Original Research

ASSOCIATION OF BASELINE GLYCOSYLATED HEMOGLOBIN WITH EARLY WOUND HEALING IN WAGNER GRADE 1-2 DIABETIC FOOT ULCERS: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Diabetic foot ulceration (DFU) is a prevalent, debilitating complication of diabetes, characterized by the interaction of neuropathy, ischemia, infection and persistent hyperglycaemia compromising tissue repair. Even though glycated haemoglobin (HbA1c) is a biologically valid marker of delayed healing, the strength of this association clinically varies across cohorts. In this study we assessed whether baseline HbA1c was related to short-term healing in patients with uncomplicated DFUs.

Methods: A hospital-based prospective observational study was conducted at S.N. Medical College and H.S.K. Hospital and Research Centre from March 2024 to May 2026. Fifty adults with type 2 diabetes and Wagner grade 1 or 2 DFUs were enrolled consecutively. Baseline HbA1c was determined by high-performance liquid chromatography and was classified as <7.0%, 7.0-8.0%, and >8.0%. Standardized calibrated wound pictures were analysed with ImitoMeasure at baseline and Day 14. The principal outcome was wound-healing rate in cm2/day; secondary outcomes were percentage wound area reduction and achievement of >=50% healing by Day 14.

Results: Thirty-one individuals had HbA1c <=8.0% and 19 had HbA1c >8.0%. Baseline age, ulcer duration, and ulcer area were similar between groups, whereas multiple ulcers were more frequent with HbA1c >8.0% (p=0.011), and low educational attainment was more common in the poorly controlled group (57.9% compared with 25.8%, p=0.023). The percentage wound area reduction was significantly lower in the HbA1c >8.0% group than in the HbA1c <=8.0% group (39.2% vs 54.7%, p=0.017), and fewer patients achieved >=50% healing by Day 14 (26.3% vs 54.8%, p=0.049). Continuous HbA1c correlated inversely with percentage area reduction (Spearman rho = -0.361, p=0.010). However, HbA1c was not an independent predictor in adjusted regression models.

Conclusion: More baseline HbA1c was related with reduced early relative wound contraction in Wagner grade 1-2 DFUs, particularly when healing was operationalized as percentage area reduction. The lack of a single independent multivariable marker in the study indicates that glycaemic burden may act in concert with wound burden and other host factors rather than in isolation. HbA1c is still useful as a stratification marker, but broader multicentre studies are required to arrive at clinically relevant thresholds.

Keywords: Diabetic Foot Ulcer, Hba1c, Glycaemic Control, Wound Healing, Ulcer Area Reduction, Wagner Grade.

INTRODUCTION

Due to its high prevalence, chronicity, recurrent infection, repeated hospitalization, and a substantial risk of lower-extremity amputation, diabetic foot ulcers are among the most consequential complications of diabetes mellitus [1-4]. Global syntheses estimate that a clinically meaningful proportion of people living with diabetes present with diabetic foot ulcers, and recurrence after apparent healing remains common enough that many authors now frame diabetic foot disease as a

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remitting-relapsing condition rather than a single episodic wound event [1, 2]. This burden is not only surgical and infectious, but also metabolic, vascular, social, and economic, with outcomes shaped by neuropathy, peripheral artery disease, delayed referral, impaired off-loading, and the quality of long-term glycaemic control [2-6].

The biomedical basis tying HbA1c to wound repair is solid. Chronic hyperglycaemia promotes advanced glycation end-product formation, endothelial dysfunction, oxidative stress, impaired leukocyte chemotaxis, altered fibroblast behaviour, disordered keratinocyte migration, and dysregulated inflammatory signalling [3,4]. These disturbances can plausibly cause a slowing of granulation, angiogenesis, contraction, and epithelialisation. In diabetes-related foot disease, the effect of hyperglycaemia is likely magnified because ulcer healing depends on a fragile interplay between perfusion, pressure redistribution, infection control, debridement, and host repair capacity [4-6]. Modern recommendations therefore highlight how wound healing cannot be separated from careful metabolic management, regardless of the treatment protocols performed (debridement, dressings, antibiotics, revascularisation, and off-loading) at the bedside [5,6].

Yet the clinical literature on HbA1c and diabetic wound healing remains mixed. Christman et al. reported that elevated HbA1c predicted slower healing in diabetic wounds, supporting the notion that long-term glycaemic burden influences tissue repair kinetics [7]. In contrast, Hicks et al. found no clinically meaningful overall association between baseline or prospective A1C and wound healing in a large clinic-based diabetic foot ulcer cohort, highlighting the complexity of this relationship once wound-level and treatment-related factors are considered [8]. A subsequent systematic review and meta-analysis concluded that the available observational literature was heterogeneous and insufficient to define a single universal glycaemic threshold for healing or amputation outcomes [9]. More recent work has therefore shifted from asking whether hyperglycaemia matters at all to asking under what clinical circumstances, with which endpoints, and over what duration its effect is most visible [10-13].

This distinction is important in lower-resource settings, where HbA1c is widely available, inexpensive relative to advanced imaging or perfusion testing, and attractive as a risk-stratification tool. If baseline HbA1c tracks with early healing response, it may help clinicians identify patients requiring intensified glycaemic optimization, closer wound surveillance, and more aggressive multidisciplinary follow-up. At the same time, overinterpreting HbA1c as a solitary determinant would be misleading in a disease strongly influenced by ulcer size, vascular status, pressure, infection, and care delivery [5,6,10-13].

Thus, the objective of the current study was to establish the relationship between baseline HbA1c levels and short-term wound healing outcomes in adults with Wagner grade 1 or 2 diabetic foot ulcers. Apart from investigating the basic relationship between HbA1c and healing rate, we also investigated the distribution of HbA1c in this cohort, its associations with selected demographic and socioeconomic variables, and comparative healing results for clinically relevant categories of HbA1c.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital prospective observational study performed in the inpatient and outpatient departments of S.N. Medical College and H.S.K. Hospital and Research Centre. Adult patients who presented with diabetic foot ulcers were screened consecutively during the study period and subsequently enrolled upon fulfilling the eligibility criteria. The purpose of this study was to assess the association between baseline glycosylated haemoglobin (HbA1c) levels and short-term wound-healing outcomes in diabetic foot ulcers.

Study Period and Participants

The study was carried out from March 2024 to May 2026. The study population comprised adult patients with type 2 diabetes mellitus presenting with diabetic foot ulcers of Wagner grade 1 or grade 2. All consecutive eligible patients attending the participating centres during the study period were considered for recruitment.

Sample Size

The minimum sample size was calculated to detect a correlation between HbA1c level and wound-healing rate. Sample size estimation was performed using MedCalc software. Assuming a two-tailed alpha error of 0.05 and 80% power, with a correlation coefficient of 0.55 derived from a previously published study by Hegde et al., the required sample size was estimated using the Fisher z-transformation formula:

$$N = \left(\frac{Z_\alpha + Z_\beta}{C}\right)^2 + 3$$

where

$$C = 0.5 \times \ln\left(\frac{1+r}{1-r}\right)$$

Using these assumptions, the minimum required sample size was 46. To account for possible

attrition and loss to follow-up, the final target sample size was rounded to 50 participants.

Eligibility Criteria

Patients were included if they were older than 18 years, were of either sex, had a diagnosis of diabetes mellitus with a clinically confirmed diabetic foot ulcer, had Wagner grade 1 or grade 2 ulceration, and provided written informed consent for participation and follow-up.

Patients were excluded if they had non-diabetic foot ulcers of any aetiology, diabetic foot ulcers of Wagner grade 3, 4, or 5, or failed to return for the scheduled follow-up assessment.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of S.N. Medical College and H.S.K. Hospital and Research Centre before commencement of recruitment. All participants received a detailed explanation of the study objectives, procedures, possible benefits, and minimal risks in their local language. Written informed consent was obtained prior to enrolment and before any study-related procedure, including blood sampling and wound photography. Confidentiality was maintained through anonymised study codes and secure storage of patient data.

Baseline Clinical Assessment

Demographic and clinical characteristic information was recorded during enrolment (Day 0) on a predesigned and pretested case record form. The variables used as documentation included age, sex, duration of diabetes mellitus, treatment details for diabetes where available, and duration of the index ulcer. A detailed examination of the lower limb was performed, and Wagner grade, presence of peripheral neuropathy, and evidence of peripheral vascular disease were recorded based on clinical assessment and available medical records.

Ulcer Assessment and Wound Documentation

Ulcer characteristics were assessed at baseline (Day 0) and again at follow-up on Day 14 by a qualified general surgeon. The ulcer site, shape, orientation, edge, margin, and floor characteristics, including granulation tissue, slough, necrosis, and exudate, were documented systematically.

An Android smartphone with an ImitoMeasure application was used for objective wound measurement. A green circular marker of known area (1 cm^2) was placed adjacent to the ulcer as a calibration reference before image acquisition. Standardised wound photographs were taken at both visits to provide as close to the same light, distance and angle as feasible. The software automatically determined the length, width, and area of an ulcer using calibrated images. Baseline wound area was specified with x and Day-14 wound area with y.

Microbiological Assessment

Wound discharge or deep tissue samples were collected during debridement, preferably before initiation or modification of antibiotic therapy. The samples were processed in the microbiology laboratory according to standard institutional procedures for culture and antibiotic susceptibility testing. Culture positivity, isolated organisms, and sensitivity patterns were recorded in the study dataset.

Laboratory Assessment of Glycaemic Control

On Day 0, 2 mL of venous blood was collected in an EDTA tube to estimate glycaemic status. Under standard conditions, samples were transferred to the hospital laboratory. HbA1c was determined by high-performance liquid chromatography according to the validated laboratory protocol. From HbA1c values, participants were stratified into three groups of glycaemic control: good control (<7.0%), moderate control (7.0-8.0%), and poor control (>8.0%). In the primary comparative analysis, subjects were also dichotomised as HbA1c ≤8% and HbA1c >8%.

Definition of Outcome Variables

The primary outcome was wound-healing rate, defined as the reduction in ulcer area over the follow-up period. This was calculated using the predefined formula:

$$\text{Wound-healing rate} = \frac{x - y}{15}$$

Where $x$represented the ulcer area on Day 0 and $y$represented the ulcer area on Day 14.

Additional healing outcomes included absolute wound area change, percentage wound area reduction, Day-14 residual ulcer area, and achievement of at least 50% wound healing by Day 14. Diabetic foot ulcer was defined as a full-thickness lesion distal to the ankle in a patient with diabetes mellitus. Peripheral neuropathy and peripheral vascular disease were recorded as binary clinical variables.

Data Management and Statistical Analysis

All clinical, microbiological, laboratory, and wound-morphometric data were entered into a pre-coded Microsoft Excel spreadsheet and cross-checked for completeness and internal consistency. Statistical analysis was performed using SPSS version 19.0 and R version 3.6.1.

Continuous variables were summarized as mean ± standard deviation if normally distributed and as median with interquartile range or range if distributional assumptions were not met. Categorical variables were presented as frequencies and percentages. For categorical measures, a Chi-square or Fisher's exact test was used for group comparisons. Continuous variables were compared using Student's unpaired t-test, Welch's t-test, Mann-Whitney U test, one-way analysis of variance, or Kruskal-Wallis test depending on the number of groups and distribution of data.

Since HbA1c and several wound-healing variables were non-normally distributed, correlation analyses were performed with Spearman's rank correlation coefficient where appropriate. Using clinically relevant covariates, adjusted regression models were constructed for the wound-healing rate, percentage wound area reduction, and achievement of at least 50% healing by Day 14. A two-tailed p-value of less than 0.05 was considered statistically significant for all analyses.

RESULTS

Baseline and Day-14 assessment of 50 patients constituted the analytic cohort. A substantial proportion of the sample suffered suboptimal glycaemic control: 17 patients had HbA1c <7.0%, 14 HbA1c 7.0%-8.0% and 19 HbA1c >8.0%. When dichotomized, 31 participants fell into the HbA1c <=8.0% group and 19 into the HbA1c >8.0% group. The majority in the cohort were male with the majority of ulcers being of Wagner grade 1 or 2 which demonstrated no obvious between-group imbalance in the size of wounds.

Baseline comparability was acceptable across glycaemic strata. Neither age, duration of diabetes, duration of the current ulcer nor baseline ulcer area were significantly different for the HbA1c <=8.0% and >8.0% groups. On the other hand, the participants with poorer glycaemic control displayed more ulcers at presentation, indicating higher wound burden despite similar dimension of the index ulcer. Low educational attainment was also significantly more prevalent overall for people with HbA1c >8.0%, while socioeconomic class, smoking, alcohol use, neuropathy, prior ulcer history, and prior amputation did not significantly differ. An inverse distribution was also detected for peripheral vascular disease, with more PVD reported in the HbA1c <=8.0% group.

The main healing signal showed up when outcomes were measured relatively rather than totally. While Day-14 ulcer area and absolute wound area change and wound healing rate in cm2/day did not differ significantly between HbA1c <=8.0% and >8.0%, the percentage of wound area reduction was significantly lower in patients with a HbA1c >8.0%. Similarly, the likelihood to achieve ≥50% wound healing by Day 14 was approximately halved in the poor control group. These results imply that elevated HbA1c was associated with a less meaningful short-term biological effect, even when gross morphometric features did not differentiate readily in a short follow-up period.

This interpretation was backed up by dose-response analysis. Percentage wound area reduction declined significantly across the three HbA1c groups, from the <7.0% to the >8.0% group, and post-hoc analyses indicated the strongest benefit belonged to the <7.0% category. Continuous HbA1c was also significantly negatively correlated with percentage wound area reduction, while correlations with baseline area, Day-14 area, absolute area change, and daily healing rate were low and not significant. In the adjusted regression models, baseline ulcer area—rather than HbA1c—independently predicted absolute healing rate in cm2/day, but HbA1c lost statistical significance for all multivariable endpoints. Collectively, the data suggest that worse glycaemic burden is associated with poorer early relative wound contraction, but also suggest that the association is not completely independent of coexisting wound and host factors in a modest-sized cohort.

Table 1. Baseline Demographic and Clinical Characteristics by Binary Glycaemic-Control Group

Characteristic	HbA1c <=8.0% (n=31)	HbA1c >8.0% (n=19)	p value
Age, years	50.0 [42.0-59.5]	47.0 [41.5-51.0]	0.289
Duration of diabetes, years	5.0 [2.5-8.0]	8.0 [4.0-10.0]	0.081
Baseline ulcer area, cm2	6.30 [4.10-11.05]	8.00 [5.40-9.95]	0.667
Number of ulcers	1.0 [1.0-1.0]	1.0 [1.0-2.0]	0.011
Low education (<=Primary)	8 (25.8%)	11 (57.9%)	0.023
Lower socioeconomic class	19 (61.3%)	13 (68.4%)	0.610
Neuropathy present	21 (67.7%)	13 (68.4%)	0.960
Peripheral vascular disease	17 (54.8%)	2 (10.5%)	0.002
Wagner grade 2 ulcer	20 (64.5%)	15 (78.9%)	0.280

The baseline comparability between the two binary glycaemic control groups was largely maintained, increasing the interpretability of future healing comparisons. The two significant disparities were elevated ulcer multiplicity and lower educational attainment in the HbA1c >8.0% group. Taken together, these observations imply that in this group, poorer glycaemic control is found not with regard to older age or greater presenting ulcer size, but with longer cumulative disease burden and social vulnerability.

Table 2. Short-Term Wound-Healing Outcomes by Hba1c Group

Outcome	HbA1c <=8.0% (n=31)	HbA1c >8.0% (n=19)	p value
Day-14 ulcer area, cm2	2.83 [1.51-5.82]	3.38 [2.28-5.47]	0.418
Absolute area change, cm2	3.57 [2.02-6.00]	2.62 [2.06-3.55]	0.272
Healing rate, cm2/day	0.24 [0.13-0.40]	0.17 [0.14-0.24]	0.276
Wound area reduction, %	54.70 [42.60-63.95]	39.20 [31.90-57.40]	0.017
>=50% healing by Day 14	17/31 (54.8%)	5/19 (26.3%)	0.049

If healing was expressed proportionally, rather than as raw area change the near-term effects on healing were the strongest. Patients with HbA1c >8.0% showed less median percentage wound reduction and less chance of achieving a clinically meaningful 50% response by Day 14. In contrast, absolute area change and daily healing rate in cm2/day showed only directional, non-significant differences, indicating that relative wound contraction may be the more sensitive early endpoint for metabolic effects.

Figure 1. Median percentage wound area reduction across baseline HbA1c categories

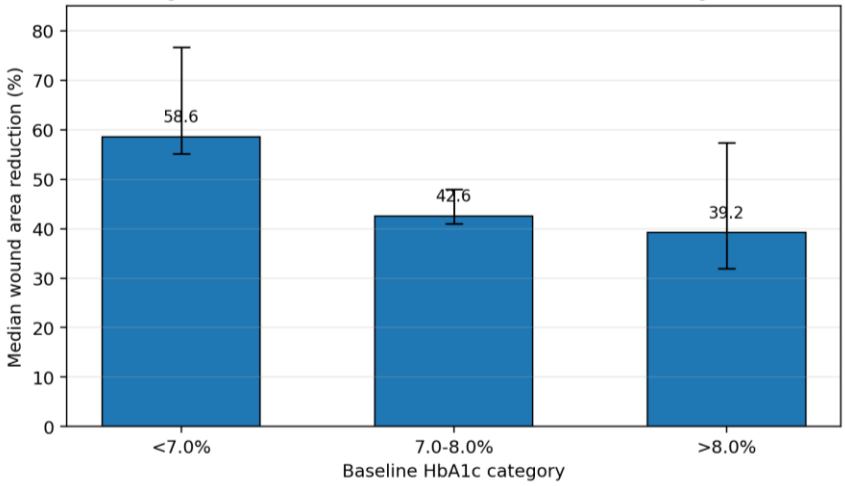


Figure 1 visually supports the dose-response signal observed in the formal analyses. Median percentage wound reduction was highest in the HbA1c <7.0% group and progressively lower in the intermediate and poorly controlled strata. The spread of interquartile values indicates some heterogeneity within each category, but the separation of the lowest-HbA1c group from the others is clinically meaningful and supports the interpretation that tighter baseline glycaemic control favored early wound contraction.

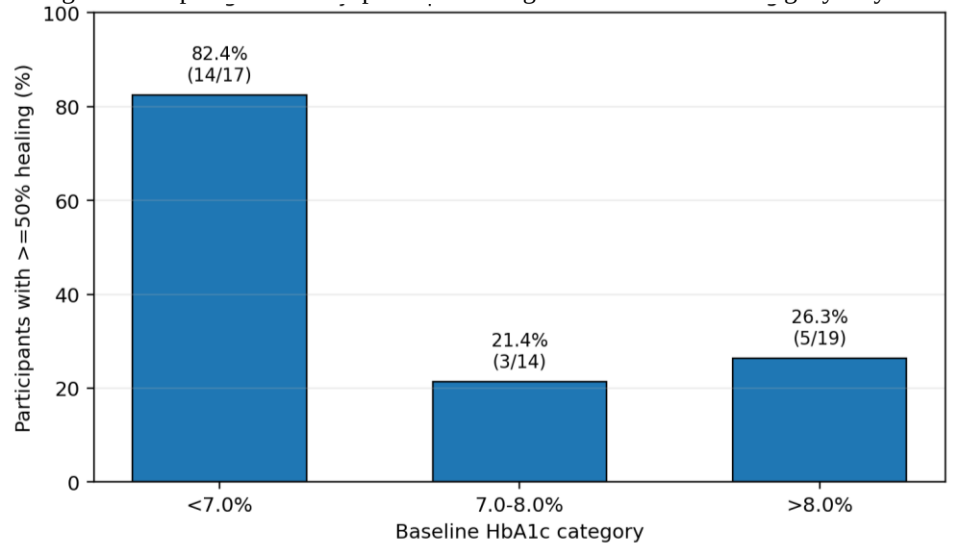
Table 3. Dose-Response Pattern of Healing Across Prespecified Hba1c Categories

Outcome	HbA1c <7.0% (n=17)	HbA1c 7.0-8.0% (n=14)	HbA1c >8.0% (n=19)	p value
Number of ulcers	1.0 [1.0-1.0]	1.0 [1.0-1.0]	1.0 [1.0-2.0]	0.028
Day-14 ulcer area, cm2	1.95 [0.85-5.18]	4.56 [2.77-6.94]	3.38 [2.28-5.47]	0.091
Healing rate, cm2/day	0.23 [0.14-0.39]	0.28 [0.13-0.39]	0.17 [0.14-0.24]	0.536
Wound area	58.60 [55.10-76.70]	42.60 [40.98-47.90]	39.20 [31.90-57.40]	0.001

reduction, %				
>=50% healing by Day 14	14/17 (82.4%)	3/14 (21.4%)	5/19 (26.3%)	Post hoc: <7% superior

A graded pattern emerged across prespecified HbA1c categories. Among the individuals measured with HbA1c <7.0%, the patient group showed the best potential healing profile (the highest median percentage wound reduction, and highest responder rate), while those with HbA1c >8.0% achieved the worst results. Intermediate group behaviour was closer to that of poorly controlled than to tightly controlled group, which would indicate that clinically relevant impairment in early wound contraction may begin before very high HbA1c values are reached.

Figure 2. Proportion of Participants Achieving >=50% Wound Healing By Day 14



Responder analysis offered a practical bedside view of outcome. More than four-fifths of patients with HbA1c <7.0% had at least 50% wound closure by Day 14, compared with roughly one-quarter of those with HbA1c 7.0%-8.0% or >8.0%. Such structure implies that a single, basic, categorical healing milestone could be a more informative measure of clinical outcomes when baseline glycaemic control is poor than a continuous change score alone.

Table 4. Correlation and Adjusted Analyses Relating Hba1c to Healing Outcomes

Analysis	Estimate	95% CI	p value
Spearman rho: HbA1c vs baseline ulcer area	0.163	-0.14 to 0.45	0.257
Spearman rho: HbA1c vs Day-14 ulcer area	0.212	-0.10 to 0.50	0.140
Spearman rho: HbA1c vs absolute area change	-0.078	-0.38 to 0.21	0.591
Spearman rho: HbA1c vs healing rate	-0.076	-0.38 to 0.22	0.600
Spearman rho: HbA1c vs wound area reduction	-0.361	-0.65 to -0.05	0.010
Adjusted linear model: HbA1c -> healing rate	beta -0.001	-0.035 to 0.034	0.976
Adjusted linear model: baseline area -> healing rate	beta 0.030	0.022 to 0.038	<0.001
Adjusted linear model:	beta -1.667	-7.511 to 4.177	0.568

HbA1c -> % area reduction			
Adjusted binomial model: HbA1c -> >=50% healing	OR 0.762	0.494 to 1.177	0.221

Continuous and adjusted analyses refined the primary association. HbA1c correlated significantly only with percentage wound area reduction, while baseline ulcer area emerged as the dominant independent predictor of absolute healing rate in regression modeling. The loss of HbA1c significance after multivariable adjustment suggests confounding and limited precision rather than complete biological irrelevance. These data support HbA1c as a pragmatic stratification marker, but not as a stand-alone determinant of early wound repair.

DISCUSSION

In this prospective observational study, higher baseline HbA1c was associated with worse early healing of diabetic foot ulcers when measured as percentage wound area reduction or by achieving at least 50% wound closure by Day 14. A significant dose-response gradient across HbA1c categories and an inverse continuous correlation between HbA1c and percentage wound reduction further supported this signal. Nevertheless, HbA1c was not independently associated with wound-healing rate, percentage reduction, or responder status after multivariable adjustment. The message is therefore nuanced: baseline glycaemic burden appeared clinically relevant in unadjusted and categorical analyses, but its effect was attenuated once wound burden and other covariates were considered.

The direction of our results is in accordance with biologic and clinical investigations that associate chronic hyperglycaemia with an impaired tissue recovery. Christman et al. demonstrated that higher HbA1c predicted slower healing in diabetic wounds [7], giving early clinical validation for the hypothesis that hyperglycaemia compromises the action of fibroblasts, angiogenesis, extracellular-matrix remodelling, and immune function. Molecular and translational reviews have further elucidated how advanced glycation, oxidative stress, persistent low-grade inflammation, and microvascular dysfunction can prolong the inflammatory phase and inhibit proliferative repair in diabetic wounds [3,4,14]. The current cohort is part of that framework: patients with poor glycaemic control showed relatively less contraction of the wound bed during a standardized 14-day period.

Our data, however, also confirm cautionary literature. In a much larger clinic-based cohort, Hicks et al. demonstrated no clinically meaningful association between baseline or prospective A1C and wound healing overall [8]. Lane and his co-authors also found that the evidence base was heterogeneous, methodologically diverse, and insufficient to warrant a universal glycaemic threshold for healing and/or amputation risk in a systematic review of observational work [9]. An evaluation of intensive glycaemic control in DFUs brought to light the practical difficulty of demonstrating a direct treatment effect from short-term glucose reduction on wound endpoints, especially when the intensity of wound care, off-loading, infection control and vascular intervention are heterogeneous across patients [10]. Our multivariable observations are consistent with these reports: when adjustment was introduced, HbA1c no longer behaved as an independent determinant.

This paradox can be explained by some characteristics of the dataset. The first, that baseline ulcer area strongly predicted absolute healing rate is not surprising since larger wounds can exhibit larger daily change in cm2 just by scale effect. Second, percentage wound reduction might represent a biologically more sensitive endpoint compared to change in raw area in this type of short-duration research as it accounts for baseline wound size and better captures proportional progress. Third, glycaemia may have a conditional, rather than universal, effect on the outcome, that could be more apparent in selected phenotypes such as uncomplicated neuropathic ulcers or early reparative response, and less apparent as ischemia, infection severity, pressure or treatment heterogeneity dominate the clinical course [5,6,8-10].

The observation that low educational level was concentrated in HbA1c >8.0% was clinically relevant. Increasingly in modern diabetic-foot literature, outcome is being considered to be influenced by not only ulcer biology but also other (social determinants, self-management, compliance, delay, and multidisciplinary care) factors [2,11,12]. Our results indicate that the disadvantage of education could be a factor influencing poor metabolic control before showing ulcers, albeit not an independent influence on short-term healing once standardized wound care started. That is of practical consideration: HbA1c ought to both be seen as a metabolic marker and a potential signal of broader care complexity.

The unexpected inverse distribution of peripheral vascular disease across glycaemic strata deserves caution. Large prospective cohorts such as EURODIALE have shown that PAD is a major determinant of non-healing and amputation risk [11], and contemporary bedside prognostic studies

continue to identify vascular insufficiency, ulcer depth, infection, smoking, and remoteness from specialist care as major adverse factors [12,13]. Our PVD pattern is therefore unlikely to represent a protective phenomenon; it more plausibly reflects referral pathways, survivor bias, or random imbalance in a small sample. The absence of a measurable short-term PVD effect on healing in this cohort should not be overinterpreted.

This study has limitations. The sample size was modest, the follow-up period was only 14 days, women were underrepresented, and only Wagner grade 1 and 2 ulcers were included, which limits generalizability to more severe disease. The multivariable models were therefore vulnerable to imprecision and overfitting, and the study was not powered to detect small independent effects across multiple correlated predictors. Nonetheless, the study also has strengths: prospective enrollment, calibrated digital wound planimetry, explicit HbA1c stratification, and clinically interpretable short-term endpoints. Future multicentre studies with longer follow-up should examine whether serial glycaemic measures, time-in-range, or HbA1c variability outperform a single baseline HbA1c in predicting complete healing, infection progression, recurrence, and amputation.

CONCLUSION

This study has limitations. The sample size was modest, the follow-up period was only 14 days, women were underrepresented, and only Wagner grade 1 and 2 ulcers were included, which limits generalizability to more severe disease. The multivariable models were therefore vulnerable to imprecision and overfitting, and the study was not powered to detect small independent effects across multiple correlated predictors. Nonetheless, the study also has strengths: prospective enrollment, calibrated digital wound planimetry, explicit HbA1c stratification, and clinically interpretable short-term endpoints. Future multicentre studies with longer follow-up should examine whether serial glycaemic measures, time-in-range, or HbA1c variability outperform a single baseline HbA1c in predicting complete healing, infection progression, recurrence, and amputation.

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