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Knowledge and attitudes of Syrian medical students regarding robotic surgery: A cross sectional study

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Background: Robotic surgery represents a significant advancement in modern medical procedures, offering enhanced precision, control, and flexibility beyond human capabilities. Despite its growing prominence globally, the adoption and perception of robotic surgery in various regions, particularly in countries like Syria remain underexplored.

Objectives: The purpose of this research was to investigate the knowledge and attitudes of Syrian Arab republic medical students concerning robotic surgery.

Methods: An online cross-sectional study was conducted in Syria from 5 April to 17 may, 2022. The research included undergraduate medical students from government and private Syrian universities. The questionnaire was taken from a previous study and then modified to suit Syrian students, which was used to assess attitudes about robotic surgery.

Results: 862 medical students from governmental (92.2%) and private (7.8%) medical colleges filled out the online survey. 40.8% were interested in surgery specialties and, nearly half (46.3%) considered themselves as no tech-savvy persons. However, just 22.6% had prior robotic surgical knowledge, where the largest source of knowledge was the internet. A majority of the students (57.3%) had a favorable attitude toward robotic surgery, and 59.1% of them believed that the use of robots will lead to improvements in the results of surgical procedures. 40% of the participants considered that Syrian patients would not accept it. Furthermore, 40% were worried that robots could take the place of surgeons in the future, and (50.6%) believe this might make surgeons weak, hesitant, and less professional.

Conclusion: A large number of medical students in Syria have no experience with robotic surgery and know nothing about the procedures. Several recommendations should be made to improve clinical teaching using modern technology and robotic surgery, particularly for medical students interested in surgery.

Keywords: *Cross-sectional analysis, Healthcare technology, Medical education, Surgical innovation, Syrian healthcare, Technological acceptance.*

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INTRODUCTION

"Robots," are computer-controlled devices that can perform a particular job on their own [1]. Till December 2023, the robotic systems used in surgery are not technically robots, but rather device handling equipment known as telemanipulators [1]. Furthermore, in the previous two decades (***ie***; 2003-2023), there have been approximately 650000 surgeries all around the globe conducted by robots [2]. Gynecology and general surgery were the most popular targets for robotic surgery in the United States, while urology surgery was the most common in Europe [2]. However, from 1970 to 2008, there has been an increased interest in robotic surgery research [3, 4]. In 1985, the Programmable Universal Machine for Assembly (***ie***; PUMA) robot was used to perform stereotactic brain biopsies and excision of thalamic astrocytomas [5, 6]. In 1992, the ROBODOCR orthopedic system was employed to conduct complete hip replacements to improve the accuracy of femoral cavity milling [7]. However, robotic surgery has shown better advantages for both specialists and patients, including less hospitalization time, lower parietal complication rates, reduced postoperative discomfort, enhanced aesthetic outcomes, a quicker return to regular daily activities, increased tissue manipulation, and improved visibility [1, 8, 9]. Moreover, bleeding issues are significantly less frequent with robotic surgery [10], and the incidence of anastomotic leakage is lower with robotic surgery than laparoscopic surgery [11], and it decreased surgical trauma and incision-related problems, such as surgical site infections [12]. Despite this, robotic surgery has significant constraints, including the requirement for larger operating room suites to accommodate the robotic arms, consoles, and computer systems on the robot platform [12]. Therefore, there is a need for a qualified bedside assistant to accomplish many responsibilities, including docking and undocking, tool interchange, and introduction and retrieval of surgical materials. Nevertheless, the lack of tactile sensory input may lead to excessive force when manipulating tissues, resulting in unintended injury, and the robotic platform has been reported to be more costly than other methods [9, 13, 14].

Many observational studies indicated that medical students (MSs) who have attended training courses in robotic surgery have a greater understanding of robotic surgery and perform better on tests of mechanical skills [15, 16]. Robotic surgery was first brought to light in the Arab world by the Kingdom of Saudi Arabia, the State of Qatar, and the Egyptian government [15, 16]. However, studies have shown that most MSs did not know about robotic surgery because their medical schools did not have strong surgical course content [15, 16]. Instead, the Internet was the main place where they learned about it [17, 18]. This is a critical matter, since there aren't nearly as many robotic surgical training programs as there are for open surgery, particularly in low-income countries like Syria.

The present study intended to examine the knowledge, attitudes, and underlying characteristics about robotic surgery held by undergraduate MSs in Syria.

METHODS

The study was established and written by following the STROCSS GUIDELINE CHECKLIST for cross sectional performance [19].

Study design and participants

A cross-sectional study was conducted online in Syria to assess MSs' knowledge and attitudes about robotic surgery. All participants agreed to participate in this survey from April 5 to May 17, 2022. According to the Syrian Ministry of Health's latest report, around 28214 MSs exist in Syria during the academic year 2022-2023. All MSs from government and private universities in Syria were contacted. They were informed of the study's objectives, including the research group's identity, their right to withdraw from the study, privacy, and data protection, and that only fully registered data will be analyzed. Six collaborators were responsible for data gathering, and all data were protected against unauthorized access. The Syrian Ethical Society for Scientific Research (University of Aleppo) granted ethical approval and research authorization (IRB: kJ/O-52) on 13 Mars 2022. As a part of the surveys, informed permission was obtained electronically from all respondents by asking them whether they were willing to participate in the research or not, and the purpose of the study was described. All the procedures were followed in accordance with the relevant guidelines and regulations of Declaration of Helsinki.

The sample size was computed using the website https://www.calculator.net/sample-size-calculator.html. The sample size was determined using a population proportion of 50%, a confidence level of 99%,

and a margin of error of 4.5%, and a population size of 28214. The required sample size was 799. The attrition of 7% for missing data, gave a revised sample size of 859 (=799/ (1-0.07)).

Measures

The questionnaire was derived from previous research in the literature [18], and then adapted for local Syrians. We applied convenience and snowball strategies to collect data from MSs. The survey's validity was determined by having 15 participants from the target audience complete a pilot version of all the questions and provide comments on the clarity and length of the questions. These 15 MSs did not participate in the final survey. For security concerns, a Google form questionnaire was created and sent to respondents through social media, including Facebook, WhatsApp, and Telegram. On the first page of the questionnaire, is a question about the willingness to participate in this research. The questionnaire consists of 27 questions organized into two sections.

The first section is dedicated to the sociodemographic variables and parents' work-related characteristics. It consists of 10 questions on the MS's age, sex, marital status, place of residence, chronic disease, nationality, academic year, medical or dentistry student, university type, parents' job. The grade point average (GPA) was determined, and four categories were identified: < 60%, 60-70%, 70-80%, and > 80% [20]. In addition, this section had three questions about basic technological knowledge, prior experience with robotic surgery, and prior awareness of any robotic surgical centers in Syria. The second section is dedicated to the attitudes towards robotic surgery. It includes 10 questions about the perspective on robotic surgery. MSs were asked if their expertise in robotic surgery came from the institution, workshops outside the college, or self-study. The MS was asked if robotic surgery causes more surgical problems or is safer than conventional surgery. In addition, the poll asks if the MS agrees with the use of robotic surgery in the medical area and whether robots will eventually replace doctors.

Statistical analysis

The statistical analysis of the data was performed using the IBM SPSS V. 28.0 package program (IBM Corporation, Armonk, NY, USA). A p-value less than 0.05 were considered for statistical significance. Categorical variables on sociodemographic characteristics of the parents were expressed using descriptive statistics and frequencies. Mann–Whitney U-test for non-normal continuous variables, and chi-squared test for categorical variables were used to identify the differences in knowledge and attitude between MSs with and without a background in robotic surgery.

RESULTS

A sample of 869 participants was invited to participate in this survey. Data of seven MSs were rejected, reducing the sample size to 862 MSs from governmental (92.2%) and private (7.8%) medical colleges.

Table 1 exposes the demographic variables of the MSs. It appears that ***i)*** 40.8% were interested in surgical specialties, ***ii)*** 46.3% considered themselves no tech-savvy persons; ***iii)*** 41.1% reported they hadn't heard anything about robotic surgery before, ***iv)*** 26.1% reported they wanted to learn more; ***v)*** 22.6% had prior robotic surgical knowledge; and ***vi)*** 2.6% knew that there was a robotic surgery center in Syria.

Table 1. Demographic variables of the medical students (n=862).

Variables	Category	Frequency	%
Sex	Females	588	68.2
Age: Median (interquartile)	Years	21(20-23)	
Region	Rural region	190	22.0
	City	672	78.0
Nationality	Syrian	838	97.2
	Non-Syrian	24	2.8
University	Governmental	795	92.2
	Private	67	7.8
Academic year	First year	57	6.6
	Second year	180	20.9
	Third year	222	25.8
	Fourth year	105	12.2
	Fifth year	219	25.4

	Sixth year	79	9.2
Grade point average	< 60%	10	1.2
	60-70%	62	7.2
	70-80%	331	38.4
	> 80%	459	53.2
Future field of interest	Surgical specialty	352	40.8
	Non-surgical specialty	280	32.5
	Another	130	15.1
	Not interested	100	11.6
Tech-savvy person	No	399	46.3
	Do not know	237	27.5
	Yes	226	26.2
Previous background about robotic surgery	No, but I want to know	225	26.1
	No	354	41.1
	Yes	283	32.8
Awareness about robotic surgery center in Syria	No	835	96.9
	Yes	22	2.6
	No response	5	0.6

Table 2 exposes the MSs' knowledge and attitudes about robotic surgery. Its main messages were: ***i)*** The largest source of knowledge was Internet (60.2%), whereas the medical curriculum comprised just 6.5%; ***ii)*** 47.0 % of MSs with past knowledge properly described robotic surgery, and 60.6 % were familiar with its features; ***iii)*** Only 31.0% were aware of the significant progress made possible by surgical robots; ***iv)*** 57.3% had a favorable attitude toward robotic surgery, and 59.1% believed using robots would improve surgical procedure results; ***v)*** 40) considered that Syrian patients would not accept robotic surgery; ***vi)*** 40% were worried that robots could take the place of surgeons in the future, ***vii)*** 50.6% believed that robotic surgery might make surgeons weak, hesitant, and less professional; and ***viii)*** 62.5 % thought that the Syrian Arab Republic should put money into and grow the robotic surgeries.

Table 2. Descriptive data of medical students' knowledge and attitudes about robotic surgery (n=862).

Variables	Category	Frequency	%
Source of background in robotic surgery	Relatives	14	1.6
	Internet	519	60.2
	Medical collage curriculum	56	6.5
	Personal experience	33	3.8
	Others	238	27.6
	Workshop	2	0.2
What is robotic surgery?	Surgeons perform surgery using robots in the operating room (right answer)	405	47.0
	Robots perform surgery under supervision of the surgeons in the operating room.	172	20.0
	Robots perform surgery in the operating room	80	9.3
	Do not know	205	23.8
In comparison to conventional open surgery, what are the characteristics of robotic surgery?	More serious side effects	23	2.7
	Larger incisions and more local side effects	18	2.1
	More safety and effectiveness of surgeries. (Right answer)	522	60.6
	Do not know	299	34.7
Which of the following is the major advance aided by surgical robots?	Minimally invasive surgery (right)	337	39.1
	Simple surgery	38	4.4
	Remote surgery (right)	267	31.0
	Do not know	220	25.5
Do you personally accept Robotic surgery?	No	170	19.7
	Do not know	198	23.0
	Yes	494	57.3
Do you think the patients in Syria will accept robotic surgery?	No	345	40.0
	Do not know	275	31.9

	Yes	242	28.1
Do you think using robots will improve surgical outcomes?	Agree	351	40.7
	Strongly agree	158	18.3
	Do not know	264	30.6
	Disagree	67	7.8
	Strongly disagree	22	2.6
Do you think using robots could replace surgeons in the future?	Somewhat	314	36.4
	No	517	60.0
	Yes	31	3.6
Do you think using robots could make surgeons weak and reluctant with less professionalism and experience?	Somewhat	359	41.6
	No	425	49.3
	Yes	78	9.0
Do you think that Syria should invest and expand the Robotic Surgeries ؟	Agree	380	44.1
	Strongly agree	159	18.4
	Do not know	184	21.3
	Disagree	101	11.7
	Strongly disagree	38	4.4

Table 3 reported a significant difference between students with and without a background in robotic surgery and four variables, including academic year, GPA, future specialization, and tech-savvy experience. MSs who were not tech-savvy had less experience with robotic surgery than those who have experience with it. In addition, MSs with a GPA>80% and no background are more likely to prefer a surgical specialization than those with a background (223 (65.4%) and 129 (36.6%), respectively).

Table 3. Comparison between medical students with and without background in robotic surgery (n=862).

Variables	Category	Background in robotic surgery		P-value
		(No=579)	(Yes=283)	
University	Governmental	537(67.6)	258(32.5)	0.416
	Private	42(62.6)	25(37.3)	
Age: Median (interquartile)	Year	21(20-23)	22(20-23)	0.326
Sex	Female	398(67.7)	190(32.3)	0.635
Region	City	442(65.8)	230(34.2)	0.101
	Rural region	137(72.1)	53(27.9)	
Nationality	Syrian	566(67.5)	272(32.5)	0.169
	Non-Syrian	13(54.2)	11(45.8)	
Academic year	First year	44(77.2)	13(22.8)	0.034
	Second year	127(70.6)	53(29.4)	
	Third year	151(68)	71(32.0)	
	Fourth year	69(65.7)	36(34.3)	
	Fifth year	147(67.1)	72(32.9)	
	Sixth year	41(51.9)	38(48.1)	
Grade point average	< 60%	6(60)	4(40)	0.049
	60-70%	46(74.2)	16(25.8)	
	70-80%	237(71.6)	94(28.4)	
	> 80%	290(63.2)	169(36.8)	
Future specialty	Surgical field	223(65.4)	129(36.6)	0.014
	Medical field	182(65)	98(35)	
	Not interested	77(77)	23(23.0)	
	Another	97(76.6)	33(25.4)	
Tech-savvy person	Do not know	169(71.3)	68(28.7)	<0.001
	No	293(73.4)	106(26.6)	
	Yes	117(51.8)	109(48.2)	

Categorical data were converted to percentages (%) for clarity and comparison.

DISCUSSION

Robotic surgery awareness among Syrian undergraduate MSs has never been studied before, and to the best of the authors' knowledge, the present study is the first of its kind. However, a significant proportion of Syrian MSs have no experience with robotic surgery; we can declare that most of Syrian MSs have a positive attitude toward robotic surgical technology and have high aspirations for it, despite the fact that only around a third of them have prior experience with such technologies. MSs were also worried about the adoption of robots by patients, as well as the potential loss of their employment and professional standing. Even MSs with a prior experience had knowledge gaps, especially regarding the major advances and surgical progress made possible by these surgical robots. However, because the Internet was the primary source of information for these MSs, findings might be explained by the lack of a robust surgical curriculum at their medical schools. On the other hand, Syria's culture may also explain why patients find robotic surgery so difficult to embrace [21]. Despite this, the majority of the MSs stated their inclinations to accept such emerging robotic surgery and aspire to more preferable outcomes using such technique, and they agreed that Syria should invest more in and expand robotic surgery.

It has been reported that MSs and other health care workers were concerned that starting using robots in the surgical field can affect their profession, making it less valuable [22, 23]. Their issues may influence their future subspecialty selections [23]**.** As a result, it may be worthwhile for those interested in the surgical field to change their mind and avoid joining it. According to the expectancy-value theory, an attitude toward an object can be represented as a function of beliefs about the object and evaluations of these expectations [24]. Surprisingly, MSs with better achievement during their academic study are less open to such modern techniques. This can be confirmed by their academic evaluations, which show that those with higher GPA who are called tech-savvy persons are less aware of robotic surgery (Table 3).

Many factors can significantly influence the undergraduate MSs career choices, such as simulation training, surgical rotations, and conventional curriculum [25]. Unfortunately, one study reported inadequate training utilizing of well-structured robotics training program [26], and another study highlighted the lack of a stimulating learning environment for MSs in the robotic operating room [27].

Overall, it is important to supply our MSs with better chances to learn and improve their knowledge regarding clinical, technical, and ethical robots' consequences in the medical field. It is also essential that Syrian medical schools develop their medical curriculum content to meet the MSs' need to find out their awareness regarding robotic surgery, address their concepts about such surgery, and determine the indications needed for robotic surgery. To achieve this aim, an integrated approach must be held. Some institutions offered preclinical and clinical curricular and extracurricular courses to prepare their MSs for the merging of artificial medicine [28]. Compared to controls, it has been shown that individuals who were taught the foundations of robotic surgical skills performed better [28]. They recommended incorporating robotics into surgical training programs before surgeons use these abilities in the operating room [29].

Although surgery needs certain qualifications, surgical doctors are chosen based on how they did in their academic studies and overall undergraduate and postgraduate evaluation without testing their inclination and manual skills [30]. One study including 155 MSs had evaluated their manual and psychomotor skills levels, reported that 83.2% have moderate qualifications for surgery [30]. The authors concluded that training virtually by simulator might be used to supplement how they decide their inclinations and choose their specialty to identify individuals with low qualifications for surgical skills and convince them to choose other specialties suitable for their capabilities [30].

LIMITATIONS

The present study has one main limitation. The cross-sectional research cannot be used to prove causation. This study's generalizability was improved via universal sampling and a response rate of 98%, which is higher than average for organizational research surveys. We avoided sample bias, response bias, non-response bias, acquiescence bias, and order bias in this research. Despite the aforementioned limitation, many actions were made to improve the study's robustness. They sample from various research locations and use

universal sampling processes to raise the external validity of study findings, calculate the sample size a priori to ensure the study's power, and use a validated instrument and account for possible confounders in the final model to increase the internal validity of study results. Furthermore, due to differences in training curricula and robotic surgery capabilities, we may not be able to apply our findings from Syria to other Middle Eastern nations.

CONCLUSION

A considerable percentage of MSs in Syria do not have any experience with robotic surgery, and a significant percentage do not know anything about the procedures involved in robotic surgery. Syria's 11 years of war and conflict have reduced the quality of medical training. Several proposals should be made to enhance clinical teaching using the newer technologies and robotic surgery, especially for the MSs willing to choose a surgery specialty after graduation.

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

The Syrian Ethical Society for Scientific Research granted ethical approval (IRB: kJ/O-52) in Aleppo, Syria on 13 Mars 2022.

CONSENT FOR PUBLICATION

All methods were carried out in accordance with relevant guidelines and regulations or declaration of Helsinki. Informed consent was obtained electronically, with participants explicitly confirming their willingness to partake in the study before proceeding with the questionnaire.

COMPETING INTERESTS

None.

FUNDING

Not Applicable.

AUTHORS' CONTRIBUTIONS

Sarya Swed: Conceptualization, Methodology, Formal Analysis, Writing-Original draft, review and editing.

Other co-authors: Writing-Review and editing

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DECLARATION

None.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are available from the corresponding author, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the first author upon reasonable request and with permission of the corresponding author.

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