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The Impact of Body Composition on Wound Healing in Type 2 Diabetes Patients: A Systematic Review

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SYSTEMATIC REVIEW

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Body composition, Obesity, Sarcopenia, Type 2 diabetes mellitus, Wound healing

ABSTRACT

Wound healing in patients with type 2 diabetes mellitus (T2DM) presents a major clinical challenge, particularly due to alterations in body composition such as reduced muscle mass and increased fat mass. This systematic review aimed to synthesize current evidence regarding the impact of body composition on wound healing effectiveness in T2DM patients. Literature was retrieved from PubMed, ProQuest, Wiley Online Library, and Google Scholar, targeting observational and experimental studies published between 2015 and 2025. Keywords included "type 2 diabetes mellitus", "wound healing", "body composition", "sarcopenia", and "obesity". Articles were selected based on predefined inclusion and exclusion criteria. Methodological quality was assessed using the Critical Appraisal Skills Programme (CASP) checklist. A total of seven eligible studies were included and analyzed narratively. The findings from the 4 articles analyzed showed that low muscle mass (sarcopenia) and high fat mass (obesity) were associated with delayed wound healing in T2DM patients. Some studies indicate that patients with better body composition balance, such as higher muscle mass index, experience faster wound healing. Heterogeneity in measurement methods and study populations limits the strength of these conclusions. This review supports the hypothesis that body composition significantly influences wound healing outcomes in T2DM. Muscle mass reduction may impair tissue repair by limiting perfusion and immune responses, while increased fat mass may contribute to chronic inflammation that hinders tissue regeneration. Further longitudinal research with standardized assessments is needed. Interventions that promote muscle mass gain and fat mass control may be essential components in wound management strategies for diabetic patients.

Key Messages:

- Body composition, especially sarcopenia and obesity, affects wound healing outcomes in type 2 diabetes mellitus patients.
- Targeting muscle mass improvement and fat reduction may enhance wound recovery in clinical settings.
- This review addresses a research gap by systematically examining the link between body composition and wound healing in T2DM.

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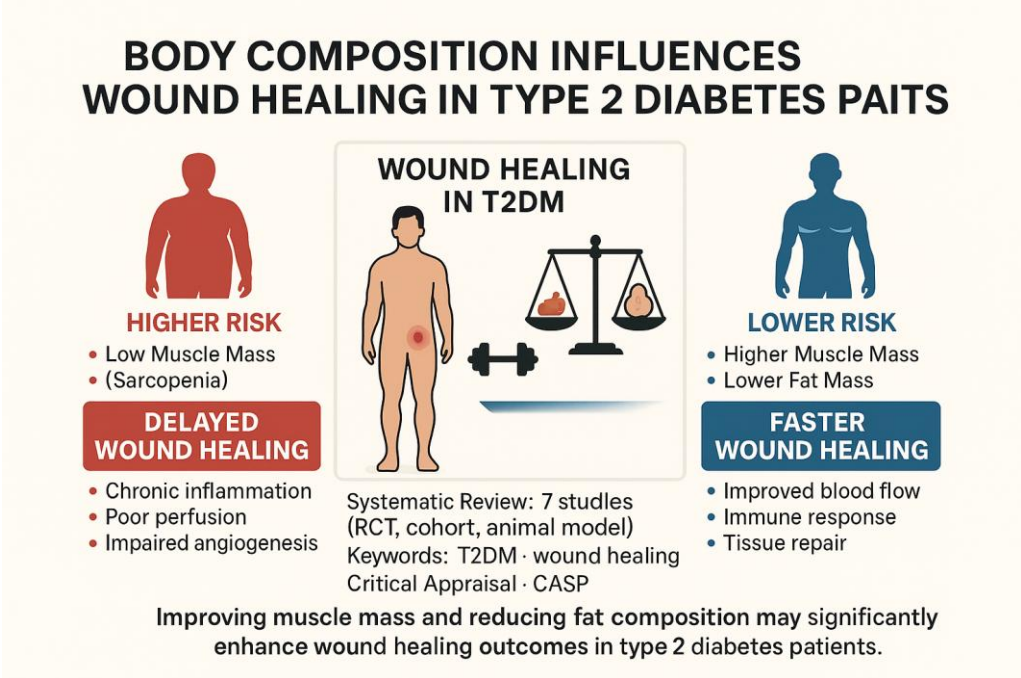
GRAPHICAL ABSTRACT



INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a chronic disease with a prevalence that continues to rise globally (1). It is associated with various complications, one of which is impaired wound healing (2–5). Patients with type 2 diabetes often experience slower wound healing (6), which is caused by several factors, including prolonged hyperglycaemia (7,8), vascular and nerve damage (9), which impair the body's ability to respond to infections and repair damaged tissue (1). While much research has focused on the impact of blood sugar levels on wound healing(7,10,11) other factors, such as body composition (8,12–14), are believed to play a significant role, yet remain largely unexplored.

Body composition, which consists of muscle mass, body fat, and water content, can affect various aspects of health, including wound healing (13,14). Some studies have shown that type 2 diabetes patients with higher muscle mass tend to have better healing capacity because muscle supports better blood circulation and glucose absorption (15–18). Conversely, patients with a body composition dominated by body fat often show slower wound healing. This may be due to higher insulin resistance and microvascular dysfunction, which hinder the delivery of oxygen and nutrients necessary for healing (19).

However, an interesting phenomenon occurs in which some patients with type 2 diabetes, despite having a proportional or ideal body weight, show highly variable results in wound healing (20–22). Some patients with a body composition dominated by body fat experience slower healing, while others with a higher muscle mass experience faster and better healing (23). This raises an important question regarding the role of body composition, beyond mere physical appearance or body weight, in determining the speed and quality of wound healing in type 2 diabetes patients.

Previous studies have examined comparative studies of body composition in patients with type 1 diabetes (14). Review studies related to body composition in patients with type 2 diabetes have not been conducted. Given these findings, it is crucial to gain a deeper understanding of the relationship between body composition and wound healing in type 2 diabetes patients to develop more targeted care strategies. Therefore, this study aims to evaluate wound healing effectiveness in type 2 diabetes patients with different body compositions and analyze how the interaction between muscle mass, body fat, and other factors influences the rate and quality of wound healing. This research is expected to provide valuable insights into more tailored management and care strategies for type 2 diabetes patients, considering not only blood sugar control but also body composition as a significant factor in wound healing.

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METHODS

The preparation of this systematic review article follows the PRISMA Checklist 2020 guidelines (24). The literature search was conducted online through four main databases: PubMed, ProQuest, Wiley Online, and Google Scholar. In formulating the research focus, the PICO framework was used, which stands for Patient, Intervention, Comparison, and Outcome, as explained by Eriksen MB (2018) (25). This approach facilitates the development of structured and focused research questions.

In the context of this review, the PICO components were formulated as follows: the study population is focused on patients with type 2 diabetes mellitus; the interventions examined include various aspects of body composition such as muscle mass, body fat, and body mass index (BMI); no explicit comparator is included in this review; and the outcome observed is the effectiveness of wound healing. To enhance the accuracy of the search, keyword selection was aligned with standard terms in MeSH (Medical Subject Headings) and adapted to the specific characteristics of each database. Several keywords used reflect terms related to the patient's condition, types of intervention, and the clinical outcomes that are the focus of the review**.** P: type 2 diabetes mellitus" OR "T2DM" OR "diabetic foot" OR "diabetic ulcer; I: body composition" OR "muscle mass" OR "fat mass" OR "BMI; C: No comparator was identified in this review article; O: wound healing" OR "ulcer healing" OR "healing rate.

The main research question addressed in this systematic review is: *How does body composition affect wound healing effectiveness in patients with type 2 diabetes mellitus?* The literature identification process was carried out through searches in four online databases PubMed, ProQuest, Wiley Online, and Google Scholar covering publications from 2015 to 2025. The initial search yielded 127 articles. After screening based on inclusion and exclusion criteria, 19 articles were deemed to meet the preliminary requirements. Two researchers then independently conducted a full-text review, resulting in the selection of 7 articles considered relevant for further analysis in this review.

The inclusion criteria consisted of articles that explicitly examined the relationship between body composition, such as muscle mass, body fat, and body mass index, and the wound healing process in patients with type 2 diabetes mellitus. Eligible studies were limited to quantitative research using designs such as clinical trials, cohort studies, or experimental animal models. Articles had to be written in either English or Indonesian and published between 2015 and 2025. Articles were excluded if they were unavailable in full text, irrelevant to the research focus, duplicates, or non-primary research such as editorials, opinion pieces, or narrative reviews. Figure 1 illustrates the process of study selection and inclusion, where a PRISMA diagram was created to illustrate the selection and inclusion process of articles in this review.

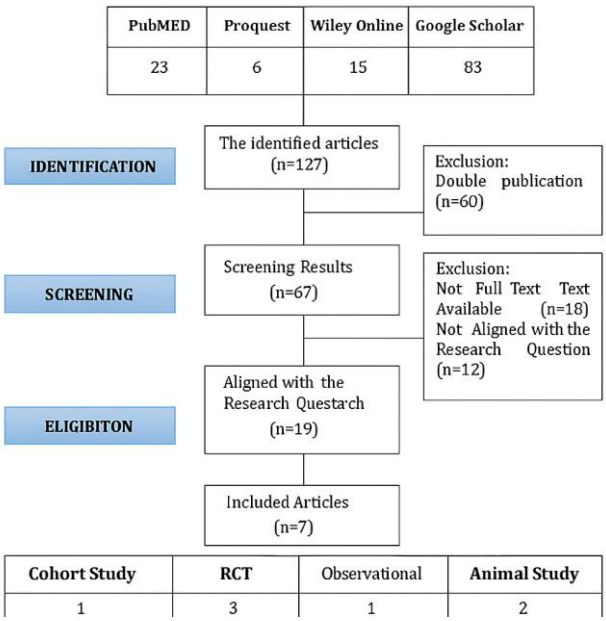

Figure 1. Flowchart illustrating the selection and inclusion process of studies.

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Table 1. Literature Synthesis of Research on Body Composition and Wound Healing Process

No	Article Title	Authors, Year	Country	Research Objective	Study Design	Population/ Sample	Body Composition	Healing Outcome	Conclusion	Study Limitations
1	Effects of Nutrition Intervention on Blood Glucose, Body Composition, and Phase Angle in Obese and Overweight Patients with Diabetic Foot Ulcers	(26)	United State	The research purpose was to examine the effects of nutrition education and supplementation on body composition in overweight and obese patients with diabetic foot ulcers.	Randomized controlled trial (RCT)	The population/sample in this study consisted of 29 overweight or obese patients between the ages of 30 and 70 years old with diabetic foot ulcers.	The body composition measures examined in this study were lean body mass and fat mass. The treatment group lost less lean body mass (3.8 kg vs. 4.9 kg) and gained less fat mass (0.9 kg vs. 3.6 kg) compared to the control group, although the differences were not statistically significant.	Although the differences in body composition between the nutrition intervention and control groups were not statistically significant, the observed changes still suggest that body composition plays a role in wound healing. The nutrition intervention group showed less loss of lean body mass and lower fat mass gain, which were clinically relevant despite lacking statistical significance.	The nutrition intervention, while not statistically significant, led to clinically relevant improvements in body composition compared to standard care alone in overweight and obese patients with diabetic foot ulcers.	The small population in the area, the impact of nutrition education or supplementation on outcome variables could not be evaluated independently. In addition, study participants were not given individual dietary recommendations. Different medications may have different effects on blood glucose concentrations and wound outcomes; however, this study did not collect data on medications used by study participants.
2	Short-Term Administration of a High-Fat Diet Impairs Wound Repair in Mice	(27)	Brasil	The research purpose was to evaluate the hypothesis that a short-term administration of a high-fat diet could affect cutaneous wound healing in mice.	randomized controlled trial (RCT).	The population/sample in this study was male C57/bl6 mice that were randomly divided into a standard diet	The factors tested were the effects of a short-term high-fat diet (60% energy from fat) compared to a standard diet (10% energy from fat) on	1) Increased inflammation, oxidative stress, and inflammatory markers in the wound 2) Delayed wound closure, increased scarring, and decreased collagen deposition 3) Negative	Short-term administration of a high-fat diet impairs cutaneous wound healing in mice.	Not mentioned

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No	Article Title	Authors, Year	Country	Research Objective	Study Design	Population/ Sample	Body Composition	Healing Outcome	Conclusion	Study Limitations
						group (10% energy from fat) or a high-fat diet group (60% energy from fat).	cutaneous wound healing in mice.	effects on wound healing, likely due to interference in the inflammatory phase of wound repair		
3	Prospective exploration of the effect of adiposity and associated microbial factors on healing and progression of diabetic foot ulcers in Tanzania: study protocol of a longitudinal cohort study	(28)	Tanzania	The research purpose is to determine the effect of adiposity and associated microbial factors on the healing and progression of diabetic foot ulcers in people with type 2 diabetes in Tanzania.	cohort study	The population and sample for this study is a prospective cohort of 300 individuals with type 2 diabetes presenting with diabetic foot ulcers (DFUs) at an outpatient clinic in Tanzania. These participants will be stratified into two groups of 150 each based on their adiposity levels (normal and high adiposity), and the two groups will be matched by age (±5 years) and sex.	The body composition measurements in this study will be conducted using bioelectrical impedance analysis (BIA) to determine the participants' percentage of body fat (%BF). Participants will be categorized into normal and high adiposity groups based on their %BF, with %BF ≥25% and ≥32% in men and women, respectively, being considered high adiposity. The two groups will be matched by age and sex.	The primary outcome of the study is the proportion of individuals with complete ulcer/wound healing at 24 weeks.	Not mentioned (the paper does not contain a "conclusion" section, as it is a study protocol describing the planned methods and objectives of a prospective cohort study that has not yet been conducted)	1) The results may not be generalizable beyond the single study site used, and will need to be validated at other centers. 2) The microbiological methods used may underestimate the full microbial burden in the diabetic foot ulcers. 3) The study may not fully capture the complex interplay between adiposity, perfusion, and the types of microbes infecting the ulcers, which could impact wound healing.
4	Adipose stem cells from type 2 diabetic mice	(29)	China	The research purpose is to compare the	Randomized controlled trial (RCT)	The population/sample in this	The T2D mice had increased adipose tissue	The healing outcomes were better in T2D mice receiving Chow	In conclusion, the authors found that while ASCs from type 2	Not mentioned

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No	Article Title	Authors, Year	Country	Research Objective	Study Design	Population/ Sample	Body Composition	Healing Outcome	Conclusion	Study Limitations
	exhibit therapeutic potential in wound healing			phenotypes and therapeutic potential of adipose stem cells (ASCs) from type 2 diabetic (T2D) mice versus healthy control mice, and to assess the ability of these ASCs to promote wound healing in a T2D mouse model.		study consisted of male C57BL/6J mice, divided into a high-fat diet (HFD) group and a standard control diet (Chow) group. The HFD group was then given a single dose of streptozotocin (STZ) to induce type 2 diabetes (T2D).	and liver weights, enlarged adipocytes in the adipose tissue and liver steatosis, as well as a dramatic decrease in pancreatic islet area compared to control mice.	ASCs compared to T2D mice receiving T2D ASCs. Specifically, Chow ASCs led to higher wound closure rates, increased numbers and lengths of epidermal sleeves indicating better re-epithelialization, and greater angiogenesis and new blood vessel formation in the wound tissue compared to T2D ASCs.	diabetic mice are slightly less effective than ASCs from healthy mice in promoting wound healing, T2D ASCs still exhibit therapeutic potential and could potentially be used for autologous stem cell therapy in humans with diabetes. arization.	
5	Lean adipose tissue macrophage derived exosome confers immunoregulation to improve wound healing in diabetes	(30)	China	The research objectives of this paper are to investigate the ability of exosomes derived from lean adipose tissue macrophages (Exos Lean) to treat chronic diabetic wounds by restoring macrophage phenotype balance.	Animal Study	The population/sample in this study consisted of diabetic db/db mice and lean, low-fat diet fed mice.	The paper does not explicitly state the "Body Composition" of the study participants. However, it indicates that the study used db/db mice as a diabetes model and low-fat diet fed mice as a lean model. The lean mice were shown to have improved insulin sensitivity, glucose tolerance, and a higher proportion of anti-inflammatory	The healing outcome in this study was that Exos Lean, but not control exosomes, accelerated wound healing in a diabetic mouse model. Exos Lean treatment reduced inflammation, increased markers of angiogenesis and M2 macrophages, and improved extracellular matrix deposition and epidermal regeneration, all of which are important for proper wound healing.	1) Exosomes derived from lean adipose tissue macrophages (Exos Lean) can improve diabetic wound healing by modulating macrophage polarization towards an anti-inflammatory M2 phenotype. 2) The mechanism by which Exos Lean improves wound healing is through increasing the expression of miR-222-3p, which then suppresses the pro-inflammatory Bim gene and leads to macrophage re-polarization. 3) The study has provided new insights into the	Not mentioned

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No	Article Title	Authors, Year	Country	Research Objective	Study Design	Population/ Sample	Body Composition	Healing Outcome	Conclusion	Study Limitations
							M2-like macrophages in their adipose tissue compared to the obese mice.		mechanisms of diabetic wound healing and identified potential therapeutic targets, such as miR-222-3p and Bim, that could be used to develop new treatments for chronic diabetic wounds.	
6	Association of Body Composition with Type 2 Diabetes: A Retrospective Chart Review Study	(31)	Taiwan	The research objectives were to analyze the body composition of individuals with type 2 diabetes (T2DM) and to examine the prevalence of low muscle mass and sarcopenic obesity in this population.	retrospective chart review	The population/sample consisted of 2404 individuals with type 2 diabetes who were at least 18 years old.	The body composition measures examined in this study were: body mass index (BMI), body fat mass (BFM), fat-free mass (FFM), visceral fat area, percent body fat (PBF), appendicular skeletal muscle mass (ASM), and skeletal muscle index (SMI).	Not mentioned (the research does not mention any "healing outcome")	Using BMI to assess obesity and determine insufficient muscle mass underestimates the prevalence of obesity and neglects the problems of sarcopenia and high body fat in people with normal BMI.	Not mentioned
7.	The effect of diabetes on the wound healing potential of adipose-tissue derived stem cells	(32)	South Korea	To investigate whether diabetes mellitus affects the wound-healing-promoting potential of adipose tissue-derived stem cells.	Animal Study	The population/sample in this study was diabetic mice, with three groups: a normal adipose stem cell group, a diabetic adipose stem cell group, and a control group.	Not mentioned	The primary healing outcome measured was the wound healing rate, which was significantly higher in the normal adipose tissue-derived stem cells group compared to both the diabetic stem cells group and the control group. Other healing outcomes like re-epithelialization, granulation tissue formation, and dermal regeneration showed similar trends, with	The conclusion is that diabetes impairs the wound-healing potential of adipose tissue-derived stem cells, though they still retain some ability to promote angiogenesis and neovascularization.	Not mentioned

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No	Article Title	Authors, Year	Country	Research Objective	Study Design	Population/ Sample	Body Composition	Healing Outcome	Conclusion	Study Limitations
								the normal stem cells group performing better. The one exception was the number of capillaries, where the diabetic stem cells group retained their ability to promote angiogenesis and neovascularization.		

Table 2. Critical Apraisal

No	CASP Question (RCT)	Basiri et al. (2022)	Schanuel et al. (2020)	Sun et al. (2020)	CASP Question (Cohort Study)	Mashili et al., 2019	CASP Question (Animal Study)	Xia et al. (2022)	(32)	CASP Question (Observational Studies)	(31)
1	Did the trial address a clearly focused issue?	Yes	Yes	Yes	Did the study address a clearly focused issue?	Yes	Is the research aim clearly stated and focused?	Yes	Yes	Did the systematic review address a clearly formulated research question?	No
2	Was the assignment of patients to treatments randomized?	Yes	Yes	Yes	Was the cohort recruited in an acceptable way?	Yes	Is the animal model appropriate for the research question?	Yes	Yes	Did the researchers search for appropriate study design(s) to answer the research question?	No
3	Were all patients who entered the trial properly accounted for at its conclusion?	Can't tell	Can't tell	Can't tell	Was the exposure accurately measured to minimise bias?	Yes	Are control and treatment groups well-structured?	Yes	Yes	Were all the relevant primary research studies likely to have been included in the systematic review?	No
4	Were patients, health workers, and study	Can't tell	No	No	Was the outcome accurately measured to	Can't tell	Is the sample size and group allocation clearly described?	Can't tell	Can't tell	Did the researchers assess the validity or methodological	No

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No	CASP Question (RCT)	Basiri et al. (2022)	Schanuel et al. (2020)	Sun et al. (2020)	CASP Question (Cohort Study)	Mashili et al., 2019	CASP Question (Animal Study)	Xia et al. (2022)	(32)	CASP Question (Observational Studies)	(31)
	personnel 'blind' to treatment?				minimise bias?					rigour of the primary research studies included in the systematic review?	
5	Were the groups similar at the start of the trial?	Yes	Yes	Yes	(a) Have the authors identified all important confounding factors?	Can't tell	Are the intervention and outcome measurements clearly described and relevant?	Yes	Yes	Did the researchers extract, and present information from the individual primary research studies appropriately and transparently?	No
6	Aside from the experimental intervention, were the groups treated equally?	Yes	Yes	Yes	(b) Have they taken account of the confounding factors in the design and/or analysis?	Yes	Are the outcome assessment methods objective and valid?	Can't tell	Can't tell	Did the researchers analyse the pooled results of the individual primary research studies appropriately?	No
7	How large was the treatment effect?	Moderate (clinical but not statistical significance)	Significant (increased inflammation, delayed healing)	Significant (improved wound healing with healthy ASCs)	(a) Was the follow up of subjects complete enough?	Can't tell	Were efforts made to minimize bias (e.g., blinding, randomization)?	Can't tell	Can't tell	Did the researchers report any limitations of the systematic review and, if so, do the limitations discussed cover all the issues you have identified during critical appraisal?	Can't tell
8	How precise was the estimate of	Low precision (not	Not stated	Not stated	(b) Was the follow up of	Yes	Were the data analyzed properly, and were results	Yes *(assumed)*	Yes *(assumed)*	Would the benefits of acting upon the results	Can't tell

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No	CASP Question (RCT)	Basiri et al. (2022)	Schanuel et al. (2020)	Sun et al. (2020)	CASP Question (Cohort Study)	Mashili et al., 2019	CASP Question (Animal Study)	Xia et al. (2022)	(32)	CASP Question (Observational Studies)	(31)
	the treatment effect?	statistically significant)			subjects long enough?		reported transparently?			outweigh any potential disadvantages, harms and/or additional demand for resources associated with acting on the results?	
9	Can the results be applied in your context?	Yes, with caution	Yes (for experimental models)	Yes (pre-clinical relevance)	What are the results of this study?	Can't tell	Can the findings be generalized to humans (translational relevance)?	Partially	Partially	Can the results of the systematic review be applied to your local population/in your local setting or context?	Yes
10	Were all clinically important outcomes considered?	Yes	Yes	Yes	How precise are the results?	Can't tell	Are any major limitations reported by the authors or apparent?	Can't tell	Can't tell	If actioned, would the findings from the systematic review represent greater or additional value for the individuals or populations for whom you are responsible?	Yes
11	Are the benefits worth the harms and costs?	Yes	Yes	Yes	Do you believe the results?	Can't tell				What is your conclusion about the systematic review – can it be used to support evidence-based decision-making?	No

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All articles that passed the selection process were critically appraised using the 2018 Critical Appraisal Skills Programme (CASP) Checklists, the 2014 evaluation tool from the Center for Evidence-Based Management (CEBMa), and the Critical Appraisal of Studies Using Laboratory Animal Models (33) (34) (35). To assess the quality and strength of the evidence of each study, the Oxford Centre for Evidence-Based Medicine (CEBM) 2009 Levels of Evidence classification was applied (36), Based on the results of critical appraisal, Table 1 shows that 7 articles analyzed are reliable, valid, and relevant to be included in this study. Among the seven included articles, three were randomized controlled trials (RCTs), categorized as level 1 to 2 evidence and graded A to B. Two articles utilized diabetic animal models to assess wound healing, classified as level 5 evidence and graded C due to their nature as non-clinical experimental studies. One article was a cohort study rated as level 2b with a grade of B, while the remaining one was a retrospective chart review categorized as observational evidence and also graded B (Table 3). Levels of evidence and levels of recommendation in research are systems used to assess the quality and strength of evidence supporting an intervention or recommendation. Levels of evidence are coded 1a-5 while levels of recommendation are A, B, C, D. Level of recommendation A with levels of evidence 1a and 1b are systematic observations, level of recommendation B with levels of evidence 2a, 2b, 3a, and 3b are cohort and case studies, level of recommendation C with level of evidence 4 is a low-quality cohort or case-control study, while level of recommendation D with level of evidence 5 is Expert opinion based on non-systematic observations of results or mechanistic studies (37). Thus, this review reflects a diversity of study designs both clinical and preclinical that collectively strengthen the conclusions regarding the relationship between body composition and wound healing in patients with type 2 diabetes mellitus.

RESULTS

Body Composition Characteristics

The body composition parameters analyzed in the studies include lean body mass, fat mass, and body mass index (BMI), as explored by Basiri R (2022)(26). Schanuel FS (2020) assessed adiposity by measuring body fat percentage using bioelectrical impedance analysis (BIA) to categorize participants based on their body fat levels (28). In the animal experimental studies, the impact of fat and muscle composition, as well as stem cell characteristics from adipose tissue, on the wound healing capacity of diabetic mice(29,30,32). Meanwhile, The distribution of skeletal muscle mass, visceral fat, and sarcopenia indicators in a large diabetic patient population, emphasizing the importance of evaluating more than just BMI to assess the risk of wound healing disturbances (31). Overall, findings from all studies affirm that both low muscle mass and high body fat proportions significantly contribute to delayed healing. Higher muscle mass supports better circulation and improved glucose metabolism, while excess body fat is associated with increased inflammation and microcirculation dysfunction, which can hinder tissue regeneration.

Table 3. Synthesis of evidence on body composition and wound healing effectiveness in patients with type 2 diabetes

Body Composition Component	Citation	Level of Evidence	Grade of Recommendation
Lean body mass, fat mass, BMI	Basiri et al. (2022)	2b	B
High-fat diet–induced adiposity	Schanuel et al. (2020)	5	C
Adipose-derived stem cells (T2DM vs. healthy)	Sun et al. (2020)	5	C
Macrophage-derived exosomes from lean adipose tissue	Xia et al. (2022)	5	C
Adipose stem cells from diabetic mice	Kim et al. (2016)	5	C
Percentage of body fat (via BIA)	Mashili et al. (2019)	2b	B
Skeletal muscle index, visceral fat area	Lin et al. (2021)	3b	B

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Wound Healing Outcomes

The wound healing outcomes reported in the analyzed studies show significant effects of body composition variations on the effectiveness of the healing process. In the study by Basiri R (2022)(26), obese patients who received nutritional interventions experienced reduced muscle mass loss and improved wound healing outcomes, although the differences were not statistically significant, they were still considered clinically meaningful. The experimental study by Lin C-L (2021) (27) showed that rats on a high-fat diet for a short period experienced increased inflammation and delayed wound closure, emphasizing the negative impact of adiposity on the early inflammatory phase of wound healing. Furthermore, Sun Y (2020) (29) demonstrated that stem cells from non-diabetic rats were more effective in accelerating epithelialization and new blood vessel formation compared to stem cells from diabetic rats. Nevertheless, stem cells from diabetic rats still showed therapeutic potential that could be utilized in wound therapy. Xia W (2022) (30) supported these findings by showing that exosomes derived from adipose macrophages of lean rats could significantly improve wound healing through mechanisms that modulate macrophages to an anti-inflammatory M2 phenotype, which plays a key role in tissue regeneration. Additionally, Kim SM (2016) (32) showed that although stem cells from diabetic rats were less effective than those from healthy rats, they still had the ability to support angiogenesis, which is crucial for wound tissue recovery.

The cohort study designed by Schanuel FS (2020) (28) aimed to compare the rate of wound healing between patients with high and normal adiposity. While the final results have not been reported due to the study still being in the protocol stage, the main outcome planned was the proportion of completely healed wounds within 24 weeks. On the other hand, Mashili F (2019) (31) highlighted the importance of a comprehensive evaluation of body composition, not just based on BMI. They found that many patients with normal BMI actually had sarcopenic obesity a combination of low muscle mass and high body fat which could increase the risk of poor wound healing. These findings emphasize that a more in-depth assessment of body composition is crucial for planning clinical interventions for type 2 diabetes patients.

DISCUSSION

This study aims to evaluate the effectiveness of wound healing in patients with type 2 diabetes based on variations in body composition, particularly the proportion of muscle mass and body fat. The key findings of this study indicate that patients with higher muscle mass and lower fat levels experience faster wound healing and better granulation tissue quality compared to patients with sarcopenia or obesity. This is shown in the study of Basiri et al. (2022) which, although not statistically significant, clinically experienced improved wound healing in the nutritional intervention group and experienced less fat mass gain and less loss of lean body mass (26). Research by Lin et al. (2021) also shows a relationship between body composition and type 2 diabetes (31). Research with mouse samples shows that giving fatty foods and giving stem cells derived from adipose tissue can interfere with wound healing potential (27,29,32), while other studies with mouse samples show wound healing using macrophage fat tissue (Exos Lean) (30).

These results align with the research by Lin et al. (2021) (31), which shows that sarcopenia significantly slows the wound healing process in type 2 diabetes patients (31). Similarly, Basiri R (2022) found that nutrition interventions focused on increasing muscle mass and healthy body composition can improve the speed and quality of diabetic wound healing, although statistical significance was not reached for some variables (26). Animal studies further support these findings by demonstrating that adipose-derived stem cells from diabetic subjects have lower regenerative potential, which impacts slower wound healing (29,30). Additionally, high fat mass has been found to trigger chronic inflammatory conditions that impair the wound healing response (28). This condition is also reinforced by findings from Dawi J (2025) (38), which state that metabolic disturbances typical of diabetes, such as hyperglycemia and insulin resistance, cause dysregulation of the inflammatory phase and worsen angiogenesis (38).

Moreover, mechanical pressure caused by excess adipose tissue and low tissue oxygenation hinders immune cell migration and granulation tissue production (39). This is exacerbated by poor peripheral vascularization, which is common in diabetic patients, especially those with central fat

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distribution (40). The impaired wound healing process in patients with suboptimal body composition can also increase the risk of complications such as infections, chronic ulcers, and amputations.

These findings are generally consistent with the classical study by Spampinato SF (2020) (2), which states that the interaction between hyperglycemia, chronic inflammation, and poor tissue perfusion leads to an imbalance in the wound healing process in diabetic patients (2). Furthermore, Lin C-L (2021)(27) found that a high-fat diet administered in a short period was enough to significantly delay wound healing in animal models. This suggests that body composition and metabolic status directly influence the dynamics of wound healing (27).

However, this review also has some limitations. Some of the studies in the synthesis are observational or case-series, which provide a lower level of evidence. The small sample sizes and lack of blinding in most studies increase the risk of bias. Additionally, some studies did not use objective tools to assess wound healing, thus questioning the validity of the results. Subjective assessments of wound conditions may also vary depending on individual perceptions and clinical standards of each institution. Wound care in patients with diabetes should not only focus on blood glucose levels but should also consider body composition especially muscle mass and fat mass. These findings imply that body composition assessment needs to be part of the clinical approach to diabetic wound management, not just blood glucose levels, and that education for patients with diabetes needs to be expanded to include the importance of maintaining muscle mass and controlling body fat, not just about a low-sugar diet (41,42). Further, more robust longitudinal studies with more robust designs (e.g., large-scale RCTs) and the use of objective tools to assess wound healing in patients with type 2 diabetes are needed. Translational research such as the development of adipose tissue stem cell therapy should continue to be explored, including in patients with diabetes. Nevertheless, the results of this analysis underscore the importance of considering body composition as an integral part of wound management in diabetes patients. Interventions aimed at improving muscle mass proportions and reducing body fat levels, whether through nutrition programs or structured physical activity, have the potential to accelerate wound healing and reduce the risk of complications.

CONCLUSION

The results of this study suggest a potential relationship between body composition specifically the proportion of muscle mass and body fat and the effectiveness of wound healing in patients with type 2 diabetes mellitus. Patients with higher muscle mass and lower body fat levels tended to show faster healing times and better quality of tissue repair. These findings suggest that body composition imbalances may contribute to impaired wound healing, possibly through mechanisms such as chronic inflammation, tissue hypoxia, and impaired angiogenesis.

However, further studies with more robust experimental designs and the use of objective measurement tools are needed to confirm causal relationships and to develop more targeted clinical guidelines. Interventions aimed at improving body composition, such as nutritional programs and physical activity, have the potential to be part of a supportive strategy in wound management in patients with diabetes, but their effectiveness still needs to be further validated.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest

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