

THE PREVALENCE, PATTERNS AND FACTORS ASSOCIATED WITH WORK-RELATED MUSCULOSKELETAL SYMPTOMS AMONG SURGICAL RESIDENTS IN KENYATTA NATIONAL HOSPITAL, NAIROBI, KENYA

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ABSTRACT

Background: In the medical sector, surgeons work in an environment that is not ergonomically ideal, and many suffer work-related musculoskeletal symptoms that may result in reduced quality of life, disability, and diminished career longevity. While data exists on musculoskeletal symptoms in practising surgeons, this is not the case for trainee surgeons.

Objective: To determine the prevalence, patterns and factors associated with work-related musculoskeletal symptoms among surgical residents working in Kenyatta National Hospital, Nairobi, Kenya.

Methods: A cross-sectional survey was done to determine the prevalence, patterns and factors associated with work-related musculoskeletal symptoms among surgical residents working in Kenyatta National Hospital. An electronic questionnaire based on the Nordic Musculoskeletal Questionnaire (NMQ) was sent to all participants via electronic messaging.

Results: Two hundred and seventeen responses were received. The overall prevalence of work-related musculoskeletal symptoms was 93%. The most commonly affected anatomic region was the lower back (68%) followed by the neck (47%). Residents from the thematic units of urology, paediatric surgery and general surgery had a 100% prevalence rate of work-related musculoskeletal symptoms. Residents from plastic surgery and ophthalmology units had the lowest prevalence rates (83% and 84% respectively). Neck symptoms were associated with using loupes (OR, 2.9, $p=0.02$) and microscopes (OR, 2.2, $p=0.05$). Female gender was associated with wrist/hand symptoms (OR, 3.84, $p=0.01$). Increasing age was associated with symptoms in the neck (OR, 1.22 $p=0.002$) and lower back (OR, 1.15 $p=0.03$). No association was found between overall prevalence and thematic unit ($p=0.13$), year of study ($p=0.903$) or hours in theatre ($p=0.97$).

Conclusion and recommendations: Surgical residents experience a significantly high prevalence of work-related musculoskeletal symptoms. Urology, paediatric surgery and general surgery residents had the highest overall prevalence of work-related musculoskeletal symptoms.

Key words: Ergonomics, Surgical residents, Musculoskeletal pain, Occupational injury, Work-related musculoskeletal symptoms

INTRODUCTION

Doctors in procedural specialities are at high risk for work-related Musculoskeletal Disorders (MSDs), which have been described as an impending epidemic (1). Within the medical sector, surgeons work in an environment that is not ergonomically ideal, and many suffer work-related musculoskeletal symptoms (2). The effects are significant, with some practitioners having reported early retirement due to work-related symptomatology (3). Work-related

musculoskeletal symptoms may cause reduced surgeon well-being, resulting in increased disability, reduced quality of life, as well as diminished career longevity (4). While a lot of data exists on musculoskeletal symptoms in practising surgeons, this is not the case for trainee surgeons.

MATERIALS AND METHODS

This was a cross-sectional study conducted at Kenyatta National Hospital (KNH), a national referral hospital and the largest hospital in the country. It

has a bed capacity of 1800. The study population included residents undertaking training in surgical specialities at the University of Nairobi. During the study, 333 students were studying in the various thematic units in the Department of Surgery. Only those who gave consent to take part were included in the study.

Cochrane’s formula was used to calculate the sample size (5). A confidence interval of 95%, with a margin of error of 5%, was used in the calculation. A conservative expected rate of 50% was, seeing that no regional studies detailing prevalence rates in surgical residents. The formula is as shown below:

$$n = \frac{Z^2 \cdot P(1-p)}{\theta^2}$$

n = sample size

z = critical value for 95% confidence interval

e = margin of error (desired level of precision)

p = estimated proportion of the population with work-related musculoskeletal symptoms/pain

The inputs were substituted as shown:

$$n = \frac{1 - 96^2 \times 0.5(1-0.5)}{0.05^2}$$

Using that formula, our sample size was estimated at 384. To correct for a finite population of 333 residents, the following formula was used:

$$n(\text{adj}) = \frac{n_1}{1 + \frac{(n_1 - 1)}{N}}$$

where n_1 is the sample size for an infinite/large population $n(\text{adj}) = 178.0$

Hence adjusted n = 178

Adding 10% for non-responders gives a total of 196 as the minimum sample size.

Because the various surgical thematic units have different numbers of residents, stratified consecutive sampling was used. The self-administered electronic questionnaire was based on the Nordic Musculoskeletal Survey, which was divided into sections on demographics and work-related musculoskeletal symptoms experienced in various anatomic regions, was sent to residents from different thematic units via electronic messaging through the different resident online groups. Reminders were sent to the various groups up to 4 times. After 4 weeks, the survey was closed after sample sizes were achieved for all thematic units. A total of 217 questionnaires were eventually filled. The target sample sizes and responses per thematic unit were as shown in Table 1.

Table 1

Sample size by thematic unit

Thematic Unit	Number in unit (%)	Minimum sample size	Actual respondents
Ophthalmology	32 (9.6%)	19	19
Paediatric surgery	24 (7.2%)	14	16
Cardiothoracic surgery	25 (7.5%)	15	18
Neurosurgery	46 (13.8)	27	28
Plastic surgery	36 (10.8%)	21	23
ENT surgery	31 (9.3%)	18	23
General surgery	35 (10.5%)	21	26
Orthopaedic surgery	68 (20.4%)	40	42
Urology	36 (10.8%)	21	22
Total	333 (100%)	196	217

Data was then cleaned for errors, coded and tabulated for ease of processing then analysed using the R statistical package. Measures of central tendencies and dispersion such as mean (for the number of hours spent in theatre per week) were carried out. Percentages were used to report demographic data. The prevalence of musculoskeletal symptoms was presented as

percentages. Statistical analyses such as Chi-square and Fischer’s test were carried out for statistical significance. Multivariable regression analysis was then carried out for associations between the prevalence of symptoms in various anatomical regions and independent variables such as devices and some demographic characteristics. The significance level was set at $p < 0.05$.

Ethical considerations

Approval for the study was sought from the Kenyatta National Hospital – University of Nairobi Ethics and Research Committee (KNH-UON ERC) and NACOSTI (National Commission for Science Technology and Innovation). Consent was sought from the respondents before filling out the questionnaire.

RESULTS

Of the 217 respondents, 153 (71%) were male while 64 (29%) were female. The mean age was 32.9 years, with a median of 33 (IQR 31 to 34 years). The

mean weight was 77kg, while the mean height was 1.7m. The mean BMI was 27. Ninety seven percent of respondents were right-handed while the rest were left-handed. The majority of individuals used glove sizes 7.0 to 8, with 44% using glove size 7.5 (Table 2).

The average amount of time that respondents spent in theatre per week in the previous year was 22hrs, with a median of 20 hr/wk (IQR 10 to 30hr/wk). Fifty five percent reported that they engaged in regular physical activities. Only 3% of respondents were smokers. Respondents from the 3rd and 5th year were the majority, consisting of 26% and 29% respectively (Table 2).

Table 2
Residents demographics

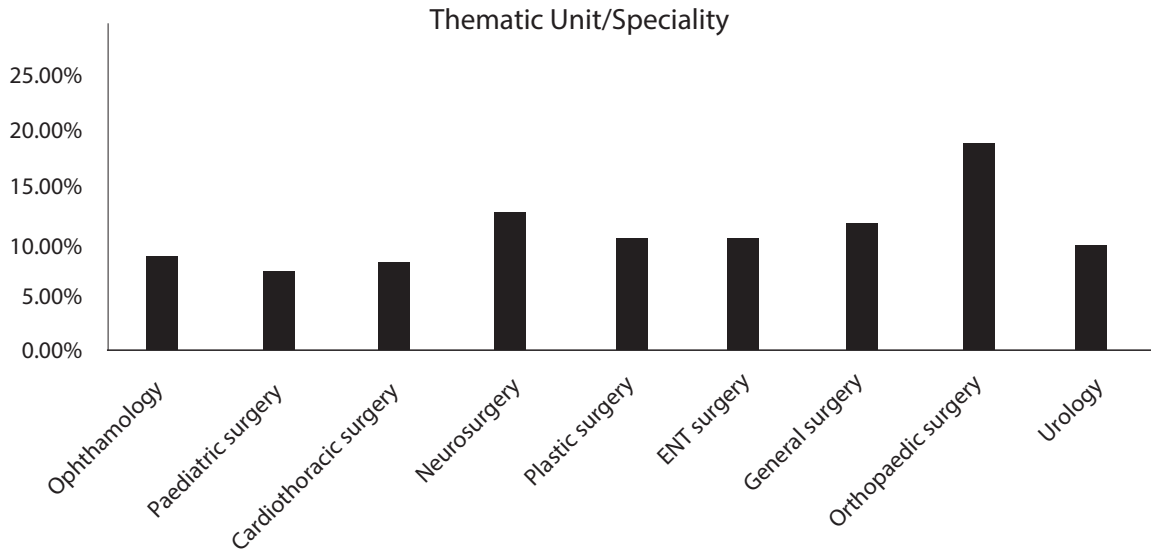
Variables	No.	(%)
Gender		
Male	153	71
Female	64	29
BMI		
<18.5	6	3
18.5-24.9	131	37
>25	80	60
Handedness		
Right	211	97
Left	6	3
Glove size		
≤6.0	8	4
6.5	33	15
7.0	33	15
7.5	96	44
8.0	45	21
≥8.5	2	1
Year of study		
1 st	23	11
2 nd	28	13
3 rd	56	26
4 th	42	19
5 th	62	29
6 th	6	3
Physical exercises		
Yes	97	44
No	120	55
Smoking		
Yes	5	3
No	212	97

Respondents from orthopaedic surgery consisted of the greatest percentage of respondents (19.4%) with those from the paediatric

surgery thematic unit representing the least (7.4% of respondents) (Figure 1).

Figure 1

Thematic unit representation (n=217)

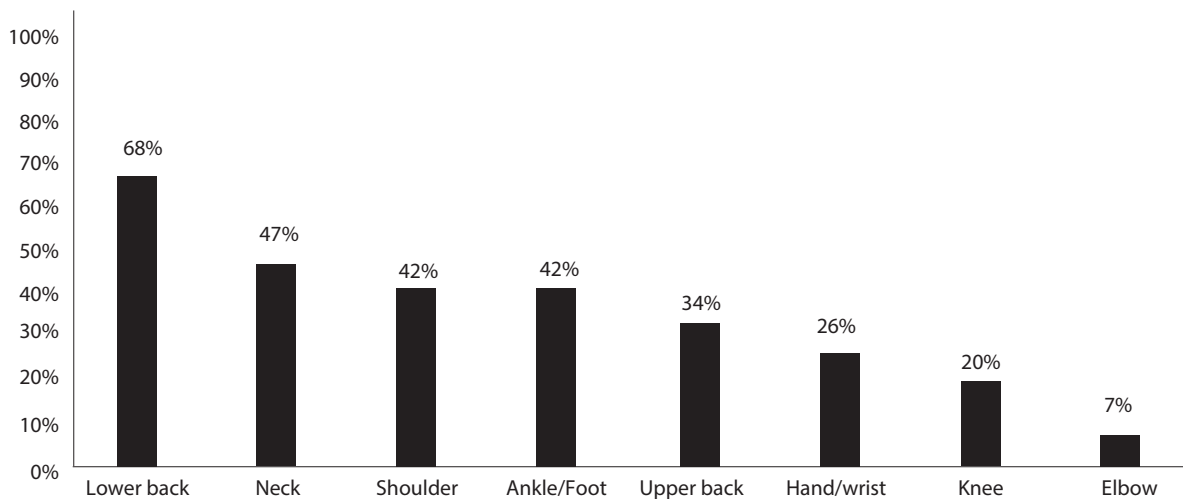


Lead gowns were the most commonly used devices by respondents at 28% followed by microscopes (24%), head lamps (20%) and loupes (15%). Overall, 42% of respondents denied using either surgical loupes, microscopes, head-lamps or lead gowns.

Overall, 93% of respondents reported experiencing musculoskeletal symptoms after a day in the operating room during the previous 12 months. The most commonly affected region was the lower back (68%) followed by the neck (47%). The elbow was the least affected area at 7% (Figure 2).

Figure 2

Symptoms of WRMSDs among surgical residents stratified by anatomic location (n=217)



Residents in the departments of urology, paediatric surgery and general surgery recorded the highest overall levels of musculoskeletal symptoms at 100% of respondents (Table 3). The least proportion of symptoms was noted among residents in plastic surgery and ophthalmology units (83% and 84% respectively), but this was

not statistically significant ($p=0.13$). Respondents in the first and fifth year of training reported a lower prevalence of symptoms (91% and 90% respectively) compared to those in their sixth year of study (100%) but this was not statistically significant ($p= 0.903$). Female respondents had a higher proportion of musculoskeletal symptoms

(97%) than their male counterparts (91%), but this was not statistically significant ($p=0.348$). Respondents using smaller glove sizes (<7) had higher prevalence rates than those with higher glove sizes (>8) (97% versus 89%) but this was not statistically significant ($p=0.36$). While smokers

recorded a higher prevalence of symptoms than non-smokers (100% vs 92%), this was not statistically significant. Individuals who engaged in regular physical exercises had the same prevalence of symptoms as those that did not (93%).

Table 3
Work-related musculoskeletal symptoms among surgical residents

Variables	No.	WRMSK symptoms present (%)	P-value
Gender			
Male	153	140(91%)	0.348
Female	64	62 (97%)	
BMI			
<18.5	6	6(100%)	0.05
18.5-24.9	80	76 (95%)	
25-29.5	89	78(88%)	
>30	42	76(87%)	
Handedness			
Right	211	196(92%)	1
Left	6	6(100%)	
Glove size			
<7.0	41	40(97%)	0.36
7.0-8.0	129	120(93%)	
>8.0	47	42(89%)	
Thematic Unit			
Cardiothoracic surgery (TCVS)	18	17(94%)	0.13
ENT Surgery	23	21(91%)	
General Surgery	26	26(100%)	
Neurosurgery	28	27(96%)	
Ophthalmology	19	16(84%)	
Orthopaedic surgery	42	38(90%)	
Paediatric surgery	16	16(100%)	
Plastic surgery (PRAS)	23	19(83%)	
Urology	22	22(100%)	
Year of study			
1st	23	21(91%)	0.903
2nd	28	26(93%)	
3rd	56	53(95%)	
4th	42	40(95%)	
5th	62	56(90%)	
6th	6	6(100%)	
Physical exercises			
Yes	97	91(93%)	0.79
No	120	111(93%)	
Smoking			
Yes	5	5 (100%)	1
No	212	197(92%)	

Multivariable logistic regression analysis revealed that the use of loupes correlated with neck symptoms (odds ratio [OR], 2.9 $p=0.02$). In addition, the use of microscopes was also correlated with neck symptoms (OR, 2.2 $p=0.05$).

Increasing age correlated with the presence of symptoms in the neck (OR, 1.22 $p=0.002$) and lower back (OR, 1.15 $p=0.03$), but not overall symptomatology ($p=0.223$). Female gender was associated with the presence of symptoms in the wrist and hand (OR, 3.84, $p=0.01$). No other association was noted for wrist/hand symptomatology.

No association was found between the overall prevalence of symptoms and thematic units ($p=0.13$), year of study ($p=0.903$) or hours in theatre ($p=0.97$). Lower back symptomatology was not associated with any of the devices assessed, BMI such as BMI, smoking, age, or sex ($p>0.05$).

DISCUSSION

The demographics of this study were similar to those of previous studies carried out on residents, such as that by McQuivey *et al.* (6) on orthopaedic surgery residents in North America. The high overall prevalence (93%) of work-related musculoskeletal symptoms after a day in the operating room within the previous year in this study is similar to other studies. McQuivey *et al.* (6) reported a prevalence rate of 97% among orthopaedic surgery residents, while Kokosis *et al.* (7) reported a prevalence of 94% among plastic surgery residents. Cerier *et al.* (8) reported 100% prevalence of musculoskeletal symptoms among General surgery residents. While studies conducted among practising surgeons have shown lower prevalence rates, such as Al Qahtani *et al.* (9) who reported 66% in orthopaedic surgeons), some authors have suggested that trainees may be expected to have lower rates than their senior counterparts. This is because the number of years in practice and caseload has been associated with higher rates of musculoskeletal symptoms in the older population (10). This high prevalence among residents may partly be due to residents assuming the role of assistants, which causes them to assume awkward prolonged positions while retracting while at the same time attempting to visualise the surgical field.

The most commonly affected anatomical region was found to be the lower back and the neck. These findings are similar to other studies.

McQuivey *et al.* (6) reported that the lower back (35%) and the neck (30%) as having the highest rates of significant symptoms. Although Kokosis *et al.* (7) and Epstein *et al.* (2) reported a higher rate in the neck at 54% and 65%, respectively.

In this study, female respondents had more musculoskeletal symptoms (97%) than their male counterparts (91%). This was also reported in a study among general surgery residents by Cerier *et al.* (8). In their study, they reported that females had higher symptomatology than male respondents (100% vs 73%) which was statistically significant ($p=0.03$). This variation may be attributed to differences in demographic characteristics in the sampled respondents.

Loupes (OR 2.9 $p=0.02$) and the use of microscopes (OR, 2.2 $p=0.05$) was associated with neck symptoms in this study. Kokosis *et al.* (7) also found an association between the use of a headlight and neck pain. However, they did not find any association between neck pain and the use of microscopes and loupes.

The use of other devices such as lead aprons and head lamps, did not reveal any association with symptoms in other regions of the body. This is despite some authors attributing work-related musculoskeletal symptoms to these devices (10,11).

Increasing age was associated with symptoms in the neck, and lower back ($p<0.05$), but not the other regions. In contrast, a study done among orthopaedic surgeons by Al_mohrej *et al.* (12) found that age was correlated with knee and foot/ankle symptoms.

The study found the female gender was significantly associated with hand/wrist symptomatology (OR, 3.84, $p=0.01$). In a study of general surgery residents by Cerier *et al.* (8) they reported a higher overall prevalence of work-related musculoskeletal symptoms among females, which was statistically significant ($p=0.03$). Fram *et al.* (13) in their study of orthopaedic surgeons reported more physical symptoms among female than male surgeons, which was attributed to the size and design of procedural tools. In this study, there was no association between glove size and wrist/hand symptomatology.

Lower back symptoms were not found to be associated with age, sex, smoking, hours in theatre per week or devices used in theatre. These findings were similar to those of Al Mohrej *et al.* (12) did not report any association between lower back

pain and age, sex, smoking or years of experience among orthopaedic surgeons.

This study has some limitations. It is based on self-reported data and therefore residents with significant WRMSD may have felt an increased need to participate in the study as compared to those with no symptoms. However, this study has a high response rate as a calculated sample size was achieved. Secondly, it raises awareness of the high level of WRMS and thus the need for formal ergonomics training. It is also the first study in sub-Saharan Africa to describe the prevalence, patterns and factors associated with work-related musculoskeletal symptoms among surgical residents.

CONCLUSION

There is a significantly high prevalence of work-related musculoskeletal symptoms among surgical residents after a day in the operating room, with the lower back being the most commonly affected anatomic region. There is an association between symptomatology in the neck with the use of surgical loupes and microscopes.

Further studies should be done to assess the impact of work-related musculoskeletal symptoms on residents' behaviour and daily lives, as well as their approaches to dealing with these symptoms. Secondly, structures should be put in place for residents to report symptoms as this may allow them to access institutional support in handling their symptoms.

REFERENCES

1. Park, A., Lee, G., Seagull, F.J., Meenaghan, N. and Dexter, D. Patients benefit while surgeons suffer: an impending epidemic. *J Am Coll Surg*. 2010; **210**(3):306–313.
2. Epstein, S., Sparer, E.H., Tran, B.N., Ruan, Q.Z., Dennerlein, J.T., Singhal, D., *et al*. Prevalence of work-related musculoskeletal disorders among surgeons and interventionalists: A systematic review and meta-analysis. *JAMA Surg*. 2018; **153**(2):
3. Davis, W.T., Fletcher, S.A. and Guillaumondegui, O.D. Musculoskeletal occupational injury among surgeons: Effects for patients, providers, and institutions. *J Surg Res*. 2014; **189**(2):207-212.e6.
4. Vijendren, A. and Yung, M. An overview of occupational hazards amongst UK otolaryngologists. *Eur Arch Otorhinolaryngol*. 2016; **273**(9):2825-32.
5. Cochran 1977 Sampling Techniques Third Edition | Aditia Purba - Academia.edu [Internet]. [cited 2022 Jul 20]. Available from: https://www.academia.edu/33380973/Cochran_1977_Sampling_Techniques_Third_Edition
6. McQuivey, K.S., D.G., Christopher, Z.K., Rosenow, C.S., Mi, L., Spangehl, M.J. and Bingham, J.S. Surgical ergonomics and musculoskeletal pain in orthopaedic surgery residents: a multicenter survey study. *JAAOS Global Res Reviews*. 2021; **5**(3): e20.00119. doi: 10.5435/JAAOSGlobal-D-20-00119. PMID :33720100; PMCID: PMC7960490.
7. Kokosis, G., Dellon, L.A., Lidsky, M.E., Hollenbeck, S.T., Lee, B.T. and Coon, D. Prevalence of musculoskeletal symptoms and ergonomics among plastic surgery residents: Results of a national survey and analysis of contributing factors. *Ann Plast Surg*. 2020; **85**(3):310–315.
8. Cerier, E., Hu, A., Goldring, A., Rho, M. and Kulkarni, S.A. Ergonomics workshop improves musculoskeletal symptoms in general surgery residents. *J Surg Res*. 2022; **280**:567-574.
9. AlQahtani, S.M., Alzahrani, M.M. and Harvey, E.J. Prevalence of musculoskeletal disorders among orthopedic trauma surgeons: An OTA survey. *Canadian J Surg*. 2016; **59**(1):42–47.
10. Alzahrani, M.M., Alqahtani, S.M., Tanzer, M. and Hamdy, R.C. Musculoskeletal disorders among orthopedic pediatric surgeons: an overlooked entity. *J Child Orthop*. 2016; **10**(5):461–466.
11. Scheidt, S., Ossendorf, R., Prangenberg, C., Wirtz, D.C., Burger, C., Kabir, K., *et al*. The impact of lead aprons on posture of orthopaedic surgeons. *Z Orthop Unfall* [Internet]. 2022; **160**(1):56–63.
12. Al-Mohrej, O.A., Elshaer, A.K., Al-Dakhil, S.S., Sayed, A.I., Aljohar, S., AlFattani, A.A. and Alhussainan, T.S. Work-related musculoskeletal disorders among Saudi orthopedic surgeons: a cross-sectional study. *Bone & Joint Open*. 2020; **1**(4):47-54.
13. Fram, B., Bishop, M.E., Beredjiklian, P., Seigerman, D. and Fram, B.R. Female sex is associated with increased reported injury rates and difficulties with use of orthopedic surgical instruments. *Cureus*. 2021; **13**(5): e14952. DOI 10.7759/cureus.14952.