ORIGINAL ARTICLE

Ergonomics knowledge, attitude, and practice among biomedical scientists

Nasar Alwahaibi, Ibrahim Al Abri, Mallak Al Sadairi and Samira Al Rawahi

ABSTRACT

Objectives: Biomedical scientists (BMSs) are important professionals for healthcare services as they help in the detection, diagnosis, and treatment of numerous diseases. However, they are at risk of getting injuries in the medical laboratory and lack of ergonomics knowledge might be the source. To assess ergonomics knowledge, attitude, and practice among Biomedical scientists.
Methods: A cross-sectional study was carried out among Biomedical scientists using a constructed questionnaire. The association between these parameters and various risk factors such as age, sex, marital status, physical exercise, heavy work at home, nationalities, qualifications, and working experience was measured using the Chi-square test.
Results: The study included 110 Biomedical scientists. Females represented 68.2% and 45.5% were between the ages of 25-34 years old. Good ergonomics knowledge showed in 54.5% and 82.7% showed a high positive attitude. However, poor ergonomics practice showed in 83.5%. There was no significant interrelation between the three parameters. A significant association was found between the male gender (0.040), more than 20 years of work experience (0.016), and good ergonomics practice.
Conclusions: Biomedical scientists have good knowledge, and a high attitude but poor practice of ergonomics. Ergonomics training and practice should be strongly enhanced among these healthcare professionals.
Keywords: Attitude, Biomedical scientists, Ergonomics, Knowledge, Practice

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INTRODUCTION

Biomedical scientists (BMSs) are important professionals for healthcare services as they help in the detection, diagnosis, and treatment of numerous diseases. However, in day-to-day practice, BMSs are continuously exposed to various hazards such as chemical, physical, mechanical, electrical, and biological, as well as prone to infectious specimens (1). The most common daily activities for BMSs include pipetting, microscopy and working in standing positions. With time, this may affect body organs such as muscles, joints, tendons, nerves, ligaments, cartilage, and spinal discs (2). These musculoskeletal disorders (MSDs) can affect the efficiency and speed of the work and eventually lead to a disruption in the healthcare system (3). It has been reported that MSDs are one of the common health problems among all health professionals (4).

The goal of laboratory ergonomics is to reduce as much as possible, the MSDs among BMSs by providing a safe and comfortable working environment. Due to the nature of their work in the medical laboratory, BMSs are at risk for many health problems. Previous studies have focused mainly on dentistry as an important profession in the healthcare system. However, scanty studies have evaluated the knowledge, attitude, and practice of ergonomics among BMSs. Thus, this study aimed to assess those ergonomics parameters among biomedical scientists.

MATERIALS AND METHODS

Ethical considerations

The study is ethically approved by the Medical Research Ethics Committee, College of Medicine and Health Sciences, Sultan Qaboos University, Oman (SQU-EC/095/2020). Preceding the study, an informed consent statement and information about the study were included in the questionnaire for participants to agree or decline to participate. Those who declined the study were immediately withdrawn from the study and could not participate in the questionnaire.

Sample size

The sample size was calculated using the infinite population sample size formula: $n = \{N \times Z^2 \times p \times (1-p)\} / \{d^2 \times (N-1) + Z^2 \times p \times (1-p)\}$ where N : Population size (The total number of BMS working at SQU and SQUH) = 170, Z (Standard value with confidence level 95%) =1.96, d (Permissible error on either side) = 10%, and p (Proportion of the characteristic under the study). The p-value was obtained from a pilot study that was conducted among 20 participants who fulfilled the research criteria.

Those who participated in the pilot study were excluded from the study. The p-value was found equal to 63.5%. The sample size was calculated as 97. After sampling, the number was increased by 15% to avoid non-response or inappropriately filled questions and that number was randomly selected from the overall population. The reliability of the questionnaire was calculated by Cronbach alpha in the pilot study and found to be 0.675.

Study design

This cross-sectional observational study was conducted in the year 2020. A constructed questionnaire was used to obtain knowledge, attitude, and practice among biomedical scientists. It was designed utilizing a literature review and other questionnaires of other populations (5,6). Due to the COVID-19 pandemic, we appointed a focal staff in each laboratory to distribute and collect the questionnaires.

Participants

This study includes all biomedical scientists of any age and nationality from the seven laboratories, namely: Anatomy, Biochemistry, Genetics, Haematology, Histopathology, Microbiology and Immunology, and Physiology. The exclusion criterion included those with less than one year of experience in work.

Questionnaire collection

The questionnaire contained a brief description of the study. It was designed to contain a mix of positive and negative questions to avoid the false-positive results because of the inappropriately filled questions. The questionnaire used in this study consisted of four sections. The first section was socio-demographic characteristics such as age, sex, marital status, physical exercise, heavy work at home, nationalities, qualifications, number of working years, specialties, BMS grade, working hours, work shifts, and overtime. The second section consisted of eight questions related to the ergonomics knowledge, such as meaning, benefits, and principles of ergonomics. The third section consisted of eight questions related to the ergonomics attitude such as ergonomics education, distribution of the work, and adjusting the workplace. The fourth section consisted of nine questions related to the ergonomics practice such as wearing comfortable shoes, using comfortable positions, and relaxing eyes and neck.

Statistical analysis

For the three categories: Yes, some extent, and no, the scores were two, one, and zero, respectively. The total score of knowledge ranged from zero to 16. Achievement of more than 66.66% of the maximum score is considered good knowledge (7).

The attitude was assessed by strongly agree, agree, neutral, disagree, or strongly disagree. The score of each question ranged from 1 to 5 giving a total score range of 5 – 40. Those who achieved more than 66.66% were regarded as having a positive attitude. The practice was evaluated like knowledge. The total score ranged from zero to 18. Achievement of more than 66.66% of the maximum score is considered as good practice (7). The data were analysed using Statistical Package for Social Science (SPSS) version 25 software (SPSS Inc., Chicago, USA). Frequencies and percentages were used to represent the categorical data such as age, gender, and specialty. Continuous data were presented as mean and standard deviation. A Chi-square test was performed to measure the significant association between risk factors and level of knowledge, attitude, and practice. The *p*-value was considered significant if it was equal to or less than 0.05.

RESULTS

A total of 110 BMSs were included in this study after excluding those who did not fit the inclusion criteria. The majority were females (68.2%) and 73.6% were married. The majority of the BMSs (45.5%) were in the age group 25-34. Surprisingly, the number of those who were doing regular physical exercises was nearly equal to those who were not at 50.9% and 49.1%, respectively (Table 1). 30.0% of BMSs reported to have heard of the term “ergonomics”, 37.3% knew the benefits of ergonomics application, and 47.3% knew the health hazard of their work without ergonomics (Table 2). Regarding the attitude, 59.1% of the BMSs strongly agreed that ergonomics education must be part of the biomedical curriculum, and 68.2% strongly agreed that distributing the work equally between the workers makes it easier. However, 20.0% of them strongly disagreed preferring to bend their head forward instead of adjusting the workspace for better viewing (Table 3). Regarding the practice of BMSs, 72.8% wore comfortable shoes while standing at work, 46.8% found enough space to put their legs and feet comfortably, and 45.0% were trying to avoid pressure on their hands and arms from sharp edges (Table 4).

There was no significant association between sociodemographic factors and ergonomics knowledge and attitude. However, the male gender and more than 20 years of work experience showed a significant association with good ergonomics practice (Table 5).

Overall, BMSs showed good knowledge and attitude in 54.5%, and 82.7%, respectively. However, good ergonomics practice was seen in only 16.5% (Figure 1). 86.7% of the BMSs with good knowledge have a positive attitude but without any significant association between knowledge and attitude. Good practice was seen in 18.6% of those who have good knowledge with no relationship between knowledge and practice. In addition, there was no relationship detected between attitude and practice (Table 6).

Table 1. Sociodemographic characteristics among biomedical scientists.

Characteristics	Number (110)	Percent (%)
Gender		
Males	35	31.8
Females	75	68.2
Age group		
<25	1	0.9
25-34	50	45.5
35-44	42	38.2
45-54	11	10.0
>54	6	5.5
Marital status		
Single	29	26.4
Married	81	73.6
Nationality		
Omani	89	80.9
Non-Omani	21	19.1
Off work physical activity		
Yes	56	50.9
No	54	49.1
Specialty		
Haematology	30	27.3
Biochemistry	23	20.9
Histopathology	21	19.1
Microbiology and Immunology	20	18.2
Genetics	8	7.3
Anatomy	6	5.5
Physiology	2	1.8
Qualification		
Diploma	7	6.4
Bachelor	71	64.5
Master	28	25.5
PhD	4	3.6
Designation		
Junior BMSs	53	48.2
Senior BMSs	38	34.6
Chief BMSs	14	12.7
Superintendent	3	2.7
Researcher	2	1.8
Total work years as BMSs		
<20	90	81.8
≥20	20	18.2

Table 2. Ergonomics knowledge among biomedical scientists

Statement	No (%)		
	Yes	To some extent	No
Do you know what is meant by ergonomics?	33(30.0)	54(49.1)	23(20.9)
Do you know the benefits of ergonomics application?	41(37.3)	43(39.1)	26(23.6)
Do you know what the health hazards of your job without ergonomics are?	52(47.3)	38(34.5)	20(18.2)
Ergonomics principles try to change the worker behaviour and not to change the working environment.	33(30.0)	43(39.1)	34(30.9)
Although ergonomics is beneficial to improving worker health, it cost more money than it saves.	12(10.9)	48(43.6)	50(45.5)
Keeping the shoulders relaxed could cause musculoskeletal disorders (MSDs).	12(10.9)	30(27.3)	68(61.8)
MSDs may be caused by grasping small instruments for long periods.	70(63.6)	32(29.1)	8(7.3)
Frequent lifting of heavy equipment at work contributes to MSDs.	95(86.4)	13(11.8)	2(1.8)

Table 3. Ergonomics attitude among biomedical scientists.

Statement	No (%)				
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Ergonomics education must be a part of the biomedical curriculum.	65(59.1)	35(31.8)	9(8.2)	0(0.0)	1(0.9)
It is important to distribute the work equally between us because it makes the work easier.	75(68.2)	33(30.0)	1(0.9)	0(0.0)	1(0.9)
I prefer to bend my head forward instead of adjusting the workspace for better viewing.	6(5.5)	18(16.3)	24(21.8)	40(36.4)	22(20.0)
Always I should bend my back while working because it makes my work easier.	9(8.2)	31(28.2)	24(21.8)	27(24.5)	19(17.3)
To finish my work on time, I prefer to attain the same position (e.g., Sitting) for long periods while working instead of changing my posture.	11(10.0)	26(23.6)	18(16.4)	39(35.5)	16(14.5)
Forceful hand movements while working enables me to get work done on time regardless of the consequences that may occur.	3(2.7)	35(31.8)	23(20.9)	34(30.9)	15(13.6)
Doing exercises like stretching, walking, etc. is important to be more productive at work.	66(60.0)	38(34.5)	6(5.5)	0(0.0)	0(0.0)
I should always try to avoid putting my angled elbow in direct contact with the work surface for a long period.	26(23.6)	47(42.7)	28(25.5)	7(6.4)	2(1.8)

Table 4. Ergonomics practice among biomedical scientists.

Statement	No (%)		
	Yes	Sometime	No
When you are working in the standing position, do you wear comfortable shoes?	79(72.8)	23(21.1)	7(6.4)
Do you find enough space to put your legs and feet in a comfortable position?	51(46.8)	38(34.9)	20(18.3)
Are your hands or arms subjected to pressure from sharp edges on work surfaces?	22(20.2)	38(34.8)	49(45.0)
Do all task requirements are visible from comfortable positions?	33(30.3)	53(48.6)	23(21.1)
Do you avoid raising your arm above your elbow level while you are working?	20(18.3)	49(45.0)	40(36.7)
Do you avoid twisting or bending your wrist?	29(26.6)	47(43.1)	33(30.3)
Do you stop after at least 15 minutes for a moment to relax your eyes and neck?	7(6.4)	52(47.7)	50(45.9)
Do you stop every 30-60 minutes to get up to stretch and move?	12(11.0)	57(52.3)	40(36.7)
While you are holding objects (e.g., Forceps), do you alternate between your fingers holding them? (ex. Thumb and index or index and middle finger)	6(5.5)	32(29.4)	71(65.1)

Table 5. Ergonomics knowledge, attitude, and practice of biomedical scientists and associations with their sociodemographic characteristics.

Sociodemographic characteristics	Knowledge		*P* value	Attitude		*P* value	Practice		*P* value
	No (%)			No (%)			No (%)		
	Good	Poor		Positive	Negative		Good	Bad	
Gender									
Male	21(60.0)	14(40.0)	0.562	28(80.0)	7(20.0)	0.806	10 (28.6)	25 (71.4)	0.040
Female	39(52.0)	36(48.0)		63(84.0)	12(16.0)		8(10.8)	66 (89.2)	
Age group									
<25	0(0.0)	1(100.0)		1(100.0)	0(0.0)		1 (100.0)	0(0.0)	
25-34	28(56.0)	22(44.0)		41(82.0)	9(18.0)		5(10.0	45 (90.0)	
35-44	21(50.0)	21(50.0)	0.678	34(81.0)	8(19.0)	0.813	6(14.3)	36 (85.7)	0.018 *
45-54	7(63.6)	4(36.4)		9(81.8)	2(18.2)		4(40.0)	6(60.0)	
>54	4(66.7)	2(33.3)		6(100.0)	0(0.0)		2(33.3)	4(66.7)	
Marital status									
Single	15(51.7)	14(48.3)	0.890	23(79.3)	6(20.7)	0.779	7(24.1)	22 (75.9)	0.318
Married	45(55.6)	36(44.4)		68(84.0)	13(16.0)		11 (13.8)	69 (86.3)	
Qualification									
Diploma	5(71.4)	2(28.6)		6(85.7)	1(14.3)		3(50.0)	3(50.0)	
Bachelor	38(53.5)	33(46.5)	0.627	60(84.5)	11(15.5)	0.531	11 (15.5)	60 (84.5)	0.120
Master	14(50.0)	14(50.0)		21(75.0)	7(25.0)		3(10.7)	25 (89.3)	
PhD	3(75.0)	1(25.0)		4(100.0)	0(0.0)		1(25.0)	3(75.0)	
Designation									
Researcher	1(50.0)	1(50.0)		2(100.0)	0(0.0)		0(0.0)	2 (100.0)	
Junior BMSs	29(54.7)	24(45.3)		43(81.1)	10(18.9)		7(13.2)	46 (86.8)	
Senior BMSs	21(55.3)	17(44.7)	0.509	32(84.2)	6(15.8)	0.878	8(21.6)	29 (78.4)	0.702
Chief BMSs	6(42.9)	8(57.1)		12(85.7)	2(14.3)		2(14.3)	12 (85.7)	
Superintendent	3(100.0)	0(0.0)		2(66.7)	1(33.3)		1(33.3)	2(66.7)	
Total work years as BMSs									
<20	47(52.2)	43(47.8)	0.430	74(82.2)	16(17.8)	1.000	1 1	7 9	0.016
≥20	13(65.0)	7(35.0)		17(85.0)	3(15.0)		(12.2) 7(36.8)	(87.8) 1 2 (63.2)	

* This cannot be considered significant even though the *P* value is less than 0.05 because more than 20% of cells have an expected count of less than 5 and the minimum expected count is less than 1 so, the chi-square test cannot be used.

Table 6. The relationship between knowledge, attitude, and practice.

	Attitude		*P* value	Practice		*P* value
	Positive No (%)	Negative No (%)		Good No (%)	Bad No (%)	
Knowledge Good Bad	52(86.7) 39(78.0)	8(13.3) 11(22.0)	0.345	11(18.6) 7(14.0)	48(81.4) 43(86.0)	0.695
Attitude Positive Negative				14(15.6) 4(21.1)	76(84.4) 15(78.9)	0.514

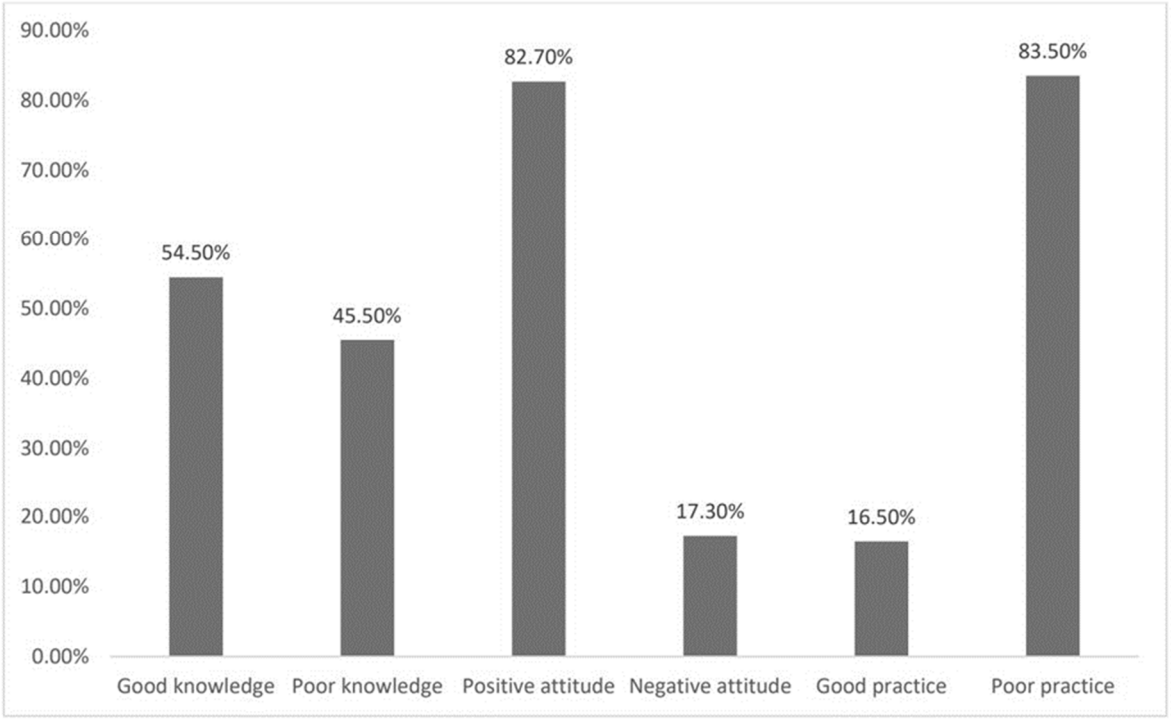

Figure 1. Level of knowledge, attitude, and practice among biomedical scientists.

DISCUSSION

The use of laboratory investigation is very important as 70% of all medical decisions are affected by the results of laboratory analysis (8-10). The application of ergonomics guidelines in the field of medical laboratory helps to minimize MSDs. MSDs are one of the common health problems among all health professionals. Several studies reported high levels of MSDs among medical laboratory scientists (11-15). These high MSDs among BMSs will eventually affect the healthcare service. Health, productivity, and well-being are important characteristics of BMSs (16). It is expected that good knowledge, a positive attitude, and good practice of ergonomics would minimize MSDs among BMSs.

In the literature review, we found only one study evaluated the ergonomics knowledge only among medical laboratory scientists in Nigeria (16). It is important to note that several instruments and products have been modified in the clinical laboratory to minimize MSDs. For example, laboratory chairs are made with comfort to adjust height, back, and legs. In addition, BMSs while purchasing any instrument, keep in their mind, the ergonomics part of these machines.

Although that 93.6% of the BMSs have high qualifications, the present study showed that only 54.5% of BMSs had good ergonomics knowledge. This finding is higher than another study that reported 25.5% (27 of 106) knowledge of ergonomics among medical laboratory scientists in Nigeria (15). We did not observe any statistically significant association between ergonomics knowledge and gender, age, marital status, qualifications, designation, specialty, and work experience. In comparison with the study in Nigeria, they showed that ergonomics knowledge was significantly associated with the male gender. Other risk factors such as qualifications, affiliations, work experience, and specialty did not affect the ergonomics knowledge (16).

The current study showed a very high positive ergonomics attitude (82.7%) among BMSs. However, gender, age, marital status, qualifications, designation, specialty, and work experience did not statistically affect the ergonomics attitude. When we asked BMSs if ergonomics education must be a part of the biomedical curriculum, 90.9% (100 of 110) agreed with this concept. In addition, 98.2% (108 of 110) believed that it is important to distribute the work equally between colleagues as it makes the work easier.

Surprisingly, good ergonomics practice was noticed in only 16.5% of BMSs. In addition, there was a statistically significant association between the male gender and good practice. This association could be related to the fact that males are less stressed than females. Thus, males can do their job more ergonomically. Furthermore, there was a significant association between work experience (more than 20 years) and good practice. Those with more work experience have adapted well to the occupational safety procedure in the medical laboratory.

Despite that, BMSs had a reasonably good ergonomics knowledge, high positive attitude, and poor practice, we did not observe any statistically significant association between knowledge and attitude, knowledge and practice, or attitude and practice. Thus, BMSs have the ergonomics knowledge and

attitude but did not result in good daily practice. In the medical laboratory, good ergonomics practice leads to fewer MSDs. In fact, good knowledge, attitude, and practice of ergonomics would help BMSs take sufficient precautions during their laboratory work and adjust their working environment accordingly. The findings of this study strongly recommend the use of a laboratory ergonomics checklist that would assess BMSs at their workplace and subsequently minimize LMSDs.

This study has some limitations. First, due to the COVID-19 pandemic, we were not able to spread the questionnaire face-to-face to the BMSs. Second, ergonomics practice was measured by questionnaire only and not by observation. Finally, the lack of similar and relevant studies for a better comparison.

In conclusion, biomedical scientists have good knowledge, and a high attitude but poor practice of ergonomics. Ergonomics training and practice should be strongly enhanced among these healthcare professionals.

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REFERENCES

1. Jegathesan M, Chin CS, Lim HH. Safety in pathology laboratories. *Malays J Pathol* 1988; 10: 1-5.
2. Haile EL, Taye B, Hussen F. Ergonomic workstations and work-related musculoskeletal disorders in the clinical laboratory. *Lab Med* 2012; 43: 11-19.
3. Dong H, Zhang Q, Liu G, et al. Prevalence and associated factors of musculoskeletal disorders among Chinese healthcare professionals working in tertiary hospitals: a cross-sectional study. *BMC Musculoskelet Disord* 2019; 20: 1-8.
4. Tinubu BM, Mbada CE, Oyeyemi AL, Fabunmi AA. Work-related musculoskeletal disorders among nurses in Ibadan, south-west Nigeria: a cross-sectional survey. *BMC Musculoskelet Disord* 2010; 11:12.
5. El-Sallamy RM, Atlam SA, Kabbash I, et al. Knowledge, attitude, and practice towards ergonomics among undergraduates of Faculty of Dentistry, Tanta University, Egypt. *Environ Sci Pollut Res Int* 2018; 25: 30793-307801.
6. Ephraim-Emmanuel B, Ogbomade R, Idumesaro B, Ugwoke I. Knowledge, attitude, and practice of preventing the occurrence of work-related musculoskeletal disorders among doctors in University of Port-Harcourt Teaching Hospital. *J Med Res Innov* 2019; 3: e000161.
7. Bharath C, Natarajan S, Venkatalakshmi S. Assessment of knowledge related to diabetes mellitus among patients attending a dental college in Salem city-A cross sectional study. *Braz Dent Sci* 2017; 20: 93-100.
8. Forsman RW. Why is the laboratory an afterthought for managed care organizations? *Clin Chem* 1996; 42: 813-816.
9. Hallworth MJ. The '70% claim': what is the evidence base? *Ann Clin Biochem* 2011; 48: 487-488.
10. Rohr UP, Binder C, Dieterle T, et al. The value of in vitro diagnostic testing in medical practice: a status report. *PLoS One* 2016; 11: e0149856.
11. Sadeghian F, Kasaeian A, Noroozi P, et al. Psychosocial and individual characteristics and musculoskeletal complaints among clinical laboratory workers. *Int J Occup Saf Ergon* 2014; 20: 355-3561.
12. Alnekhilan AF, Altamimi AM, Alaqeel BY, et al. Work-related musculoskeletal disorders among clinical laboratory workers. *Avicenna J Med* 2020; 10: 29-34.
13. Maulik S, Iqbal R. Occupational health and musculoskeletal symptoms among Indian medical laboratory technicians. *JOHE* 2013; 2: 82-92.
14. Ramadan PA, Ferreira MJ. Risk factors associated with the reporting of musculoskeletal symptoms in workers at a laboratory of clinical pathology. *Ann Occup Hyg* 2006; 50: 297-303.
15. Maulik S, Iqbal R, De A, Chandra AM. Evaluation of the working posture and prevalence of musculoskeletal symptoms among medical laboratory technicians. *J Back Musculoskelet Rehabil* 2014; 27: 453-461.
16. Oladeinde B, Ekejindu I, Omoregie R, Aguh O. Awareness and knowledge of ergonomics among Medical Laboratory Scientists in Nigeria. *Ann Med Health Sci Res* 2015; 5: 423-427.
17. Alwahaibi N, Al Abri I, Al Sadairi M, Al Rawahi S. Ergonomics knowledge, attitude, and practice among biomedical scientists. medRxiv 2021.07.25.21261088; doi: https://doi.org/10.1101/2021.07.25.21261088

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