Assessment of Surgical Site Infections from Signs & Symptoms of the Wound and Associated Factors in Public Hospitals of Hodeidah City, Yemen

Abdulsalam M. A. Nasser*, Prof. Xinping Zhang, Lianping Yang, Fares J. Sawafta, Bassam Salah,

Abdulsalam M.A.Nasser.
Master Degree
Department of Social Medicine and Health Management
Tongji Medical Collage-
Huazhong University of Science and Technology
13 Hang Kong Road, Wuhan, P.R. China

Prof. Dr. Xinping Zhang
Department of Social Medicine and Health Management
Tongji Medical Collage
Huazhong University of Science and Technology
13 Hang Kong Road, Wuhan, P.R. China

Abstract

The objective of this paper is to assess surgical site infections (SSI's) from signs &symptoms of the wound and associated factors in public hospitals of Hodeidah City, Yemen. This paper was conducted using cross-sectional analyses. A sample of 300 cases of patients was randomly selected. A structured questionnaire was prepared to collect data from patients. SPSS was employed to analyze data and univariate and multiple logistic regressions to reflect the socio-demographic characteristics of the cases and factors associated with (SSI's). The paper revealed that (34%) of the patients suffered from infection, and (66%) did not suffered from infection. The binary logistic regression showed that "age", "other diseases", "Problems with the healing of the wound" and "discharge from wound"(P=0.0006, P=0.0066, P<.0001, P<.0001 respectively) were associated with (SSI's). The paper also revealed that (SSI's) are widely spread in public hospitals especially in surgical wards and a number of existing associated factors.

Keywords: Surgical site infection, signs &symptoms, associated factors

Introduction

(SSI's) still form of a large health problem even in the developed countries, it contributes substantially to patient morbidity, mortality, prolonged hospitalization and therapy. (SSI's) are the 2nd most common hospital acquired infections, accounting for 16% of nosocomial infections (Doebbing, 1992) and they prolong hospitalization from 1 to 16 days (Forrester, 1995).

The estimated average cost of each SSI in USA is $2, 739 (Jarvis, 1996). In developing countries, like the Republic of Yemen, the importance of preventing nosocomial infections is more evident and very vital due to limited economic resources. Rates of (SSI's) vary from country to country. In the Republic of Yemen the rate of SSI was 7.6% in clean wound infection without prophylactic antibiotics (Noman et al., 2001). In the USA infection rates, with pre-operative antibiotics, ranged from 0.8%- 1.3% and 10.2% for clean, clean contaminated and contaminated wound (Doebbing., 1992), whereas in Britain the SSI's rates were 1.3%-3.9% in clean, 3%-4% in clean contaminated, 8.5% in contaminated and 28%-40% in dirty operations (Forrester, 1995). In Poland, a case control study of 1,527 surgically treated patients, revealed wound infection rate of 8.9% (Anielski et al., 1998).

In a study of (SSI's) rate in the obstetrics and gynecology in the USA, revealed that 24 infections (5.2%) were detected out of 469 surgical procedures (Gravel et al., 1995). In a prevalence study, in Italy, 79 (1.61%) nosocomial wound infections were recorded among 4983 operated patients (Wischnewski et al., 1998).

In Australia, 138 wound infections were diagnosed (incidence10.1%) of which less than one 3rd were before discharge and the remainder after discharge (Mitchell et al., 1999). The current study, is generally aimed at estimating the incidence of (SSI's) and it's relation to factors such as patient, operation and hospital and specifically, to determine the incidence of SSI's in clean or not clean, and to identify the infected wounds of the signs and symptoms associated with wound and nursing practice.

Material and Methods

Enrolment of Subjects

The study was conducted using cross-sectional study in July 2012. 300 patients were selected from two public hospitals of Hodeida city (Al-Thawra General Hospital and Al-Ulafi Hospital) during the period 1st of July, 2012 through the 30th of September 2012 by random sampling method.

A structured questionnaire was prepared to collect data and the questionnaire was first prepared in English language and then translated to Arabic language. The following information were designed to collect from patients: medical history, gender, age, education status, socioeconomic status, profession, previous surgery, other diseases and signs and symptoms of post-surgical infection by the questionnaire.

Statistical Analysis

The Statistical Package for Social Sciences (SPSS) version 12 was used to analyze data. The univariate and multiple logistic regressions were used to reflect the demographic characteristics of the cases and factors associated with (SSI's).

Results

The level of Surgical Site Infections

The results showed that 102 (34.00%) suffered from (SSI's) and the rest 198 (66.00%) did not suffered from (SSI's) among the 300 patients as shown in Figure1 & Table 1.

The single factor analysis associated with SSI's showed that the socio-demographic characteristics of the cases either suffering or not suffering from (SSI's). The Chi-square test of socio-demographic characteristics of the cases revealed that sex (χ^2=8.7196, P=0.0031); age, (χ^2=24.6845, P<.0001); education status (χ^2=17.9605, P=0.0030), socioeconomic (χ^2=25.4291, P<.0001) and profession (χ^2=32.3975, P<.0001) were significant and affecting (SSI's). Besides, the comparison of gender on the (SSI's) showed that out of the 300 cases, 114 (38%) were males patients (27 (26.47%) suffered from (SSI's) and 87 (43.93%) did not suffer from (SSI's)) and 186 (62%) were females patients (75 (73.53%) suffered from (SSI's) and 111 (56.07%) did not suffer from (SSI's)), as shown in Figure2 & Table 2.

The Chi-square test showed that other factors such as "other diseases (suffer other diseases) (χ^2=5.0142, P=0.0251)" (diabetes, obese patients, hypertension, heart diseases and others) were found to be significant and the remaining factors (under the care of physician or health care (χ^2=1.7974, P=0.1800)" and "take medications (χ^2=0.4057, P=0.5241)" were not significant as shown in Table 3.

The Chi-square test also showed that other factors; fever ($\chi^2$55.8401-P<.0001), extend of wound breakdown (P<.0001), problems with the wound (P<.0001), problems with the healing of the wound (χ^2=148.9732, P<.0001), discharge from wound (χ^2=236.6864, P<.0001) and some additional symptoms that applied to the patient (P<.0001) were significant and a single factor; (Pain or soreness in addition to the discomfort experienced following the operation (χ^2 =3.3454 , P= 0.0674) was not significant as shown in Table 4.

Multi-factor analysis associated with (SSI's) showed that the binary logistic regression indicated that "age" ($\chi^2$11.8295-P=0.0006), "suffer from other diseases" (χ^2=7.3670, P=0.0066) including (diabetes, obese patients, hypertension, heart diseases and others) "problems with the healing of the wound" (χ^2=17.7513, P<.0001) including (diseases that interfere with healing like diseases that decrease the patient immunity systems as DM, cancer, obese patients, severe bleeding after the operation and others) "discharge from wound" (χ^2=34.5110, P<.0001) including (serous discharge, purulent discharge and bloody discharge), and these factors were found to be significant and associated with (SSI's) as shown in Table 5.

Discussion

Despite advances in the operative techniques and better understanding of the pathogenesis of wound infection, postoperative wound infection continues to be a major source of morbidity and mortality for patients undergoing operative procedures (Masood et al., 2005). Previous studies in different countries such as Pakistan (Ahmed et al., 2007) and (Sangrasi et al., 2008), India (Lilani et al., 2005), Mali (Togo et al., 2010) and Ethiopia (Wondemagegn et al., 2010) and (Endalafer et al., 2011) reported that the infections rates were 11-13%, 9-12%, 10.2% and 10.9% respectively. Though, the rate of SSI's in the Republic of Yemen was 7.6% in clean wound infection without prophylactic antibiotics according to studies such as (Noman et al., 2001) however, this paper reached to the fact that the infections rate was 34% among the patients in the public hospitals without the use of the prophylactic antibiotics preoperative and which might reduce the postoperative infection rates.

The study revealed that the gender (P=0.0031) was significant with (SSI's) which was higher in females (40.32%) than males (23.68%) and that the possible reasons could be the multiple factors in females or contribution of other diseases such as diabetes; prolonged duration of preoperative hospital stay (pre-operative and post-operative) (Altemeier et al., 1968) and indications for surgery like caesarean section. Besides, the previous studies showed that patients with pre-morbid illnesses, such as diabetes mellitus are at high risk of developing SSI's due to their low immunity (Delamaire et al., 1997). In the European countries, the incidence of infections after caesarean section (before hospital discharge) varies between 0.1% and 3.7% (Eriksen et al., 2009), and some previous researches also showed that risk factors associated with (SSI's) were age above 45 years, female sex, diabetic status and surgeries such as, hysterectomy, cholecystectomy and appendectomy (Suchitra et al., 2009). According to (Moir et al., 1985; Pelle et al., 1986), greater rate of infection associated with obese women undergoing caesarean section surgery was reported. The study identified that obesity, increasing age and method of skin closure increased the risk of (SSI's) following caesarean section (A. Johnson et al., 2006). The antibiotic should be administered preoperatively, ideally within 30 min of the induction of anesthesia. An adequate concentration of antibiotic within the serum and tissues will reduce the risk of resident bacteria overcoming the immune system during the immediate postoperative period (Mangram et al., 1999).

This paper concluded that rate of infection among males (26.47%) suffered from (SSI's) and among females (73.53%) suffered from (SSI's) figure 3 (χ^2= 8.71960, P =0031). Our findings were also comparable with previous study in Yemen 2002, that showed the rate of infection among males (1.6%) was statistically comparable with that (2.7%) in females (Chi square= 0.85 and P=0.36) (Noman et al., 2001).

This paper also concluded that "age" (P<.0001) were significant with (SSI's). It can be due to multiple factors like low healing rate, malnutrition, mal-absorption, increased catabolic processes and low immunity (Mark et al., 1994). Our findings were also comparable with other study the patients with age of more than 50 years had a higher incidence (25%) of postoperative wound infection and as compared to 8.6% in patients having age less than 26 years. an odd ratio for surgical wound infection is 1.2 for every 10 years of age14 (Masood et al., 2005). And another study revealed 2007, Journal of the American College of Surgeons (one prospective observational study using logistic regression to analyze data collected from142 medical centers identified age as an independent risk factor for (SSI's) (Neumayer et al., 2007).

The study revealed that "education status", "socioeconomic" and "profession" were found significant with (SSI's) P=0.0030, P<.0001 and P<.0001 respectively, might have effects on the patient health and also on his life, like health care, environmental exposure, and health behavior. In addition, chronic stress associated with lower SES may also increase morbidity and mortality.

Especially in a country such as Yemen suffering from poverty (54.5 %) (World Bank, 2012; Clemens et al., 2010; World Bank, 2011), and unemployment (60%) (World Development Indicators 2012; World Bank, 2012).

Education is one of the most powerful instruments for reducing poverty and inequality and lays a foundation for sustained economic growth. In fact, education is a key factor to health inequality, supporting early childhood education may have health benefits. When policymakers debate the merits of increasing access to education, they rarely consider improvements in the health of the population (C.E. Ross et al., 1995; M.A. Winkleby et al., 1992; Nancy et al., 2002).

Socio-economic status is a complex characteristic, generally understood to encompass not only income and education level, the measures most commonly used, but also a wide range of associated factors that may affect the quality of health care patients receive, including insurance status, access to care, patients' health beliefs, and many facets of the doctor-patient relationship, such as trust and communication (Potosky et al., 1998; Andrulis et al., 1998) (Schillinger et al.,2002; Willems et al., 2005). In the United States, states with greater income inequality and higher mortality also have fewer primary care doctors per capita (L. Shi et al., 1999). Patients of low SES receive fewer preventive services (Susannah et al., 2008; Ross et al., 2006; Gornick et al., 1996; Schootman et al., 2006). Moreover, SES disparities exist even among fully insured patients (Franks et al., 2002; Franks et al., 2003; Gornick et al., 1996; Brown et al., 2003). SES influences health care quality and outcomes (Susannah et al., 2008; Bernheim et al., 2007).

In addition to income for the providing means for purchasing health care, higher incomes can provide better nutrition, housing, schooling, and recreation. Independent of actual income levels, the distribution of income within countries and states has been linked to rates of mortality (Nancy et al., 2002). In addition the Persons who lack insurance receive less medical care, including screening and treatment, than those who are covered and may receive poorer-quality care (Nancy et al., 2002). A Canadian study found that lower-SES Canadians used primary care more frequently but, when adjusted for health care need, were less likely to get specialty care (S. Dunlop et al., 2000). A recent study from Canada showed higher mortality among men with less income, less education, and lower occupational status for a variety of causes of death, all of which were amenable to medical treatment (E. Wood et al., 1999).

Occupational status is a more complex variable, and its measurement varies depending on one's theoretical perspective about the significance of various aspects of work life. One aspect is simply whether or not one is employed, since the employed have better health than the unemployed have (C.E. Ross et al., 1995). Although some of this association is a function of the "healthy worker" effect, there is evidence that being unemployed and the length of unemployment affect health status. However, some types of benefits for the unemployed can buffer the adverse effects on health. Lower-status jobs expose workers to both physical and psychosocial risks (R. Catalano et al., 1992).

The paper also showed that the contribution of other diseases to the wound infection, such as (diabetes, obesity, hypertension, heart diseases) were a significant (P=0.0251) with SSI. In this study revealed also the total rate of diabetes 48 (16%), as distributed 45 (93.75%) among gender suffered from infection and 3 (6.25%) not suffered from infection (χ^2 91.0314 - P <.0001) were found to be significant with SSI. Diabetes is a major cause of heart disease and stroke. Death rates for heart disease and the risk of stroke are about 2-4 times higher among adults with diabetes than among those without diabetes (National Diabetes Fact Sheet, 2011).

However, there was a previous study in Yemen, Sana'a 2008 where the rate of DM was found between males and females (11.6%, 6.5% respectively, P=0.14) (Abdullah et al., 2008). In addition, 67% of U.S. adults who reported to have diabetes also reported to have high blood pressure (C.E. Ross et al., 1995). However, there was the contribution of diabetes to (SSI's) risk is controversial, because the independent contribution of diabetes to the (SSI's) risk has not typically been assessed after controlling for potential confounding factors. Besides, increased glucose levels in the immediate postoperative period were associated with increased (SSI's) risk. Nevertheless, further studies are needed to assess the efficiency of perioperative blood glucose control as a preventive measure, medical condition, such as hypoproteinaemia low blood protein may also affect healing (Donald et al., 2007; Zainab et al., 2009).

This paper showed that the contribution of some signs and symptoms of the wound revealed that Fever P<.0001; Extend of wound breakdown P<.0001(edges intact, edge separate, open by physician); problems with the wound P<.0001 (swelling, pain, heat); problems with the healing of the wound P<.0001(diseases that interfere with healing like diseases that decrease the patient immunity systems as DM, obesity, severe bleeding after the operation and others) and other diseases like cancer of liver and kidney or lung conditions that may slow the healing process and another medical condition, such as low blood protein may also affect healing (Zainab et al., 2009).

Discharge from wound P<.0001 (serous discharge, purulent discharge and bloody discharge) and some additional symptoms that applied to the patient P<.0001 (Redness or inflammation, warmer/hotter, swollen and the edge wound separated or "gaped open") were significant with (SSI's) and the rest factors (Pain or soreness P=0.0674) were not significant with SSI.

Patient with (SSI's) suffering from redness, delayed healing, fever, pain, tenderness, warmth, or swelling and Many factors influence surgical wound healing and determine the potential for, and the incidence of infection (Buggy, 2000) like DM, smoking, poor nutrition, alcoholism, chronic renal failure, jaundice, obesity, advanced age, poor physical condition, medication, previous radiotherapy and chemotherapy. The level of bacterial burden is the most significant risk factor (Berard et al., 1964; Cruse et al., 1980; Cruse et al., 1992), but modern surgical techniques and the use of prophylactic antibiotics have reduced this risk. Discharge: As patients are frequently discharged soon after surgery, it is vital that nurses provide them with explicit instructions on how to care for their wound, including washing and bathing, as well as passing on the contact details of who to call if they have any concerns. After the wound dressing has been removed at 48 hours, it is quite safe for patients to take a shower (NICE, 2008; Kiernan, 2012).

In this paper in the binary logistic regression revealed Factors associated with surgical site infections (SSI's) that age were associated with (SSI's), "other diseases" as (diabetes, obese patients, hypertension, heart diseases and others), "healing problems"(diseases that interfere with healing like diseases that decrease the patient immunity systems as "DM", "obese patients", "severe bleeding after the operation and others") other diseases are like cancer of liver and kidney or lung conditions that may slow the healing process . And another medical condition, such as low blood protein hypoproteinaemia may also affect healing (Zainab et al., 2009), and "discharge from wound" (serous discharge, purulent discharge and bloody discharge), were associated with (SSI's) in the other hand wearing gown was not associated with (SSI's) Table 5. This paper pointed to factors associated with (SSI's) and which affect the susceptibility of any wound to infection, some of which strongly predispose to wound infection. According to studies; there are risk factors for the patients that affect the incidence of wound infection which include pre-existing illness, length of operation, wound class, and wound contamination. Other factors such as age (aging), malignancy, metabolic diseases, malnutrition, immunosuppression, cigarette smoking, and emergency procedures was found to be the predisposing factors for (SSI's) (PL Nandi et al., 1999).

Conclusion

The paper revealed that (SSI's) is widely present in public hospitals of Hudeidah city, Yemen especially in surgical wards. Many factors such as age ,gender, education status, socio-economic, other diseases such as diabetes, obese patients, hypertension, heart diseases, problems with the healing as DM, obese patients, and other diseases like cancer of liver and kidney or lung conditions were found to be associated with (SSI's).

Further Research

Since an across sectional design was used, the finding of this study could be of more strength and provide more accurate picture if it used a longitudinal design. The research was conducted in one city in the west of Yemen i.e. Hudeidah city and only two hospitals and hence, the results were limited as the study did not cover all the public hospitals in Yemen.

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Figures

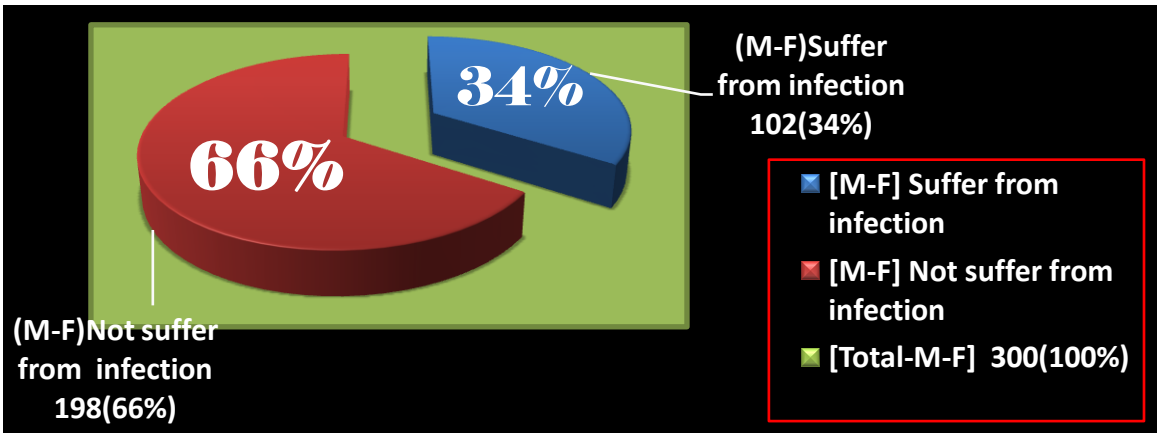

Figure 1 Frequency and Percentage of Patients who do/do not suffer from Infection

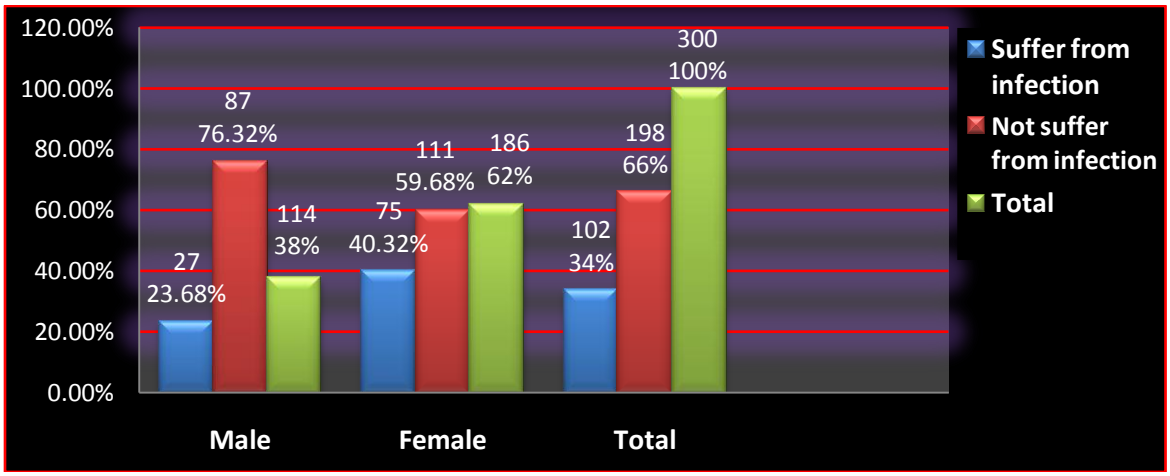

Figure 2 Frequency and Percentage of Patients who do/do not suffer from Infection based on (SSI)

Tables

Table1. Frequency and Percentage of Patients who do/do not suffer from infection

			Frequency	Percentage%
Infection	Suffer from infection	Yes	102	34.00%
	Not suffer from infection	No	198	66.00%
	Total		300	100.00%

The results show that 102(34.00%) suffered from (SSI's) and 198(66.00%) did not suffered from (SSI's) among the 300 patients as shown in Table 1.

Table 2 Chi-square test of Socio-demographic Characteristics of Subjects Associated with SSI

Factors		**Suffer from infection (**%)A	**Not suffer from infection (**%)B	**%=A/(A+B)**	χ^2	***P***
Sex	Male	27(23.68)	87(76.32)	27/(27+87)=2.3	8.7196	0.0031
	Female	75(40.32)	111(59.68)	75/(75+111)=4.0		
Age	Less than20years	27(37.50)	45(62.50)	27/(27+45)=3.7	24.6845	<.0001
	20-40years	66(44.00)	84(56.00)	66/(66+84)=4.4		
	40-60years	3(9.09)	30(90.91)	3/(3+30)=0.90		
	60-and more	6(13.33)	39(86.67)	6/(6+39)=1.3		
Education status	literate	9(50.00)	9(50.00)	9/(9+9)=5	17.9605	0.0030
	illiterate	54(32.14)	114(67.86)	54/(54+114)=3. 2		
	Primary school	12(26.67)	33(73.33)	12/(12+33)=2.6		
	High school	24(44.44)	30(55.56)	24/(24+30)=4.4		
	University level	0(0.00)	12(100.00)			
	other	3(100.00)	0(0.00%)	3(100.00)		
Socioeconomic	High-income	0(0.00%)	3(100.00)	3(100.00)	25.4291	<.0001
	Middle income	48(55.17)	39(44.83)	48/(48+39)=5.5		
	Low income	21(24.14)	66(75.86)	21/(21+66)=2.4		
	No income	33(26.83)	90(73.17)	33/(33+90)=2.6		
Profession	Highly qualified professions	3(100.00)	0(0.00)	3(100.00)	32.3975	<.0001
	Professional worker	6(22.22)	21(77.78)	6/(6+21)=2.2		
	Housewife	66(47.83)	72(52.17)	66/(66+72)=4.7		
	Unemployed	15(22.73)	51(77.27)	15/(15+51)=2.2		
	Farmer	0(0.00%)	12(100.00)			
	Other	12(22.22)	42(77.78)	12/(12+42)= 2.2		

The % in the table should be calculated and explained, such as suffer rate of females is 4.0% which is higher than males 2.3%, the highest of suffer rate in profession is highly qualified professions which reach 100% .

Table 3 Chi-Square Test for Other Diseases and Post-Operative Treatments Associated with SSI

Factors		**Suffer from infection (%) A**	**Not suffer from infection (%) B**	**%=A/(A+B)**	χ^2	***P***
Suffer from other diseases	Yes	54(40.91)	78(59.09)	54/(54+78)=4.0	5.0142	0.0251
	No	48(28.57)	120(71.43)	48/(48+120)=2.8		
"kind of diseases"	Diabetes mellitus	45(93.75)	3(6.25)	45/(45+3)=9.3	91.0314	<.0001
	Obese patient	0(0.00)	18(100.00)			
	Hypertension	0(0.00)	21(100.00)			
	Heart diseases	0(0.00)	6(100.00)			
	other	9(23.08)	30 (76.92)	9/(9+30)=2.3		
Under the care of physician or health care.	Yes	102(34.69)	192 (65.31)	102/(102+192)=3.4	1.7974	0.1800
	No	0(0.00)	6(100.00)			
Take medications	Yes	102(34.34)	195(65.66)	102/(102+195)=3.4	0.4057	0.5241
	No	0(0.00)	3(100.00)			

The Chi-square test showed that other factors such as "other diseases' (suffer from other diseases) were found to be significant and the remaining factors were not significant as shown in Table3.

Table 4 Chi-Square Test for Some Signs and Symptoms of the Wound

Factors		Suffer from infection (%)A	Not suffer from infection (%)B	%=A/(A+B)	χ^2	*P*
Fever	Yes	93(50.00)	93(50.00)	93/(93+93)=5	55.8401	<.0001
	No	9(7.89)	105(92.11)	9/(9+105)=0.79		
Extend of wound breakdown	Edges intact	23(11.50)	177(88.50)	23/(23+177)=1.1	135.3610	<.0001
	Edge separate	59(100.00)	0(0.00)	59(100.00)	142.5677	
	Open by physician	41(100.00)	0(0.00)	41(100.00)	92.1871	
Problems with the wound	swelling	60(95.24)	3(4.76)	60/(60+3)=9.5	133.2705	<.0001
	pain	96(42.67)	129(57.33)	96/(96+129)=4.2	30.1248	
	heat	90(63.83)	51(36.17)	90/(90+51)=6.3	105.4923	
Problems with the healing	Yes	72(88.89)	9(11.11)	72/(72+9)=8.8	148.9732	<.0001
	No	30(13.70)	189(86.30)	30/(30+189)=1.3		
Discharge from wound	Yes	90(96.77)	3(3.23)	90/(90+3)=9.6	236.6864	<.0001
	No	12(5.80)	195(94.20)	12/(12+195)=0.58		
Additional symptoms that applied to the patient are wound.	-**Pain** or soreness in addition to the discomfort experienced following the operation.	102(35.05)	189(64.95)	102/(102+189)=3.5	3.3454	0.0674
	-**Redness** or inflammation spreading from the edges of the wound.	90(83.33)	18(16.67%)	90/(90+18)=8.3	183.0214	<.0001
	-**The** area around the wound felt warmer/hotter than the surrounding skin.	87(70.73)	36(29.27)	87/(87+36)=7.0	125.3466	<.0001
	-**The** area around the wound became swollen.	57(100.00)	0(0.00)	57(100.00)	136.6013	<.0001
	-**The** edge of any part of the wound separated or gaped open.	63(100.00)	0(0.00)	63(100.00)	154.8027	<.0001

The Chi-square test for signs and symptoms of the wound revealed that fever, extend of wound breakdown, problems with the wound, problems with the healing of the wound, discharge from wound and some additional symptoms that applied to the patient were significant and the rest factor (Pain or soreness in addition to the discomfort experienced following the operation) were not significant as shown in Table 4.

Table 5 Binary logistic Regression for Factors Associated with Surgical Site Infection (SSI's)

Factors	Standardized Estimate	χ^2	*P*	OR (95% Wald CL)
Age	1.1502	11.8295	0.0006	1.214 (1.033 1.793)
Suffer from other diseases	0.6476	7.3670	0.0066	1.943 (1.017 2.519)
Problems with the healing	0.8058	17.7513	<.0001	1.237 (1.108 1.642)
Discharge from wound	2.0054	34.5110	<.0001	1.201 (1.091 1.505)

Table 5 shows that the binary logistic regression revealed that "Age", "Suffer from other diseases" "Problems with the healing of the wound" "Discharge from wound" and this factors associated with (SSI's) and were found to be significant with (SSI's) as shown in Table 5.