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Low Muscle Mass Is a Risk Factor for Type 2 Diabetes Among Cameroonian Adults

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Abstract

Background: Obesity is well established as a risk factor for type 2 diabetes (T2D). However, few studies have explored the association between body composition components and the risk of developing T2D. This study investigates the relationship between low muscle mass and the risk of T2D.

Methods: We conducted a cross-sectional study on 333 Cameroonian adults. Diabetes risk was assessed using the Findrisc score, while body composition was measured using bioelectrical impedance analysis. Low muscle mass was defined as an appendicular skeletal muscle mass index (ASMI) < 7 kg/m² in men and < 5.5 kg/m² in women. Data were analyzed using R software. Pearson's correlation coefficient and univariate and multivariate logistic regressions were used to assess the association between low muscle mass and the risk of T2D.

Results: The mean age of participants was 47±13 years, with a female predominance (63% vs. 37%). A positive correlation was observed between ASMI and the Findrisc score (R = 0.31, p = 0.02). Participants with low muscle mass had a 2.14 times higher risk of developing T2D compared to those with normal muscle mass (95% CI: 0.57–8.84, p = 0.002).

Conclusion: Individuals with low muscle mass have an increased risk of T2D, highlighting the importance of body composition in diabetes prevention. Muscle mass assessment should be integrated into screening and prevention strategies, particularly for at-risk populations

Keywords: Muscle mass, Type 2 diabetes, Findrisc score, Bioelectrical impedance analysis

Introduction

Type 2 diabetes (T2D) is a metabolic disorder characterized by chronic hyperglycemia due to insulin resistance and/or impaired insulin secretion (1). It is the most common form of diabetes and represents a major public health concern, particularly in developing countries (2). Traditional risk factors include obesity, sedentary lifestyle, hypertension, and family history (1). However, body composition is increasingly being recognized as a potential risk factor due to the distinct metabolic roles of adipose tissue and muscle mass (3). On one hand, excessive accumulation of adipose tissue, particularly in the visceral region, is well established as a risk factor for T2D (4). On the other hand, muscle mass plays a crucial role in insulin sensitivity and glucose oxidation (5). A low level of muscle mass could therefore exacerbate insulin resistance and consequently increase the risk of T2D (6–8). The underlying

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molecular mechanisms include altered insulin signaling, the role of pro-inflammatory cytokines released by adipose tissue, and reduced glucose uptake by muscle cells (9). Thus, an imbalance between excess fat and insufficient muscle mass could amplify metabolic dysfunction and increase the risk of T2D.

Despite this evidence, few studies in sub-Saharan Africa, and particularly in Cameroon, have specifically explored the relationship between muscle mass and the risk of developing T2D (10). Most research has focused on overall or visceral obesity, often neglecting the muscular component. However, genetic, environmental, and nutritional specificities in Cameroon could influence how body composition affects glucose metabolism. It is therefore crucial to address this gap and understand how low muscle mass may contribute to the risk of T2D in this context. This study aims to assess the association between low muscle mass and the risk of type 2 diabetes in Cameroonian adults, to better understand the potential mechanisms and guide prevention strategies targeting body composition.

Materials and Methods

Study design

Our study is part of the strategies for preventing type 2 diabetes (T2D) by investigating potential new risk factors, such as low muscle mass, which have rarely been studied in the Cameroonian context. This is particularly relevant as the epidemiological markers of T2D (prevalence, incidence, mortality rate) are steadily increasing. Ethical approval (No. 2024/1626) was granted by the Ethics Committee of the Douala Gyneco-Obstetric and Pediatric Hospital, and the study was conducted during the 2024 World Diabetes Day at this hospital.

Study participants and procedures

The study included adult Cameroonians of both sexes who attended the hospital for activities related to the 2024 World Diabetes Day, such as free T2D screening, awareness campaigns on prevention strategies, and sports walks. In Cameroon, the majority of the population is not well informed about T2D prevention strategies. Events like World Diabetes Day provide an opportunity for the Ministry of Public Health to organize media-driven awareness campaigns, attracting large crowds to health facilities for free diabetes screening. Within this context, our sample consisted of 333 adults who voluntarily agreed to participate in the study.

Data collection

Participants who consented to the study during World Diabetes Day activities completed a questionnaire assessing diabetes risk and body composition, assisted by a doctor or nurse to ensure data quality. Diabetes risk was assessed using the FINDRISC (Finnish Diabetes Risk Score) (11), which consists of a series of questions covering clinical and sociodemographic parameters, including age, BMI, waist circumference, physical activity level, dietary habits (fruit and vegetable consumption), family history of diabetes, and previous high blood glucose levels. Each response was assigned a specific score, and the total classified individuals into different risk levels: Low risk (score 0–11, risk ≈ 5%), High risk (score ≥ 15, risk ≈ 33%), and Diabetic within the next 10 years (score ≥ 20). Only participants with a high-risk score (≥ 15) were included in our study. Height and weight were measured following standardized World Health Organization (WHO) techniques (12). Height was recorded to the nearest 0.1 cm using a stadiometer, while weight was measured with participants wearing light clothing using a floor scale. Body Mass Index (BMI) was calculated as weight (kg) divided by height (m^2). Body composition values were obtained using bioelectrical impedance analysis (BIA) (13). The device was calibrated following standard operating procedures (14). Participants removed their shoes and jewelry before stepping onto the device, ensuring both feet were correctly placed on the designated electrodes. The Appendicular Skeletal Muscle Mass Index (ASMI) was calculated as ASM (kg) divided by height (m^2) (15), and low muscle mass was defined as ASMI <7 kg/m^2 in men and <5.5 kg/m^2 in women (16).

Statistical analysis

Data were analyzed using R software version 4.4.2 for Windows. Continuous data were assessed for normality using Shapiro-Wilcoxon tests, and descriptive statistics were reported as means ± standard deviation (SD) for parametric data, and frequencies and percentages for categorical data. Group differences were analyzed using the Wilcoxon rank-sum test for independent non-parametric data and Pearson's chi-square test for categorical data. To determine the association between muscle mass and diabetes risk, we performed Pearson's correlation coefficient analysis, along with univariate and multivariate logistic regressions. The null hypothesis confidence interval was set at 95%, with a 5% margin of error, and a p-value < 0.05 was considered statistically significant.

General Characteristics of the Study Population

Patients at risk of type 2 diabetes (T2D) were older (53±10 years vs. 40±12 years) and heavier (91±14 kg vs. 86±17 kg), with significant differences ($p < 0.001$ and $p = 0.003$, respectively). Their muscle mass was also lower (27.9±5.6 vs. 29.6±6.9; $p = 0.003$). However, BMI and ASMI did not differ significantly between groups ($p = 0.051$ and $p = 0.082$). There were no significant differences in sex distribution and daily physical activity practice ($p > 0.3$ and $p > 0.9$) (Table 1).

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Table 1: General characteristics of the study population.

Characteristic	Type 2 diabetes risk			
	Overall (N = 333)	No (N = 161)	Yes (N = 172)	p-value
Age (Years)	47±13	40±12	53±10	**<0.001*** **
Gender				0.3
Female	210 (63%)	96 (29%)	114 (34%)	
Male	123 (37%)	65 (20%)	58 (17%)	
Weight	89±15	86±17	91±14	**0.003****
BMI	29.2±5.3	28.7±5.7	29.7±4.8	0.051
Muscle Mass	28.8±6.3	29.6±6.9	27.9±5.6	**0.003****
ASMI	7.15±1.45	7.00±1.56	7.29±1.33	0.082
Daily Physical Activity Practice				>0.9
No	209 (63%)	102 (31%)	107 (32%)	
Yes	124 (37%)	59 (18%)	65 (20%)	

BMI: Body Mass Index; ASMI: Appendicular Skeletal Muscle Mass Index. The data are presented as frequencies and percentages. P-value: The Wilcoxon rank sum test and Pearson's Chi-squared test were performed to compare the different characteristics between patients at risk or not at risk of diabetes. For these tests, the confidence interval for the null hypothesis was set at 95%, and the margin of error at 5% (p is considered significant at p < 0.05).

Analysis of the Potential Relationship Between ASMI and Diabetes Risk

Figure 1 illustrates the correlation analysis between diabetes risk, as assessed by the FINDRISC score, and the appendicular skeletal muscle mass index (ASMI). A positive trend was observed (R = 0.31, p = 0.02), indicating that an increase in ASMI appears to be associated with an increase in the FINDRISC score. This suggests a potential relationship between muscle mass and diabetes risk, although the extent and significance of this correlation require further analysis (Figure 1).

Verification of the Association Between Muscle Mass and Type 2 Diabetes Risk

The results of the logistic regression analysis examining the association between muscle mass and T2D risk show that, in the univariate analysis, individuals with low muscle mass had a significantly higher risk of developing T2D compared to those with normal muscle mass (COR = 1.82, 95% CI: 1.16–2.87, p = 0.009). However, after adjusting for other factors in the multivariate analysis, the association remained significant, with an adjusted odds ratio (AOR) of 2.14 (95% CI: 0.57–8.84, p = 0.002). Moreover, ASMI was not significantly associated with T2D risk, neither in the univariate analysis (p = 0.063) nor in the multivariate analysis (p = 0.45). These results suggest that low muscle mass is independently associated with an increased risk of type 2 diabetes (Table 2).

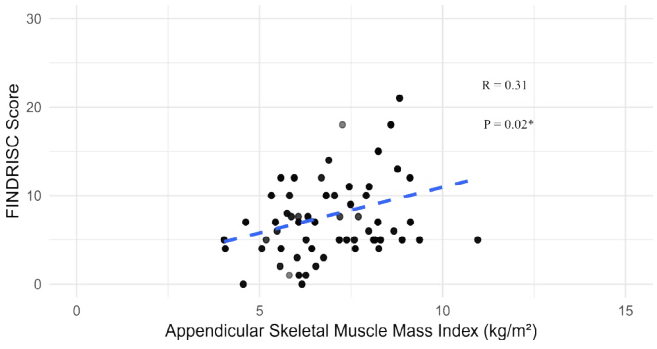

Figure 1: Relationship between appendicular skeletal muscle mass index and diabetes risk

Discussion

The results of our study highlight a strong association between low muscle mass and an increased risk of type 2 diabetes (T2D) among Cameroonian adults. Participants with low muscle mass had more than twice the risk (AOR = 2.14) of developing T2D compared to those with normal muscle mass, after adjusting for relevant variables. Additionally, the positive correlation (R = 0.31, p = 0.02) between the appendicular skeletal muscle mass index (ASMI) and the Findrisc risk score suggests that ASMI contributes significantly to the assessment of T2D risk in this population. Several pathophysiological mechanisms could explain these findings. First, skeletal muscle is the primary site for glucose uptake under insulin action, and any reduction in muscle mass may impair this capacity, thereby facilitating insulin resistance (3,17,18). Second, muscle mass loss is often accompanied by an increase in adipose tissue, particularly visceral fat, which is associated with a pro-inflammatory environment and further deterioration of insulin sensitivity

(4,19,20). Moreover, chronic inflammation, cytokine secretion, and impaired insulin signaling in muscles could further exacerbate glycemic dysregulation (3). In Cameroon, as in many low- and middle-income countries, nutritional transition and sedentary lifestyles have led to a double burden: an excess of fat mass and a reduction in muscle mass (10). This situation complicates T2D prevention efforts, given the genetic and cultural specificities of African populations, which may influence the distribution of fat and muscle mass.

Strengths and Limitations of the Study

One of the major strengths of our study is the simultaneous assessment of T2D risk using the Findrisc score and body composition using bioelectrical impedance analysis (BIA), allowing for a more comprehensive analysis of the relationship between muscle mass and T2D risk. However, the cross-sectional design prevents us from establishing causality. Furthermore, although the Findrisc score is validated in various contexts, it remains a risk indicator and does not replace clinical or biological diagnoses (such as the oral glucose tolerance test or HbA1c). Finally, our sample of 333 participants is relatively small for representing the diversity of the Cameroonian population, and larger studies would be needed to confirm and generalize these findings.

Perspectives and Implications

Our study findings support the integration of muscle mass assessment into T2D risk screening strategies, particularly in resource-limited settings. Interventions aimed at maintaining or increasing muscle mass—such as strength training and improving protein intake—could help reduce the prevalence and complications of T2D. Further longitudinal or experimental studies would help clarify causal pathways and identify targeted preventive interventions.

Conclusion

Overall, our study provides new insights into the role of body composition, particularly muscle mass, in the risk of developing T2D among Cameroonian adults. The results suggest that considering only excess weight is insufficient and that an approach that includes the preservation or enhancement of muscle mass is essential for more effective T2D prevention in this population.

Ethical Approval and Consent to Participate

Our study was reviewed and approved by the Institutional Ethics Committee of Douala Gynaeco-Obstetric and Pediatric Hospital (N°2024/1626/HGOPED/DG/CEI). Written informed consent for participation in this study was obtained from each participant. Given that our study involved experiments on human subjects and/or the use of human tissue samples, we confirm that all experiments were conducted in accordance with applicable guidelines and regulations.

Consent for publication: Not applicable

Availability of Data and Materials

The data used in this study can be made available upon request by the reviewers

Competing interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be interpreted as a potential conflict of interest.

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Author's Contributions

MEND and NMWS conceptualised the study, designed the experimental approach, and developed the writing plan. MEND, NBV, MA and OS were responsible for participant recruitment and laboratory analyses. Statistical analysis was performed by NMWS. MEND drafted the initial manuscript, while OS and CSP critically reviewed and revised it. All authors made substantial, direct, and intellectual contributions to the work and approved the final version of the manuscript for publication.

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