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Awareness and Knowledge of Caesarean Section (CS) Complications among Healthcare Students and How It Affects Their Decision-Making for Future Delivery

—A Prospective Cross-Sectional Survey

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Abstract

Introduction: Caesarean deliveries (C-sections) are increasing at a rapid rate worldwide. The World Health Organization has stated that no region in the world is justified in having a C-section rate greater than 15%, which is the median percentage globally. The C-section rate in Jeddah City, Saudi Arabia, was reported to exceed 25%; at least 13% of these C-sections were performed without a valid medical reason. With a high CS rate, the number of complications associated with surgery increases. **Aim:** This aper aims to assess the awareness and knowledge of healthcare students about C-sections' complications and their impact on their future decision-making for modes of women's delivery. **Subjects and Methods:** It is a cross-sectional, pre-structured online survey planned to include 502 healthcare students (males and females) across different academic study grades of ten different healthcare programs at the Batterjee Medical College (BMC), Jeddah, Saudi Arabia, during six months, from January 1st to June 30th, 2024. **Results:** Healthcare students' awareness and knowledge have a subsequent effect on their choice of the woman's mode of delivery. High-scoring knowledge shows a strong negative linear correlation with choice of CS (r = -0.96811) and a weak positive linear correlation with vaginal delivery (r = 0.43834). Unfortunately, most of the participating students have an inadequate (or poor) knowledge score (256, 50.99%), a high choice of CS (180, 35.86%), and a low choice of vaginal delivery (76, 15.14%). **Conclusion:** The estimated degree of aware-

ness and knowledge about C-sections' complications were different among male and female healthcare students, as well as varied across different healthcare programs. The background awareness and knowledge has a subsequent effect on the participating students' future choice of the woman's mode of delivery.

Keywords

Caesarean Section Rate, CS Indications, Short-Term Maternal Complications of CS, Long-Term Maternal Complications of CS, Foetal Complications of CS

1. Background

Worldwide, Caesarean Sections (CS) are the most common obstetric surgery [1]-[3]. It is simply a surgical incision made in the anterior abdominal wall and in the uterus to deliver one or more foetuses after viability [4]. The World Health Organization (WHO) states that a maximum of 10% - 15% of all deliveries should have CS, as per their guidelines (the ideal CS rate) [5]. Regretfully, the American Centre for Disease Control and Prevention [6] reported that the current CS rate grew from 20.7% in 1995 to 31.6% in 2016.

A caesarean section becomes one of the most common surgical procedures done in hospitals. Some health sectors now have CS rates over 50% [7]. There is no evidence that higher rates improve any outcomes, yet the CS rates continue to rise. Low-risk mothers (all pregnant women with a single, viable, mature foetus, in a longitudinal lie, cephalic with vertex presentation, without any associated medical or surgical problems) should have a chance for a trial of vaginal delivery.

However, it is crucial to note that, in cases where there is an obstetrical justification, a caesarean section can save patients' lives. The following are among the conditions that warrant a caesarean delivery [7]-[9]:

(1) Contracted or deformed maternal bony pelvis (inlet, mid-cavity, and/or outlet) leading to cephalo-pelvic disproportion (CPD) and failed labour progress.

(2) Obstructed maternal soft pelvic tissue (large myoma, cervical atresia/stenosis, cervical fibroid/invasive cancer).

(3) Maternal past operative history of ≥ 2 previous LSCS or 1 USCS, hysterotomy, metroplasty, repaired uterine prolapse, full-thickness myomectomy, repaired genital (vesico-vaginal or recto-vaginal) fistula, and/or repaired vaginal wall prolapse, permanent cervical cerclage, or when CS-Hysterectomy is indicated, or peri-mortem CS.

(4) Maternal current infection with human papilloma virus (HPV), herpes simplex virus (HSV), or human immune deficiency virus (HIV), hepatitis-C virus, severe chorioamnionitis with maternal sepsis.

(5) Maternal medical disorders with pregnancy: uncontrolled DM with macrosomic foetus (risk of shoulder dystocia), advanced cardiac or pulmonary disease,

cerebral aneurysm, severe pre-eclampsia or eclampsia, arrested labor progress due to non-corrected uterine hypertonicity or inertia, foetal distress with utero-placental insufficiency, ante-partum haemorrhage (placenta previa, abruptio placenta, vasa previa), severe oligohydramnios or polyhydramnios with unstable foetal lie.

(6) Foetal malposition: occipito-posterior position (persistent oblique occipito-posterior and deep transverse arrest of the occiput).

(7) Foetal malpresentations; such as face presentation (mento-posterior), braw presentation, shoulder presentation (transverse lie), cord presentation, breech presentation (as in primigravida, footling presentation, foetal weight is > 3.5 kg or < 1.5 kg (severe preterm), hyperextended foetal head).

(8) Multifetal pregnancy: twin pregnancy (when the 1st twin is not in vertex, cephalic presentation, conjoined twins, mono-amniotic twins), triplets, or higher order.

(9) Congenital foetal malformation: hydrocephalus, Rh-isoimmunization (hydrops fetalis), meningo-myelocele, parasitic head or limbs.

(10) The main irrelevant indications for a cesarean delivery include advanced maternal age, precious pregnancy, CS on a maternal request [1], patient-doctor convenience, medical malpractice, social and cultural changes, adaptation of small family norms, as well as anxiety among doctors about possible lawsuits if something goes wrong with the foetus [8].

Fear of vaginal birth (tocophobia), avoiding labour problems such as perineal damage and pelvic organ prolapse, and a past family history of good-experienced C-sections are the most common causes for C-sections performed on demand without a medical indication [10]. Furthermore, women who had private insurance had a 40% higher likelihood of choosing C-sections than those who had public (governmental) insurance [11] [12]. Also, women with a higher income typically have a higher rate of C-sections [13]. On the other hand, some expectant mothers decide on C-sections because friends and relatives advise them that vaginal deliveries on their own are uncomfortable [14].

Due to ineffective healthcare systems, high morbidity and mortality rates have been linked to the incapacity to execute C-sections in many rural parts of the world, including African nations [15]. Caesarean delivery has a number of risks and problems in comparison to vaginal birth [16]. The assumption that operative C-section is almost a risk-free procedure should be changed. The CS complications [16]-[22] can be listed as follows:

Complications related to Anaesthesia:

(1) General anaesthesia: failed intubation, gastric aspiration (Mendelson's syndrome), awareness with recall of intra-operative events [22], drug overdose, hypoxia, apnea, and cardiac arrest.

(2) Epidural/Spinal anaesthesia: hypotension and headache.

Intra-operative complications:

(1) Shock: hemorrhagic or neurogenic.

(2) Wound extension and injury to great blood vessel.

(3) Injury to urinary bladder or ureters.

(4) Injury to intestines.

Short-term post-operative complications:

(1) Severe bleeding caused by uterine atony or DIC [17], with possible development of Sheehan's syndrome.

(2) Ogilvie Syndrome (Acute colonic pseudo-obstruction) and Acute Kidney Injury (a life threatening condition) [17].

(3) Risks of massive blood transfusion.

(4) Atonic post-partum hysterectomy [20].

(5) Maternal death.

(6) Wound hematoma or infection [19].

(7) Generalized peritonitis, localized para-metritis, and post-partum endometritis [19].

(8) Hospital-acquired infection: Bronchitis, bronchopneumonia.

(9) Post-operative paralytic ileus, acute gastric dilatation, intestinal obstruction.

(10) Bed rest with risk of thromboembolic disorders (TEDs).

(11) Admission into intensive care units with its financial burden.

(12) Urinary tract infection.

(13) Long hospital stay and prolonged recovery time.

Long-term post-operative complications:

(1) Peritoneal adhesions leading to intestinal obstruction, ectopic pregnancy, subfertility or infertility [20].

(2) Endometriosis leading to subfertility or infertility.

(3) Risk of scar dehiscence or rupture uterus in future pregnancies [17].

(4) Risk of abnormal placentation (placenta previa, accrete, increta).

(5) Incisional hernia.

(6) Ugly operative scar.

(7) Low chance for future successful vaginal delivery (VBAC).

(7) Persistent pelvic pain, pelvic abscess.

(9) Medico-legal court litigations.

(10) Future repeated C-sections with its cumulative costs [17].

Baby complications:

(1) Operative trauma (cut to baby skin or fracture clavicle).

(2) Transient tachypnea and pulmonary hypertension.

(3) Low APGAR score (Appearance, Pulse, Grimace, Activity, and Respiration) and frequent admission to NICU (breathing problems).

(4) Risk of acquiring hospital-infection.

(5) Increased costs for neonatal care.

(6) Difficult foetal extraction leading to hypoxia, asphyxia, or foetal death.

(7) Delay initiation of natural feeding or failure of breast-feeding.

(7) Risk of childhood bronchial asthma, obesity, allergic rhinitis, type-I DM [20].

2. Aims of the Study (Objectives)

1) To measure the degree of awareness and knowledge about C-sections' complications among healthcare students in Jeddah City, Saudi Arabia.

2) To trace the effect of students' awareness and knowledge about C-sections' complications on their attitudes and decision-making towards the future mode of women's delivery.

3. Patients and Methods

3.1. Study Design and Setting

This is a prospective, cross-sectional, study planned to be conducted online (through a private invitation link sent to healthcare students (males and females) across ten different healthcare programs at the BMC to share "*anonymously*" on different platforms of social media commonly used in Saudi Arabia, like Facebook®, Messenger®, WhatsApp®, Twitter®, Instagram®, Telegram®, Snapchat®, and TickTok®)**,** aiming to reach a large number of students across different studying grades. The questionnaire was published for three months, from January 1st to March 31st, 2024, while the whole study was completed in a six-month period.

3.2. Proposed Study Questions

(1) What is the degree of awareness and knowledge among healthcare students at the Batterjee Medical College (BMC) in Jeddah City about Caesarean Section complications?

(2) Is there a significant correlation between students' background awareness and knowledge and their potential attitude and practice towards the mode of women's delivery? The null hypothesis (H0) assumes no correlation, while the real hypothesis (H1) adopts the existence of a correlation between the two variables.

3.3. Selecting and Excluding Criteria

Our selection criteria included any undergraduate healthcare student (male or female) from any of the BMC's ten health-related programs (preparatory year, general medicine practice, dentistry, pharmacy, physical therapy, nursing, occupational therapy, radiology sciences, respiratory therapy, and healthcare administration programs) from different studying grades who is still affiliated with the Batterjee Medical College (BMC). The recruited students, as they are living in different districts and villages related geographically to the city of Jeddah, epitomized the whole city.

The exclusion criteria included all undergraduate and postgraduate medical students (males and females) who are affiliated with other healthcare colleges, other than the Batterjee Medical College (BMC), either in the city of Jeddah or in any other city in Saudi Arabia or worldwide.

3.4. Sample Size Calculation

The minimal sample size required for a valid study of unknown population is 385

students, which can be calculated in two ways: online at www.*calculator.net,* and then confirmed by using the following mathematical equation, considering the level of confidence is 95% with an expected prevalence of 50% and precision of 0.05 (margin of error):

$$n = \frac{z^2 Xp(1-p)}{\varepsilon^2}$$

$$n = \frac{1.96^2 X\, 0.5(1-0.5)}{0.05^2} = 385$$

Where:

n: s the sample size.

z: s the z-score of 95% confidence level (1.96).

p: is the expected population proportion (50%).

ε: s the margin of error (5%).

Since our population was known as 3008 total students (registered in the 10 different healthcare programs at the BMC for the academic year 2023-2024), we used the following correction formula:

$$fn = \frac{P}{1+P/n}$$

$$fn = \frac{1551}{1+1551/384.16} = 341$$

Where:

n: minimal sample size.

fn: corrected sample size.

P: known population (3008 students).

Accordingly, we planned to recruit more participants to increase the statistical validity and reliability of the study. We received 512 valid answer sheets (the initial 10 students' responses were used for the questionnaire validation process). After the process of filtration, the final number of participants was **502**. With the current number of participating students, the margin of error became 3.99%.

3.5. Study Tools

The information was gathered through an online survey, and the co-authors used an electronic Google Form (Google LLC, Mountain View, California, United States) to record participant replies anonymously (https://forms.gle/ZJu395iFzoD5XoWHA).

There are four sections on the questionnaire. The first section (18 questions) covered the socio-demographic characteristics of the participating students, such as age, sex, income, education grade, and family income. Sources of information about CS complications were covered in Section two (4 questions). The third section entailed "true", "false", or "I don't know" answers (5 questions) about the students' awareness and knowledge of C-Section complications. When it comes to answering questions, the students who say "true" will get one point, and those who say "false or I don't know" will get zero. Students with a score of 0 - 1 will be

deemed to have an inadequate (*Poor*) understanding of C-section problems; while students with a score of 2 - 3 will be considered to have reasonable (*Fair*) knowledge. Students with scores of 4 - 5 will be believed to have comprehensive (*Good*) knowledge. The last section listed (10 questions) about the factors that may affect decision-making for future women's modes of delivery.

The questionnaire validation process has been completed by using a representative sample of 10 students, which is demonstrating satisfactory reliability (Pearson's correlation coefficient is 0.968) and validity (Cronbach's α coefficient is 0.85).

3.6. Data Analysis

The collected data were statistically analysed using Microsoft Office, Excel® version 2016 (64-bit edition), and the Statistical Package for Social Studies (SPSS®) version 26.0 (64-bit edition) created by IBM, in Chicago, IL, USA. The Pearson Chi-square test and Fisher's exact test were used for categorical variables, while the Student's t-test was used for continuous data variables. The significance cut-off is 0.05, and it was used as the *P*-value. The survey's results have been presented in graphs and by using numbers, percentages, mean values, and standard deviations (SD). The correlation between students' knowledge scores and their choice of mode of women's delivery was assessed by linear regression analysis.

3.7. Ethical Considerations

Approval obtained at the start of the study from the institutional research board (IRB) of the Batterjee Medical College, Jeddah, Saudi Arabia (Registration number for ethical permission: RES/2024/21). All procedures were consistent with ethical and scientific research committee standards and with the Helsinki Declaration of 1964 and its later modifications.

Informed consent was obtained from each student who agreed to participate "*freely*" in our study. Data were collected anonymously, and the confidentiality of participants' data is guaranteed. The collected data was kept safely as a soft copy, without sharing any, except if requested by the BMC research unit for verification. I, as the principal author, will not permit access, view, and/or alter any confidential information unless I have received authorization as required to complete my research.

4. Results

The current study's students were selected from ten different healthcare programs at the Batterjee Medical College (BMC) in Jeddah, Saudi Arabia. The total recruited students (males and females) were 502 students out of the total of 3008 already registered students in the BMC, a percentage of 16.69% (**Table 1**). The major recorded scholars were from the General Medicine Practice program, 172 out of 754 (22.81%), while the lower recorded students were 5.12% from the Res-

piratory Therapy program, 15 out of 293 (Figure 1).

Table 1. Participated students/healthcare program.

BMC Healthcare Programs	Registered Students			Participated Students	
	Males	Females	Total	Number	Percentage (%)
Preparatory Year	199	598	797	**168**	21.08
General Medicine Practice	227	527	754	**172**	22.81
Dentistry	60	122	182	**34**	18.68
Pharmacy	59	103	162	**26**	16.05
Physical Therapy	21	68	89	**12**	13.48
Nursing	131	307	438	**41**	09.36
Occupational Therapy	6	45	51	**11**	21.57
Radiology Sciences	37	114	151	**9**	05.96
Respiratory Therapy	58	235	293	**15**	05.12
Healthcare Administration	20	71	91	**14**	15.38
Total	818	2190	3008	**502**	16.69%

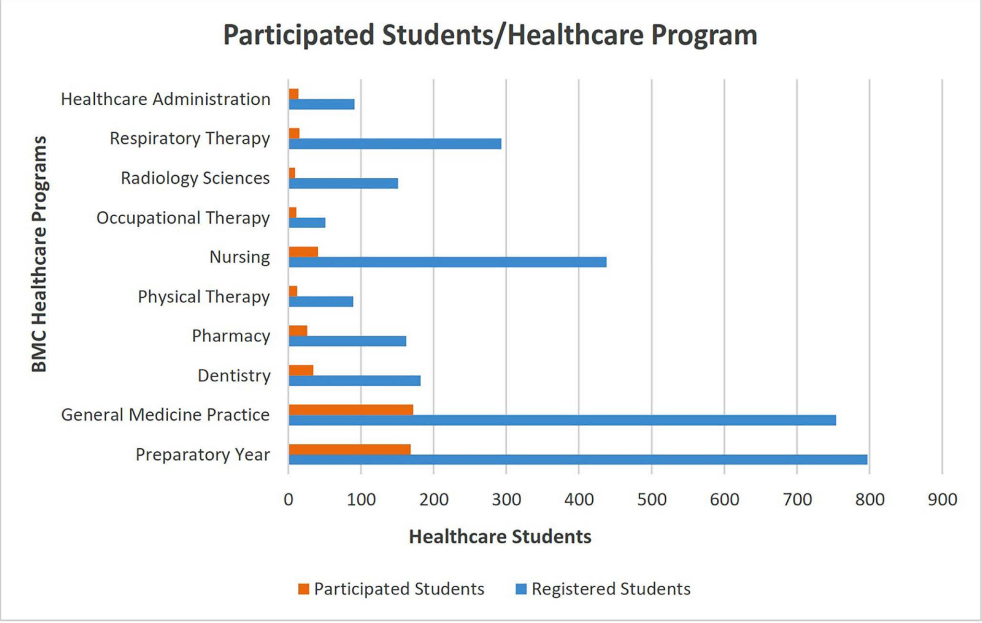

Figure 1. Participated students per each healthcare program at BMC.

Regarding the socio-demographic characteristics of the participating students (Table 2), we can see that the age ranged from 15 years old to more than 35 years old, with a predominance of the age group (from 20 to less than 25); 255 students out of 502 (50.8%). The shared female students were higher than male students (386 by a percentage of 76.89%, comparable to 116 by a percentage of 23.11%, respectively).

Table 2. Socio-demographic characteristics of participated students.

SN	Variables Sociodemographic Data		Frequency (N = 502)	Percentage (%)
Q1	Age (in years)	15 - < 20	165	32.87
		20 - < 25	255	50.80
		25 - < 30	50	09.96
		30 - < 35	18	03.59
		≥ 35	14	02.79
Q2	Gender (Sex)	Male	116	23.11
		Female	386	76.89
Q3	Nationality	Saudi	311	61.95
		Non-Saudi	191	38.05
Q4	Ethnicity	Arabic	367	73.11
		Asian	109	21.71
		African	13	02.59
		British	6	01.20
		American	7	01.39
Q5	Religion	Muslim	466	92.83
		Christian	10	01.99
		Others	26	05.18
Q6	College Program	Preparatory Year	168	33.47
		General Medicine Practice	172	34.26
		Dentistry	34	06.77
		Pharmacy	26	05.18
		Physical Therapy	12	02.39
		Nursing	41	08.17
		Occupational Therapy	11	02.19
		Radiology Sciences	9	01.79
		Respiratory Therapy	15	02.99
		Healthcare Administration	14	02.79
Q7	Studying Grade	The 1st	209	41.63
		The 2nd	77	15.34
		The 3rd	98	19.52
		The 4th	40	07.97
		The 5th	35	06.97
		The 6th	43	08.57
Q8	Parents' Education	Primary (G1 - 6)	81	16.14
		Intermediate (G7 - 9)	31	06.18
		High school (G10 - 12)	79	15.74
		University	212	42.23
		Postgraduate	99	19.72
Q9	Home Residence	City (Urban)	451	89.84

Continued

		Village (Rural)	**51**	10.16
Q10	Marital Status	Single	**432**	86.06
		Married	**61**	12.15
		Divorced	**7**	01.39
		Widowed	**2**	00.40
Q11	Duration of Marriage (in years)	None	**363**	72.31
		< 5	**75**	14.94
		5 - < 10	**19**	03.78
		10 - < 15	**17**	03.39
		15 - < 20	**11**	02.19
		≥ 20	**17**	03.39
Q12	Parity (for females)	None	**430**	85.66
		1-2	**38**	07.57
		3-4	**25**	04.98
		≥ 5	**9**	01.79
Q13	Mode of Delivery	None	**417**	83.07
		Vaginal	**48**	09.56
		Instrumental	**11**	02.19
		Caesarean Section	**26**	05.18
Q14	Working status	Student	**435**	86.65
		Graduate	**43**	08.57
		Employed	**24**	04.78
Q15	Monthly Income (in US Dollars)	< 4,000	**213**	42.43
		4,000 - < 6,000	**108**	21.51
		6,000 - < 8,000	**77**	15.34
		8,000 - < 10,000	**32**	06.37
		≥ 10,000	**72**	14.34
Q16	Special habits	Smoking	**44**	08.76
		Alcohol Drinking	**13**	02.59
		None	**445**	88.65
Q17	Chronic illness	Hypertension	**36**	07.17
		Diabetes Mellitus	**16**	03.19
		Thyroid disease	**17**	03.39
		Anaemia	**43**	08.57
		Bronchial Asthma	**18**	03.59
		Renal disease	**2**	00.40
		Others	**18**	03.59
		None	**352**	70.12
Q18	Health Insurance	Public/Governmental	**126**	25.10
		Private	**135**	26.89
		None	**241**	48.01

Concerning parents' education level, we can notice that most of the participating students' parents have a university grade (212 out of 502 with a percentage of 42.23%). On the other hand, parents' with an intermediate (grade-9) certificate were the minimum (31 out of 502 with a percentage of 6.18%).

The students who lived in the urban were 451 (89.84%) comparable to students who lived in nearby villages 51 (10.16%). In addition, we noticed that the majority of involved students in the current study were single; 432 out of 502 (86.06%). 59 married female students delivered by vaginal route, while 26 students delivered by C-section.

The majority of participating students (213 out of 502, 42.43%) have low family income (< 4,000.00 USD/month), while the minority of students (32 out of 502, 6.37%) have high family income (8,000.00: < 10,000.00 USD/month). For most of the involved students, there were no associated medical illnesses (352 out of 502, 70.12%) and no healthcare insurance (241 out of 502, 48.01%).

The main source of students' information about caesarean section operation (Table 3) was obtained from their medical study (144, 28.69%), without previous participation in neither labour awareness campaign (320, 63.75%) nor educational activity about CS operation (310, 61.75%), with a significant *P*-value < 0.00001.

Table 3. Information sources of participated students.

SN	Variables Sources of Information		Frequency (N = 502)	Percentage (%)	Chi-Square X^2	*Significance* *P*-value*
Q1	What is your source of information about CS operation?	Doctor/Nurse	**97**	19.32	55.12	< 0.00001*
		Medical study	**144**	28.69		
		Family member	**101**	20.12		
		Friends	**51**	10.16		
		Social media	**109**	21.71		
Q2	Did you participate in a labour awareness campaign before?	Yes	**182**	36.25	75.87	< 0.00001*
		No	**320**	63.75		
Q3	Did you attend any educational activity about CS operation?	Yes	**192**	38.25	55.47	< 0.00001*
		No	**310**	61.75		
Q4	Who do you prefer to lead CS awareness campaign?	University staff	**107**	21.31	116.99	< 0.00001*
		MOH doctors	**141**	28.09		
		Medical students	**84**	16.73		
		Para-medical personnel	**26**	04.98		
		Others	**144**	28.69		

*Statistical significance ($P < 0.05$).

Upon asking the participating students about possible C-section complications, including those related to anaesthesia, intra-operative complications, short- and long-term post-operative complications, as well as neonate risks (Table 4), their

awareness and knowledge were variable with statistical significance (*P*-value = 0.017978). According to our scoring system (Table 5), the majority of students (256, 50.99%) had inadequate (poor) knowledge, while the remaining were grouped with a reasonable (fair) level (124, 24.70%) and comprehensive (good) knowledge (122, 24.30%) (Figure 2).

Table 4. Awareness & knowledge about CS complications.

SN	Variables C-Section Complications	True Answer (N = 502)	Percentage (%)	Chi-Square X^2	*Significance* *P*-value*
Q1	Complications related to Anaesthesia	**276**	54.98		
Q2	Intra-operative complications	**228**	45.42		
Q3	Short-term post-operative complications	**269**	53.59	11.92	0.017978*
Q4	Long-term post-operative complications	**264**	52.59		
Q5	Baby complications	**247**	49.20		

*Statistical significance ($P < 0.05$).

Table 5. Knowledge Scoring for participated students.

Total Score	Score Interpretation	Frequency (N = 502)	Percentage (%)	Chi-Square X^2	*Significance* *P*-value*
0 - 1	Inadequate (Poor)	**256**	50.99		
2 – 3	Reasonable (Fair)	**124**	24.70	105.7291	< 0.00001*
4 – 5	Comprehensive (Good)	**122**	24.30		
	Total	**502**	100%		

*Statistical significance ($P < 0.05$).

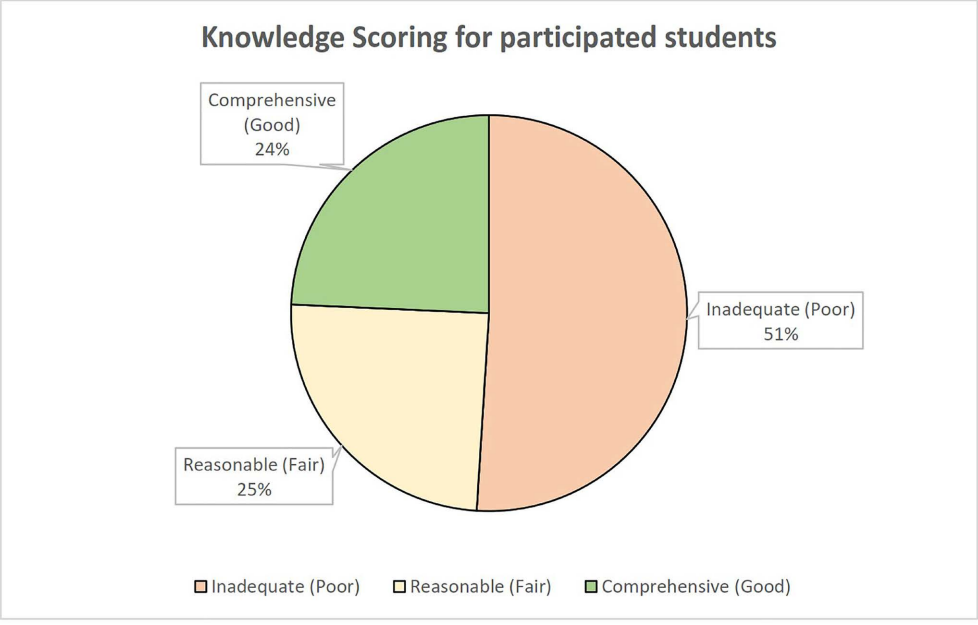

Figure 2. Knowledge scoring for participated students.

For assessment of students' attitude and practice (decision-making) in choosing the mode of women's delivery, we asked them about the factor(s) that influenced their decision to choose either vaginal delivery or operative C-section (Table 6). The students who preferred C-section were 282 (56.18%) comparable to those who advised vaginal delivery (220, 43.82%), with statistical significance (*P*-value is 0.00001).

Table 6. Students' attitude towards decision-making for future delivery.

Variables C-Section Complications		Yes Answer (N = 502)	Percentage (%)	Chi-Square X^2	*Significance* *P*-value*
Why do you prefer C-Section? Total = 282 (56.18)	1. Booking at convenient time.	**35**	06.97	15.3147 With Yates correction 14.8247	0.000091* 0.000118*
	2. No feeling of labour pains.	**56**	11.16		
	3. Avoid risk of urinary or faecal incontinence, and vertical transmission of infections.	**19**	03.78		
	4. Cost-free (health insurance).	**9**	01.79		
	5. Have a medical indication.	**26**	05.18		
	6. More safe for woman.	**62**	12.35		
	7. More safe for baby.	**30**	05.98		
	8. Previous bad experience of vaginal delivery.	**15**	02.99		
	9. Other causes.	**30**	05.98		
Why do you prefer vaginal delivery? Total = 220 (43.82)	1. No operative complications.	**60**	11.95		
	2. No wound pain for long time.	**49**	09.76		
	3. Short stay & rapid recovery.	**35**	06.97		
	4. Early bonding & breast-feeding.	**16**	03.19		
	5. No need for personal assistance	**20**	03.98		
	6. Low-cost (if no insurance).	**10**	01.99		
	7. Previous bad experience of C-Section delivery.	**10**	01.99		
	8. Enhance baby immunity.	**10**	01.99		
	9. Other causes.	**10**	01.99		

*Statistical significance ($P < 0.05$).

The correlation between students' knowledge and their attitude for choice the mode of delivery is shown (Table 7). To know which of our study's hypotheses is correct (H0 or H1), we used a scatter plot, where the x-axis represents the constant variables (Knowledge score) and the y-axis represents the dependable variables (choice of CS or VD). After calculation of the correlation coefficient (r) for both cases, we found that there is a strong negative linear correlation between students'

knowledge score and their choice of C-section (r = −0.96811) which means that with a higher score of knowledge, there is less choice of CS as a mode of delivery (Figure 3).

Table 7. Correlation between students' knowledge and their attitude.

Total Score	Score Interpretation	C-Section		Vaginal Delivery		Chi-Square X^2	*Significance* *P*-value*
		N	%	N	%		
0 - 1	Inadequate (Poor)	**180**	35.86	**76**	15.14	85.491	<0.00001*
2 – 3	Reasonable (Fair)	**81**	16.14	**43**	08.57		
4 – 5	Comprehensive (Good)	**26**	05.18	**96**	19.12		
	Total	**287** (57.17)		**215** (42.83)			

*Statistical significance ($P < 0.05$).

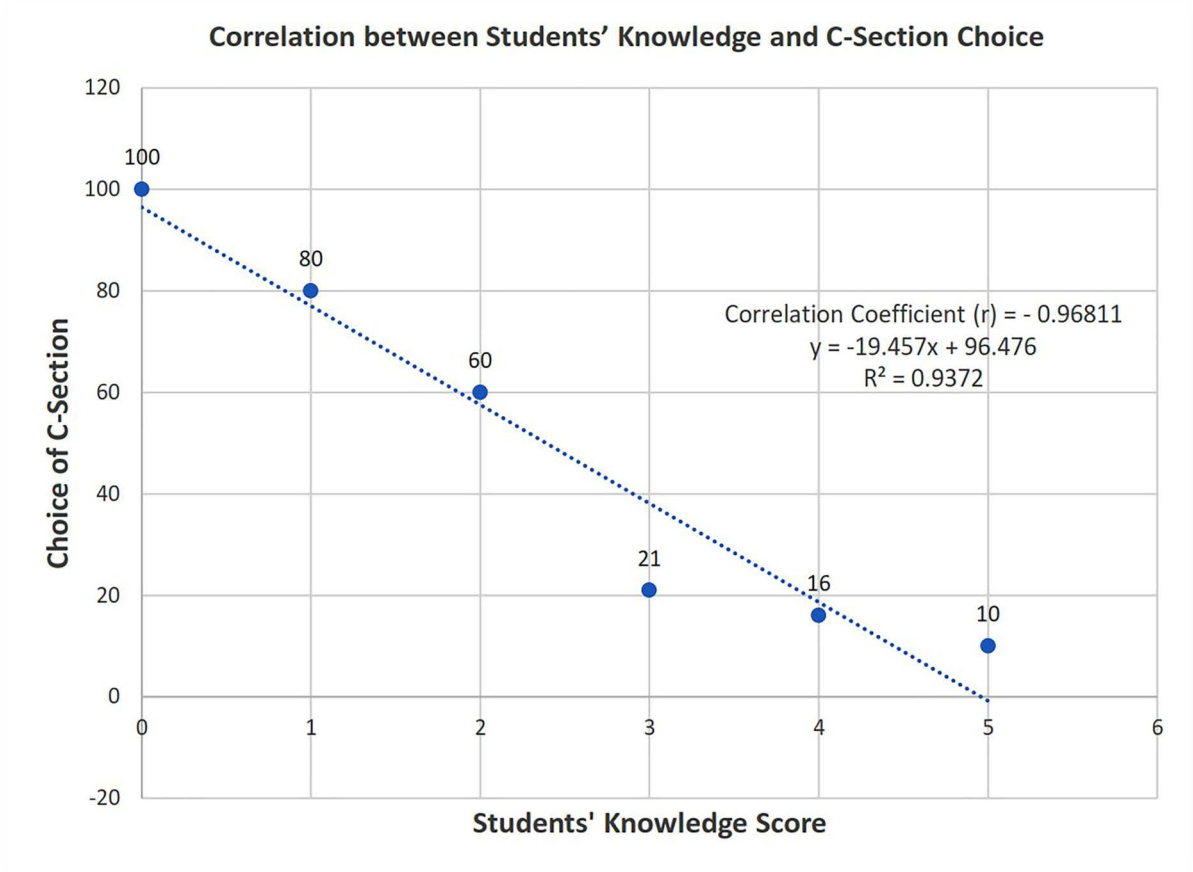

Figure 3. Correlation between students' knowledge and Cesarean Section choice.

On the other hand, there is a weak positive linear correlation between students' knowledge score and their choice of vaginal delivery (r = 0.43834) which means that with a higher score of knowledge, there is more choice of vaginal delivery as a mode of delivery (Figure 4). Accordingly, we can agree with the real hypothesis (H1).

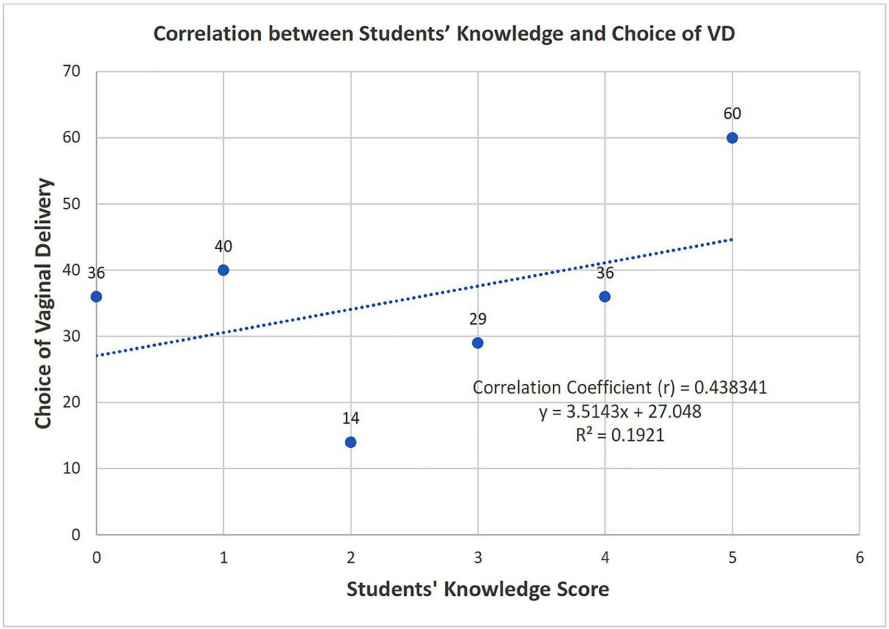

Figure 4. Correlation between students' knowledge and Vaginal Delivery choice.

5. Discussion

The Caesarean section has become a common surgical method for giving delivery in 21st-century obstetric practices [21].

The incidence of CS operations is increasing every day, passing far beyond WHO's recommended rate of not exceeding 15% for all deliveries. In Canada [17], the rate of caesarean births has increased from 5.2% in 1969 up to 25.6% in 2003. In European countries, it accounts for 25%, while in Germany, it is 31.7% and in America, it is 32.2% [20]. In China, the overall annual CS rate increased from 29% in 2008 to 40% in 2016 [23].

In the Middle East, the rate of CS in the United Arab Emirates was 33% in 2016 [7]. In Saudi Arabia, the CS rate was 27% in Riyadh, and 26.3% in Jeddah, in the year 2016 [15]. At Tanta University Hospital, Egypt, the rate of caesarean sections was 41% in 2013, 45% in 2014, and 46% in 2015 [8].

However, by strictly monitoring vaginal deliveries, enforcing tight standards regarding the request for CS, and establishing a legal framework for medical litigation, a number of European nations have been able to gradually reduce their rates of CS.

In a cross-sectional study carried out in Jeddah, Saudi Arabia, in year 2020, awareness and knowledge of CS complications have been evaluated among women during antenatal and postnatal periods. Most of the participating women had a poor knowledge score about CS complications [15]. Similar findings were reported in cross-sectional studies carried out at Kasr Al Ainy University Hospital, Cairo, Egypt, in 2020 [24], Baghdad teaching hospital, Iraq, in 2022 [25], in Riyadh City, Saudi Arabia, in 2023 [26], and in Baha City, Saudi Arabia in 2024 [27]. These findings were a strong drive for us to carry out this study to cover the

gap (between the poor knowledge of pregnant women and their choice of mode of delivery) indirectly through good preparation of healthcare providers.

In general, women's health education, improving pregnant women's knowledge and perceptions of CS and its possible complications are crucial for a good outcome, proper decision making, and managing any future medico-legal conditions [25].

In a Chinese study [28], attendance at a prenatal education course influences the mode of delivery and reduces the unnecessary caesarean section. In a Turkish study [29] aimed to evaluate the knowledge, attitude, and awareness levels among grade 4 female medical students about CS deliveries and vaginal deliveries and which type of delivery would be preferred in the future. The level of knowledge and awareness was found to be very low, generally. Up to our knowledge, no further research have studied the correlation between the level (score) of healthcare students and its impact on their future decision making for the mode of women's delivery.

According to the results of our study, there is a need for additional training programs during the internship. We also hope that this study will be able to contribute to the planning of some changes in educational content during the gynaecology and obstetrics clerkships and increase the effectiveness of the education programs.

To combat the growing epidemic of non-indicated Caesarean sections, a comprehensive strategy is essential. At the local and international levels, a variety of interventions focused on the root reasons for excessive use of caesarean sections ought to be developed and put into action [30].

6. Conclusion

The estimated degree of awareness and knowledge about C-sections' complications were different among male and female healthcare students, as well as varied across different healthcare programs. The background awareness and knowledge has a subsequent effect on the participating students' future choice of the woman's mode of delivery. High-scoring knowledge shows a strong negative linear correlation with choice of CS and a weak positive linear correlation with vaginal delivery.

6.1. Limitations of Previous Studies

Currently, there are many studies that measure the awareness and knowledge of pregnant women about the possible complications associated with Caesarean Section operations and their own choice of mode of delivery, but none (except the Turkish study [29]) evaluates such relationship among healthcare students.

6.2. Strengths of the Current Study

To the best of our knowledge, this novel research addresses the single most effective measure (awareness and knowledge of healthcare personnel about C-section

complications) that indirectly will reduce the high rate of non-medically indicated CS operations that has not been adequately studied previously in the whole of the Middle East.

Students of different healthcare programs frequently have the ability to make a difference in their communities through public health education in addition to their decision-making based on up-to-date evidence of the pros and cons of operative caesarean sections for their female partners, family members, and community.

6.3. Recommendations (Take-Home Messages)

(1) Although a caesarean section is safer than in the past, it is a major abdominal surgery and poses many extra harms for mothers and babies in comparison to vaginal birth.

(2) Proper counseling is the main factor that affects the woman's choice of mode of delivery. Healthcare professionals (frontline workers) such as doctors, nurses, and midwives should be well knowledgeable to inform pregnant women visiting antenatal clinics about indications and potential C-section complications.

Authors' Contributions

Remah M. Kamel: The main author of the study, participated in the idea and design of this study, statistical analysis, interpretation of data, writing of the manuscript, critical review, and submission for publication.

Raghad Aljuhani, Yousef Albog, Husna Irfan, and Faten Yaseen: All contributed by sharing the link to the survey questionnaire across different social media and collected the participants' responses and feedback.

Conflicts of Interest

The authors have no conflict of interest.

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