

FACTORS RELATED TO SURGICAL SITE INFECTION FOLLOWING CESAREAN SECTION IN A BAGHDAD'S WOMEN

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ABSTRACT

Background: Cesarean Section (CS) is one of the most commonly performed surgical procedures in an obstetrical and gynecological department. Surgical site infection (SSI) after a cesarean section increases maternal morbidity with prolongs hospital stay and increased medical costs. **Objective:** The aim of this study was to identify the associated factors with surgical site infection among cesarean section cases. **Methods and patients:** A prospective, descriptive study was conducted at Al-Krkh Hospital, Department of Obstetrics and Gynecology from first of January to 30th of Jun 2017, we selected convenient sample of 200 women who underwent a surgical procedure for delivery during the study period were included in the study. Data

were collected from the patient by direct interview with the participants using a structured questionnaire and examination of wound till discharge was done. Data Statistical analyses were done using SPSS. **Result:** Out of the 200 women involved, 23(11.5%) of them had SSI, which represents the incidence rate of SSI post-CS in our setting and 177 (88.5%) of them were non-infected wound. The mean age was 29 years and the most prevalent age was from 29-40 years (74%), the mean BMI of women was 27.20 and without any significantly associated between age women, BMI and SSI after cesarean section ($p=0.066$), ($P=0.509$). SSI was found to be common in women who had an emergency cesarean section ($p=0.005$), rupture of membrane before surgery ($p=0.020$), the women who had vertical skin incision ($p=0.001$) and subcuticular skin suturing ($p=0.001$) during surgery. **Conclusion:** The most

important factors that related to SSI after CS, were modifiable factors, would lead obstetricians to pay more attention during daily practice.

KEYWORDS: Cesarean Section (CS), surgical site infection (SSI).

1. INTRODUCTION

Caesarean section (CS): is a surgical procedure in which one or more incisions are made through anterior abdominal wall (laparotomy) and uterus (hysterotomy) to deliver one or more babies or rarely to deliver a dead fetus^[1] Cesarean section (CS) is one of the most commonly undertaken operations worldwide and accounts for up to 60% of deliveries in some countries, Million women who undergo this operation per year face substantially increased risks of maternal morbidity and mortality compared with women who deliver vaginally.^[2]

The global rate of caesarean section is not known, but, if it is 10%, 13 million cesarean sections are performed each year, equivalent to 24 each minute.^[3] so the incidence of re-laparotomy after caesarean section is 0.12–1.04% and the most common indications being intra-abdominal bleeding, intra-abdominal abscess or bladder and bowel complications.^[4]

Also caesarean section is the most important risk factor for postpartum sepsis, which may arise from a number of sources. Wound infection and endometritis are the commonest sites of postoperative infection and the risk of sepsis is, unsurprisingly, higher for emergency compared with elective caesarean section.^[5]

Skin incision type

General approaches to CD are (Pfannenstiel, Joel-Cohen)

- **Pfannenstiel skin incision** is slightly curved, two to three cm or two fingers above the symphysis pubis, with the midportion of the incision within the shaved area of the pubic hair.^[6]
- **Joel-Cohen incision** is straight, three cm below the line that joins the anterior superior iliac spines, slightly more cephalad than Pfannenstiel.^[7]

- **Uterine incision type**

- **Transverse incision**

We recommend using a transverse incision along the lower uterine segment (Monroe-Kerr or Kerr incision).

- Advantages of the transverse incision include less blood loss, less need for bladder dissection, easier reapproximation, and lower risk of rupture in subsequent pregnancies as compared with vertical incisions.^[2]
- The major disadvantage of the transverse incision is that significant lateral extension is not possible without risking laceration of major vessels. A —J| or inverted —T| extension is often required if a larger incision is needed.^[2]

- **Vertical incision**

There are two types of vertical incision, the low vertical (Kronig, De Lee, or Cornell) and the classical vertical.

- **The low vertical** is performed in the lower uterine segment and appears to be as strong as the low transverse incision.^[8]
- The major disadvantage of the low vertical incision is the possibility of extension cephalic into the uterine fundus or caudally into the bladder, cervix or vagina. It's also difficult to determine that the low vertical incision is truly low, as the separation between lower and upper uterine segment is easily identifiable clinically.^[9]
- **The classical incision** that extend into the upper uterine segment(fundus).This incision is rarely performed at or near term because in subsequent pregnancies its associated with higher frequency of uterine dehiscence (rupture).

- **Infections**^[10]

Once skin is injured, micro-organisms that are normally sequestered at the skin surface obtain access to the underlying tissues. The state of infection and replication standing of the microorganisms verify whether or not the wound is classed as having, colonization, local infection, Contamination and or spreading invasive infection.

- Contamination accrue in the presence of non-replicating organisms on a wound.

- Colonization is the presence of replicating microorganisms on the wound without tissue damage.
- Local critical colonization is an intermediate stage, with microorganism replication and the beginning of local tissue responses.^[10]

There are different levels of wound infections

- Superficial infection: the infection is in the skin area only.
- Deep infection: the infection goes deeper than the skin into the muscle and tissue.
- Organ/space: the infection is deep and involves the organ and space where you had surgery.^[11]

Criteria for diagnosing a superficial incisional SSI^[12]

• Superficial Incisional SSI

Infection occurs within 30 days after caesarean section and Infection involves only skin or subcutaneous tissue of the incision and at least one of the following.

1. Septic voidance, with or without laboratory confirmation, from the superficial incision.
2. Organisms isolated from associate degree aseptically obtained culture of fluid or tissue from the superficial incision.
3. A minimum of one in every of the subsequent signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture-negative.
4. Diagnosing of superficial incisional SSI by the physician or attending medical practitioner.

Criteria for diagnosing a deep incisional SSI^[13]

• Deep Incisional SSI

Infection occurs within 30 days after caesarean section and Infection involves deep soft tissues (e.g. Fascial and muscle layers) of the incision and a minimum of one in every of the following.

1. Purulent drainage from the deep incision by not from the organ/space component of the surgical site.
2. A deep incision spontaneously or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C), localized pain, or tenderness, unless site is culture negative.

3. Associate degree symptom or alternative proof of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosing of a deep incisional SSI by a physician or a attending medical practitioner.

Criteria for diagnosing an organ/space SSI^[14]

Organ/Space Incisional SSI: Infection occurs within 30 days after caesarean section and Infection involves any part of the anatomy (e.g. organs or spaces), other than the incision, which was opened or manipulated during the caesarean section and at least one of the following.

1. Septic voidance from a drain that's placed through a stab wound into the organ/space.
2. Organisms isolated from associate degree aseptically obtained culture of fluid or tissue within the organ/space.
3. Associate degree symptom or alternative proof of infection involving the organ/space that's found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4. Diagnosing of associate organ/space SSI by a physician or attending medical practitioner

Risk factors for C-section wound infection^[15,16,17]

Some ladies are more possible than others to induce a post-cesarean wound infection with more risk factors that can included

1. Obesity.
2. Diabetes mellitus.
3. Immunosuppressive disorder.
4. Chorioamnionitis (infection of the amniotic fluid and fetal membrane) during labor.
5. Taking long-term steroids (by mouth or intravenously).
6. Poor prenatal care (few visits to a doctor).
7. Previous cesarean deliveries.
8. Lack of cautionary antibiotics or pre-incision antimicrobial care.
9. Prolong labor or surgery.
10. Excessive blood loss during labor, delivery, or surgery.

According to a 2012 study revealed within the South African Medical Journal, women who receive nylon sutures after a cesarean delivery are also more likely to develop an infection.

Staple sutures can also be problematic. Sutures made up of polyglycolide (PGA) are preferred as a result of they're each absorbed and perishable.

Healing: Wound healing is a complex and dynamic process of replacing devitalized and missing cellular structures and tissue layers, highly dependent on the coordinated functions of soluble mediators, blood cells, extracellular matrix, and parenchymal cells.^[18]

Process of wound healing

Wound healing proceeds through four, but overlapping, phases, such as hemostasis, inflammation, proliferation (also known as replication and synthesis stage), and remodeling, four stages were created because of practical reasons.^[19]

- **Hemostasis phase:** The first stage of wound healing starts immediately after an injury appears. It begins with narrowing the damaged vessels, which is caused by the activity of vasoconstriction factors, such as serotonin, thromboxane A₂, or adrenaline being, on the other hand, connected with adhesion, aggregation, and platelets' activation in the damaged place.^[19]

- **Inflammatory phase:** Inflammatory part of the healing method develops throughout twenty four hours from the instant once associate injury occurred and lasts for up to forty eight hours on the average. This phase is accompanied by characteristic inflammatory symptoms, such as redness, body heat, swelling, and pain around the wounded place.^[20]

- **Proliferation phase:** During this point, the number of cells in the wound bed increases, which is connected with migration and proliferation of fibroblasts and endothelial cells as well as keratinocytes. The proliferation phase is connected with the activity of fibroblasts which, in the presence of newly formed blood vessels, proliferate and synthesize Extracellular matrix (ECM) components. Endothelial cells proliferate and migrate above the granulation tissue-closing the wound surface.^[21]

- **Remodeling phase:** Remodeling is that the last part of the healing method. In its course, the wound surface is contracted. The key phenomenon of wound contracture is phenotypic differentiation of the preexisting fibroblasts into myofibroblasts.^[22]

Elements of Wound Healing: Platelets: Platelets play a critical role in wound healing, actively promoting cell recruitment, tissue regeneration and matrix remodeling, angiogenesis and blood vessel maturation.^[23]

- **Neutrophils:** Neutrophils are the first inflammatory cells which appear in the wound area. These cells create the first line of defense against infections phagocytosing and killing the bacteria by generating reactive oxygen and nitrogen species and digesting, by released proteases (elastase, collagenase, and cathepsin G) the damaged, during the injury, connective tissue components.^[24]

- **Thrombin:** Thrombin is the protease involved in blood coagulation. Its deregulation can lead to hemostatic abnormalities, which range from subtle subclinical to serious life-threatening coagulopathies, i.e., during septicemia.^[25]

- **Macrophages:** Macrophages are cells of a great importance for the process of healing, macrophages play a double role in the healing process. On one hand, they participate in phagocytosis and process of killing bacteria or removing debris, by secreting matrix metalloproteinase.^[23]

- **Collagen:** Collagen is a protein, accounting about 30% of the total protein in the human body. In normal tissues, collagen provides strength, integrity and structure.^[25]

- **Fibroblasts and keratinocytes:** Fibroblasts and keratinocytes are two of the major cell types that respond to the inflammatory phase in the cutaneous repair/regeneration process.^[20]

Factors Affecting Wound Healing: Multiple factors can lead to impaired wound healing. In general terms, the factors that influence repair can be categorized into local and systemic. Local factors are those that directly influence the characteristics of the wound itself, while systemic factors are the overall health or disease state of the individual that affect his or her ability to heal. Many of these factors are related, and the systemic factors act through the local effects affecting wound healing.

Prevent wound infection in C-section^[26,27]

- Most follow the instructions of wound care and postoperative medication directions given by your doctor or nurse. And avoid skin folds that cover the incision area.

- Prophylactic antibiotics to prevent an infection, don't skip doses or stop using them until you have finished the entire course of treatment.
- Wound cleaning and change the dressings regularly.
- Check temperature regularly and inspection for incision sites that contain pus, swell, or tenderness, or show redness on the skin that spreads from the incision site.
- Maintain a healthy weight and avoid pregnancy with an obese body mass index.

2. Aim of study: identified factors that associated with surgical site infection after cesarean section.

3. METHODOLOGY

3.1 Study design: A Prospective descriptive study.

3.2 Study setting: The study was conducted in Baghdad Governorate which is the capital of the Republic of Iraq, with a total area of 204.2 square kilometers.

The city is located in the heart of Iraq on a vast plain bisected by the Tigris river into two halves; with the eastern half being called 'Risafa' and the Western half known as 'Karkh' (Appendix 1).

Al-Karkh health directorate in (Al-karkh side of Baghdad) had seven hospitals distributed according to the geographical location and population divisions in the region. Each hospital has department of obstetrics and gynecology. The study was conducted at one hospital were selected by using a random sampling technique, which were in center of city; called alkarkh obstetric hospital.

3.3. Time Data Collection: The study was carried out during the period from first of January to 30th of Jun 2017.

3.4. Study population: pregnant women within selected criteria.

1. Inclusion criteria

- 1- Aged 18 -40 years as identified from card.
- 2- All pregnant women who had labor pain for delivery with induced CS.
- 3- All gestational ages were determined by first day of the last menstrual period and confirmed with an ultrasound.

- 4- Full-term pregnancy :(37—42 wks.)
- 5- Primigravida and multigravida were included with natural pregnancy.
- 6- Pregnant women with indicated or elective cesarean section.

2.2 Exclusion Criteria

- 1- Pregnant women with a chromosomal or anatomic abnormality, luteal phase defect, known cardiac disease, renal dysfunction, confirmed peptic ulcer, SLE, kidney stones, rheumatoid arthritis diabetes mellitus, abnormal results of an oral glucose tolerance test, previous thromboembolism, known malignancy, malabsorption syndrome, sensitivity to aspirin, hypertension or current treatment with antihypertensive drugs, previous prednisone therapy, an abnormal chest radiographic result, or a positive result of a tuberculin skin test.
- 2- Spontaneous vaginal delivery.
- 3- Premature rupture membrane: before the onset of labor.
- 4- Preterm labor: labor at <37 weeks of gestation.
- 5- Post term labor: labor at >42wks of gestation.
- 6- Still birth (intrauterine death at or after 28 weeks of gestation).
- 7- -teenage mother with twin baby.

3.5 Sample Size: 1. The minimum sample size for the study was calculated using the Epi-Info statistical software. Sample size is based on the following assumptions: the overall satisfaction is 50%, the confidence level at 95%, the power of the study to be taken at the high level of 80% for more precision and the P value of equal or < 0.05 as a cut point for significance. This gave an estimated sample size of 178 women, which was approximated to 200 women. An extra 10% of the estimated sample size was added for incomplete or unreliable answers and to reduce sample bias, giving a final sample size of 200 pregnant women, selected as convenience sample.

3.6 Sampling Method: A multistage sampling technique will be adopted starting with the 3 hospitals in alkarkh side of Baghdad city as a first stage, we will choose (2 in the city center and 1 in the rural areas). In the second stage and by using a simple random sampling, we will select 1 hospitals from each of the 3 hospitals to ensure a representative sample.

3.7 Tools of the study: Two modified forms of questionnaire that draw from WHO/MOH. Exit interview questionnaire by using an Arabic language consist of two components, one of a socio-demographic characteristics, and the other component of maternal measuring.

Time Data Collection: The study was carried out during the period from first of March to end of Jun, 2018.

Data Collection: This study will be carried out by direct interview with the participants using a structured questionnaire. A structured questionnaire is developed to collect information from the pregnant women or accompanier. The subtending was conducted by the researcher. Some information of maternal factors and certain other information was obtained from the records, while other information was obtained from the participant.

Data Collection Tool

1- Questionnaire: A structured questionnaire is the base for data collection developed by the researcher and reviewed by the supervisor and it is consisting of; The demographic information includes: code NO., gender, birthday, weight, height and BMI, age of women in pregnancy and Parity was considered as number of gestations resulting in live birth or still birth.

Maternal characteristics such as education was coded as not education and, or primary or secondary education and high education, types of CS, mother occupation, maternal smoking during pregnancy, weight pre- pregnancy, and family history of diabetes mellitus (DM)/hypertension, history of abortion and presence of gestational diabetes mellitus were obtained from the pregnancy chart.

Wound observation was done for the development of SSI (surgical site infection) on third, fifth post-operative day and on the day of discharge. All the suspected surgical sites were evaluated irrespective of the day of operation.

2. Categorization of surgical site infection for this study

Superficial surgical site infection - infection involves only skin or subcutaneous tissue which is treated by dressing and antibiotics.

Deep incisional SSI - infection involves deep soft tissue (e.g. fascial and muscle layers) or presence of wound dehiscence which requires secondary suturing.

Organ/space SSI - infection involves any part of the anatomy (e.g. organs or spaces), other than the incision, which was opened or manipulated during an operation which required exploration and closing.

2. Anthropometric measurements

1. Weight: taken by a sensitive digital UNICEF Scale, with the patients wearing the lightest possible clothes results were taken to the nearest 0.1 kg.
2. Height: will be measured by using a measuring without shoes, results were taken to the nearest 0.1 cm.
3. Body mass index (BMI) percentile, was determined using the 2000Centers for Disease Control and Prevention (CDC). BMI is a ratio between height and weight and is calculated by dividing weight in kg by height² in m² (BMI = kg/m²).

3.8 Operational definition

- **Age:** The age of each pregnant is taken from the family card in the primary health care centers or from parents, calculated in months.
- **Sex:** The state of being male or female.
- **Parity:** The number of births that a woman has had after 20 weeks' gestation.
- **Primipara:** A woman who has given birth to one child or who is giving birth for the first time.
- **Multigravida:** A woman who has been pregnant more than one time.¹¹⁶
- **Gravidity:** Describes the total number of confirmed pregnancies that a woman has had, regardless of the outcome.

3.9 STATISTICAL ANALYSIS

Data was translated into a computerized database structure. Statistical analyses was done using SPSS (Statistical Package for Social Sciences). Version 20 computer software for windows. Categorical variables were presented as frequency and percentage, Chi-square was used to test the significance of the association between categorical variables. with considered P. Value of ≤ 0.05 was statistically significant.

3.10 Ethical consideration

1. Agreement of MOH-Iraq, and Baghdad Al Karkh directorate of health.
2. The collection of data was kept confidential and not be divulged except for the purpose of the study.
3. The Participant's agreement will be considered and they will be informed that the participation is voluntary and they can withdraw from the study after having agreed to participate.

RESULT

The total sample of current study was 200 women underwent CS. The mean age was 29 years and the most prevalent age was from 29-40 years (74%) as show in figure 1. Out of 200 women involved, 23(11.5%) of them had SSI, which represents the incidence rate of SSI post CS in our setting and 177 (88.5%) of them were non infected wound (figure 2, table 1). the demographic characteristics of study sample were 24.5% Ladies whom within aged 18- 28 years old and 73.5% were in age 29-40 while they lowest proportion were at aged >40 years old (2%). Regarding to education level the study founded highest prevalence were in secondary level (27.5%) while 22.5% women were illiterate. Also the highest prevalence of study sample were non employed women 109 (54.5%) but the employed women were 91 (45.5%) and finally very small percent of smoker women were found in our sample compares to nonsmoker women as (2% and 98% respectively). Table 2.

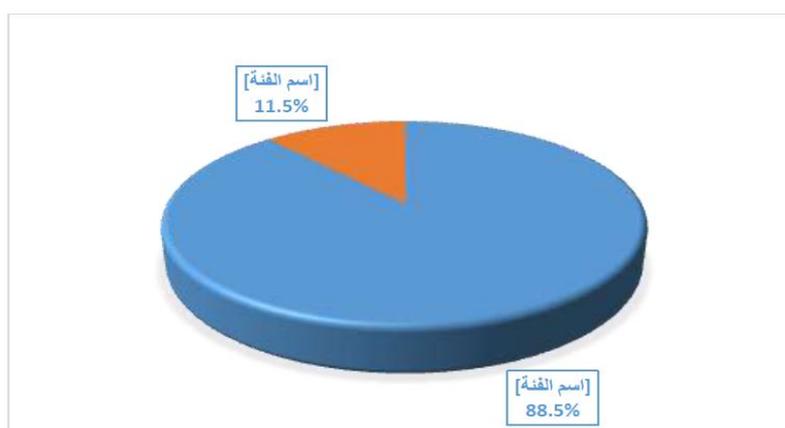


Figure 1: distribution of study sample according to age. N=200.

Table 1: Distribution of study sample according to Sociodemographic. N=200.

Age at delivery		Frequency	Percent
	18-29	49	24.5
	29-40	147	73.5
	>40	4	2.0
	Total	200	100.0
women Education		Frequency	Percent
	0	45	22.5
	primary	51	25.5
	secondary	55	27.5
	university	49	24.5
	Total	200	100.0
Smoker women		Frequency	Percent
	non smoke	196	98.00
	smoke	4	2.00

	Total	200	100.0
Employed women		Frequency	Percent
	no	109	54.5
	yes	91	45.5
	Total	200	100.0

The result of current study showed in table (2) and table (3) the frequency of obstetric characteristic and surgery site infection factors. In table (2) founded 117(58.5%) were one parity women and 83(41.5%) were tow parity women, while the women that have antenatal care in study sample were 178(89%) and 11% that don't have any antenatal care. Regarding to type of cesarean section, the result showed more prevalence among delivered women by emergency cesarean section 164(78%) while the women have elective cesarean section were 30 (18%) as show in figure (3).also the women that have rapture membrane were 140(70%) and 60(30%) were don't have rapture membrane before caesarian section.

In table (3) show the factors related to surgery site of infection, regarding to types of skin incision, (96%) were vertical incision and 8 (4%) were have horizontal incision. While the types of skin suturing the result show 12 (6 %) were interrupted suture and 188(94%) were subcuticular suturing.

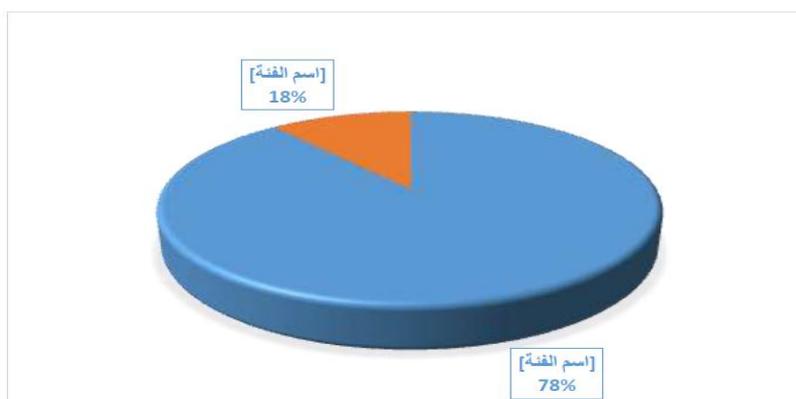


Figure 3: distribution of study sample according to types of CS. N=200.

Table 1: Distribution of study sample according to obstetric factors. N=200.

Parity		Frequency	Percent
	1	117	58.5
	2	83	41.5
	Total	200	100.0
ANC		Frequency	Percent
	yes	175	89.0
	no	25	11.0
	Total	200	100.0

Type CS		Frequency	Percent
	Emergency	164	78.0
	elective	30	18.0
	Total	200	100.0
Rupture of membranes		Frequency	Percent
yes		140	70.0
no		60	30.0
Total		200	100.0

Table 1: Distribution of study sample according to SSI factors. N=200.

Types of incision (skin)		Frequency	Percent
	vertical	8	4.00
	horizontal	192	96.0
	Total	200	100.0
Types of suturing (skin)		Frequency	Percent
	Interrupted	12	6.00
	Subcuticular	188	94.0
	Total	200	100.0

Concerning maternal BMI, it was found the mean BMI of women was 27.20 with SD= 5.089 without any significantly associated between overweight and obese women and increase the site of infection after cesarean section ($p=0.066$) table 4.

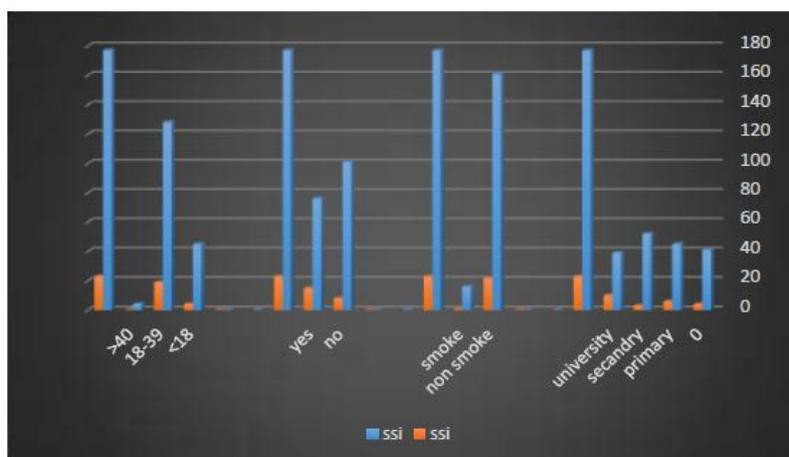
Table 4: Relation between women BMI and SSI. N=200.

		N	Mean	Std. Deviation
Women BMI	non infected	177	26.96319	5.06265
	infected	23	29.03518	5.025713
T test =0.809		p= 0.066		

Regarding to relation between sociodemographic factors and SSI. The study showed there are not any significant association between education level of women and infection of site of operation ($p=0.107$). also smoker women that have infected wound were one cases and without significant association with surgery site infection in study sample ($p=0.39$). while the employed women the study founded the infected wound in site of surgery double among employed women than non-employed women with significant association between them ($p=0.036$). But regarding to age of women the result don't show any significant association with SSI ($p=0.509$). Table 5.

Table 5: relation between sociodemographic characteristic and SSI. N=200.

		non infected	infected	p-value
Mother Education	0	41	4	0.107 df=3
	primary	45	6	
	secondary	52	3	
	university	39	10	
Total		177	23	
		non infected	infected	p-value
Smoker mother	non smoke	175	23	0.39
	smoke	2	0	df=1
Total		177	23	F*
		non infected	infected	
Employed mother	No	101	8	0.036 df=1
	Yes	76	15	
Total		177	23	
		non infected	infected	
Age at delivery	<18	45	4	0.509 df=2
	18-39	128	19	
	>40	4	0	
Total		177	23	

**Figure 4: Distribution of study sample according to sociodemographic characteristic and SSI. N=200.**

In a comparison of obstetric characteristics between the study groups; we founded parity and antenatal care were not significant associated with their site infection of surgery ($p=0.532$, $p=0.067$ respectively). Also there weren't significantly association founded between rupture membrane and infection wound after operation ($p=0.02$). While there were significantly association founded between wound infection and types of cesarean section (emergency or elective) $p=0.005$. Table 6 and figure 5.

Table 6: distribution of study sample according to obstetric characteristic and SSI. N=200.

		SSI	
		non infected	infected
Parity	1	105	12
	2	72	11
Total		177	23
Pearson Chi-Square 0.428, DF= 1, P= 0.532			
		SSI	
		non infected	infected
ANC	yes	162	13
	no	15	10
Total		177	23
Pearson Chi-Square 10.243, DF= 1, P= 0.067			
		SSI	
		non infected	infected
Type CS	emergency	150	14
	elective	27	9
Total		177	23
Pearson Chi-Square 7.862, DF= 1, P= 0.005			
		SSI	
		non infected	infected
Rupture of membranes	yes	120	20
	no	57	3
Total		177	23
Pearson Chi-Square 1.160, DF= 1, P= 0.02			

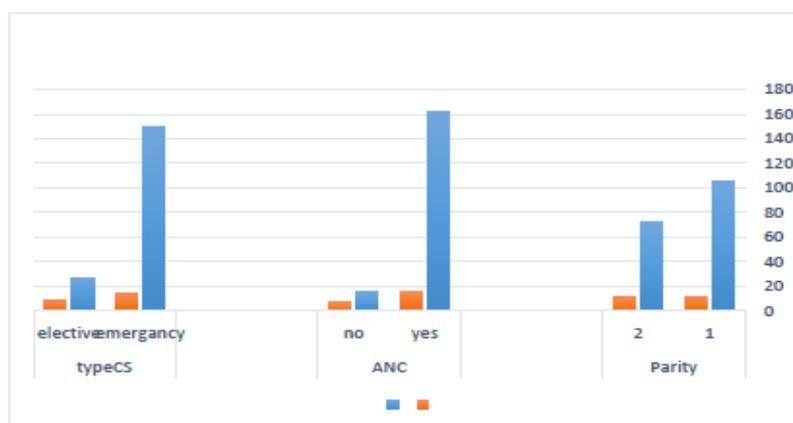


Figure 5: Distribution of study sample according to obstetrics characteristic and SSI. N=200.

On other hand the current study showed the relationship between the wound characteristic and surgical site infection, we founded the women who had vertical incision more infected wound after surgery from the women who had horizontal incision with significant association with surgical site infection (p=0.001). As shown in table (7). And figure (8).

Regarding to wound suturing, the results showed the women who had Subcuticular suturing were more infected wound than women who elective emergency no yes 2 1 typeCS ANC Parity suturing the wound by interrupted method with significant association between them ($p=0.001$). as shown in in table (7). And figure (9).

Table 7: Distribution of study sample according to wound characteristic and SSI. N=200.

		non infected	infected	Total
Types of incision (skin)	vertical	1	7	8
	horizontal	176	16	192
Total		177	23	200
Pearson Chi-Square 47.294, DF= 1, P= 0.001				
		non infected	infected	Total
Types of suturing (skin)	Interrupted	5	7	12
	Subcuticular	172	16	188
Total		177	23	200
Pearson Chi-Square 27.512, DF= 1, P= 0.001				

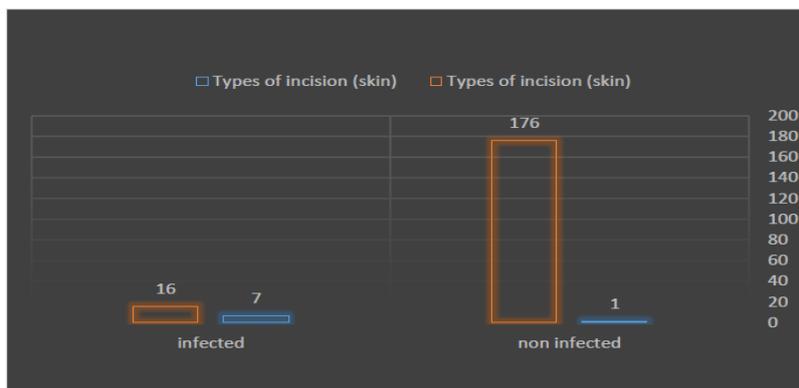


Figure 8: Distribution of study sample according to types of incision and SSI. N=200.

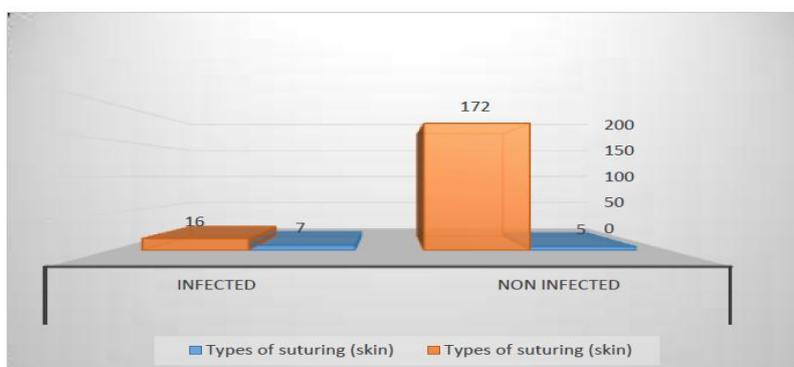


Figure 9: Distribution of study sample according to types of wound suturing and SSI. N=200.

DISCUSSION

Cesarean section (CS) is one of the commonest and most famous surgeries in obstetrics. Surgical site infections (SSI) rise maternal morbidity, elongate hospital admission, and have a direct effect on healthcare cost. Usually most data and articles come from modern world, with high quality medical services and an effective health system.^[28]

Surgical site infection following caesarean section found high rates in this study, which comprises 11.5%. Comparing to other studies conducted in different parts of the world, this result it is similar to study conducted in Iraq 2014.^[29] but the surgical site infection following CS was found to be lower in other studies: Oman study 66%,^[30] US 5%, 29 Norway 8.3%,^[31] and UK 9.6%.³² also were Similar rates founded in other studies conducted in UK 11.2% and Ethiopia 11.4%.^[33] However, higher rate (16%) was found in studies conducted in US and India (24.2%) before intervention.^[34]

In a retrospective study done in Patan hospital in Nepal, the surgical site infection rate was found to be only 2.7% which is lower compared to this study. However, another study conducted in Chitwan showed wound complications rate for the entire cohort was found 15.2%.^[35,36] The possible explanation of these differences might be related to variations in study setting and sample constitution. In addition to wide different in health system developing between the region, in Iraq the infection prevention and control program very weak and increase nosocomial infection. Also the war on Iraq in the previous time, added regarding patients whom internally moved due to terrorism after caused by appearance of what was called [Islamic State in Iraq and Syria (ISIS)].

Developing SSI after cesarean-section have multiple risk factors and has been influence to result of study. Sociodemographic characteristic of study sample in current study were revealing the age of women, smoking women and education level, all these factors don't have any correlation to surgery site infection after cesarean section. this result similar to case control study conducted in Baghdad 2015.^[37] and another descriptive study in Kurdistan al-Iraq 2014.^[29]

Regarding to obstetric factors that related to cesarean section outcome and Variable risk factors of post cesarean section surgical site infection were investigated within this study, revealing the following factors.

In the present study parity was a obstetric factor that statically not significant with increase the risk of wound infection after cesarean section ($p=0.532$), this result similar to study conducted in Iraq³⁷ ($p=0.874$), in Brussels, Belgium 2014.³⁸ and another study conducted in Nigeria 12 ($p=0.450$, $p=0.642$ respectively).

Regarding to antenatal care, the result of study founded no any significant association between women who had never attended ANC clinic throughout pregnancy and infection site of surgery, this result similar to study conducted in Iraq.^[29]

While the types of cesarean section were statically significant with SSI, The ratio of elective and emergency surgery rate in this study observed was 1:5. So, more incidence of SSI was observed in those who had undergone emergency CS (61%) compared to elective CS (39%) and was statistically significant ($p=0.005$). this result was similar to study conducted in India also revealed that Emergency caesarean section predisposes more to SSI as compared to elective (80.16%).^[29] Similar findings were identified in a study conducted in Ethiopia where emergency surgery had two times increased risk of surgical site infection (11.9% vs 5.4%) than elective cases.^[33] This finding could be attributable to the fact that in emergency cases membrane rupture and multiple vaginal examinations are frequent.

There is also increased risk of bacterial contamination or breaks in sterile technique or lack of timely antibiotic prophylaxis. But another studies disagreement with our result, it found Type of CS (either emergency or elective) was not a significant risk factor of SSI.^[39,40] The possible explanation of these differences might be related to variations in study setting and sample constitution.

The relation between rupture of the membranes and infection wound after cesarean section also showed statistically significant risk for surgical site infection ($P=0.02$). This result agreement with study conducted in Oman that revealed four-fold increased risk in the rate of wound infection among patient after operation.² also another case control study conducted in Baghdad founded increase risk of SSI with rupture membrane.^[37]

Rapture membrane lead to increase chance of the amniotic fluid infected. It is thought that the non-sterile amniotic fluid may act as a transport medium by which bacteria come into contact with the uterine and skin incision leading to chorioamnionitis and its sequelae.

Overweight and obesity is consider risk factors of multiple disease like heart disease and diabetic mellitus, also increase body weight causes more fat accumulation in skin and vessels, in our study showed the women who had overweight and obesity more among the patients that have infected wound in site of surgery from the women that non-infected but without any significant association ($p=0.066$).this result similar to study conducted in USA^[41], but in another study postulated BMI increase the risk of wound complications after Cesarean delivery due to physical characteristics (increased tissue trauma, increased wound length, increased tension on the wound) as well as biological characteristics (decreased vascularity and oxygenation of adipose tissue, decreased penetration of prophylactic antibiotics). this result disagreement to another study conducted in Iraq^[37], the possible causes of this different might be attributed to different of study sample and study design.

In current study increased rate of surgical site infection was observed in women with vertical incision than those with horizontal incision which was statistically significant ($p=0.001$). This result similar to study conducted in Baghdad ($p=0.001$).^[37] and another a study conducted in India, vertical incision of skin had been found to be a risk factor for developing SSI.^[34] but this result disagreement with case control study conducted in brazil.^[42] The possible explanation of Infection is transverse incisions are made in the lower part of the abdomen, near the pubis, which naturally forms a skin fold. This, in turn, can accumulate moisture, secretions and dirt, which could increase the chances of an SSI.

A vertical incision of CS was mentioned by many papers to increase the risk of SSI and may lead to formation of a hematoma due to less vascular tissues, while a transverse incision was associated with less wound dehiscence.^[43]

Based hospital Study conducted in USA found a greater incidence of wound complications in women with vertical skin incisions those with transverse incision.^[44]

Suturing techniques played an important role in SSI development after CS, subcuticular suturing was a good predictor of SSI, when compared to an interrupted technique which had lower infection events. In current study, the SSI was also found to be significantly higher ($P<0.001$) in those where subcuticular suturing than women who had intracutaneous suture.

This result similar to study conducted in Iraq.^[37] also another study conducted in UK revealed the lowest SSI rate in patients where a continuous suture had been used; 1.3% in 2009, to

6.7% in 2010 and 10.7% in 2011.^[45] but another study conducted in Iraq^[29] disagreement with our result, interrupted technique more surgical site infection than women with subcuticular suturing. The possible causes of this different might be attributed to different of study sample and study design.

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