training.

The number of residents or fellows with MSDs was in comparison less than consultants with MSDs. This was statistically significant, the Chi-square statistic with Yates correction is 5.624; $P = 0.01772$.

The majority of participants, 60.92% ($n = 251$) with MSD reported symptoms for an average of 2–7 days per month. More than 14 days per month of musculoskeletal symptoms was reported by 12 (2.91%) while 1–2 days of MSD was declared by 91 (22.09%) and 7–14 days of musculoskeletal discomfort was reported by 58 (14.08%).

Among the reported musculoskeletal symptoms, the majority had pain/discomfort in the lower back ($n = 233$), followed by neck ($n = 202$) and upper back ($n = 159$). The reported symptoms are shown in Figure 2.

Table 3: Practice pattern and musculoskeletal disorder

	Risk factor	OR	95% CI	*P*
Average number of patients seen per week	>300	1.65	1.097–2.49	0.0164
Average number of hours of surgery per week	>20 h	1.77	1.07–2.91	0.0249
Average total number of hours of practice per week	>50 h	1.73	1.04–2.87	0.0349

OR: Odds ratio, CI: Confidence interval

The procedures most commonly reported to aggravate musculoskeletal discomfort were surgeries ($n = 307$, 74.5%),

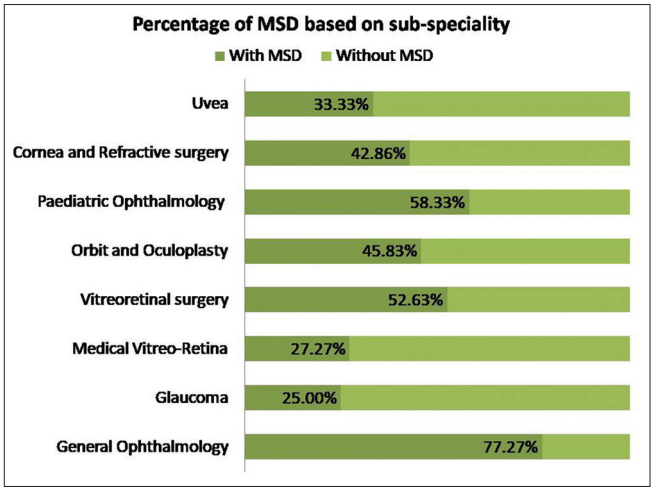

Figure 1: Subspecialty practice among ophthalmologists with self-reported musculoskeletal discomfort

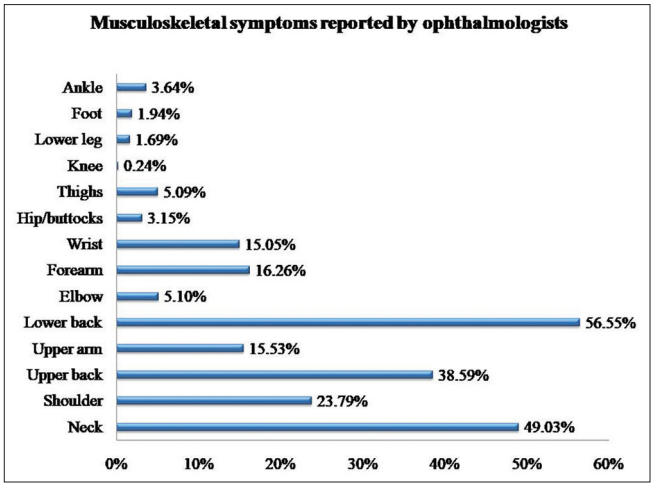

Figure 2: Musculoskeletal pain or discomfort reported by ophthalmologists

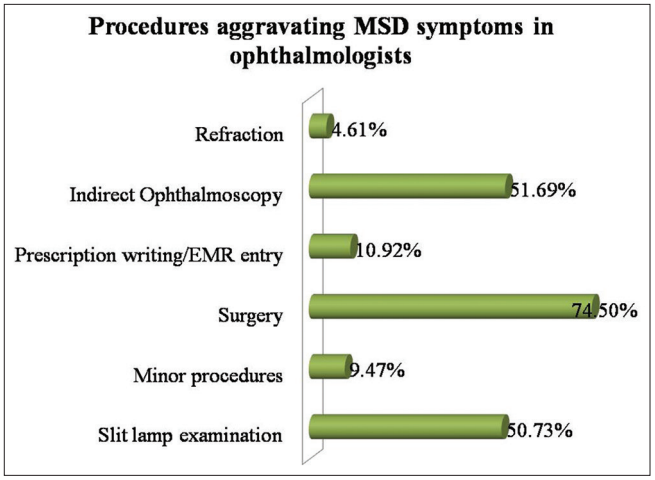

Figure 3: Procedures that aggravate musculoskeletal discomfort among ophthalmologists

indirect ophthalmoscopy (n = 213, 51.69%), and slit-lamp examination (n = 209, 50.73%), as shown in Figure 3.

As a remedial measure, when ophthalmologists from our study encountered work-related musculoskeletal symptoms, the majority of them resorted to rest (n = 243) and simple exercises (n = 134). The other measures taken are shown in Table 4.

While a majority of participants (n = 275, 66.75%) with work-related MSDs did not require major interventions, almost 20% needed braces for more than 2 weeks and 14% required rest for more than 1 week. Other interventions are shown in Table 5. Among the ophthalmologists in our study, about 123 (29.85%) had to take a leave of absence from work for more than 3 days in a row.

The number of years of ophthalmology practice indicated a small but nonsignificant positive relationship with the number of pain areas; r (412) = 0.0896, P = 0.677.

Among the ophthalmologists who responded to our survey, 139 (33.74%) affirmed that musculoskeletal complaints interfered in their professional work and personal life (39.56%). Table 6 indicates the effects of musculoskeletal symptoms on professional and personal life as reported by Indian ophthalmologists in our survey.

On analyzing the physical activity, we found that doctors who had some form of exercise had a decreased odds of developing MSD, odds ratio = 0.2692 (confidence interval: 0.1800–0.4026; $P < 0.0001$).

Table 4: Remedial measures to work-related musculoskeletal disorders among ophthalmologists

Remedial measure	*n* (%)
Rest	243 (58.98)
Consult orthopedician	37 (8.98)
Physiotherapy	42 (10.19)
Self-medicate	41 (9.95)
Simple exercises (stretches)	134 (32.52)
Workouts	18 (4.37)
Alternative medicine	1 (0.24)
Make changes in clinic settings	99 (24.03)
Yoga	5 (1.21)

Table 5: Interventions for work-related musculoskeletal disorders among ophthalmologists

Interventions for work-related MSDs	*n* (%)
Rest for >1 week	61 (14.81)
Prolonged medications (NSAIDs, muscle relaxants, steroids)	39 (9.47)
Physiotherapy	42 (10.19)
Braces for >2 weeks	81 (19.66)
Surgery	0
None	275 (66.75)

MSD: Musculoskeletal disorder, NSAIDs: Nonsteroidal anti-inflammatory drugs

Discussion

In this online survey, 74.77% of ophthalmologists reported work-related MSDs. A study among US ophthalmologists showed a prevalence of work-related MSD at 66% and 48% among Canadian ophthalmologists.[15,16] This alarmingly high prevalence in India could be due to a high patient load owing to a low ophthalmologist–population density, i.e., 1:1,00,000, while in developed countries like the USA, the ratio of an ophthalmologist to the population is 5–6/100,000.[17,18]

We observed that males had a predilection to develop musculoskeletal pains compared to female ophthalmologists. This could be attributed to lower reporting of pains by females due to a higher pain acceptance level.[19] Alternatively, the disparity in practice patterns and lifestyle between the genders could also contribute to this difference in self-reported symptoms.[20] In our study, participants with higher age had a higher prevalence of MSD symptoms. This could be due to degenerative aging changes in the musculoskeletal system.

Among the respondents with a high BMI, the prevalence of work-related MSD was significantly higher than those with a normal BMI. The likelihood of developing an MSD is postulated to increase with an increase in the level of obesity as measured by BMI.[21] A specific association with lower back pain is reported in the general population with being overweight or obese.[22] Considering lower backache being reported by more than half of our study population, maintaining a normal BMI could help in reducing the symptoms.

The most commonly reported problem areas were neck and lower back in our study, followed by shoulder and upper back pains/discomfort. While more than half (56%) of the respondents declared lower back pain and 38% reported upper back pain in our survey, a study among UK ophthalmologists revealed 50% of ophthalmologists had back pain and 39% of Canadian ophthalmologists.[7,23] A disconcerting 70% reported back pain in a survey among Indian ophthalmologists.[24] There was a 49% prevalence of neck pain and 24% of shoulder pain.

Table 6: Effects of musculoskeletal disorder on professional and personal life

Query	Yes, *n* (%)	No, *n* (%)
Has there been any interference in your work due to musculoskeletal pains?	139 (33.74)	273 (66.26)
Has musculoskeletal disease affected your quality of personal life?	163 (39.56)	249 (60.44)
Has the presence of musculoskeletal diseases caused you psychological stress?	178 (43.20)	234 (56.8)
Has any of these symptoms disrupted your work for >3 days in a row?	123 (29.85)	289 (70.15)

This is much lower than the 70% prevalence of neck pain and 57% of shoulder pain in the study population comprising US ophthalmologists.[16,25] This study by Tan *et al*. also showed a higher prevalence of MSDs in ophthalmologists at 81.4%.[26] This alarming rise could be as this is a recent study done in 2021 in comparison to earlier studies.

Specialty-wise, among pediatric ophthalmologists, 58% had musculoskeletal symptoms, whereas 53% of vitreoretinal surgeons and 46% of oculoplastic surgeons had MSDs. A study by Fouzdar Jain *et al*. among pediatric ophthalmologists in the USA observed a 66% musculoskeletal discomfort.[26] Among ophthalmic plastic surgeons, an alarming 72% was reported.[27] A larger survey encompassing a greater number of ophthalmologists from each subspecialty may be preferable to deduce the role of subspecialty-specific role in the development of work-related MSDs. Residents or fellows were less likely to develop MSDs in our study despite the long working hours. This could be attributed to a tedious lifestyle and overload of patients among Indian ophthalmologists owing to low ophthalmologist density.[18]

This translates to a perceptibly high number of patients and the number of hours of surgery is a risk factor in developing musculoskeletal pains in ophthalmologists, as observed by the study in US ophthalmologists; which however, did not correlate with the number of hours of practice.[15] This mirrors the analyses from the responses in our study except that we found that the greater the hours of practice, the odds of developing MSDs increased.

Repetitive tasks as simple as the slit-lamp examination, awkward postures during surgery, and indirect ophthalmoscopy have been considered the main villains in ophthalmic practice causing a strain on neck, shoulders, and lower back typically.[14,16] While sedentary lifestyle has been known to be associated with MSDs, its importance in ophthalmic practice has not been studied.[28] Our study revealed a similar observation among ophthalmologists wherein those with some kind of physical activity ranging from daily walks and mild workouts to intense workouts. Hence, incorporating exercise into daily routine could prove beneficial in eye care physicians and surgeons.

MSDs have significantly affected both personal and professional lives, also causing psychological stress in ophthalmologists in our survey. Although such declarations have been found significant in several other studies, a detailed study is required to assess the quality of life and psychological stress caused by MSD that could signal toward the gravity of the situation.[11,15] Despite a disturbing level of musculoskeletal pains, only a small portion have seeked orthopedician's help or physiotherapy. Seeking timely consultation must be stressed upon to avoid loss of work, financial burden, and career interruption.

The role of good ergonomics in preventing ophthalmic practice-related MSD is very imperative. Although aware of ergonomic practices, only a small portion is practiced regularly. Self-motivation and reinforcement could play an important role in assuring the adaptation of awareness into practice. The unrealistic expectation of lowering the patient load in a densely populated country like India along with financial stress on eye care professionals leaves one with improving ergonomics, modulating the workplace environment, and effectively amending the instruments to suit the optimum postures. The American Academy of Ophthalmology had set up a task force for the same, which provided ergonomic guidelines and standards for ophthalmic equipment.[29] Encouraging the adoption of these standards by the ophthalmic device manufacturers could go a long way. The use of heads-up displays for surgeries received positive feedback in terms of reduced cervical and lower back pain associated with comfortable seating postures and neutral positions.[30,31]

Few of our respondents have received any kind of training in terms of ergonomics during ophthalmology residency in the face of a substantial prevalence of MSDs in the fraternity. A study using an intervention with an ergonomics education module for ophthalmology residents gave promising results wherein the rapid upper limb assessment injury risk score decreased after completion of the module.[32] This opens up the potential that ergonomic education introduced in residency training, CMEs, and conferences could help mitigate work-related musculoskeletal injuries. The majority of our respondents opined that introducing ergonomic training would be beneficial in extenuating musculoskeletal pain or discomfort arising from ophthalmic practice.

Another concern found in an interview with medical device manufacturers found a gap in the communication between device designers and the intended users.[33] Employing exercise programs for surgeons by professionally trained personnel can help improve their musculoskeletal health and aid in reducing injury risk.[34]

This study assessed MSDs among ophthalmologists in India based on a subjective questionnaire. A multicenter study with large number of participants for objective and clinical assessment of work-related musculoskeletal complaints is furthered.

In conclusion, our survey revealed that close to three-fourths of the population had work-related musculoskeletal pains. Majority reported lower back and neck pains, followed by shoulder pains. Surgery, slit-lamp examination, and indirect ophthalmoscopy were reported to aggravate symptoms. Male gender and increasing age are seen having a higher prevalence of MSD. Longer working hours, hours of surgery, and a greater average number of patients seen showed increased odds of developing MSDs. Higher BMI and a sedentary lifestyle were associated with musculoskeletal discomfort. The number of years of practice correlated with a higher number of pain areas. The awareness of ergonomic practices was low among participants but the majority were in favor of introducing

ergonomic training to extenuating musculoskeletal pain or discomfort arising from ophthalmic practice.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Centre for Disease Control. NIOSH Program Portfolio: Musculoskeletal Disorders: Program Description. Available from: https://www.cdc.gov/niosh/programs/msd/default.html. [Last accessed on 2021 Jan 20].
2. Woolf AD, Akesson K. Understanding the burden of musculoskeletal conditions. The burden is huge and not reflected in national health priorities. BMJ 2001;322:1079-80.
3. World Health Organization. Global Burden of Disease. Global Programme on Evidence for Health Policy Discussion Paper 50. Geneva: World Health Organization; 2000.
4. Yasobant S, Rajkumar P. Work-related musculoskeletal disorders among health care professionals: A cross-sectional assessment of risk factors in a tertiary hospital, India. Indian J Occup Environ Med 2014;18:75-81.
5. Lahoti S, Narayan A, Ottayil Z, Unnikrishnan B. Prevalence of musculoskeletal disorders among doctors in Mangalore: A cross-sectional survey. Int J Health Allied Sci 2014;3:204-7.
6. Alzayani MK, Salama KF, Zafar M. Work-related musculoskeletal disorders among dental staff in armed force hospital in Dhahran, Saudi Arabia. Int J Prev Med 2021;12:119.
7. 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.
8. Davis WT, Fletcher SA, Guillamondegui OD. Musculoskeletal occupational injury among surgeons: Effects for patients, providers, and institutions. J Surg Res 2014;189:207-12.e6.
9. Dhimitri KC, McGwin G Jr., McNeal SF, Lee P, Morse PA, Patterson M, *et al.* Symptoms of musculoskeletal disorders in ophthalmologists. Am J Ophthalmol 2005;139:179-81.
10. Resnikoff S, Felch W, Gauthier TM, Spivey B. The number of ophthalmologists in practice and training worldwide: A growing gap despite more than 200,000 practitioners. Br J Ophthalmol 2012;96:783-7.
11. Alamri AM, Tedla JS, Ahmad I, Laftal A, Al Ghamdi A. Musculoskeletal disorders among ophthalmologists in the Kingdom of Saudi Arabia: A cross-sectional study. King Khalid Univ J Health Sci 2018;3:7.
12. Al-Marwani Al-Juhani M, Khandekar R, Al-Harby M, Al-Hassan A, Edward DP. Neck and upper back pain among eye care professionals. Occup Med (Lond) 2015;65:753-7.
13. Chams H, Mohammadi SF, Moayyeri A. Frequency and assortment of self-report occupational complaints among Iranian ophthalmologists: A preliminary survey. MedGenMed 2004;6:1.
14. Shaw C, Bourkiza R, Wickham L, Mccarthy I, Mckechnie C. Mechanical exposure of ophthalmic surgeons: A quantitative ergonomic evaluation of indirect ophthalmoscopy and slit-lamp biomicroscopy. Can J Ophthalmol 2017;52:302-7.
15. Schechet SA, DeVience E, DeVience S, Shukla S, Kaleem M. Survey of musculoskeletal disorders among US ophthalmologists. Digit J Ophthalmol 2021;26:36-45.
16. Diaconita V, Uhlman K, Mao A, Mather R. Survey of occupational musculoskeletal pain and injury in Canadian ophthalmology. Can J Ophthalmol 2019;54:314-22.
17. Awan H, Khan MD, Felch W, Spivey B, Taylor H, Resnikoff S, *et al.* Status of ophthalmic education and the eye health workforce in South Asian association for regional cooperation countries. Asia Pac J Ophthalmol (Phila) 2014;3:74-82.
18. Feng PW, Ahluwalia A, Feng H, Adelman RA. National trends in the United States eye care workforce from 1995 to 2017. Am J Ophthalmol 2020;218:128-35.
19. Rovner GS, Sunnerhagen KS, Björkdahl A, Gerdle B, Börsbo B, Johansson F, *et al.* Chronic pain and sex-differences; women accept and move, while men feel blue. PLoS One 2017;12:e0175737.
20. McAlister C, Jin YP, Braga-Mele R, DesMarchais BF, Buys YM. Comparison of lifestyle and practice patterns between male and female Canadian ophthalmologists. Can J Ophthalmol 2014;49:287-90.
21. Kortt M, Baldry J. The association between musculoskeletal disorders and obesity. Aust Health Rev 2002;25:207-14.
22. Sheng B, Feng C, Zhang D, Spitler H, Shi L. Associations between obesity and spinal diseases: A medical expenditure panel study analysis. Int J Environ Res Public Health 2017;14:183.
23. Hyer JN, Lee RM, Chowdhury HR, Smith HB, Dhital A, Khandwala M. National survey of back & neck pain amongst consultant ophthalmologists in the United Kingdom. Int Ophthalmol 2015;35:769-75.
24. Venkatesh R, Kumar S. Back pain in ophthalmology: National survey of Indian ophthalmologists. Indian J Ophthalmol 2017;65:678-82.
25. Tan NE, Wortz BT, Rosenberg ED, Radcliffe NM, Gupta PK. Digital survey assessment of factors associated with musculoskeletal complaints among US ophthalmologists. Clin Ophthalmol 2021;15:4865-74.
26. Fouzdar Jain S, Akhter S, Ishihara R, Siddicky S, High R, Suh DW. The prevalence of work-related musculoskeletal disease among pediatric ophthalmologists. Clin Ophthalmol 2022;16:833-40.
27. Sivak-Callcott JA, Diaz SR, Ducatman AM, Rosen CL, Nimbarte AD, Sedgeman JA. A survey study of occupational pain and injury in ophthalmic plastic surgeons. Ophthalmic Plast Reconstr Surg 2011;27:28-32.
28. Park JH, Moon JH, Kim HJ, Kong MH, Oh YH. Sedentary lifestyle: Overview of updated evidence of potential health risks. Korean J Fam Med 2020;41:365-73.
29. Marx JL. Ergonomics: Back to the future. Ophthalmology 2012;119:211-2.
30. Tan NE, Wortz BT, Rosenberg ED, Radcliffe NM, Gupta PK. Impact of heads-up display use on ophthalmologist productivity, wellness, and musculoskeletal symptoms: A survey study. J Curr Ophthalmol 2022;34:305-11.
31. Bin Helayel H, Al-Mazidi S, AlAkeely A. Can the three-dimensional heads-up display improve ergonomics, surgical performance, and ophthalmology training compared to conventional microscopy? Clin Ophthalmol 2021;15:679-86.
32. Ratzlaff TD, Diesbourg TL, McAllister MJ, von Hacht M, Brissette AR, Bona MD. Evaluating the efficacy of an educational ergonomics module for improving slit lamp positioning in ophthalmology residents. Can J Ophthalmol 2019;54:159-63.
33. Vincent CJ, Li Y, Blandford A. Integration of human factors and ergonomics during medical device design and development: It's all about communication. Appl Ergon 2014;45:413-9.
34. Schlussel AT, Maykel JA. Ergonomics and musculoskeletal health of the surgeon. Clin Colon Rectal Surg 2019;32:424-34.