

Study Protocol

**Association Between Body Roundness Index and
Wound Healing Post-Thoracic Surgery: A Prospective
Study**

NCT ID not yet assigned

Unique Protocol ID: TJ-JRB202503009

Data:2025.05.01

Background

The thorax is a vital region of the human body, and the issue of postoperative wound healing following thoracic surgery has long been a subject of clinical concern. Thoracic surgeries—including cardiac surgery, thoracoscopic procedures, and open thoracotomy—are commonly performed for the treatment of cardiopulmonary diseases, tumors, and trauma. Although advancements in surgical techniques and medical equipment have significantly improved surgical success rates, complications such as wound infection, dehiscence, and poor cosmetic outcomes remain relatively common due to the high tension and extensive movement associated with the thoracic region[3]. Poor wound healing in the chest can have a profound impact on patients' psychological well-being, social interactions, and overall quality of life[4]. Excessive tension in soft tissues and skin is considered a key factor contributing to delayed healing and unfavorable scarring. Studies have identified gender, age, and the use of anticoagulants as risk factors for impaired wound healing, while serum lipids may play a protective role. Lipids are critically involved in modulating inflammation, angiogenesis, cellular proliferation, and tissue regeneration, all of which are essential processes in wound healing[5][9].

Obesity has emerged as a growing concern in modern medicine and now poses a serious threat to the health of a large proportion of the population. According to the *Chinese Guidelines for the Diagnosis and Treatment of Obesity*[7], both overweight and obesity exert profound negative effects on multiple organ systems, including the cardiovascular, respiratory, and gastrointestinal systems. Numerous studies have identified excessive obesity as a major risk factor for cardiovascular and cerebrovascular diseases, type 2 diabetes, and chronic kidney disease. In clinical practice, body mass index (BMI) is commonly used to assess obesity[17-19]. However, BMI has several limitations, as it cannot

distinguish between lean body mass and fat mass, nor can it accurately reflect fat distribution throughout the body[7][21]. Recent research by Xiaoqian Zhang and colleagues has shown that the Body Roundness Index (BRI), a novel anthropometric measure, is closely associated with all-cause mortality in the U.S. population. Similarly, the Weight-Adjusted Waist Index (WWI) has gained increasing attention as a new parameter for evaluating body composition, due to its improved accuracy in estimating fat content and its strong correlation with various metabolic risk factors[22].

Recent studies have further confirmed that the Weight-Adjusted Waist Index (WWI), as an indicator of body fat distribution, demonstrates superior predictive value for various conditions, including cardiovascular and cerebrovascular diseases, chronic kidney disease, and urgency urinary incontinence (UUI)[17][23][24]. Despite advances in medical technology and a growing understanding of wound healing among healthcare professionals, postoperative wound complications remain a persistent issue. Although numerous new techniques, materials, and management strategies have been developed to promote wound healing, the incidence of poor wound healing continues to be a significant clinical concern[1][2][9][10].

Objective

By analyzing the associations between factors such as height, smoking history, age, BMI, BRI, waist-to-hip ratio, and lipid profiles with postoperative wound healing, this study aims to elucidate how these variables influence the wound healing process. Understanding these relationships will help identify novel therapeutic targets and support the development of innovative interventions to promote more efficient and effective skin wound healing.

Study Design

The research team conducted discussions and analyses to develop the study protocol, including inclusion and exclusion criteria and the clinical data required for statistical analysis. Clinical and follow-up data of enrolled subjects were collected through the HIS system of Tongji Medical College. Using SPSS version 26.0, subjects were grouped based on whether their wounds achieved secondary healing, and intergroup differences were analyzed to preliminarily identify potential factors associated with impaired wound healing. Subsequently, logistic regression analysis was performed to further determine risk factors influencing wound healing. Multivariate logistic regression analysis was then conducted to identify independent risk factors affecting wound healing. These findings aim to provide clinically feasible intervention strategies to promote more efficient and effective wound healing.

Participant Selection

Inclusion Criteria:

- Patients who underwent surgical treatment in the Department of Thoracic Surgery at Tongji Hospital;
- Complete clinical data and diagnostic test results available;
- Postoperative follow-up conducted regularly in accordance with medical advice, with comprehensive follow-up records;

Exclusion Criteria:

- Without surgery or transferred to other departments;

- Missing basic information;
- Failure to review on time or refusal to follow up;
- Additional surgeries within 30 days of discharge from the hospital;

Sample Size Calculation

A total of 400 patients undergoing thoracic surgery in the Department of Thoracic Surgery at Tongji Hospital, affiliated with Tongji Medical College of Huazhong University of Science and Technology, will be enrolled.

Study Procedure

The research team conducted a thorough literature review to gain a comprehensive understanding of the relevant background before initiating the study design. Inclusion and exclusion criteria, as well as the clinical data required for statistical analysis, were established accordingly. A total of 500 participants are planned for enrollment; subjects not meeting the exclusion criteria will be excluded.

Data collection and follow-up will be conducted using the HIS system of Tongji Hospital. The variables to be collected include gender, age, height (m), weight (kg), waist circumference, abdominal circumference, hip circumference (cm), comorbidities (such as hypertension, coronary heart disease, diabetes), preoperative cholesterol, triglycerides, low-density lipoprotein (g/L), and type of surgery.

Data analysis will be performed using SPSS version 26.0. Initially, independent t-tests will be applied to compare groups based on wound healing status (healed vs. secondary healing) at 30 days postoperatively to identify potential factors associated with impaired wound healing. Variables identified as significant in univariate logistic regression analysis will be entered into a multivariate

logistic regression model. Statistical significance is set at $p < 0.05$. This analysis aims to determine independent risk factors for poor chest wound healing and to propose preventive measures accordingly, culminating in the completion of the study report.

Potential Risks and Mitigation Strategies

This study is observational in nature, with data collected exclusively by inpatient physicians at our hospital. Patient privacy will be strictly protected throughout the data collection process. If any issues related to poor wound healing arise during follow-up, the follow-up personnel will inform patients of appropriate subsequent treatment options. Patients lost to follow-up will be excluded from the study.

Data Collection and Statistical Analysis

Upon admission, patient data including gender, age, height (m), weight (kg), waist circumference, abdominal circumference, hip circumference (cm), comorbidities (such as hypertension, coronary heart disease, diabetes), and preoperative laboratory values including cholesterol, triglycerides, and low-density lipoprotein (g/L) will be collected. Postoperatively, data on the surgical procedure and routine pathological findings will be recorded. Wound healing status will be assessed during a follow-up visit 30 days after surgery. Group comparisons based on wound healing status (healed versus secondary healing) at 30 days will be performed using independent t-tests. Potential factors influencing wound healing will be evaluated using logistic regression analysis. Variables demonstrating statistical significance in univariate analysis will be included in a multivariate logistic regression model. A p -value < 0.05 will be considered statistically significant. This analysis aims to identify independent

risk factors associated with poor chest wound healing and to propose feasible preventive measures accordingly.

References

- [1] Gunton JE, Gergis CM, Lau T, Vicaretti M, Begg L, Flood V. Vitamin C improves healing of foot ulcers: a randomised, double-blind, placebo-controlled trial. *Br J Nutr.* 2021 Nov 28;126(10):1451-1458. doi: 10.1017/S0007114520003815. Epub 2020 Sep 28. PMID: 32981536.
- [2] Chen P, Vilorio NC, Dhatariya K, Jeffcoate W, Lobmann R, McIntosh C, Piaggesi A, Steinberg J, Vas P, Viswanathan V, Wu S, Game F. Guidelines on interventions to enhance healing of foot ulcers in people with diabetes (IWGDF 2023 update). *Diabetes Metab Res Rev.* 2024 Mar;40(3):e3644. doi: 10.1002/dmrr.3644. Epub 2023 May 25. PMID: 37232034.
- [3] Luo W, Tao Y, Wang Y, Ouyang Z, Huang J, Long X. Comparing running vs interrupted sutures for skin closure: A systematic review and meta-analysis. *Int Wound J.* 2023 Jan;20(1):210-220. doi: 10.1111/iwj.13863. Epub 2022 Jun 17. PMID: 35715955; PMCID: PMC9797933.
- [4] Panton J, Vingan N, Barillas J, Akgul Y, Lazzarini A, Coroneos CJ, Amirlak B, Kenkel J, Culver A. Postoperative Mechanomodulation Decreases T-Junction Dehiscence After Reduction Mammaplasty: Early Scar Analysis From a Randomized Controlled Trial. *Aesthet Surg J.* 2023 Nov 16;43(12):NP1033-NP1048. doi: 10.1093/asj/sjad269. PMID: 37606245; PMCID: PMC10902896.
- [5] Schlager JG, Hartmann D, Wallmichrath J, Ruiz San Jose V, Patzer K, French LE, Kendziora B.

Patient-dependent risk factors for wound infection after skin surgery: A systematic review and meta-analysis. *Int Wound J.* 2022 Nov;19(7):1748-1757. doi: 10.1111/iwj.13780. Epub 2022 Mar 1. PMID: 35229471; PMCID: PMC9615300.

[6] Choudhary V, Choudhary M, Bollag WB. Exploring Skin Wound Healing Models and the Impact of Natural Lipids on the Healing Process. *Int J Mol Sci.* 2024 Mar 28;25(7):3790. doi: 10.3390/ijms25073790. PMID: 38612601; PMCID: PMC11011291.

[7] Ruan H, Ran X, Li SS, Zhang Q. Dyslipidemia versus obesity as predictors of ischemic stroke prognosis: a multi-center study in China. *Lipids Health Dis.* 2024 Mar 9;23(1):72. doi: 10.1186/s12944-024-02061-9. PMID: 38461258; PMCID: PMC10924996.

[8] Jayedi A, Soltani S, Zargar MS, Khan TA, Shab-Bidar S. Central fatness and risk of all cause mortality: systematic review and dose-response meta-analysis of 72 prospective cohort studies. *BMJ.* 2020 Sep 23;370:m3324. doi: 10.1136/bmj.m3324. PMID: 32967840; PMCID: PMC7509947.

[9] Mohapatra S, Gangadharan K, Pitchumoni CS. Malnutrition in obesity before and after bariatric surgery. *Dis Mon.* 2020 Feb;66(2):100866. doi: 10.1016/j.disamonth.2019.06.008. Epub 2019 Jul 10. PMID: 31301800.

[10] Zeng, Junhao MBa; Pan, Yuyan MDa; Chaker, Sara C. BSb; Torres-Guzman, Ricardo MDb; Lineaweaver, William C. MDb; Qi, Fazhi MDa. Neural and Inflammatory Interactions in Wound Healing. *Annals of Plastic Surgery* 93(2S):p S91-S97, August 2024. | DOI: 10.1097/SAP.0000000000003933

[11] Hicks BM, Fillion KB, Yin H, Sakr L, Udell JA, Azoulay L. Angiotensin converting enzyme inhibitors and risk of lung cancer: population based cohort study. *BMJ*. 2018 Oct 24;363:k4209. doi: 10.1136/bmj.k4209. PMID: 30355745; PMCID: PMC6199558.

[12] Cheng H, Yang Z, Guo J, Zu Y, Li F, Zhao B. Association Between Weight-Adjusted Waist Index and Emphysema in Adults in the United States: A Cross-Sectional Study Involving 44,949 Participants. *Adv Respir Med*. 2024 Nov 21;92(6):472-484. doi: 10.3390/arm92060043. PMID: 39584854; PMCID: PMC11586996.

[13] Sun H, Huang J, Tang H, Wei B. Association between weight-adjusted-waist index and urge urinary incontinence: a cross-sectional study from NHANES 2013 to 2018. *Sci Rep*. 2024 Jan 4;14(1):478. doi: 10.1038/s41598-024-51216-2. PMID: 38177657; PMCID: PMC10767076.

[14] Xue R, Li Q, Geng Y, Wang H, Wang F, Zhang S. Abdominal obesity and risk of CVD: a dose-response meta-analysis of thirty-one prospective studies. *Br J Nutr*. 2021 Nov 14;126(9):1420-1430. doi: 10.1017/S0007114521000064. Epub 2021 Jan 12. PMID: 33431092.

[15] Sánchez-Bacaicoa C, Santano-Mogena E, Rico-Martín S, Rey-Sánchez P, Juárez-Vela R, Sánchez Muñoz-Torrero JF, López-Espuela F, Calderón-García JF. Association between Asymptomatic Hyperuricemia with Adiposity Indices: A Cross-Sectional Study in a Spanish Population. *Nutrients*. 2023 Nov 16;15(22):4798. doi: 10.3390/nu15224798. PMID: 38004193; PMCID: PMC10675342.

[16] Zhang X, Ma N, Lin Q, Chen K, Zheng F, Wu J, Dong X, Niu W. Body Roundness Index and All-Cause Mortality Among US Adults. *JAMA Netw Open*. 2024 Jun 3;7(6):e2415051. doi:

10.1001/jamanetworkopen.2024.15051. Erratum in: JAMA Netw Open. 2024 Jul 1;7(7):e2426540.

doi: 10.1001/jamanetworkopen.2024.26540. PMID: 38837158; PMCID: PMC11154161.

[17] Bray GA, Heisel WE, Afshin A, Jensen MD, Dietz WH, Long M, Kushner RF, Daniels SR, Wadden TA, Tsai AG, Hu FB, Jakicic JM, Ryan DH, Wolfe BM, Inge TH. The Science of Obesity Management: An Endocrine Society Scientific Statement. *Endocr Rev*. 2018 Apr 1;39(2):79-132.

doi: 10.1210/er.2017-00253. PMID: 29518206; PMCID: PMC5888222.

[18] Stefan N, Häring HU, Hu FB, Schulze MB. Divergent associations of height with cardiometabolic disease and cancer: epidemiology, pathophysiology, and global implications. *Lancet Diabetes Endocrinol*. 2016 May;4(5):457-67. doi: 10.1016/S2213-8587(15)00474-X. Epub 2016 Jan 28.

PMID: 26827112.

[19] Park Y, Kim NH, Kwon TY, Kim SG. A novel adiposity index as an integrated predictor of cardiometabolic disease morbidity and mortality. *Sci Rep*. 2018 Nov 13;8(1):16753. doi: 10.1038/s41598-018-35073-4. PMID: 30425288; PMCID: PMC6233180.

[20] Li X, Wang L, Zhou H, Xu H. Association between weight-adjusted-waist index and chronic kidney disease: a cross-sectional study. *BMC Nephrol*. 2023 Sep 11;24(1):266. doi: 10.1186/s12882-023-03316-w. PMID: 37691097; PMCID: PMC10494374.

[21] Arora, Lovkesh; Sharma, Surangama; Carillo, James F.. Obesity and anesthesia. *Current Opinion in Anaesthesiology* 37(3):p 299-307, June 2024. | DOI: 10.1097/ACO.0000000000001377

[22] Middelkoop K, Micklesfield L, Stewart J, Walker N, Jolliffe DA, Mendham AE, Coussens AK,

Nuttall J, Tang J, Fraser WD, Momand W, Cooper C, Harvey NC, Wilkinson RJ, Bekker LG, Martineau AR. Influence of vitamin D supplementation on growth, body composition, pubertal development and spirometry in South African schoolchildren: a randomised controlled trial (ViDiKids). *BMJ Paediatr Open*. 2024 Apr 10;8(1):e002495. doi: 10.1136/bmjpo-2024-002495. PMID: 38599800; PMCID: PMC11015302.

[23] Peña OA, Martin P. Cellular and molecular mechanisms of skin wound healing. *Nat Rev Mol Cell Biol*. 2024 Aug;25(8):599-616. doi: 10.1038/s41580-024-00715-1. Epub 2024 Mar 25. PMID: 38528155.

[24] Zeng J, Pan Y, Chaker SC, Torres-Guzman R, Lineaweaver WC, Qi F. Neural and Inflammatory Interactions in Wound Healing. *Ann Plast Surg*. 2024 Aug 1;93(2S Suppl 1):S91-S97. doi: 10.1097/SAP.0000000000003933. PMID: 39101856.

[25] Cioce A, Cavani A, Cattani C, Scopelliti F. Role of the Skin Immune System in Wound Healing. *Cells*. 2024 Apr 4;13(7):624. doi: 10.3390/cells13070624. PMID: 38607063; PMCID: PMC11011555.

[26] Spotnitz WD, Falstrom JK, Rodeheaver GT. The role of sutures and fibrin sealant in wound healing. *Surg Clin North Am*. 1997 Jun;77(3):651-69. doi: 10.1016/s0039-6109(05)70573-9. PMID: 9194885.

[27] Başbüyük GÖ, Ayremlou P, Saeidlou SN, Ay F, Dalkiran A, Simzari W, Vitályos GÁ, Bektaş Y. A comparison of the different anthropometric indices for assessing malnutrition among older people in Turkey: a large population-based screening. *J Health Popul Nutr*. 2021 Mar 30;40(1):13. doi:

10.1186/s41043-021-00228-z. PMID: 33785057; PMCID: PMC8011074.

[28] Zhou D, Liu X, Huang Y, Feng Y. A nonlinear association between body roundness index and all-cause mortality and cardiovascular mortality in general population. *Public Health Nutr.* 2022 Nov;25(11):3008-3015. doi: 10.1017/S1368980022001768. Epub 2022 Aug 19. PMID: 35983642; PMCID: PMC9991644.

[29] Zhang L, Yin J, Sun H, Dong W, Liu Z, Yang J, Liu Y. The relationship between body roundness index and depression: A cross-sectional study using data from the National Health and Nutrition Examination Survey (NHANES) 2011-2018. *J Affect Disord.* 2024 Sep 15;361:17-23. doi: 10.1016/j.jad.2024.05.153. Epub 2024 May 28. PMID: 38815765.