# CORRELATION BETWEEN SUBCUTANEOUS FAT THICKNESS AND SUPERFICIAL SURGICAL SITE INFECTION IN PATIENTS UNDERGOING OPEN APPENDECTOMY

Naveen Mahaseth[1], Santosh Shah[1], Kritendra Raj Sharma[1]

## ABSTRACT

### INTRODUCTION

Surgical site infection (SSI) is a commonly encountered complication in any surgery and is commonly associated with appendicitis. Obesity has been associated with delayed wound healing and risk of infections and this research aims to validate the fact.

### MATERIAL AND METHODS

Prospective observational study was carried out in Universal College of Medical Sciences, Bhairahawa, Nepal, from September 2017 to December 2018 on all cases of appendectomy meeting the inclusion criteria.

### RESULTS

Of total 100 cases of acute appendicitis, 35% cases developed superficial surgical site infection (SSSI).The development of SSSI in patients with subcutaneous fat thickness (SCFT) of greater that 2.5 cm, between 1.5 cm to 2.5 cm and less than 1.5 cm were 62.5%, 41.9% and 6.1% respectively. Similarly, 40% of patients in grade I obesity group, 63.6% of patients in pre-obese group and 31.1% of patients in normal BMI group developed SSSI. On comparison between SCFT and BMI on a ROC curve, SCFT (0.785) has more AUC than BMI (0.762).

### CONCLUSION

It has been observed that patients with increasing amount of SCFT at incision site had higher chances of developing SSSI. It could also be concluded that though both increased BMI and SCFT had increased frequency of occurrence SSSI, SCFT was more reliable in predicting the chances of SSSI as significant number of cases of SSSI were occurring in normal BMI and pre- obese group.

**KEYWORDS** Body Mass Index (BMI), Subcutaneous Fat Thickness (SCFT), Superficial Surgical Site Infection (SSSI), Surgical Site Infection (SSI).

1. Department of Surgery, Universal College of Medical Sciences, Bhairahawa, Nepal

DOI: http//doi.org/10.3126/jucms.v8i02.34242

**For Correspondence**
Dr. Naveen Mahaseth
Department of Surgery
Universal College of Medical Sciences
Bhairahawa, Nepal
Email: meet4navin@hotmail.com

## INTRODUCTION

Surgical-site infection (SSI) is the most prevalent type of hospital infection in surgical patients and is associated with an increase in hospital stay, costs and morbidity/lethality. The knowledge of the main risk factors for this type of infection is important for the establishment of prevention measures regarding modifiable risks factors.[1]

Clearly, there is strong evidence indicating the association between obesity and poorer surgical outcomes, especially in relation to wound healing.[2] In the existing body of literature, obesity, regardless of the definition used, is thought to increase the risk of SSI.[3] Several studies postulate the mechanisms by which obesity increases risk of SSI. Potential factors include the intrinsic tenuous anatomic properties and poor vascularity of adipose tissue.[4] Relative vascular insufficiency, thus decreased oxygen tension, may result in decreased collagen synthesis, decreased capacity to fight infection, and decreased ability to support the necessary mechanisms of the healing cascade.[5] Because 40% of the elective surgical population is overweight or obese, SSIs that might be a result of an obesity-related risk factor deserve additional scrutiny.[6] Measurements of BMI, waist circumference and waist-hip ratio, and body composition assessments using skin fold thickness and bioelectrical impedance analysis have been widely used due to their convenience and relatively low cost.[7]

A novel concept in preoperative risk stratification is analytic morphomics. This approach involves using preoperative imaging to obtain morphometric measures such as core muscle size, bone mineral density, arterial calcification, and body composition.[8]Although BMI is typically used to define obesity, there is clearly a wide variation in how precisely it describes body composition.[9] Within this context, applying these morphometric measures of body composition to surgical patients may further inform preoperative risk stratification and clinical decision-making.[10]

## MATERIAL AND METHODS

This is a prospective observational study, enrolling patients with acute appendicitis, conducted at Department of Surgery, Universal College of Medical Science - Teaching Hospital (UCMS-TH), Bhairahawa, Nepal, following the approval from Institutional Review Committee (IRC). Consent was taken from the patient in written before enrollment in the study. The duration of study was from September 2017 to December 2018.

### Inclusion criteria

1. Above 15 years and less than 60 years of age
2. All patients undergoing open appendectomy via various incisions in right iliac fossa.

### Exclusion criteria

1. Laparoscopic appendectomies
2. Appendicitis associated with other abdominal pathologies (e.g. ascites, peritonitis, bowel obstruction, abdominal and pelvic malignancies)
3. Patients taking immunosuppressants

The target sample size was 87. To make the outcome more valid it was increased to 100. The patients were interviewed using a preformed proforma. Information regarding the demographic details, history, clinical examination, investigations and ultra-sonographic measurement of SCFT, intra operative findings and the occurrence of SSSI were collected. The subcutaneous fat thickness at the incision site was measured and recorded with ultra-sonographic guidance. CDC criteria was taken for defining SSSI according to which SSSI are infection that occurs within 30 days after the operative procedure and involves only skin or subcutaneous tissue of the incision, and at least one of the following is present:

1. Purulent drainage from the superficial incision.
2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
3. At least one of the following signs or symptoms of infection: Pain or tenderness, localized swelling, redness, or heat and superficial incisions deliberately opened by surgeon, unless culture of incision is negative.
4. Diagnosis of superficial incisional SSI by the surgeon or attending physician.[11]

All the data was entered in the Microsoft excel and exported to SPSS (Statistical package for social science) version 20 for data, editing and analysis.

## RESULTS

Among the 100 patients under study 35% of the patients developed SSSI with 65% not developing SSSI. The mean difference between different continuous variables with SSSI category (Yes/no) is calculated by using independent sample t-test. It was seen that the mean age of those patients who had SSSI is 35.51 years and those patients who did not have SSSI is 28.35 years with mean difference of age 4.16 years and *p*-value (0.112) and was found statistically insignificant. Similarly, the mean among weight was 65.25 kg in SSSI group and 58.58 kg in non-SSSI group with the mean difference of 6.67 kg and *p*-value of .001 which was found to be statistically significant. The mean subcutaneous fat thickness in patients who has SSSI was 2.36 cm and those who did not have was 1.72 cm with mean difference of .612 cm and *p*-value of <.001 which was found to be statistically significant. The mean BMI in patients with SSSI was found to be 24.84 kg/m$^2$ and in those without SSSI was 21.7404 kg/m$^2$ with mean difference of 3.10

and *p*-value of <0.001 which was found to be statistically significant (Table 1).

**Table 1. Table depicting means of patients in relation to SSSI in accordance to age, weight, height, BMI, subcutaneous fat thickness**

| Superficial surgical site infection | | N | Mean | Standard deviation | Mean difference | t-value | *p*-value |
|---|---|---|---|---|---|---|---|
| Age | Yes | 35 | 32.5143 | 11.90495 | 4.16044 | 1.563 | .112 |
| | No | 65 | 28.3538 | 13.09631 | | | |
| Weight | Yes | 35 | 65.2571 | 8.60350 | 6.67253 | 3.344 | .001 |
| | No | 65 | 58.5846 | 9.96853 | | | |
| Height | Yes | 35 | 162.0286 | 6.24729 | -2.18681 | -1.565 | .111 |
| | No | 65 | 164.2154 | 6.87725 | | | |
| BMI | Yes | 35 | 24.8427 | 2.86598 | 3.10234 | 4.357 | <0.001 |
| | No | 65 | 21.7404 | 3.64616 | | | |
| Subcutaneous fat thickness | Yes | 35 | 2.3600 | .46979 | .63385 | 5.333 | <0.001 |
| | No | 65 | 1.7262 | .61219 | | | |

The association between gender and SSSI is calculated by using chi-square test. It was seen that out of 58 males, 29.3% had SSSI and out of 42 females, 42.9% had SSSI. Though there is difference in occurrence of SSSI in the two sexes, the difference here is not found to be statistically significant with *p*-value (0.204).

The association between subcutaneous fat thickness and SSSI is calculated by using chi-square test. The development of SSSI in patients with subcutaneous fat thickness(SCFT) of greater that 2.5 cm, between 1.5 cm to 2.5 cm and less than 1.5 cm were 62.5%, 41.9% and 6.1% respectively. The association between different subcutaneous fat thickness and SSSI is found highly statistically significant with chi-square value (24.179) and *p*-value (<0.001) (Table 2).

**Table 2. Table showing frequency of SSSI in relation to different subcutaneous fat thickness**

| | | | Superficial surgical site infection | | Total | Chi-square value | *p*-value |
|---|---|---|---|---|---|---|---|
| | | | Yes | No | | | |
| Subcutaneous fat thickness | <1.5 | Count | 2 | 31 | 33 | 24.179 | <0.001 |
| | | % | 6.1% | 93.9% | 100.0% | | |
| | 1.6-2.5 | Count | 18 | 25 | 43 | | |
| | | % | 41.9% | 58.1% | 100.0% | | |
| | >2.5 | Count | 15 | 9 | 24 | | |
| | | % | 62.5% | 37.5% | 100.0% | | |
| Total | | Count | 35 | 65 | 100 | | |
| | | % | 35.0% | 65.0% | 100.0% | | |

It was observed that 63.6% of patients in pre-obese BMI group had SSSI followed by 40% in obese grade I group followed by 31.1% in normal BMI group with no SSSI occurring in patients with below normal BMI. The occurrence and non-occurrence of SSSI among groups in different BMI group had a *p*-value <.001 and was found to be statistically significant (Table 3).

**Table 3. Table showing frequency of occurrence of SSSI in different BMI groups**

| | | | Superficial surgical site infection | | Total | Chi-square value | *p*-value |
|---|---|---|---|---|---|---|---|
| | | | Yes | No | | | |
| BMI | <18.5 | Count | 0 | 12 | 12 | 18.244 | <0.001 |
| | | % | 0.00% | 100.00% | 100.00% | | |
| | 18.5-24.9 | Count | 19 | 42 | 61 | | |
| | | % | 31.10% | 68.90% | 100.00% | | |
| | 25-29.9 | Count | 14 | 8 | 22 | | |
| | | % | 63.60% | 36.40% | 100.00% | | |
| | 30-34.9 | Count | 2 | 3 | 5 | | |
| | | % | 40.00% | 60.00% | 100.00% | | |
| Total | | Count | 35 | 65 | 100 | | |
| | | % | 35.00% | 65.00% | 100.00% | | |

The best predictor of SSSI among BMI and SCFT is determined by using ROC curve. From the above Table and Figure, it was seen the SCFT has more AUC (0.785) with sensitivity of 80% and specificity of 69.2% than BMI with AUC (0.762). From this result we can conclude that SCFT is a better predictor of SSSI than BMI (Fig 1).

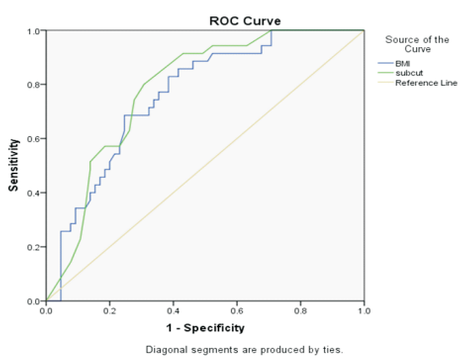


**Figure 1. The AUC comparing SCFT and BMI with occurrence of SSSI**

## DISCUSSION

This study has tried to highlight the fact that obesity has a role in development of SSI in patients undergoing open appendectomy. Among 100 patients who underwent open appendectomy via various incisions in RIF 35 (35%) patients developed superficial/incisional SSI which is significantly higher than the data published in other articles. Most of the recently published articles have mentioned their infection rate to be as high as 17 percent.[12]

Our results show almost twice the rate of SSI at our center. This can be attributed to higher number of patients with increasing body weight specially increasing SCFT. A similar study conducted by SurajBhattarai et al had incidence of SSI as low as 2% (2nd post-operative day) and 3% (3rd post operative day).[13] It reveals the magnitude of the problem being faced in our institution and also a reflection of the problem in this region as a whole. This also highlights the need to address the

problem and this study has aimed to address a factor related to its occurrence. Of the various well established risk factors for post-operative complications, obesity has an impact for wound site related local complications. The body fat burden and specifically the incision site fat can lead to development of SSSI.

In a study conducted by De Lucia et al, ultrasonographic measures had a positive correlation with MRI measures of visceral and subcutaneous fat (visceral: r 0.82 and r 0.80 and subcutaneous: r 0.63 and r 0.60 in men and women respectively). It concluded that ultrasonography is a valid method to estimate visceral and subcutaneous fat in epidemiological studies of men and women when MRI and CT are not feasible.[14]

Similar to this present study, Lee et al demonstrated in his study that patients with subcutaneous fat thickness of more than 50 mm who underwent a midline posterior approach for lumbar spine surgery had four-fold increase in odds of developing SSI compared to those with less than 50 mm. Though the site of interest between this study and the study by Lee JJ et al is different, similar to this study it also utilizes local SCFT measurement as an independent risk assessment tool for SSI in posterior lumbar spine surgery. [15]

In this present study comparing SCFT and BMI on the basis of area under the ROC curve regarding SSSI we could acknowledge that SCFT had AUC 0.785 and BMI had AUC 0.762 with having *p*-value <0.001 which is highly significant. In comparison, the study done by Levi B et al had AUC 0.60 with *p*-value 0.023 for SCFT which was statistically significant and AUC 0.52 with *p*-value 0.73 for BMI which was not significant.[16] This clearly showed the superiority of SCFT over BMI in predicting SSSI in their study.

## CONCLUSION

This study tried to evaluate the correlation between subcutaneous fat thickness at incision site and the subsequent development of SSSI. It was observed that with increasing SCFT higher percentages of patients had occurrence of SSSI. This conclusion can help in anticipation of occurrence of SSSI in patients with higher SCFT and help develop various interventions to reduce the risk. It will also help pave way for further more studies regarding the same.

## REFERENCES

1. Dominioni L, Imperatori A, Rotolo N, Rovera F. Risk factors for surgical infections. Surg Infect. 2006;7(2):9-12.

2. Pierpont YN, Dinh TP, Salas RE, Johnson EL, Wright TG, Robson MC, et al. Obesity and surgical wound healing: A current review. ISRN Obes. 2014;2(14):1-13.

3. Choban PS, Flancbaum L. The impact of obesity on surgical outcomes: a review. J Am Coll Surg. 1997;185(8):593-03.

4. Smahel J. Adipose tissue in plastic surgery. Ann Plast Surg. 1986;16(5):444-53.

5. Jonsson K, Jensen JA, Goodson WH, Scheuenstuhl H, West J, Hopf HW, et al. Tissue oxygenation, anemia, and perfusion in relation to wound healing in surgical patients. Ann Surg. 1991;214(5):605-13.

6. Choban PS, Heckler R, Burge JC, Flancbaum L. Increased incidence of nosocomial infections in obese surgical patients. Am Surg. 1995;61(11):1001-5.

7. Rezende F, Rosado L, Franceschinni S, Rosado G, Ribeiro R, MarinsJC. Critical revision of the available methods for evaluate the body composition in population-based and clinical studies. Arch LatinoamNutr. 2007;57(12):327-34.

8. Englesbe MJ, Patel SP, He K, Lynch RJ, Schaubel DE, Harbaugh C, et al. Sarcopenia and mortality after liver transplantation. J Am Coll Surg. 2010;211(2):271-8.

9. Heymsfield SB, Gallagher D, Mayer L, Beetsch J, Pietrobelli A. Scaling of human body composition to stature: New insights into body mass index. Am J Clin Nutr. 2007;86(1):82-91.

10. Lee JS, Terjimanian MN, Tishberg LM, Alawieh AZ, Harbaugh CM, Sheetz KH, et al. Surgical site infection and analytic morphometric assessment of body composition in patients undergoing midline laparotomy. J Am Coll Surg. 2011;213(2) :236-44.

11. Centers for Disease Control and Prevention (CDC). Surgical Site Infection (SSI) Event. Atlanta: CDC,2013. http://www.cdc.gov/ nhsn/pdfs/pscmanual/9pscssi current.pdf. Accessed July 2013.

12. Foster D, Kethman W, Cai LZ, Weiser TG, et al. Surgical site infections after appendectomy performed in low and middle human development index countries : A systematic review . Surg Infect (Larachmt). 2018;19(3):237-244 .

13. Bhattarai S, Tamrakar K. The Incidence of surgical site infections in acute non- perforated appendicitis. Journal of Chitwan Medical College. 2019;9(2):11-14.

14. De Lucia Rolfe E, Sleigh A, Finucane FM, Brage S, Stolk RP, Cooper C, et al. Ultrasound measurements of visceral and subcutaneous abdominal thickness to predict abdominal adiposity among older men and women. Obesity (Silver Spring). 2010;18(3):625-31.

15. Lee JJ, Odeh KI, Holcombe SA, Patel RD, Wang SC, Goulet JA, et al. Fat Thickness as a Risk factor for infection in lumbar spine surgery. Orthopedics. 2016;1-5.

16. Levi B, Zhang P, Lisiecki J, Terjimanian MN, Rinkinen J, Agarwal S, et al. Use of morphometric assessment of body composition to quantify risk of surgical-site infection in patients undergoing component separation ventral hernia repair. Plast Reconstr Surg. 2014;133(4):559e-66e.