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Undiagnosed Diabetes and Insulin Resistance Hidden Behind Self-Report in Libyan Adults

Salmah Zaydan Zaydan[a]*, Salem Hasn Abukres[b,c]

[a] Zletin Medical Center, Zletin, Libya

[b] Faculty of Pharmacy, Elmergib University, Al Khums, Libya

[c] Faculty of Pharmacy, Alasmarya University, Zletin, Libya

* Corresponding author email: zsalma553@gmail.com

ABSTRACT

Background: Self-reported diabetes status is often utilized in epidemiologic surveys but may misclassify glycaemic status and metabolic risk. Aim: To assess consensus between pre-test self-reported diabetes status and laboratory-confirmed HbA1c and insulin resistance classifications in a Libyan adult sample.

Methods: Cross-sectional secondary analysis of N = 223 adults enrolled in a HOMA-IR cutoff study in Zletin, Libya. Participants replied a pre-sample questionnaire item ("Do you have diabetes?": Yes / No / Don't know) and gave blood for HbA1c and biochemical IR classification (HOMA-IR–based categories). HbA1c was classified as Normal (<5.7%), Prediabetic (5.7–6.4%), and Diabetic (≥6.5%). Cross-tabulations, Pearson chi-square, and Spearman rank-order correlation were used to examine associations; significance set at $p < 0.05$.

Results: The findings of our study, based on the questionnaire, were as follows: Self-report: 20.6% Yes, 76.7% No, 2.7% Don't know. And lab-confirmed HbA1c test; HbA1c classification: 50.7% Normal, 26.5% Prediabetic, 22.9% Diabetic. Cross-tabulation showed 84.8% of self-reported diabetics had diabetic-range HbA1c; 4.1% of those denying diabetes had diabetic-range HbA1c; 83.3% of "Don't know" respondents were diabetic by HbA1c. High IR was present in 73.9% of self-reported diabetics and 46.8% of those denying diabetes. Pearson chi-square clarified a significant association between self-report and IR levels ($\chi^2 = 18.861$, df = 6, $p = 0.004$). Spearman correlation showed a marginal negative association ($\rho = -0.131$, $p = 0.051$).

Conclusions: Our study found that self-reported results are consistent with the biomarkers of most individuals diagnosed with diabetes. However, a significant proportion particularly those who deny or are unsure of their diabetes have undiagnosed diabetes or high insulin resistance. It is likely that some self-reported diabetic patients with normal HbA1c levels actually have well-controlled diabetes. Regular biomarker monitoring and careful risk assessment are recommended.

Keywords: Diabetes; HbA1c; Insulin resistance; Self-report; Libya

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1. Introduction

Accurate verification: of diabetes status at the population level supports effective clinical management, surveillance, and resource planning. Many large surveys are relying on a single self-report item to identify people with diabetes because it is inexpensive and easy to administer; however, self-report may underestimate true prevalence by missing undiagnosed cases and may misclassify people with well-controlled disease or limited health literacy, producing biased estimates of disease burden [1,2]. Validation studies from various settings report variable sensitivity and high specificity for self-reported diabetes, with sensitivity depending on local screening practices, access to care, and the diagnostic criteria used for biomarker confirmation. For example, The Atherosclerosis Risk in Communities (ARIC) [3] study confirms that self-reported diabetes demonstrates high specificity (95.6%–96.8%) but variable sensitivity (58.5%–70.8%), with accuracy heavily dependent on the diagnostic criteria used for verification. Furthermore, the study notes that, in addition to diagnostic criteria, sensitivity is influenced by access to care and local screening practices, which can increase reporting accuracy. This may lead to error associated with the use of self-reported diabetes versus diabetes defined by biomarkers and medication use [3].

Biochemical tests give extra information that fits together to support diagnoses. For example, HbA1c reflects average glycaemia over a three months period and it is accepted for diagnosis and monitoring using standard thresholds (normal, prediabetes, diabetes) [4]. Insulin resistance estimated from fasting insulin and glucose using the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR) model identifies early metabolic dysfunction that often occurs before hyperglycaemia and clinical diagnosis; HOMA-IR is useful in epidemiologic studies to detect risk subgroups even when HbA1c alone is not used as diagnostic test [5]. Because HbA1c and HOMA-IR measure different pathophysiologic stages (glycaemic exposure versus insulin sensitivity) discordance between self-report, HbA1c, and HOMA-IR is expected.

Previous validation study shows that a small fraction of individuals who deny diabetes have biomarker-confirmed disease, and conversely some self-reported cases have biomarker values below diagnostic thresholds due to successful treatment or measurement timing [3]. Few studies, however, combine self-report, HbA1c, and HOMA-IR categories in a single sample, and there is a paucity of such evidence from North Africa and Libya specifically—regions where screening coverage and health-system access may differ from other settings. Understanding discordance in Libyan adults therefore informs local screening priorities, interpretation of survey-based prevalence estimates, and targeted public-health interventions.

Aim: Using data from a HOMA-IR cutoff study in Zliten, Libya, we quantify concordance between a single pre-test self-report item and laboratory HbA1c and HOMA-IR-based IR categories, explore likely causes of discordance (undiagnosed disease, well-controlled treated diabetes, measurement timing), and discuss implications for screening and public-health policy in the Libyan context.

2. Methods

Study Design and Setting

This analysis is a secondary cross-sectional evaluation of data collected as part of the parent study titled Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) cut-off value of a sample of Libyan population (unpublished). The parent study recruited adults in Zletin, Libya and conducted from December 2023 to December 2024 to determine HOMA-IR thresholds appropriate for the local population; our current paper uses the questionnaire and laboratory data collected prior to publication of the parent study results. Ethical approval for the

* Corresponding author email: zsalma553@gmail.com

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parent study and this secondary analysis was obtained from the Ethics Committee of Zliten Medical Centre (PH12-2023). All participants provided written informed consent.

Study Population

Adults enrolled in the parent HOMA-IR study who completed the pre-specimen questionnaire and provided blood samples were included (N = 223).

Inclusion Criteria

To create a homogeneous and reliable dataset, strict inclusion criteria were applied:

Age Range: 18–90 years (chosen to capture the full spectrum of adult metabolic profiles, including age-related physiological changes).

Fasting Status: Participants were required to undergo ≥12 hours of fasting before blood sample collection. This was essential to ensure accurate measurements of metabolic parameters such as fasting plasma glucose and fasting plasma insulin.

Exclusion Criteria

To ensure data accuracy, a thorough clinical medical examination and appropriate tests (such as pregnancy tests and CRP tests) were used to exclude cases with one or more of the following conditions:

1. Acute Infections: acute infections (such as bacterial or viral conditions) can temporarily alter metabolic markers, leading to misleading conclusions. Samples with elevate C-reactive protein were excluded.
2. Pregnancy: pregnancy induces significant hormonal changes, which would affect glucose metabolism independently of IR mechanisms.
3. Patients with chronic metabolic disorders: conditions such as chronic kidney disease, thyroid disorders, and adrenal insufficiencies can significantly affect glucose regulation, lipid metabolism, and insulin sensitivity.
4. Patients currently use medications that may affecting glucose such as glucocorticoids (increase hepatic glucose release and decrease insulin sensitivity).

Data Collection and measures

Self-reported diabetes status: The questionnaire included a single question asked immediately before blood was drawn: "Do you have diabetes?" with answer options of yes, no, and don't know. No additional questions about treatment or its duration were collected in the questionnaire used for this analysis.

HbA1c: It was measured in the study laboratory using an Architect i1000SR analyzer (Abbott Laboratories, USA) and a Mindray BS240 Pro system and classified according to standard thresholds: normal (<5.7%), pre-diabetic (5.7-6.4%), diabetic (≥6.5%).

Insulin resistance: It was calculated using the balanced model assessment equation (HOMA-IR) and classified as normal, low, medium, and high insulin resistance according to the thresholds defined in the original (unpublished) HOMA-IR cutoff study.

Descriptive statistics summarized participant characteristics, self-reported diabetes status, HbA1c categories, and IR levels. Cross-tabulations compared self-report with HbA1c categories and insulin resistance levels. Pearson chi-square was used to test the relation between categorical variables; Spearman's rank correlation coefficient assessed the ordinal relationship between self-reported diabetes status (no → don't know → yes) and insulin resistance level (normal, low, moderate or high). Statistical significance was set at $p < 0.05$. Statistical analyses were performed using IBM SPSS Statistics (Version 23).

* Corresponding author email: zsalma553@gmail.com

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3. Results

Demographic data: the majority of sample were females (76.2%), average age was 38.4 years and ranged from 20-80 years. See Table (1) for more details.

Table 1. Demographic data

Gender	Frequency (%)	Age average
Male	53(23.8)	39.1
Female	170(76.2)	38.2

Self-reported diabetes prevalence

Regarding the prevalence of self-reported diabetes, the majority of participants (76.7%, n=171) indicated they did not have the disease. However, 20.6% (n=46) reported a history of diabetes, while a small minority (2.7%, n=6) were unsure of their status.

Based on HbA1c levels, approximately half of the study participants (50.7%, n=113) were classified as having normal blood sugar levels (<5.7%). Prediabetes (5.7-6.4%) was diagnosed in 26.5% of participants (n=59), while 22.9% (n=51) met the clinical criteria for diabetes (≥6.5%).

Cross-tabulation: Self-report vs HbA1c

Cross-analysis of self-reported data with laboratory-confirmed HbA1c test results reveals a significant gap in diabetes awareness and management among study participants. While 84.8% of those who reported having diabetes were confirmed to have the condition based on elevated HbA1c levels, a substantial proportion of the "not diabetic" (29.8%, n=51) and "don't know" (16.7%, n=1) groups were identified as prediabetic, representing a high-risk group unaware of their metabolic status. Importantly, the data highlight a clear problem with undiagnosed cases: 4.1% (n=7) of those who believed they were healthy and 83.3% (n=5) of those who were unsure met the clinical criteria for diabetes (HbA1c 6.5%), suggesting that laboratory testing is necessary to complement self-reporting and obtain accurate estimates of disease prevalence. See Table 2.

Table 2. Diabetes Status by Self-Reported Diagnosis (N = 223)

Self-Reported DM Status	Normal HbA1c (<5.7%)	Prediabetic HbA1c (5.7–6.4%)	Diabetic HbA1c (≥6.5%)	Total n (%)
Yes DM	0 (0.0%)	7 (15.2%)	39 (84.8%)	46 (20.6%)
No DM	113 (66.1%)	51 (29.8%)	7 (4.1%)	171 (76.7%)
Don't know	0 (0.0%)	1 (16.7%)	5 (83.3%)	6 (2.7%)
Total	113 (50.7%)	59 (26.5%)	51 (22.9%)	223 (100%)

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Insulin resistance distribution by self-report

The analysis reveals a widespread prevalence of insulin resistance even among participants who reported not having diabetes. Specifically, nearly half of the "non-diabetic" group (46.8%, n=80) were found to have high insulin resistance, while an additional 22.8% (n=39) showed moderate levels, suggesting that a significant proportion of this group is at high metabolic risk despite their self-reported status. In contrast, those who were aware of their diabetes exhibited the highest percentage of severe resistance (73.9%, n=34), while 100% of those in the "don't know" category fell within the high insulin resistance range. Overall, more than half of all study participants (53.8%) exhibited high insulin resistance, highlighting a significant public health concern regarding early metabolic dysfunction in this population.

Table 3. Distribution of Insulin Resistance Levels by Diabetes Status (N = 223)

Self-Reported DM Status	Normal insulin resistance	Low insulin resistance	Moderate insulin resistance	High insulin resistance	Total (n)
Yes DM	6 (13.0%)	0 (0.0%)	6 (13.0%)	34 (73.9%)	46
No DM	28 (16.4%)	24 (14.0%)	39 (22.8%)	80 (46.8%)	171
I don't know	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (100%)	6
Total	34 (15.2%)	24 (10.8%)	45 (20.2%)	120 (53.8%)	223

Statistical tests

Pearson's chi-squared test: ρ = −0.131, p = 0.051 — A statistically significant association exists between self-reported diabetes status and insulin resistance levels. Spearman's rank correlation coefficient: ρ = −0.131, p = 0.051 — A marginally negative correlation, indicating a weak trend where increased self-reported diabetes status is associated with increased insulin resistance.

4. Discussion

A substantial and concerning finding of our study is the presence of undiagnosed diabetes and elevated metabolic risk among participants who denied or were unsure about having diabetes. Although most self-reported diabetics were biochemically confirmed and showed high insulin resistance, the more critical signal is that 4.1% of those who said “No” had diabetic-range HbA1c and nearly half of this subgroup exhibited high insulin resistance, while 83.3% of the “Don’t know” respondents were diabetic by HbA1c. These discordant, previously unrecognized cases represent missed opportunities for early intervention and prevention and indicate that reliance on self-report alone may undercount accurate disease burden and may cause delay of treatment for people who are at high metabolic risk [1,2,3].

The biological pathway from insulin resistance includes progressive insulin resistance combined with pancreatic β-cell dysfunction increases the chance of developing hyperglycaemia and actual diabetes [5]. Obesity, overweight and higher body mass index are major drivers of both insulin resistance and the rising prevalence of diabetes, through mechanisms that include adipose-driven inflammation and

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altered insulin signalling [4,5]. Because insulin resistance typically precedes hyperglycaemia, the high insulin resistance prevalence among participants who denied diabetes suggests many individuals at pending risk of progression; targeted biochemical screening, for example, HbA1c or HOMA-IR testing in adults with risk factors, and community education should therefore be prioritized to detect and manage these hidden conditions before complications arise [5].

A subset of participants who reported having diabetes but had normal HbA1c levels likely represents individuals with good glycaemic control. For example, those using effective drug therapy, following healthy lifestyle, and/or adhering to treatment. Because HbA1c reflects average blood glucose over the preceding two to three months, treated patients may have values below diagnostic thresholds despite a clinical diagnosis of diabetes. Therefore, a normal HbA1c in a person with known diabetes should be interpreted as evidence of disease control rather than absence of disease, and single HbA1c measurements should not be used to reclassify a prior clinical diagnosis without the appropriate measures [6,7].

The observed pattern, high prevalence of undiagnosed diabetes and elevated insulin resistance among those who said that they do not have diabetes, has important clinical consequences. For instance, prolonged, undetected hyperglycaemia accelerates microvascular and macrovascular damage; chronic kidney disease is a well-documented complication of delayed diagnosis and prolonged hyperglycaemia [8]. Local Libyan research confirms this, identifying metabolic risk factors; mainly diabetes and hypertension, as leading drivers of a significant, rising burden of renal disease in the population [9]. From a surveillance viewpoint, our results indicate that surveys relying solely on self-report will underestimate true prevalence and metabolic risk, particularly in settings with incomplete screening coverage or variable health literacy [1,2].

Policy implications of our study include: integrating routine biochemical screening (HbA1c) or risk-based targeted testing into primary care and community outreach. Especially, for adults with risk factors such as elderly, elevated body mass index, family history, or hypertension, would improve early detection and enable earlier intervention [3,6]. Public-health programs should also stress education about diabetes risk and the importance of diagnostic tests.

Future research in Libya should examine barriers to screening and diagnosis, evaluate cost-effectiveness of targeted biochemical screening strategies, and monitor trends in undiagnosed disease as screening programs expand.

Limitations

There are numerous limitations of our study. The representativeness of the sample may be limited by the study population and setting; therefore, generalizing the results to all Libyan adults requires caution. Furthermore, the one-item self-report question did not include information on the duration of diagnosis, treatment status, or date of previous examination. Finally, the classification of insulin resistance was based on the HOMA-IR index thresholds used in the original (unpublished) study; methodological differences may limit comparability with other studies.

Conclusion

Self-reported diabetes status matches biochemical indicators in most diagnosed individuals, but it misses a significant proportion of those

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with undiagnosed diabetes or high insulin resistance. It is likely that some self-reported diabetic patients with normal HbA1c levels reflect a well-controlled disease rather than a misdiagnosis. Combining self-reporting with targeted biochemical screening will improve the identification of at-risk individuals and support timely preventive and therapeutic interventions.

ETHICAL STATEMENT:

Obtained from the Ethics Committee of Zliten Medical Centre (MC12-2023). All participants provided written informed consent.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

AUTHORS' CONTRIBUTIONS

SA and SZ shared study conception, design, analysis, and manuscript drafting; Salmah Zaydan performed data collection. All authors reviewed and approved the final manuscript.

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* Corresponding author email: zsalma553@gmail.com