

Evaluation of Orthopedics and Traumatology Education among Clerkship Students at International University of Africa

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Abstract

Background

Musculoskeletal diseases are significant cause of morbidity and disability worldwide. Knowledge regarding these conditions is essential to the medical practice. The purpose of this study is to assess the adequacy of undergraduate orthopaedic knowledge among IUA students.

Methods

This is a descriptive cross-sectional study conducted among final year medical students at the faculty of Medicine of the International University of Africa who finished orthopedic teaching. The validated basic cognitive examination designed by Freedman and Bernstein, consisting of 25 short answer questions was used in this study. Overall scores and responses to the individual questions were analyzed. The recommended passing score of 73.1 per cent as suggested by Freedman and Bernstein was considered.

Result

Ninety-eight students took the examination. The students' scores in the cognitive part ranged from 6 to 25. The average cognitive score was 56.9%, with a range of 24–100%. Only six (6.12%) of participants obtained the passing score of $\geq 73.1\%$. Only one student obtains the full mark in the cognitive part (25 points out of 25 points). Thirty-two students (32.7%) considered orthopedic cases the most challenging to perform a physical examination and diagnosis. Most students (64.3%) rank bedside teaching rounds with the consultant as the most elements of learning environments have an impact on their orthopedic education. Forty (40.8%) of students thought the time allotted to orthopedics in the medical curriculum was inadequate. Fifty (51%) of students mention that they may consider orthopedic as a future career.

Conclusion

The majority of the IUA students were not achieved the pass mark set by Freedman and Bernstein validated basic musculoskeletal examination. Curriculum and teaching methods is inadequate and should be re-evaluated to address this problem.. Graduate medical education should provide a strong foundation for diagnosing and treating musculoskeletal disorders.

Background

Musculoskeletal disorders (MSD) are considered a significant burden among Global Burden of Disease (GBD) data and the largest contributors to the need for rehabilitation services ⁽¹⁾. It is one of the significant causes of morbidity throughout the world, with substantial influence on health and quality of

life and inflicting an enormous burden of cost on health systems. Globally, musculoskeletal problems account for 23–27.8% of primary care visits and around 20% of emergency department visits ⁽²⁾. Furthermore, musculoskeletal conditions account for 30% of General Practitioners' consultations. With an aging population and a dramatic rise in the frequency of obesity, musculoskeletal disorders are rising around the world with reported incidence of 2.9% of the population suffers from musculoskeletal conditions ⁽³⁾.

Treatment of musculoskeletal disorders is multidisciplinary and involving a variety of medical professions as well as other healthcare providers. The rising prevalence of musculoskeletal disorders necessitates that future doctors must be well-trained and knowledgeable regarding diagnosis and treating these disorders ⁽²⁾. Medical school is the main source of formal education with regard to the musculoskeletal system. In most medical institutions, undergraduate musculoskeletal education is still insufficient in both basic science and clinical training ⁽⁴⁾. Despite the rising frequency of musculoskeletal problems across a broad range of clinical practice, the Association of American Medical Colleges (AAMC) stated that medical schools are not successfully training the future physicians in this discipline ⁽⁵⁾. Furthermore, recent research implies that the disparity between the magnitude of the problem and graduate doctors' competency in musculoskeletal medicine is due to educational shortcomings in medical schools ^(4,6-10). The inadequacy of undergraduate musculoskeletal education has brought it to attention ⁽¹¹⁾. Improving the undergraduate musculoskeletal curriculum will aid in the training of competent frontline doctors to deal with the major healthcare issues such as these conditions. Since the quality of education received may influence the eventual career choice, it is equally essential to provide high quality musculoskeletal education to attract the best students to orthopedics and trauma surgery ⁽¹²⁾.

This study aims to evaluate the undergraduate medical students at the International University of Africa (IUA) regarding their knowledge of Orthopedics surgery and their perceptions of the learning environment, time devoted to their education in this field, and the factors that may contribute to choosing orthopedics surgery as a future career among these students.

Material And Methods

Study design and area

A descriptive cross-sectional study was conducted among final year students at the faculty of Medicine at the International University of Africa who finished orthopedics teaching. The International University of Africa (IUA) is a unique pan-African educational institution in Khartoum, Sudan. It receives students from over 84 countries worldwide, most of them from African countries. The Faculty of Medicine was founded in 1994, and the first batch was admitted in 1997. The main goal is to graduate students who are clinically competent and community-oriented medical doctors. The faculty of Medicine adopts an education program that has been designed to employ innovative approaches in medical education. The

problem-based, community-oriented medical education approach uses scientific knowledge and good clinical skills integrated with behavioral, socio-cultural, and communication skills to enable graduates to appreciate and solve health problems individually and in family, community, and country settings. The curriculum observes the core competencies adopted internationally and nationally for quality MBBS graduates. The educational program comprises a five-year undergraduate study, three years in the basic sciences, and two in the Clinical clerkship period. ⁽¹³⁾

Study population

Inclusion criteria

All male and female medical students from different nationalities who finished the surgery module in clerkship and agreed to participate in this study were included.

Exclusion criteria

Students who refuse to participate and those who have their student attendance profile less than what was stated by faculty regulations were excluded from this study.

Sample size and sampling technique

The total number of students in the targeted batch was 126. Total coverage sampling technique was used by taking the students who accepted to participate in the study.

Data collection method and tool

A pilot test was carried out in 30 medical students from the previous batch, who voluntarily accepted to participate and sat for the test. The piloting process assured the clarity and the structural design of the questions. A modified Freidman and Bernstein validated test in the best of four questions format were provided as an electronic test via Google form. The form was distributed to the participants in the exam room. The students were allowed to answer the test in one hour, after that, the form was closed immediately. The candidates sat for the test one week before their final general surgery exam. A validated test assesses students' basic competency in orthopedics and traumatology. This validated test was developed by Freidman and Bernstein at the University Of Pennsylvania School Of Medicine. This test is aimed to assess the adequacy of orthopedic and traumatology teaching at medical schools. Freidman and Bernstein developed an essential competency examination composed of twenty-five short answer questions. This exam is figured out to cover problems encountered in primary care, such as fractures and dislocations, low back pain, and osteoarthritis. The recommended mean passing score is $\geq 73.1\%$. ⁽⁷⁾ We used the Kirkpatrick model ⁽¹⁶⁾ level one learning assessment through Freidman and Bernstein test. The Kirkpatrick level two assesses students' perceptions regarding their confidence in conducting a physical clinical examination and the time allocated for studying orthopedics and traumatology within the surgery module.

Moreover, the questionnaire contains three additional sections. The first section was designed to assess medical students' perceptions of their ability to conduct clinical physical examinations in orthopedics and traumatology cases compared to other clerkship disciplines. A scale from 1–3 was used to assess the difficulty of performing the physical clinical examination. The scale is defined as 1 as easiest, 2 as moderate, and 3 as the most difficult specialty to conduct a physical examination. The second section was aimed to assess whether the time allocated for orthopedic and a traumatology course is enough or not. Finally, a question about whether they may consider pursuing orthopedics as a future career and the factors that may influence this decision were included.

Data management and analyses

Data were reviewed, organized and computed using Microsoft Excel version 2010. Descriptive statistics in form of frequencies were analyzed using Statistical Package for the Social Sciences (SPSS) Version 26.

Ethical considerations

Ethical approval

was obtained from the ethical review committee of the Sudan Medical Specialization Board. The participants signed written informed consent after explaining the objectives of the study. Participation in the study was optional, and permission from the International University of Africa was obtained for conducting this study.

Results

Of 126 students, 28 students were voluntarily decided not to participate. Ninety–eight students took the examination. The students' scores in the cognitive part ranged from (6–25). The average cognitive score was 56.9%, with a range of 24% – 100%. About Ninety-two (93.8%) of our students were not achieved the pass mark stated by Freedman and Bernstein. Only six (6.12%) of participants obtained a score the passing score of $\geq 73.1\%$. However, only one student obtained the full mark in the cognitive part (25 points out of 25 points). The students' mean score for each question is shown in Table (1). It is ranged from 93.9% for the question on carpal tunnel syndrome (Question No. 10) to 16.3% for (Question No. 25) on anatomy. Anatomy-based questions (questions 8, 10, 11, 12, 15, 20, 22, 23, 24, 25) were answered poorly with an average score of 51.43%. Regarding orthopedics emergencies questions (questions number 2, 4, 5, 6, 7) were better answered with an average of 67.98%.

Thirty-two students (32.7%) considered orthopedics cases the most challenging to perform a physical examination and diagnosis in comparison to Pediatrics 27 (27.6%), Medicine 42 (42.9%), Obstetric and Gynecology 20 (20.9%) and Surgery 20 (20.4%). However, seventeen students (17.3%) believe that orthopedics is the easiest clinical specialty to perform a physical examination and diagnosis Table (2).

Regarding students' assessment of the effectiveness of learning educational methods, most students (64.3%) rank bedside teaching rounds with the consultant as the most elements of learning environments

have an impact on their orthopedics education. Table (3) outlines how students rated the educational benefit of different learning methods in relation to musculoskeletal curriculum items.

Forty (40.8%) of students thought the time allotted to orthopedics in the medical curriculum was inadequate. Hence, fourteen (14.3%) and thirty-five (35.7%) students respond with good and adequate, respectively. Only nine (9.2%) believed that time is grossly inadequate Figure (1). In addition, students were asked if they would consider orthopedics as a future career. Fifty (51%) of students responded "yes". Moreover, factors that motivate students toward a career in orthopedic and trauma surgery are shown in the figure (2).

Table 1
Cognitive examination score (Total number of students = 98).

#	Questions	Correct answers	Number of students	%
1	What common problem must all newborns is examined for?	Developmental dislocation of the hip	55	56.1%
2	What is compartment syndrome?	Increased pressure in a closed fascial space	85	86.7%
3	Acute septic arthritis of the knee may be differentiated from inflammatory arthritis by which laboratory test?	Analysis of Fluid from aspiration	60	61.2%
4	A patient's dislocates his knee in a car accident. What structure/s is/are at risk for injury and therefore must be evaluated?	Popliteal artery	82	83.7%
5	A patient punches his companion in the face and sustains a fracture of the 5th metacarpal and a 3-mm break in skin over the fracture. What is the correct treatment and why?	Irrigation and debridement; risk of infection	42	42.9%
6	A patient comes to the outpatient clinic complaining of low-back pain that wakes him from sleep. What two diagnoses are you concerned about?	Tumor and infection	36	36.7%
7	How is compartment syndrome treated?	Fasciotomy	88	89.8%
8	A patient lands on his hand and is tender to palpation in the snuff box (the space between the thumb extensor and the adductor tendons). Initial radiographs do not show a fracture. What diagnosis must be considered?	Scaphoid fracture	81	82.7%
9	A 25-year-old male is involved in a motor vehicle accident. His left limb is in a position of flexion at the hip and knee with internal rotation and adduction at the hip. What is the most likely diagnosis?	Hip dislocation	75	76.5%
10	What nerve is compressed in carpal tunnel syndrome?	Median nerve	92	93.9%
11	A patient has a disc herniation pressing the 5th lumbar nerve root. How is the motor function of the fifth lumbar root tested?	Dorsi flexion of the great toe	34	34.7%
12	How is the motor function of the median nerve tested in the hand?	Opposition of the thumb	44	44.9%

#	Questions	Correct answers	Number of students	%
13	A 12-year-old boy severely twists his ankle. Radiographs show only a soft tissue swelling. He is tender at the distal aspect of the fibula. What are the two possible diagnoses?	Ligament sprain and Salter Harris 1 fracture	69	70.4%
14	A patient presents with new onset low back pain. Under what conditions are plain radiographs indicated?	History of trauma	51	52.0%
		Neurological deficit	27	27.6%
15	A patient has a displaced fracture near the fibular neck. What structure is at risk for injury?	Common peroneal nerve	61	62.2%
16	A 20-year-old injures his knee while playing football. You see him in the same day and he has a knee effusion. An aspiration shows frank blood. What are the three common diagnoses?	Ligament tear, fracture	27	27.6%
17	What are the two common sources of cancer metastasis to the bone?	Breast and lung	67	68.4%
18	Name two differences between rheumatoid arthritis and osteoarthritis?	Pathology Rheumatoid Arthritis is inflammatory	43	43.9%
		Rheumatoid arthritis pain increase by movement	33	33.7%
19	What malignancy may be present in bone yet typically is not detected on the bone scan?	Multiple Myeloma	46	46.9%
20	What is the function of the normal anterior cruciate ligament of the knee?	To prevent anterior translation of the tibia on the femur	47	48.0%
21	What is the difference between osteoporosis and osteomalacia?	Osteoporosis decreased bone density	63	64.3%
22	In elderly patients, displaced fractures of the neck of femur are typically treated by joint replacement, whereas fractures of the trochanter are treated by plate and screws. Why?	Neck of femur fracture will affect the Blood supply to femoral head	68	69.4%
23	What muscle/s is involved in lateral epicondylitis?	Extensor Carpi Ulnaris	8	8.2%

#	Questions	Correct answers	Number of students	%
		Extensor carpi radialis brevis	41	41.8%
24	Rupture of the biceps at the elbow results in weakness of both elbow flexion and ...?	Forearm Supination:	46	46.9%
25	What muscle(s) control(s) external rotation of the humerus with the arm by the side?	Infraspinatus	16	16.3%

Table 2
Student's perception toward physical examination and diagnosis in orthopedics.

Subject	Rank		
	Easy	Moderate	Difficult
Medicine	9 (9.2%)	47 (48%)	42 (42.9%)
Surgery	26 (26.5%)	52 (53.1%)	20 (20.4%)
Obstetrics and gynecology	44 (44.9%)	34 (34.7%)	20 (20.4%)
Pediatrics	16 (16.3%)	55 (56.1%)	27 (27.6%)
Orthopedics	17 (17.3%)	49 (50%)	32 (32.7%)

Table.3 Students' assessment of the effectiveness of educational methods of learning

Items	1	2	3	4	5
Bedside teaching rounds with consultant	3 (3.1%)	3 (3.1%)	11 (11.2%)	16 (16.3%)	63 (64.3%)
Independent reading	3 (3.1%)	1 (1%)	15 (15.3%)	27 (27.6%)	51 (52%)
Seeing patients in clinic/ ER	5(5.1%)	7(7.1%)	20(20.4%)	27(27.6%)	39(39.8%)
Formal lectures	3(3.1%)	7(7.1%)	23(32.5%)	23(32.5%)	42(42.9%)

Discussion

This study showed that most of IUA students in Clerkship semesters did not have a basic level of competence in orthopedics medicine. This is clearly demonstrated by a low average cognitive score of 56.9%, and only six (6.12%) participants obtained a passing score of $\geq 73.1\%$. This study showed that the anatomy section was answered poorly with an average score of 51.43% in comparison to orthopedics emergencies questions which were better answered with an average of 67.98%. However, when our

findings were compared to J K Jones et al ⁽¹¹⁾, students' scores in their study were less than what encountered in this study.

In Rojan Tamrakar et al ⁽³⁾ study demonstrated a poor score in general orthopedics and anatomy questions with the average scores, which in contrary, is less than what shown in this study for IUA students. Elizabeth Matzkin et al ⁽⁶⁾ study demonstrated that most of the graduate students as well as practicing physicians do not have the basic competence knowledge in orthopaedics and traumatology medicine; moreover, this was also noted among our study group. Furthermore, Freedman and Bernstein ⁽⁷⁾, Jagdish Menon and Dilip K Patro ⁽⁸⁾, Rob Dachs et al. ⁽⁴⁾, all those authors their result agreed to our findings and they concluded that graduate students were poorly prepared to manage musculoskeletal problems. More instructional time and reassessment of the orthopedics curriculum is recommended to meet the educational requirements and fill this gap among medical graduates. Despite the fact that anatomy is one of the basic courses of medical schools education, the time devoted to anatomical teaching and dissection is declining. The lack of exposure to basic anatomy and musculoskeletal medicine as a whole may contribute to the underlying lack of musculoskeletal medical knowledge. This also appeared in this study as the average score on the basic anatomy questions was 51.43%, in comparison to 49% in Elizabeth et al. ⁽⁶⁾ study which shows fewer score than in this study.

The duration of orthopedics teaching was different at different medical centers. In IUA, Orthopedic surgery is combined as part of the general surgery module, in the first nine weeks, with a total of twelve lectures and weekly rounds. In UK, the average undergraduate teaching time dedicated to orthopedics surgery teaching is around two and a half weeks ⁽¹²⁾. This is typically delivered within a five to eight week block combined with other allied specialties. Freedman and Bernstein mentioned the duration of only two weeks of orthopedics teaching among their study population ⁽⁷⁾. Moreover, in South African medical schools, six weeks duration was allocated for the orthopedics education ⁽⁴⁾. As compared to the other medical institutions, aforementioned we had few weeks more allocated for teaching orthopedics surgery. In Nepal ⁽³⁾, students while at their medical school were posted for the eight weeks in the orthopedics department. Further, they had to undergo 4 weeks of the rotational internship in the orthopedics department. As opposed to our institute, medical students in IUA did not undergo any further exposure to orthopedics teaching apart from medical college, i.e., during the internship period. Many studies show that undergraduate medical students spend very few hours on the musculoskeletal system, both in basic science and clinical training ^(4,10,12,14-15). In this study, the amount of time spent on musculoskeletal medicine in the curriculum of IUA was reported inadequate by 40% of students. This compare to Jagdish Menon et al. ⁽⁸⁾ study in which 30 of their students (32.5%) felt that the time devoted to orthopedics in the medical curriculum was inadequate. In a similar study done at Harvard Medical School ⁽¹⁰⁾, (86%) of the students in the study recommended more time as a way to change the current musculoskeletal curriculum.

In this study, one-third (32.7%) of the students consider orthopedics cases hard to do diagnosis and physical examination compared to other medical specialties. In comparison with another study ⁽⁹⁾,

seventeen students (42.5%) felt that orthopedics was the most challenging specialty to make a clinical diagnosis. Moreover, Harvard Medical School study ⁽¹⁰⁾ shows that the students felt low to the average level of confidence in examining the musculoskeletal system compared to their confidence levels in examining pulmonary systems ($P < .001$ for all years). Among our participants, one-third (32.7%) of the students consider orthopedic cases hard to do diagnosis and physical examination compared to other medical specialties. In comparison with another study ⁽⁹⁾, seventeen students (42.5%) felt that orthopedics was the most challenging specialty to make a clinical diagnosis. Moreover, Harvard Medical School study ⁽¹⁰⁾ shows that the students felt low to the average level of confidence in examining the musculoskeletal system compared to their confidence levels in examining pulmonary systems ($P < .001$ for all years).

Moreover, in this study the most important element of learning methods that have an impact on orthopedics education among students was the bedside teaching rounds with the consultant. This finding was similar to those shown in previous studies ^(2, 4, 9). Learning environments that allow for direct contact with patients appear to be more valuable learning environments. This type of interaction when guided by faculty members they appear to be more beneficial to students, as evidenced by the fact that the majority of students consider consultant bedside teaching to be the preferred learning setting.

Positive student experiences during surgical rotations, according to research, may contribute to students deciding to pursue a future career in surgery ⁽⁴⁾. About half of the students in this study have mentioned that they may consider considering the orthopedics and traumatology career in the future. This is also reported by 54% of students in IUA. Hence, other factors such as interest in orthopedics and traumatology career, teacher role model, and seeing patients in clinic, ward and emergency room were also reported by students. Boutefnouchet et al. ⁽¹⁷⁾ found that students mentioned that quality of teaching and seeing patients within the clinical setting are the most significant motivating factors in developing an interest in Orthopaedics and Traumatology as a future career. Early exposure and teaching of medical students to orthopedics and traumatology are substantial to obtaining sufficient knowledge and sustaining their interest in this career ⁽⁴⁾. It is crucial to ensure a good learning environment and a well-structured curriculum to enhance the quality of musculoskeletal learning among undergraduate students. These factors will affect the students' perception of orthopedics and traumatology careers, which will improve learning outcomes among these students. In addition, a previous reported the assessment of 112 junior doctors after completion of two-year foundation training in the UK, and only 8.9% passed the assessment. The scores followed a similar pattern based on the doctors' career intentions. ⁽¹⁴⁾

Considering the high prevalence of musculoskeletal problems in the community and the necessity for doctors to be able to handle them correctly, it is crucial that medical education at all levels pay attention for training in musculoskeletal conditions in the future, in order to graduate competent doctors. In a more professional clinical context Epstein and Hundert defined competence as —the habitual and judicious use of communication, knowledge, technical skills, clinical reasoning, emotions, values and reflection in daily practice for the benefit of the individual, and the community being served ⁽¹⁸⁾. Hence, the basic

orthopaedic and traumatology knowledge gained by the medical students during undergraduate period form a platform for future progress and motivations, a review of the orthopedic curriculum in undergraduate education, including time allocation, teaching techniques, materials, and faculty skills, is essential to provide the upcoming medical doctors with the necessary knowledge and skills for a safe and good orthopedic practice.

Conclusion

In summary, fundamental knowledge of musculoskeletal disorders is essential in medical practice. Graduate medical students should provide a strong foundation for diagnosing and treating musculoskeletal disorders. The current study concluded that the knowledge of final medical students in IUA regarding musculoskeletal medicine is less than standard set by the validated test of Friedman and Bernstein. More dedicated time in orthopedic education would be beneficial to engage students with the specialty. A strong foundation in orthopedics medicine should be established for undergraduate students in order to address this issue. This highlights the importance of attention to be awarded to the field of musculoskeletal medicine within undergraduate curricula. Moreover, the bedside teaching rounds with the consultant is the most impacted learning element in the education environment that impacts orthopedics education among our students. The duration of orthopedic teaching is variable in different medical schools. In this study, 40% of students reported inadequate time spent on musculoskeletal medicine in the curriculum of IUA. Furthermore, Student experiences during surgical rotations may influence students' decision to pursue a surgical profession. About half of the students mentioned that they may consider orthopedics and traumatology specialty as a future career. Given the prevalence of musculoskeletal problems in society and the necessity for doctors to be able to handle them correctly, it is critical that education at all levels prioritizes musculoskeletal condition training.

Declarations

Funding: This study has been self-funded.

Competing interests: The authors declare that they have no conflict of interest

Availability of data and materials: The data that support the findings of this study are available from the corresponding author, upon request.

Authors' contributions: Hassan Elbahri conceived the research idea. Hassan Elbahri performed the data collection. Elmuntasir Salah supervised the work. Hassan M. Ahmed and Hassan Elbahri initiate the first draft of the manuscript. All authors discussed the results and contributed to the final manuscript.

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Ethics approval and consent to participate: Ethical approval was obtained from the ethical review committee of the Sudan Medical Specialization Board. All methods were carried out in accordance with relevant guidelines and regulations. The participants signed written informed consent on the first page of the questionnaire after explaining the objectives of the study. Participation in the study was optional, and a permission letter from the International University of Africa was obtained for conducting this study.

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Figures

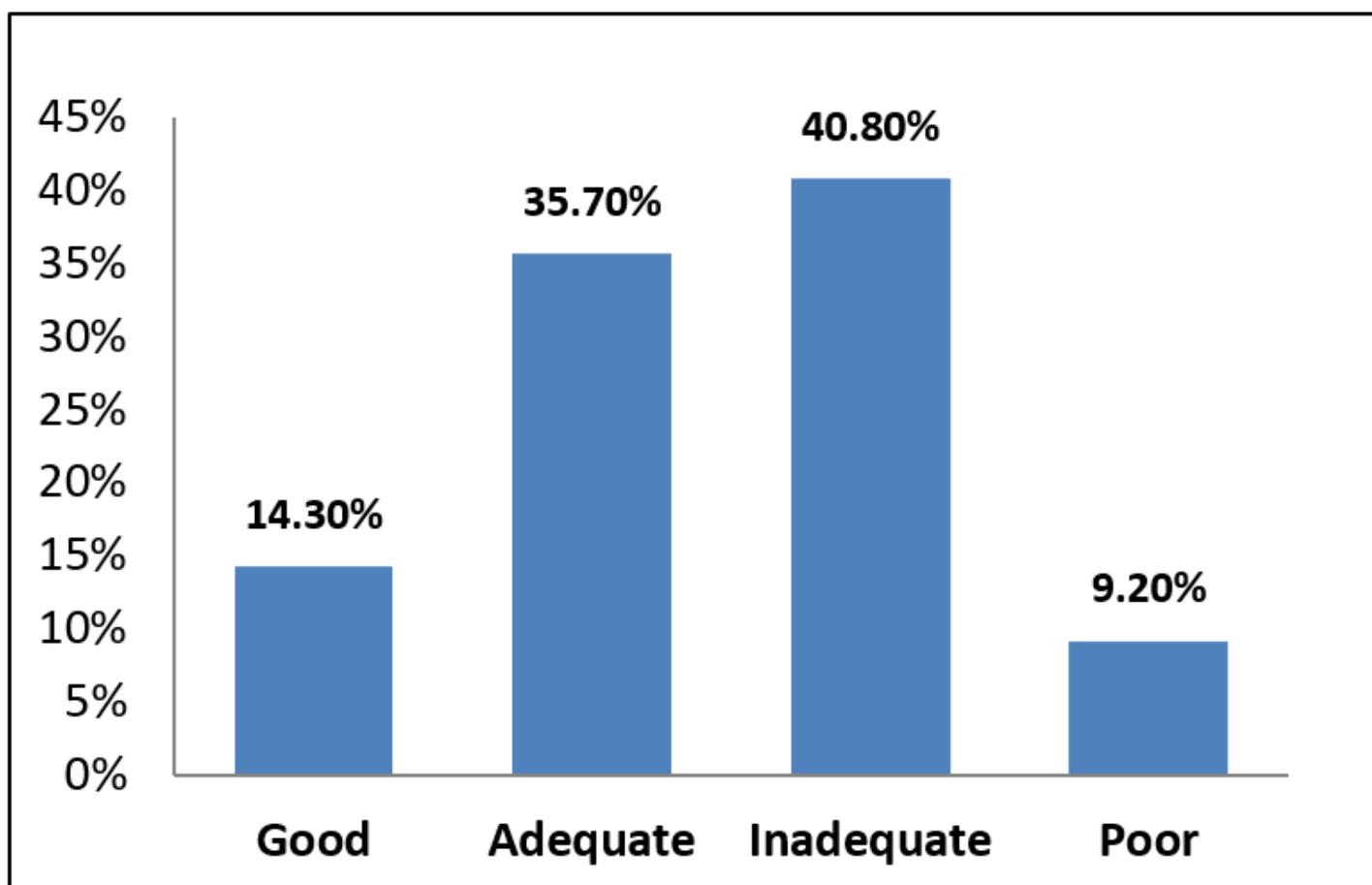


Figure 1

Students' perception toward time allocated to study orthopedics and traumatology.

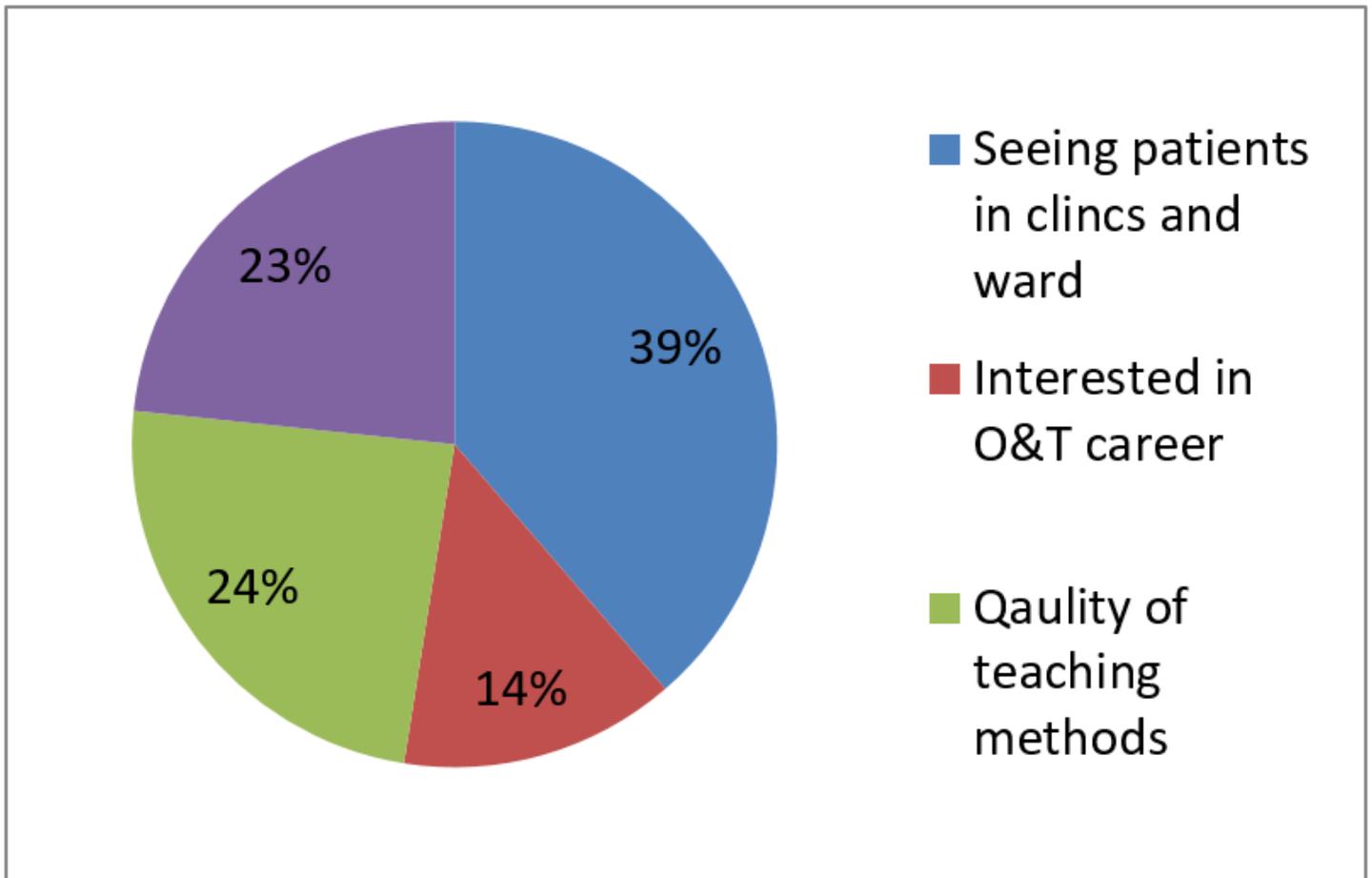


Figure 2

Motivating factors for taking an orthopaedic as a future career