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Research Article

**A CROSS-SECTIONAL STUDY TO ASSESS THE AWARENESS AND
ADHERENCE TO THE GUIDELINES OF ERGONOMICS IN
MINIMALLY INVASIVE SURGERIES PERFORMED BY RESIDENTS
AND SURGEONS AT A TERTIARY CARE HOSPITAL IN LAHORE**

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Abstract:

Minimal invasive surgeries have been performed on the patients for the well-known advantages of it and it has been used in several fields of surgery such as general surgery, gynaecology & obstetrics, urology and cardiothoracic etc. The concentration of the surgeon and his quality of skill required is very high especially when it comes to fine work required in MIS. Hence there is an increasing need to follow basic ergonomic guidelines to make it relatively easy for the surgeons and improve their efficiency and safety of the procedures. Ergonomics refers to a scientific discipline which sets a bond between the system elements and comprehension of human interactions, with the application of professional theory, methods, data and principles for the optimization of the overall performance of the system and human well-being. Surgeons working in operating rooms which have not been designed according to their comfort and needs make them prone to musculoskeletal pain and injuries. Designing a surgical unit by keeping in view the needs and comfort of surgeons is not only likely to make their job easy but also help their confidence and reduce their stress. Factors that are most likely to affect his/her approach are the height of the table and the size and height of the monitor. The staff should be able to adjust these according to the need but due to the lack of understanding and ignorance of ergonomic guidelines, surgeons may perform MIS in a way which is either not safe or a cause of discomfort. This research will study the correlation between table height, monitor height and size and the development of pain in the neck, arms, shoulder, knee or feet and also the awareness regarding ergonomic guidelines among the surgeons of Mayo Hospital, Lahore (MHL), from September 2016 to October 2017.

Keywords: Awareness, Level of Adherence, Ergonomics, Guidelines, Minimally Invasive Surgeries, Surgeons, Residents, Mayo Hospital.

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INTRODUCTION:

According to Konecny and Matern (2007) the ergonomics' objective is to resolve the lack of awareness in the operating room about the working conditions; it also highlighted the basic deficiencies of the ergonomics in the operating room about the adherence and awareness which lead to serious consequences by surgeons towards staff and patients on regular basis [1, 2]. In the survey, about 97% of the surgical staff (surgeons) noticed an improvement in the overall ergonomics in the operating room [3]. Another author specifically focused on the axial skeletal movement and posture back in 2001 and concluded that neck and trunk are involved in the posture of laparoscopic surgery which is not to be stationary but moving frequently (upper extremities). Ergonomics can change the design of the instruments and environment of the operation theatre in the course of laparoscopic surgeries [4]. According to Szeto (2009), there is a higher prevalence of work-related musculoskeletal signs among the working surgeons of Hong Kong special in the neck, lower back, shoulder and upper back with respective proportions of 83%, 68%, 58% and 53%. Neck symptoms are directly linked with the restricted small movements of the neck (89%). The research outcomes clearly reflect that musculoskeletal signs are directly linked with the psychosocial and physical factors [5].

OBJECTIVES:

1) To assess the awareness of ergonomic guidelines in surgeons of MHL. 2) To study the level of self-reported adherence to ergonomics guidelines in minimally invasive surgeries by surgeons and residents working in surgical and allied disciplines.

Aim: The aim of this research was to assess the significant interdependence among table height, monitor size and height and musculoskeletal pain in the course and after surgical operations and to check their comfort level within their work environment.

HYPOTHESES:

1. There will be a significant association between the height of monitor and neck pain.
2. There will be a significant association between the size of monitor and neck pain.
3. There will be a significant association between the height of the table being used and knee pain.
4. There will be a significant association between the height of the table being used and shoulder pain.

5. There will be a significant association between the height of the table being used and arm pain.
6. There will be a significant association between working hours per day and feet pain.
7. There will be a negative correlation between the comfortable eye-hand-target axis and arm pain.

METHODOLOGY:

The study was conducted on faculty members (associate professors, professors, assistant professors), postgraduate trainees (trainee registrars, senior house officers, senior registrars, senior medical officers) and belonged to the departments of general surgery, gynae & obs., ophthalmology and ENT. The nurses and members of the paramedical staff were not included in the study. It is a cross-sectional study. The study was conducted with the help of a questionnaire. The copies of the questionnaire were handed out to 48 available doctors of the above-mentioned departments at the time of distribution of the questionnaires and were collected from 43 doctors who responded by returning answered questionnaires. With a total of 94 doctors working in these departments according to the list provided by the administration, the response rate was 46%.

Duration of practice as a surgeon was considered along with total working hours per day, per week and the number of MIS performed per week and per month. Operating room factors considered were the height of the monitor, size of monitor and height of the table used. Factors of physical discomfort considered were shoulder pain, neck pain, knee pain, arm pain and pain in feet and it was also asked if it needed medication or not. They were also asked if they were comfortable with their eye-hand-target axis and if they were aware of ergonomic guidelines.

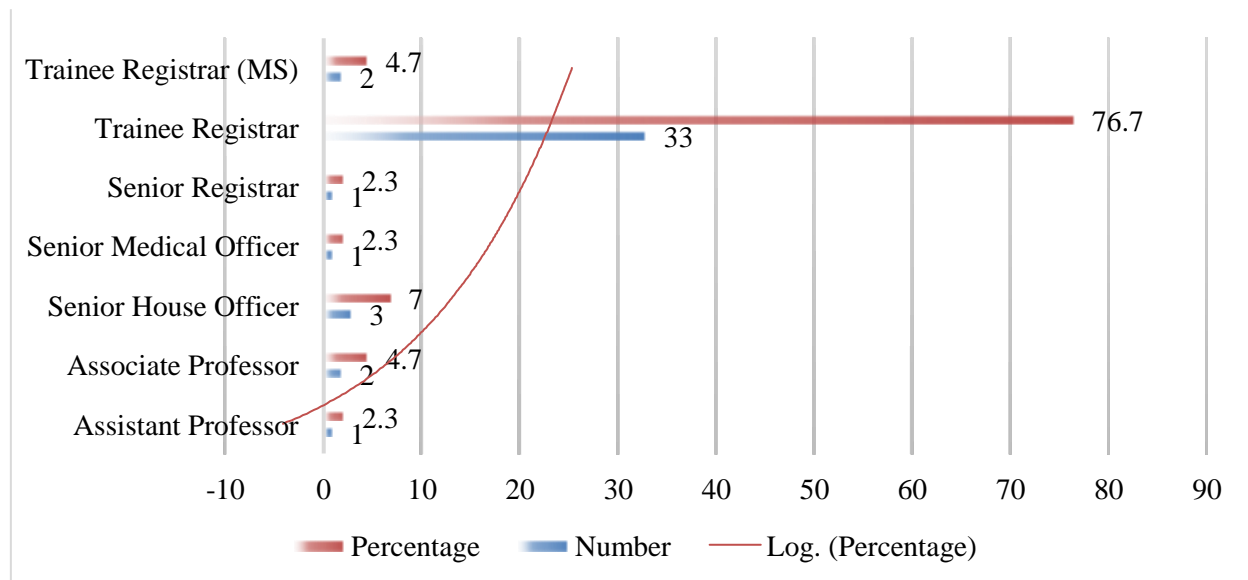
Data collected, was entered into SPSS. Then frequencies and correlations between different variables were observed and were noted down. Hypotheses formulated about the expected association between operating room factors (table height, monitor height and size) and physical discomfort (neck, shoulder, knee, arm, feet pain) were tested with Chi-Square tests and results were noted and conclusions were made.

RESULTS:

Of the doctors who responded only three were faculty members (7%) while the rest did not belong to faculty.

Table – I: Designations of Respondents

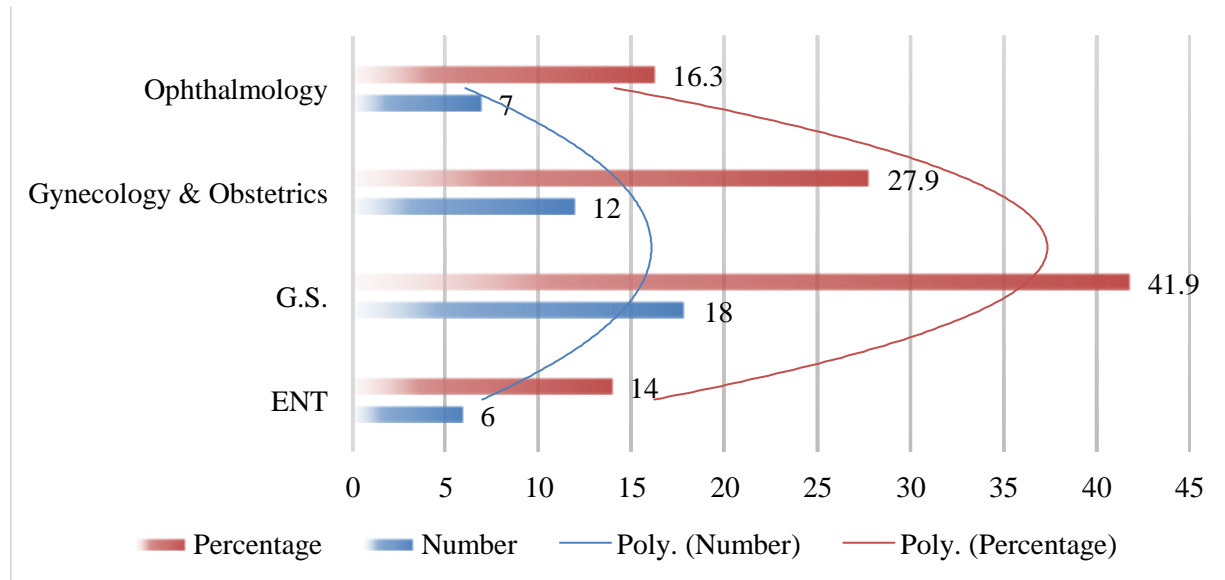
	Number	Percentage
Assistant Professor	1	2.3
Associate Professor	2	4.7
Senior House Officer	3	7
Senior Medical Officer	1	2.3
Senior Registrar	1	2.3
Trainee Registrar	33	76.7
Trainee Registrar (MS)	2	4.7



42% of the respondents belonged to the general surgery department.

Table – II: Respondents' Distribution According to the Department they belong

	Number	Percentage
ENT	6	14
G.S.	18	41.9
Gynecology & Obstetrics	12	27.9
Ophthalmology	7	16.3



Self-reported Awareness: 21 out of 43 doctors surveyed, which is about 51%, reported unawareness with ergonomic guidelines. While 20 reported that they have knowledge of ergonomic guidelines (46.5%). 2 didn't respond to the question.

Height of Monitor: 33 of the total 43 surgeons (76.7%) said that the monitor they used was at their eye level. 9 out of 43 said it was above eye level (20.9%) and 1 said it was below eye level (2.3%).

Of those (33) who said that the monitors they use are at their eye level, 27 reported that they were comfortable with it (81%) and rest of the 6 mentioned that it should be either above or below their eye level. 31 out of 43 were comfortable with whatever the height of monitor they were using which is a 72% satisfaction rate.

Table - III: Height of the Monitor in Use Comfortable Height of Monitor

Comfortable Height of Monitor		At Eye Level	Above Eye Level	Below Eye Level	Total	Pearson Chi-Square Test Value
Height of Monitor in Use	At Eye Level	27	4	2	33	0.003
	Above Eye Level	6	3	0	9	
	Below Eye Level	0	0	1	1	

Size of the Monitor: 20 out of 43 reported their monitor size to be 14 inches (46.5%), 21 (48.8%) to be 26 inches and 2 (4.7%) to be greater than 26 inches. 22 out of 43 (51%) were not satisfied with the size of the monitor they were using and reported that they might be comfortable using a bigger screen. 20 (46.5%) said that >26-inch screen would be

satisfactory for their use. Least number of surgeons showing satisfaction with the size of their monitors were those using one of 14 inches while there was a significant satisfaction with surgeons using 26 inches and greater than 26-inch screens.

Table – IV: Size of Monitor Comfortable Size of Monitor

Comfortable Size of Monitor		14"	26"	> 26"	Total	Pearson Chi-Square Test Value
Size of Monitor	14"	6	4	10	20	0.008
	26"	0	13	8	21	
	> 26"	0	0	2	2	

The height of Table: 26 out of 43 (60.5%) said that the table on which they perform surgeries has a height which is about their umbilical level. 15 (34.9%) said their table's height is above umbilical level and 2 (4.7%) reported it to be below umbilical level.

Out of 26 who reported that the height of the table they use is about their umbilical level, 24 said that they

were comfortable with the height of the table (92%), and out of 15 who said that their table's height was above their umbilical level, 11 were satisfied with it (73%). A total of 35 out of 43 were comfortable with their table's height (81%).

Table – V: Height of Table Comfortable Height of Table

Comfortable Height of Monitor		At Umbilical Level	Above Umbilical Level	Below Umbilical Level	Total	Pearson Chi-Square Test Value
Height of Table	At Umbilical Level	24	1	1	26	0.000
	Above Umbilical Level	4	11	0	15	
	Below Umbilical Level	2	0	0	2	

Frequency of Neck Pain: 20 out of 43 reported neck pain during or after surgery (46.5%) while 23 did not which is about 53.5% of the total.

Frequency of Shoulder Pain: 11 out of 43 reported shoulder pain during or after surgery (25.6%) while 32 said they haven't encountered shoulder pain (74.4%).

Frequency of Arm Pain: 14 out of 43 said they have felt arm pain during or after surgery one time or another (32.6%) while 29 said they do not (67.4%).

Frequency of Knee Pain: 7 out of 43 said they have felt knee pain during or after surgery one time or another (16.3%) while 36 (83.7%) said they haven't.

Frequency of Feet Pain: 17 out of 43 said they have felt feet pain during or after surgery one time or another (39.5%) while 26 said they haven't (60.5%).

Hypothesis 1: There will be a significant association between the height of monitor and neck pain. Table 4 below shows cross tabulation between the height of monitor in the use and occurrence of neck pain during surgery. Chi-Square analysis shows there is no significant association between the height of monitor and neck pain.

Table – VI: Height of the Monitor in Use Neck Pain during Surgery

Neck Pain During Surgery		Yes	No	Total	Pearson Chi-Square Test Value
The height of Monitor in Use	At Eye Level	17	16	33	0.401
	Above Eye Level	3	6	9	
	Below Eye Level	0	1	1	

Hypothesis 2: There will be a significant association between the size of monitor and neck pain. Table 5 below shows cross tabulation between the size of the monitor in the use and occurrence of neck pain during

surgery. Chi-Square analysis shows there is no significant association between the size of monitor and neck pain.

Table – VII: Size of Monitor Neck Pain during Surgery

Neck Pain During Surgery		Yes	No	Total	Pearson Chi-Square Test Value
Size of Monitor	14"	8	12	20	0.266
	26"	10	11	21	
	> 26"	2	0	2	

Hypothesis 3: There will be a significant association between the height of the table being used and knee pain.

When this hypothesis was tested with Chi-Square, it showed remarkable results. Those surgeons who reported that the height of the table on which they perform surgeries was about the level of their umbilical region or above umbilical region, showed no significant association with knee pain and the majority of them did not complain of knee pain. But the two of the total forty-three who reported that their

table's height did not match their umbilical region and is now also reported that they suffer from knee pain. This can be explained by the fact that surgeons working on low table heights have to keep their standing posture a little awkwardly bent to have a comfortable approach towards the patient. Back pain has not been studied in this research; otherwise, it would have been interesting to note the association here.

Table – VIII: Height of Table Knee Pain during Surgery

Knee Pain During Surgery		Yes	No	Total	Pearson Chi-Square Test Value
Height of Table	At Umbilical Level	1	25	26	0.001
	Above Umbilical Level	4	11	15	
	Below Umbilical Level	2	0	2	

Hypothesis 4: There will be a significant association between the height of the table being used and shoulder pain.

When this hypothesis was tested with Chi-Square, it showed remarkable results. Those surgeons who reported that the height of the table on which they perform surgeries was about the level of their umbilical region or above umbilical region, showed no significant association with shoulder pain and the

majority of them did not complain of shoulder pain. But the two of the total forty-three who reported that their table's height did not match their umbilical region and is now also reported that they suffer from shoulder pain. This can be explained by the fact that surgeons working on low table heights have to keep their standing posture a little awkwardly bent to have a comfortable approach towards the patient.

Table – IX: Height of Table Shoulder Pain during Surgery

Shoulder Pain During Surgery		Yes	No	Total	Pearson Chi-Square Test Value
Height of Table	At Umbilical Level	7	19	26	0.03
	Above Umbilical Level	2	13	15	
	Below Umbilical Level	2	0	2	

Hypothesis 5: There will be a significant association between the height of the table being used and arm pain.

When this hypothesis was tested with Chi-Square, it showed remarkable results. Those surgeons who reported that the height of the table on which they perform surgeries was about the level of their umbilical region or above umbilical region, showed no significant association with arm pain and the

majority of them did not complain of arm pain. But the two of the total forty-three who reported that their table's height did not match their umbilical region and is low also reported that they suffer from arm pain. This can be explained by the fact that surgeons working on low table heights have to keep an awkward upper extremity posture to have a comfortable approach towards the patient.

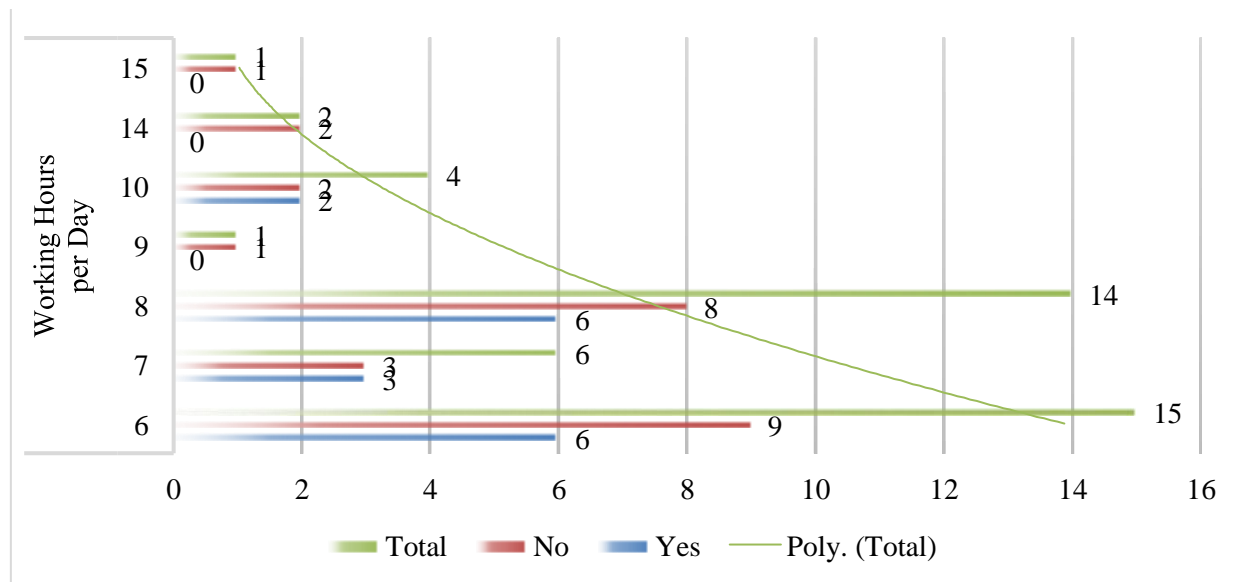
Table – X: Height of Table Arm Pain during Surgery

Arm Pain During Surgery		Yes	No	Total	Pearson Chi-Square Test Value
Height of Table	At Umbilical Level	6	20	26	0.061
	Above Umbilical Level	6	9	15	
	Below Umbilical Level	2	0	2	

Hypothesis 6: There is a significant association between feet pain and the total working hours taken by a surgeon in a day.

Table – XI: Working Hours per Day Feet Pain during Surgery

Feet Pain During Surgery		Yes	No	Total	Pearson Chi-Square Test Value
Working Hours per Day	6	6	9	15	0.791
	7	3	3	6	
	8	6	8	14	
	9	0	1	1	
	10	2	2	4	
	14	0	2	2	
	15	0	1	1	



Hypothesis 7: There will be a negative correlation between the comfortable eye-hand-target axis and arm pain.

Table 10 shows cross tabulation between the comfortable eye-hand-target axis and arm pain. Chi-Square test shows that there is no significant

association between the comfortable eye-hand-target axis and arm pain although there is an increase in the percentage of the surgeons reporting arm pain who also report uncomfortable eye-hand-target axis.

Table – XII: Comfortable Eye-Hand-Target Axis Arm Pain during Surgery

Arm Pain During Surgery		Yes	No	Total	Pearson Chi-Square Test Value
Comfortable Eye Hand Target Axis	Yes	11	25	36	
	No	3	4	7	0.525

DISCUSSION:

A majority percentage (51%) of surgeons in MHL are unaware of ergonomic guidelines which are higher than expected and it also makes it even harder to work for and implementing a system resulting in quality ergonomic conditions for surgeons. The study conducted by Modi, Kuswaha, Dave (2007) in three medical colleges and teaching hospitals of Ahmedabad concluded with 64% of the surgeons reporting that they were aware of ergonomic guidelines regarding laparoscopic surgery while the practice of it was somewhat lower at about 54% and 4% respectively in terms of table height and monitor height. They hadn't studied the causes of this lower practice and commented that it may be due to the nonadjustable table and monitor height. In MHL, despite the fact that a large number of surgeons are unaware of ergonomic guidelines, they have defined

their comfort zone especially when it comes to table height and monitor height but not in the case of the size of monitor [6]. The causes have not been studied in this research either but it can be explained by the adjustable height of the tables and monitors used here. Size of monitors installed by the hospital administration being non-adjustable, creates discomfort for many surgeons.

The study conducted by Szeto, et al. (2009) among the surgeons in Hong Kong reported that 82.9% of surgeons feel pain in the neck during or after surgeries. Through this, we may infer that a surgeon's neck is vulnerable to musculoskeletal pain due to a sustained posture during surgery [7]. In our study which was conducted in MHL, physical discomfort was found less prevalent but those who did report a physical discomfort the chief complaint was also found to be of neck pain with 46.5% saying that they

feel neck pain during or after surgery but don't require any medication for its cure. This means that although physical discomfort is an issue, it is not a serious one here.

It was expected that there would be a close association between operating room factors and physical discomfort and several assumptions were made regarding this. But the results proved that there was little association between uncomfortable monitor height and neck pain etc [8]. with only bad table height knowing to cause knee, arm, shoulder pain. Bad table height causes a surgeon to remain in a sustained awkward and uncomfortable posture which results in several health issues. A study conducted by Wauben, Veelen, Gossot & Goossens (2006) had similar results to this study. On the whole, almost 80% of respondents reported neck, shoulder and back discomforts and there was no specific cause for these physical discomforts. But the information which turned out to be the hallmark of that research was that a clear majority (89%) of respondents, similar to this study, were unaware of the ergonomic guidelines. The study concluded with the statement that the lack of ergonomic guidelines was a major problem in the operating room.

CONCLUSION:

A higher than expected number of surgeons are unaware of ergonomic guidelines (51%). Even then, many are comfortable with table height and monitor height. A high percentage (46.5%) of surgeons suffers from neck pain during or after surgeries. Shoulder pain, knee pain, arm pain and feet pain is less common. Low table height is associated with physical discomfort expressed as knee pain, shoulder pain and arm pain.

Greater than 26-inch monitors are more comfortable than 14-inch monitors.

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