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WORD COUNT 3747
TIME SUBMITTED 18-JAN-2022 09:48PM
PAPER ID 81524291

Name of Journal: *World Journal of Gastrointestinal Endoscopy*

Manuscript NO: 67128

Manuscript Type: ORIGINAL ARTICLE

Observational Study

Ergonomics of gastrointestinal endoscopies: Musculoskeletal injury among endoscopy physicians, nurses, and technicians

Ergonomics of gastrointestinal endoscopy

Abstract

BACKGROUND

Musculoskeletal injuries have plagued endoscopists and ancillary staff for decades without any innovative and strong ergonomic guidelines. It has placed a physical and mental strain on our endoscopists and ancillary staff. We have very have limited data supporting this claim in our region and most data is supported by western literature.

AIM

This study aims to document the prevalence of musculoskeletal injuries, awareness, and practices of ergonomics by endoscopists and ancillary staff.

METHODS

This is an observational cross-sectional study, conducted in Karachi, a city that boasts the maximum number of daily endoscopies in the country. An eleven-point self-administered questionnaire was distributed and used to evaluate musculoskeletal injuries and ergonomic adjustments amongst three tertiary care setups in Karachi. An onsite survey *via* a 13-point checklist for endoscopy suite facilities was used to assess the ergonomically friendly conveniences at five tertiary care setups in Karachi. A total of 56 participants replied with a filled survey.

RESULTS

There were 56 participants in total with 39 (69.6%) males.

Pain and numbness were documented by 75% of the patients, with pain in the neck (41.1%), lower back (32.1%), shoulder (21.4%), thumb (12.5%), hand (23.2%), elbow (8.9%) and carpal tunnel syndrome (7.1%) selectively. 33.3% attributed their symptoms to endoscopy, 14.2% said that symptoms were not caused by endoscopy while 52.4% were not certain whether endoscopy had caused their symptoms. 21.4% had to take time off their work while 33.9% took medications for pain.

Ergonomic modifications to prevent musculoskeletal injury, included placement of endoscopic monitor at eye level, cardiac monitor in front, stopped to move patients, sitting while performing colonoscopy, and navigated height-adjustable bed was used by 21.4%.

9 out of 13 ergonomic facilities were not present in all five tertiary care hospitals.

Conveniences such as anti-fatigue mats, height-adjustable computer stations, and time out between patients were not present.

CONCLUSION

Three-fourth of our endoscopists reported musculoskeletal injuries of which more than half are not sure or attributed this problem to endoscopy. The prevalence of musculoskeletal injuries warrants urgent attention.

Key Words: endoscopy; ergonomics; injury; musculoskeletal; endoscopists; gastroenterologist

Shah SZ, Rehman ST, Khan A, Hussain MM, Ali M, Sarwar S, Abid S. Ergonomics of gastrointestinal endoscopies: Musculoskeletal injury among endoscopy physicians, nurses, and technicians . *World J Gastrointest Endosc* 2022; In press

Core Tip: Musculoskeletal injuries (MSI) have impacted gastroenterologists and ancillary staff involved in endoscopy. Maneuvers, time duration, and failure of ergonomic practices and provision of facilities have led to the prevalence of MSI. This has resulted in stress, chronic pain management, office leaves, and consumption of analgesics. We found three-fourth of our endoscopists reported MSI of which more than half were not sure or attributed this problem to endoscopy. The high prevalence of MSI and lack of awareness among endoscopists and ancillary staff needs to be addressed urgently.

INTRODUCTION

Several studies have suggested a high prevalence of musculoskeletal injuries (MSI) among endoscopists and ancillary staff. Survey-based studies estimate a 29% to 89% prevalence of musculoskeletal pain among gastroenterologist[1] which directly translates to a loss of productivity. Rigorous training and increased demand for endoscopies make a gastroenterologist an asset in the workplace, especially in the developing world. A work-related injury can greatly affect the quality and longevity of the gastroenterologist which can ultimately exacerbate the shortage of specialists[2]. Improving ergonomic conditions will ensure maximum utilization of this scarce human resource. MSI are widespread and are strongly correlated with high procedure volume and procedure duration[3]. Endoscopists are at risk for overuse syndromes and overuse injuries, such as carpal tunnel syndrome (CTS), De Quervain's tenosynovitis, and lateral epicondylitis because of the repetitive movements, pinching and gripping of the endoscope, pushing, pulling, torquing of the insertion tube and potentially awkward posture associated with endoscopic procedures[1,3]. However, institutional changes reported minimizing MSI are limited which can be an important contributory factor of lack of awareness[1].

Limited documented data especially in the eastern population and lack of awareness are contributory factors to the lack of widespread change. Additionally, a robust analysis to identify risk factors associated with endoscopy-related injury is lacking.

Creating awareness about the importance of ergonomics in endoscopy may prevent future injury. There is no standardized curriculum for learning endoscopic techniques and most endoscopists learn their skills during their fellowship training through their faculty mentor which creates great variability in the level of skill among trainees. This variability and lack of emphasis on ergonomics during teaching propagate the risk of MSI. Strategies for the management of the risk of MSI related to the practice of endoscopy include compliance with currently recommended ergonomic practices, standardized education of trainees in ergonomic technique when practicing endoscopy, research toward the modification and development of more ergonomic endoscopes and procedure spaces, and institutional emphasis[4]. This study aims to document the prevalence of MSI, awareness, and practice of ergonomics by endoscopists and ancillary staff.

MATERIALS AND METHODS

Questionnaires were tendered to endoscopists and ancillary staff. The questionnaire was designed and informed consent was implied by a completed response to the survey. The survey was handed out following June 2019 onwards with a collection on follow-up from respondents. Ethical approval was obtained from Ethics Review Committee Aga Khan University (5357-Med-ERC-18).

Study Subjects

Participants were endoscopists and ancillary staff found in the endoscopy suite. Three tertiary care hospitals namely, Aga Khan University Hospital, Liaquat National Hospital, and Dr. Ruth K. M. Pfau Civil Hospital, all located in Karachi, Pakistan had their endoscopy physicians, nurses and technicians approached. There was no monetary compensation for participation.

Evaluation of musculoskeletal injuries

An eleven-point, self-administered, paper-based survey was devised by an endoscopist and a member of the ancillary staff **(Supplementary Table 1)**. Items in the questionnaire were generated based on literature review[2,3,5] and multidisciplinary discussions on the

topic. These questions focused on demographics, average physical activity, location of the injury. It also questioned the subject's perception of work/endoscopy-related MSI and further intrigued on their remedies, the need for skipping work, and the use of ergonomic techniques to facilitate themselves.

Initially, the survey was pilot-tested by handing it over to endoscopists and ancillary staff members from the Department of Gastroenterology at Aga Khan University Hospital. The purpose was to evaluate its language, content clarity, and to deduce an approximate time to complete, although trained researchers were present during data collection to clear out any ambiguity. The final survey evaluated the respondent's general demographic, characteristics, workload, type, treatment, and impact of severity of MSI on a daily professional capacity. The survey took approximately 6 minutes to be filled out.

Assessment of facilities to prevent musculoskeletal injuries

A 13-point checklist (**Supplementary Table 2**) was adapted and devised from literature search[10, 11, 14, 16]. Five tertiary care hospitals, namely, Aga Khan University Hospital, Ziauddin University Hospital, Liaquat National Hospital, Dr. Ruth K. M. Pfau Civil Hospital, Sindh Institute of Urology, and Transplant all placed within Karachi, Pakistan had their endoscopic suites evaluated. The checklist was used to assess measures employed by these 5 major tertiary care hospitals in this metropolis to reduce MSI.

Ergonomic conditions were evaluated by the investigators. These 13 points briefly assessed the suite for endoscopic monitor, monitor height adjustability, booms, and stands. It also assessed time out between two consecutive patients, support stands, anti-fatigue mats, tiltable examination beds, cardiac monitor adjustability, and having the endoscopic retrograde cholangiopancreatography (ERCP) room in the same suite (**Supplementary Table 2**).

Statistical Analysis

This observational cross-sectional study had its statistical review performed by a biomedical statistician present at the Department of Medicine at Aga Khan University.

Analysis was performed using SPSS (Statistical Package of Social Sciences) version 19. Continuous variables were reported as mean ± SD (Standard Deviation). Prevalence (%) of demographic as well as clinical factors was assessed and all participants were divided into four groups: endoscopists, trainees, nurses, and technicians, and had their frequency of MSI compared in different groups by chi-square test. This data was stratified by gender and evaluated. All p-values were based on two-sided tests and significance was set at a p-value less than 0.05.

RESULTS

Demographics

Data from 56 participants were collected, of which 39 (69.6%) were male. 87.5% had right-hand dominance. There were 23.2% endoscopists, 16.1% gastroenterology residents, 26.8% endoscopy nurses, and 33.9% endoscopy technicians.

The level of physical activity was appraised. No regular exercise was seen in 41.1%, 23.2% had exercised less than 150 minutes/week, 8.9% had 150 minutes/week and 26.8% had more than 150 minutes/week of exercise.

Musculoskeletal Injuries

Participants who had been doing endoscopies for up to 5 years accounted for 48.9%, while 51% had been involved in endoscopy for more than 5 years.

Pain and numbness were reported by 75% of total respondents with anatomical regions specified (**Figure 1)** as neck (41.1%) lower back pain (32.1%) shoulder pain (21.4%), thumb pain (12.5%) hand pain (23.2%), elbow pain (8.9%) and carpal tunnel (7.1%), being the most affected with pain.

On an individual basis, out of endoscopists, residents, nurses, and technicians, we found endoscopists reporting the least to experience pain (53.8%) (**Table 2**). This was followed by residents at 77.8%, technicians at 78.9%, and finally with nurses reporting the most pain at 86.7%. Overall, there is not much distribution amongst the subgroups of the endoscopy team however we saw four cases of carpal tunnel syndrome (CTS). All four belonged to endoscopy nurses or endoscopy technicians.

We found a majority of the male and female technicians (66% and 100%) (**Table 3**) agreeing to neck pain which is the most common area affected overall while most nurses, both in males (100%) and females (53.8%) said to experience no pain in their neck. This does have real-time value as we found nurses using and performing hand and wrist-based actions and movements more frequently and likewise the nurses in our setup play a major role in holding the mouth guard. Table 3 can be seen showing a sub-analysis of gender-based data of male *vs* females in their respective professions of endoscopists, residents, nurses, and technicians.

Of all the total respondents only 33.3% of those having pain attributed it to endoscopy while, 52.4% were not certain whether the symptoms had been caused by endoscopy and 14.3% said that symptoms were not caused by endoscopy.

During endoscopy, 32.1%, complaint of the pain being evident while, 33.3% were quite bothered by this symptom.

Duration of symptoms more than 6 mo in 30.5% of the participants although in 57.1% symptoms were static while increasing in 10.7%. Around 21.4% had to take time off from work on the other hand 33.9% took medications for resolution of pain.

Assessment of facilities and awareness of ergonomics

The responders were asked if they use some modifications to prevent these injuries (**Supplementary Table 1**). Specific modifications that were assessed were endoscopic monitor at eye level (21.4%), cardiac monitor in front (12.5%), stopped to move patients (8.9%), respondents sat while performing colonoscopy (12.5%), and height-adjustable patient beds (23.2%).

All 5 tertiary care institutions ensured that the endoscopist monitor was located directly in front of the endoscopist and monitor boom, mobile stands, and endoscope support stands were available **(Figure 2)**. All 5 hospitals also ensured that the patient examination table was height adjustable. 4 out of the 5 hospitals had a tiltable examination table. 3 out of 5 tertiary setups had adjustable monitor height, adjustable cardiac monitor, 2-piece lead apron, non-slip flooring, and covered bundled wires. 3 of 5 hospitals also had an ERCP room in the endoscopy suite.

1 hospital provided an adjustable computer station and none of the institutions provided anti-fatigue mats/gel floor pads or had a time-out session of 10 minutes or more in between two consecutive endoscopy patients.

DISCUSSION

In this study, we tried to shed light on challenges affecting MSI in endoscopists along with the ancillary staff. Numerous studies have identified procedure volume and number of years in practice to be a risk factors for injury[8]. We similarly approached by documenting the prevalence of such injuries. Furthermore, we documented the awareness and practice of ergonomic intervention by current endoscopists and the ancillary staff, alongside the availability and use of ergonomic facilities in our tertiary care institutions.

Prevalence and awareness of musculoskeletal injury

Workplace injury has undoubtedly put an additional strain on the already chronic shortage of specialists. It can harm the productivity of healthcare workers and cause long-term pain and disability.

As high as 29 % to 89 % overall prevalence of pain or MSI has been reported among reporting endoscopists in numerous literature[1,5–7]. Our study highlighted in affirmative, with our respondents acknowledging the prevalence of such pain and injury in 75% of our subjects, similar to Hansel *et al* at 74%[5]. In the largest survey done, examining endoscopy-related MSI, which targeted members of the American Society for Gastrointestinal Endoscopy (ASGE), 53 % of endoscopists had reported injuries[13]. Similarly, in a study involving 190 endoscopists in Japan, 43 % reported musculoskeletal pain[15].

The site of injury plays an important role in the hindrance of an endoscopist's work. The three most commonly affected anatomical regions in our series were the neck, lower back, and shoulders, at 41.1%, 32.1%, and 21.4%. These numbers were partially contradictory to most articles we found, such as Hans *et al* quoting shoulders and back

at ~42% and ~38%[12] and Villa *et al* signifying the right wrist and left thumb being the most affected at 53% and 48%[3].

Although literature such as Villa *et al* reported almost half of their subjects, 47%, acknowledging pain related to that of endoscopies[3], our study reflected one-third (33.3%) of our respondents attributing their symptoms due to such procedures. This could be identified as a lack of awareness or as a reluctance to practice ergonomic activities in the endoscopy suites.

Surprisingly, 52.4% stated that they could not be certain whether endoscopy was a cause of their symptoms and 14.3% said their symptoms were not caused by performing these procedures. When we initially quoted three-quarters of our respondents acknowledging the presence of pain due to their work but still numbers as high as 52.4% being undecided and 14.3% declining to accept endoscopic procedures as being a reason, it gives us a huge group to address such chronic issues.

Some of the most important factors are repetitive movements and overuse of muscles along with prolonged standing, all of which are important parts of conducting an endoscopy. Some studies even go as far as quoting more than 16 h or 20 cases per week can lead to an increase in the risk of MSI[7,8]. Although factors leading to these injuries were not directly studied in our numbers, previous literature shed some light as stated above.

Arguably, gender does play a role according to a study conducted in ASGE fellows which reported female gender as the only significant risk factor for MSI based on factors pertaining to their hand size and grip strength[13]. 30.3% were females in our study but a relative comparison showed no gender-related difference in MSI (**Table 3**).

Most literature on the prevalence of endoscopic MSI did not evaluate the impact of regular activity and work. Alarmingly, we noted 21.4% of our respondents had to take time off from work due to endoscopy-related pain. This number was an increase from other literature we found and can be subjectively linked to limited specialists and ancillary staff in this field in the city and long working hours this entails[2, 5]. Morais *et al* a recent study conducted amongst Portuguese endoscopists quoted 10.1% of their

respondents took an off with a median of 30 days on account of endoscopy-related injuries[2]. This number contrasts with previous literature in which only a few endoscopists reported missing work and that too only for a few days[5].

In regards to our study, this significant loss of productivity needs to be properly addressed. This will ensure avoidable time off and lead to a decreased load on fellow endoscopists and ancillary staff.

Awareness and Implementation of Facilities for Ergonomics

Our study investigated further on the account of what is being done from/ the endoscopist's end and what is being provided at an institutional level to decrease MSI. Endoscopists with the availability of portable/flexible or placed on boom equipment such as an endoscopy monitor and cardiac/vital monitor at their disposal can make adjustments that can play a vital role in preventing injuries[14].

Documentation of injuries is mostly the first step in improving and promoting discussion on workplace ergonomics as indicated in a national survey, Austin *et al* where gastroenterology trainees and program directors were approached pre and post ergonomic training and numbers as high as 90% reportedly agreed to have a positive impact due to ergonomic training sessions[13]. These eventually lead to minimizing the number of injuries and creating a more ergonomic friendly work environment for endoscopists. Such practices are uncommon in our institutions.

Multiple factors were questioned in our survey that we compiled based on the current literature search and the proven adjustments and maneuvers that played a role in ergonomics[14]. Out of the total, 23.2% adjusted the height-adjustable-bed, 12.5% placed a cardiac monitor in front, 8.9% stopped to move patients and 8.9% sat while performing the procedure. Such low numbers speak volumes on the limited awareness of ergonomics despite the availability and also shed light on why ergonomic sessions are a must to undertake in the initial training months of endoscopy. Regional pain as described above could all be caused due to poor posture. Lack of posture and ergonomic timeouts play a vital role in such context. Effective strategies to ensure good posture can significantly improve endoscopists' pain.

To avoid improper positioning, endoscopy units should consider having an "ergonomic timeout" before starting a procedure to ensure proper bed height, patient position, and monitor location[3,6]. There is a clear role for widespread education and the implementation of guidelines for the best clinical practice of ergonomics[6,9–11]. It is easy to see the need for more training to ensure a higher percentage of respondents take preventive measures to improve their quality of life.

Assessment of facilities at endoscopy suite

To elucidate this aspect, our 13-point checklist was studied at five tertiary care hospitals where we examined the accessibility to basic endoscopy suit ergonomic capabilities in the devices used for every endoscopic procedure. Out of the five hospitals, none of them had a time out of ten mins or more between two patients which could lead to patient identification errors and would give insufficient time for the endoscopist to complete individualized patient reports. A ten-minute time-out would also support decreased muscle fatigue levels.

Height-adjustable examination beds, endoscopy support stand, monitor booms, and having the accessibility of the main endoscopic camera screen in front were available in all five tertiary care facilities.

None of the hospitals had any form of anti-fatigue mats or gel floor pads. Although three of them did have anti-slip flooring with wires being covered for protection against tripping over. Three of the hospitals had movable cardiac/vital monitors alongside height-adjustable monitors for the endoscopist. One of the tertiary care hospitals had an adjustable computer station while three of the hospitals had the ERCP procedure room within the reaches of the endoscopic procedure room.

Limitations

Our respondents were limited to 56 participants. For ergonomic evaluations, only five units in a geographic area limit the generalizability of the findings. An analysis of the pre and post ergonomic training with quantitative and qualitative analysis on our subjects would have added to the reliability of our findings.

CONCLUSION

This is the first study to be conducted in Pakistan for injuries caused by endoscopy. Our endoscopists had a significant prevalence of MSI leading to hindrance in their day-to-day activities and professional continuity.

Lack of knowledge and awareness of such injuries both at a personal and institutional level need to be addressed. Multiple areas need to be addressed in a strategic approach. We must increase awareness of these injuries among endoscopists and staff and standardized curricula to educate fellows on ergonomic practices to reduce the early development of overuse injuries. Institutions should also have standardized ergonomic protocols in place in endoscopy suites.

More research is needed to document the efficacy of an intervention in improving quality of life and productivity.

ARTICLE HIGHLIGHTS

Research background

Ergonomics in the field of gastroenterology with regards to musculoskeletal injuries among endoscopists and ancillary staff have been highlighted in studies from the western world. Musculoskeletal injuries affect the quality and longevity of the gastroenterologist which can lead to a shortage of specialists. There has been a dearth of literature on the topic from our region.

Research motivation

Creating awareness about the importance of ergonomics in endoscopy, that may prevent future injuries. Research would lead towards the modification and development of more ergonomic endoscopes and techniques. Furthermore, procedure rooms and spaces with institutional emphasis would promote strategies for the management of musculoskeletal injury.

Research objectives

Our objective is to document the prevalence of musculoskeletal injuries, awareness, and practice of ergonomics by endoscopists, ancillary staff, and institutions.

Research methods

An observational cross-sectional study in Karachi. An eleven-point self-administered questionnaire was distributed and used to evaluate musculoskeletal injuries and ergonomic adjustments amongst three tertiary care setups in Karachi. An onsite survey *via* a 13-point checklist for endoscopy suite facilities was used to assess the ergonomically friendly conveniences at five tertiary care setups.

Research results

There were 56 participants in total with 39 (69.6%) males. Pain and numbness were documented by 75% of the respondents, with the neck (41.1%) and lower back (32.1%), being the most commonly affected regions. 21.4% had to take time off their work while 33.9% took medications for pain. Ergonomic modifications to prevent musculoskeletal injury were used by 21.4%. Institutions lacked sufficient ergonomic facilities.

Research conclusions

Three-fourth of our endoscopists reported musculoskeletal injuries of which more than half are not sure or attributed this problem to endoscopy. The prevalence of musculoskeletal injuries warrants urgent attention.

Research perspectives

It would be interesting to see interventions to improve the ergonomics among participants, such as pre and post-intervention improvement and the impact of creating awareness. Research can be directed towards the development of curriculum and guidelines addressing ergonomics and modifications to prevent musculoskeletal injuries.

ACKNOWLEDGEMENTS

We thank all the respondents for taking out their time to fill in our questionnaire and also thank the following five hospitals for allowing us to examine their endoscopy suites: Aga Khan University Hospital, Liaquat National Hospital, Ziauddin University Hospital, Dr. Ruth K. M. Pfau Civil Hospital and Sindh Institute of Urology and Transplant.

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