

Systematic Review

Epidemiology of musculoskeletal disorder among surgeons: a systematic review

Shamika S. Baraskar*, Pradeep Borkar

Dr. APJ Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences, Loni, Maharashtra, India

Received: 03 May 2022

Revised: 23 May 2022

Accepted: 03 June 2022

*Correspondence:

Dr. Shamika S. Baraskar,

E-mail: shamikabaraskar311@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Surgeons spend most of their working time in ergonomically challenging postures. These postures lead to musculoskeletal pain. WRMD's consists various symptoms like pain, fatigue, stiffness, weakness. A significant prevalence of neck, shoulder, back and wrist pain has been reported among surgeons. The aim of the study was to study Epidemiology of Work-Related Musculoskeletal Disorders Among Surgeons. Article systematically reviews epidemiology studies on musculoskeletal disorder among surgeons, literature search was undertaken using google scholar, PubMed, Medline and ScienceDirect from last 10 years from 2012 to 2022. Total 11 studies were included. We applied the checklist, Strengthening the Reporting of Observational studies in Epidemiology (STROBE), to assess the quality of reporting of the included studies. A total of 50 articles were identified. Exclusion criteria lead to 26 full-text articles being screened, generating a total of 11 articles for review. Seven cross sectional studies, two cohort studies and two observational studies were included. Based on analysis of included studies, most of the study stated high prevalence of cervical spine diseases among surgeons. They should represent a major step forward in prevention of WRMSDs among surgeons.

Keywords: Prevalence, WRMSDs, Surgeons, Ergonomics, Work-related musculoskeletal disorders

INTRODUCTION

Occupation of surgeons is taken into account to be high risk profession as they're exposed to varied activity hazards. The variety of in operation skills imposes totally different demands of physical efforts on surgeons. Among the discipline of general surgery, the foremost ordinarily used surgical approaches involve open procedures and minimally invasive procedures, and therefore the latter ones are getting a lot of and a lot of standards as technology advances. Laparoscopic and endovascular procedures are commonly performed requires very fine eye-hand coordination from the surgeons. For example, laparoscopic surgery needs the

surgeons to work with abducted shoulders for long periods of your time and fluoroscopy guided endovascular procedures need the surgeon to wear a lead apron of 5-7 weight unit throughout the whole procedure.¹

Work-related musculoskeletal disorder (WRMD) is a cumulative term for preventable work-related musculoskeletal disorder which affect muscles, nerves and tendons which leads to musculoskeletal pain. Work-related musculoskeletal disorder is an increasing concern for surgeons, which can adversely impact their quality of life and career length. WRMD usually occurs by constantly adopting static positions. Surgeons spend most

of their working time in ergonomically challenging postures. These postures lead to musculoskeletal pain. WRMD's consists various symptoms like pain, fatigue, stiffness, weakness. A significant prevalence of neck, shoulder, back and wrist pain has been reported among surgeons. The use of vibrating power tools, Kerrison punches with repetitive hand movements leads to repetitive strain injury, carpal tunnel syndrome and wrist and hand dysfunction. Numerous cross-sectional studies report that more than 80% of at-risk surgeons experience significant pain while performing surgery. A large number of research have studied global burden of diseases and injuries related to occupation. Annual incidence of WMSDs was estimated to comprise almost 1/3rd of all occupational diseases in the world in 1994, which makes WMSDs as the most common occupational disease affecting workers throughout the world. Among health care providers, surgeons are always at higher risk of developing work-related musculoskeletal disorders. There is paucity of study on WRMSD among surgeon in various sub-specialties.² This paper systematically reviews about the epidemiology of musculoskeletal disorder among surgeons and discuss the scope of preventive measures and burden on quality of life.

The aim was to study and summarize the findings in the articles on epidemiology of musculoskeletal disorders that occur in surgeons. This review was carried out by searching in databases including PubMed, Google Scholar, ResearchGate, Science Direct. Search was done using the following keywords Musculoskeletal disorders, Musculoskeletal problems, WRMSD's, surgeons, ergonomics. Articles included in the study were between 2012-2022 and the study was carried out in Pravara Institute of Medical Sciences. The inclusion criteria were: full text articles, articles which are published in last 10 years, cross sectional studies and observational studies, population including population of all genders, the exclusion criteria were as follows: duplicate articles, case reports, articles with only abstracts, statistics which did not present % of specific disorders.

Search strategy

The following databases were searched: PubMed, Google Scholar, Science Direct and Research Gate between January 2012 to December 2022. In addition, other sources and reference lists of published papers were searched. The search keywords utilized were surgeon; musculoskeletal disorders; musculoskeletal problems; prevalence of musculoskeletal injuries; postural disorders and ergonomics.

Study selection

Total 50 articles were selected for the review. After application of our inclusion exclusion criteria 24 articles were excluded out of which 4 articles were only with abstract, 8 were case study and 12 were review articles, 26 articles were judged to be relevant. Ultimately 20

articles were selected for methodological quality assessment. 9 studies that accomplished < 15 points according STROBE checklist were excluded after methodological assessment. Finally, 11 studies were included in quality synthesis.

Data extraction

The following information was extracted: author's name, publication year, sample size, description of data collection methods, prevalence rate, response rate, outcomes and associated

Procedure

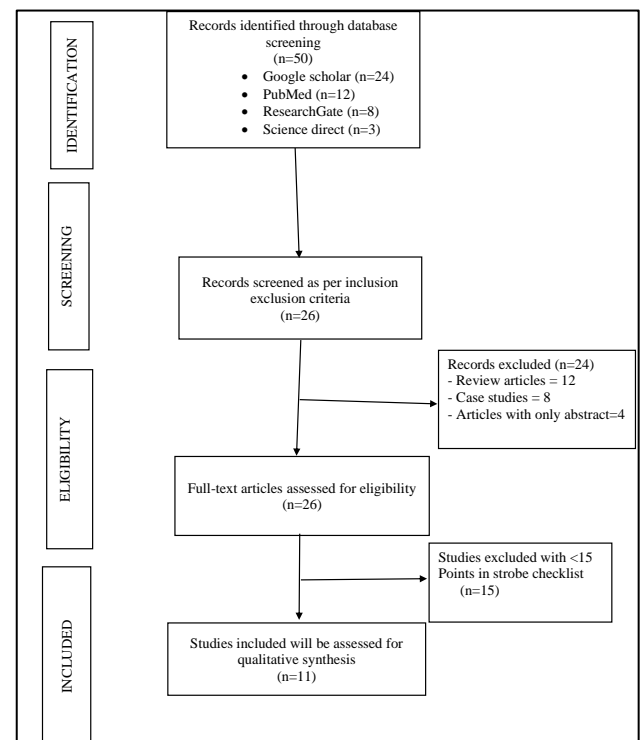


Figure 1: PRISMA flow chart of included articles.¹⁵

Assessment of methodological quality

The assessment of methodological quality was performed using STROBE checklist. STROBE checklist was invented with the aim of Strengthening the Report of Observational and studies in Epidemiology. This scale consisted of 22 points concerning the title, abstract, objectives, study design, sample size, presence of inclusion and exclusion criteria variables, outcome measures, main result, type of sample studied, presence of conflict of interest, and presence of bias, limitation, funding. The maximum score possible was 18 and studies were classified as low evidential values. (<15 points).

RESULTS

Total records for database screening were 50. After application of our inclusion exclusion criteria 26, out of

which 24 articles were excluded, 26 articles were judged to be relevant. Ultimately 11 articles were accepted for qualitative synthesis. Seven cross sectional studies, two

cohort studies and two observational studies were included.

Table 1: Study demographics.

Title of the article	Name of the journal	Year of publication	Sample size	Country	Outcome measures	Result and conclusion
A national survey of workplace-related musculoskeletal disorder and ergonomic practices amongst Irish otolaryngologists	Irish Journal of Medical Science	May 08, 2021	n=49	Ireland	Nordic Musculoskeletal Questionnaire	The neck was the most frequent anatomical location affected by pain at 59.2%, followed by upper back (34.7%) and lower back (32.6%) WRMD occurred on a daily (16.3%), weekly (26.5%), and monthly (28.6%) basis for respondents.
Prevalence of work related musculoskeletal disorders among physicians, surgeons and dentists: a comparative study	Annals of Medical and Health Sciences Research	August 22, 2014	300	India	A self-reporting general questionnaire and Standered Nordic MSD questionnaire	Musculoskeletal pain was most prevalent among dentists 61% (61/100), followed by surgeons 37% (37/100) and physicians 20% (20/100). Nearly 15% of physicians (3/20), 40% (15/37) of Surgeons and 60% (35/61) of Dentists had MSD problems in more than one site.
The painful truth: work-related musculoskeletal disorders in Australian surgeons	Occupational Medicine	December 12, 2017	329	Australia	Nordic Musculoskeletal questionnaire 12	From ~2058 recipients, 329 (16%) responded; 137 (42%) surgeons reported shoulder, neck or upper back pain in a 7-day period, 245 (75%) reported pain and 101 (31%) had pain preventing normal work in a 12-month period
Musculoskeletal pain in resident orthopaedic surgeons: results of a novel survey	Journal of Orthopaedic & Sports Physical Therapy		39	United Kingdoms	Nordic Musculoskeletal Questionnaire 12 (NMQ)	Significant levels of musculoskeletal symptoms were found in the resident surgeons, with the most common self-reported symptoms reported in the neck (59%), lower back (55%), upper back (35%), and shoulders (34%).
Work-Related Musculoskeletal Complaints in Surgeons	Healthcare	31-10-2021, 9, 1482	95	Romania	Nordic Musculoskeletal Questionnaire	The most common WMSCs were reported on the lower back (74.73%), followed by complaints in the neck region (55.79%), shoulder and upper back (46.32%), knee (31.58%), wrist-hand (16.84%), elbow (14.74%), hip (11.58%) and ankle-foot (4.21%).
Ergonomic risk factors and musculoskeletal symptoms in surgeons with three	Medical Journal of the Islamic Republic	December 28, 2016	81	Tehran (Iran)	Nordic Questionnaire	The results of this study revealed that the prevalence of musculoskeletal symptoms was high in 3 types of open

Continued.

Title of the article	Name of the journal	Year of publication	Sample size	Country	Outcome measures	Result and conclusion
types of surgery: Open, laparoscopic, and microsurgery	c of Iran					surgery, laparoscopy, and microsurgery among the surgeons. In addition, it was found that these symptoms were more prevalent in the neck, waist, and hands.
Evaluation of work-related musculoskeletal problems in pediatric surgeons	Pediatric Surgery International	May 27, 2021	82	Turkey	Cornell Musculoskeletal Discomfort Questionnaire	The results showed that there was a correlation between BMI and right shoulder, right thigh, and left thigh pain scores and the duration of treatment received due to work-related musculoskeletal problems ($p=0.026$, 0.05 , 0.014 , and 0.006 , respectively)
Work-related musculoskeletal symptoms amongst Otolaryngologists and Head and Neck surgeons in Canada	Eur Arch Otorhinolaryngol	20-10-2017	595	Canada	A four-item scale	The response rate was 23%. Ninety seven percent (97%) of respondents experienced some physical symptom in one or many regions of their body. Seventyfour percents (74%) of respondents noted an exacerbation of their musculoskeletal symptoms by work. Musculoskeletal symptoms limited the daily activities of 45% of respondents while 23% think that their occupational longevity will be diminished by these limitation.
Postural ergonomics and work-related musculoskeletal disorders in neurosurgery: lessons from an international survey	Acta Neurochir (2021)	17-02-2021	409	Europe	Nordic musculoskeletal questionnaire	The vast majority of the participants (87.9%) had experienced WMSDs, mainly affecting the shoulder, neck, and back muscles. The most common operations performed by the participants were "Craniotomy for convexity/intrinsic tumors" (24.1%) and "Open lumbar basic spine" (24.1%). Neurosurgeons agreed that ergonomics is an underexposed area in the neurosurgical field (84.8%)
Prevalence of musculoskeletal disorders among orthopedic trauma surgeons: an OTA survey	Recherche	December 7, 2015	86	North America	Visual analog scale.	The majority of musculoskeletal complaints and disorders were low back pain (26.7%), wrist or forearm tendinitis (17.4%), elbow lateral epicondylitis (15.1%), plantar fasciitis (14.0%), carpal tunnel

Continued.

Title of the article	Name of the journal	Year of publication	Sample size	Country	Outcome measures	Result and conclusion
						syndrome (12.8%), shoulder pain or tendinitis (12.8%) and knee osteoarthritis (9.3%)
Pattern and determinants of musculoskeletal pain among surgeons in Abha and Khamis Mushet City, Saudi Arabia	International Journal of Medicine in Developing Countries	18 January 2020	225	Saudi Arabia	Visual analog scale and structured interview questionnaire	The most prevalent degree of pain is moderate (48.9%), whereas the mild pain represents 46.2% and the severe represents 3.1%. The most common pain symptoms are pain with 32.9% and fatigue with 20%. Furthermore, 18.7% of the sampled surgeons reported discomfort. More than half of the sampled surgeons recorded incorrect posture as the aggravating factor of pain, whereas 12.4% recorded a prolonged sitting.

Table 2: Score of articles on basis of strobe scale.¹⁵

References	Sample size	Outcome measures	Strobe score	Methodological issue
Seamus Boyle	49	Nordic Musculoskeletal Questionnaire	15	Low sample size, increased risk of bias, not able to generalize
Rambabu T	300	A self-reporting general questionnaire and Slandered Nordic MSD questionnaire (Kuorinka et al. 1986)	15	Increased risk of bias, not able to generalise
Grant KMK	329	Nordic Musculoskeletal questionnaire 12	15	Insufficient information of study participants, no mention of study limitation, not able to generalize
Knudsen ML	39	Nordic Musculoskeletal Questionnaire12 (NMQ)	15	Low sample size, insufficient information of study participants, no mention of study limitation
Luciana AL	91	Nordic Musculoskeletal Questionnaire12 (NMQ)	17	Increased risk of bias, not able to generalise
Aghilinejad M	81	Nordic Musculoskeletal Questionnaire12 (NMQ)	15	Increased risk of bias, not able to generalise, insufficient information of how study sample was arrived
Akbiyik M	82	Cornell musculoskeletal discomfort questionnaire	16	increased risk of bias, not able to generalise
Bolduc-Bégin J	595	A four-item scale	16	not able to generalize, no mention of study limitation
Mavrovounis G	409	Nordic musculoskeletal questionnaire	17	Increased risk of bias
Saad M	86	Visual analog scale.	15	Insufficient information of how the sample size was arrived and number of included study participants
Shaker A	150	Visual analog scale and structured interview questionnaire	15	Increased risk of bias, not able to generalize, no mention of study limitation

The sample size of included articles ranges from 39 to 595 surgeons. The articles included in study included plastic surgeons, neurosurgeons, orthopedic surgeons, laparoscopic surgeons, pediatric surgeons.

The most injury caused due to WRMSD in surgeons is cervical spine disorder.

Followed by shoulder pain and upper back pain surgeons are also affected by knee pain, wrist pain, elbow pain and hip pain. Surgeons are least affected by ankle and foot pain.

Specific risk factors

During non-neutral postural positions, frequently used during surgery, extended periods of isometric action put pressure on the cartilage. Pro-inflammatory cytokines eventually erode the articular cartilage, causing degenerative osteoarthritis. Simultaneous reactive growth of bony spurs [osteophytes] either impinge nerve roots or affect the spinal canal, both of which can lead to chronic pain. Individual factors, such as age, comorbidities, and past trauma directly affect the integrity of the joint and tendon anatomy. Aging tendons, for instance, are more prone to microtears and calcifications, which can predispose the surgeon to a higher likelihood of MSDs when coupled with repetitive overuse. Occupational factors, such as posture and positioning during surgery and work schedule, affect the loading of the joint or tendon. During surgery, surgeons often adopt awkward positions for extended periods, placing unnatural pressures on joints, tendons, and muscles. Work scheduling and work periods without break affect the duration of action on the affected structure, which then cause progressive degeneration.

Poor sitting postures in review clinics are also contributory to MSDs.

DISCUSSION

Among spine surgeons, sustained neck flexion is seen as a major risk factor for musculoskeletal disorders. Such posture is frequently necessary during procedures, particularly during cervical spine approaches. An additional contributing factor may be that surgeons tend to neglect their posture during surgery the procedure itself requires full concentration¹⁹. Surgeons spend prolonged periods of time in neck flexion, is consistent with previous studies. Prolonged static neck flexion has been associated with localized muscular fatigue and pain of the neck extension musculature which can lead to subsequent biomechanical load on the cervical intervertebral discs.

If surgeons are hampered by muscle fatigue or pain in muscles and joints, it may increase the risk of failures and complications during surgery. Moreover, repeated musculoskeletal complaints will increase the risk of

developing chronic musculoskeletal pain that may shorten surgeons' active surgical career. From a societal perspective, this may be problematic since it takes many years of education to become skilled for highly specialised surgical procedures. Therefore, surgeons' musculoskeletal health is of vital importance and must be considered alongside with patient safety. In a long-term perspective, it is of uttermost importance to understand the potential ergonomic deficits related to different minimally invasive surgical techniques in order to develop relevant preventive and rehabilitation strategies for surgeons.¹⁵

Table 3: Most commonly described work-related musculoskeletal disorders among surgeons.⁷

Cervical pain	74.73%
Shoulder pain	55.79%
Upper back pain	43.32%
Knee pain	31.58%
Wrist pain	16.84%
Elbow pain	14.74%
Hip pain	11.58%
Ankle – foot pain	4.21%

Seamus Boyle carried out a survey study using 102 surgeons out of which 49 completed the survey work-related musculoskeletal pain was experienced by 71.4% The neck was the most frequently affected location (59.2%). Treatment for WRMD was sought by 36.7% of participants³. Michael L. Knudsen conducted a cross sectional survey among 39 resident orthopaedic surgeons. Significant levels of musculoskeletal symptoms were found in residents with the most common self-reported symptoms reported in the neck (59%), lower back (55%), upper back (35%), and shoulders (34%)⁶. Ergonomic education is important for all at-risk members of surgery team, ergonomic awareness is learned and practiced behaviour¹⁴. In spite of the increase in the prevalence of work-related musculoskeletal symptoms, there is both limited ergonomic awareness and inadequate practice of ergonomic guidelines by surgeons as reported in literature. These statistics show that more surgeons should be made aware of ergonomic practices like ensuring optimum operating surface height and monitor height, appropriate lighting and temperature OR layout and other safety related ergonomic issues like floor clearance.

The ergonomic burden of using the surgical equipment has been well documented in scientific literature¹⁴. The use of slit lamp bio microscopy and indirect ophthalmoscopy has been associated with increased anterior deltoid and cervical trapezius muscle activity. These increases in muscle activity may be associated with the lack of arm support during microscopic work, and the slumped position that surgeons adopt to approximate themselves to the microscope. This may provide a physiological rationale for the musculoskeletal pain

reported from surgeons, which is strengthened by the prolonged asymmetrical static postures observed while this equipment is being used¹⁷. During tasks performed intra-operatively and in an outpatient clinic, surgeons should aim to maintain an anatomically neutral posture and avoid asymmetrical, extreme end of range postures. Maintenance of a near-neutral posture is especially important when using equipment that may increase the biomechanical loading on the surgeon's body. A recent systematic review found the implementation of a saddle seat during surgical procedures to be effective in reducing musculoskeletal discomfort in the neck, back, shoulder and arm in microsurgery. The use of intraoperative microbreaks during surgical procedures has been highlighted in recent literature, providing evidence that 20 second breaks every 20 minutes can help reduce musculoskeletal pain, improving physical performance and mental focus¹⁷.

With increasing number of surgical procedures being done by the minimally invasive technique, it is likely that surgeons in future will be at even greater risk of developing WRMSDs, if prompt and timely measures are not initiated. Due consideration also needs to be given to time management to avoid overload and fatigue in surgeons. A strong relationship has been observed between surgeon distress/fatigue and perceived medical errors. Looking to the future and the important issue of patient safety, we believe that ergonomics in the operation theatre focusing not only on the surgeon but the entire operating team will translate into better surgical outcome & improvements in the patient safety culture.

Clinical implication

Understanding the epidemiology of musculoskeletal injuries will help the clinician to avoid the risk of further musculoskeletal disorder, improve and plan preventive strategies.

Limitations

Sample size and response rate were suboptimal in some studies. As the study was time bound sample size was small.

CONCLUSION

Based on the analysis of included studies most of the study stated high prevalence of WRMSD among surgeon. These disorders are associated with intrinsic factors like age, gender and extrinsic factors like work environment, practice hours and type of surgery. most of the study stated high prevalence of cervical spine diseases among surgeons. They should represent a major step forward in prevention of WRMSDs among surgeons.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

REFERENCES

1. Szeto GPY, Ho S, Ting ACw. Work-related Musculoskeletal Symptoms in Surgeons. *J Occup Rehabil.* 2009;19:175-84.
2. Vaidya A, Sainju NK, Joshi SK. Work related musculoskeletal disorders among surgeons working in a tertiary care hospital in Kathmandu, Nepal. *Int J Occup Saf Health.* 2017;5(2):6-10.
3. Boyle S, Fitzgerald C, Conlon BJ, Vijendren A. A national survey of workplace-related musculoskeletal disorder and ergonomic practices amongst Irish otolaryngologists. *Irish Journal of Medical Science (1971).* 2021;1-6.
4. Rambabu T, Suneetha K. Prevalence of work related musculoskeletal disorders among physicians, surgeons and dentists: a comparative study. *Annals of medical and health sciences research.* 2014;4(4):578-82.
5. Grant KM, Vo T, Tiong LU. The painful truth: work-related musculoskeletal disorders in Australian surgeons. *Occupational Medicine.* 2020;70(1):60-3.
6. Knudsen ML, Ludewig PM, Braman JP. Musculoskeletal pain in resident orthopaedic surgeons: results of a novel survey. *The Iowa orthopaedic journal.* 2014;34:190.
7. Rață AL, Barac S, Garleanu LL, Onofrei RR. Work-Related Musculoskeletal Complaints in Surgeons. In *Healthcare. Multidisciplinary Digital Publishing Institute.* 2021;9(11):1482.
8. Aghilinejad M, Ehsani AA, Talebi A, Koochpayehzadeh J, Dehghan N. Ergonomic risk factors and musculoskeletal symptoms in surgeons with three types of surgery: Open, laparoscopic, and microsurgery. *Medical journal of the Islamic Republic of Iran.* 2016;30:467.
9. Akbiyik F, Uysal Ö, Firat T, Bek N. Evaluation of work-related musculoskeletal problems in pediatric surgeons. *Pediatric Surgery International.* 2021;37(10):1333-8.
10. Bolduc-Bégin J, Prince F, Christopoulos A, Ayad T. Work-related musculoskeletal symptoms amongst Otolaryngologists and Head and Neck surgeons in Canada. *European Archives of Oto-Rhino-Laryngology.* 2018;275(1):261-7.
11. Mavrovounis G, Meling TR, Lafuente J, Fountas KN, Demetriades AK. Postural ergonomics and work-related musculoskeletal disorders in neurosurgery: lessons from an international survey. *Acta neurochirurgica.* 2021;163(6):1541-52.
12. AlQahtani SM, Alzahrani MM, Harvey EJ. Prevalence of musculoskeletal disorders among orthopedic trauma surgeons: an OTA survey. *Canadian Journal of Surgery.* 2016;59(1):42.
13. Shaker A, Ala'a Abdulrhman Almazzah AH, Asiri MS, AlQahtani MA, Ali M, Al-Mteer A et al. Pattern and determinants of musculoskeletal pain among surgeons in Abha and Khamis Mushet City, Saudi Arabia. *IJMDC.* 2020;4:652-9.

14. Epstein S, Tran BN, Capone AC, Ruan QZ, Lee BT, Singhal D. Work-related musculoskeletal disorders among plastic surgeons: a systematic review. *Journal of Reconstructive Microsurgery.* 2018;34(08):553-62.
15. Dalager T, Sjøgaard K, Bech KT, Mogensen O, Jensen PT. Musculoskeletal pain among surgeons performing minimally invasive surgery: a systematic review. *Surgical endoscopy.* 2017;31(2):516-26.
16. Lavé A, Gondar R, Demetriades AK, Meling TR. Ergonomics and musculoskeletal disorders in neurosurgery: a systematic review. *Acta Neurochirurgica.* 2020;162(9):2213.
17. Maxner A, Gray H, Vijendren A. A systematic review of biomechanical risk factors for the development of work-related musculoskeletal disorders in surgeons of the head and neck. *Work.* 2021;1-7.
18. Singh RM, Borkar P. Prevalence of work-related musculoskeletal disorders among IT professionals in India-a literature review. *International Journal of Research in Medical Sciences.* 2020;8(10):3765.
19. Shinde KV, Borkar P. Epidemiology of Musculoskeletal Disorders in Musicians-Systematic Review.

Cite this article as: Baraskar SS, Borkar P. Epidemiology of musculoskeletal disorder among surgeons: a systematic review. *Int J Res Med Sci* 2022;10:1519-26.