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Original Article

The predictive utility of one-hour plasma glucose in oral glucose tolerance test: A study of 231 nondiabetic patients

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Abstract

This study aims to assess the predictive value of one-hour plasma glucose levels (1h-PG) in identifying high-risk individuals for type 2 diabetes mellitus (T2DM) among nondiabetic patients. A prospective analysis was conducted on 231 patients at Constanța Emergency Hospital, using Oral Glucose Tolerance Tests (OGTT) with measurements at 0, 30, 60, and 120 minutes. The 1h-PG was compared with fasting plasma glucose (FPG) and 2-hour plasma glucose (2h-PG) to determine its diagnostic sensitivity and utility in screening for prediabetes and diabetes. Our findings, supported by recent studies, indicate that 1h-PG offers greater sensitivity in detecting early dysglycemia compared to traditional measures. Targeted early screening can reduce the incidence of diabetes-related complications.

Keywords: one-hour plasma glucose, type 2 diabetes mellitus, prediabetes, early screening.

Introduction

Type 2 diabetes mellitus (T2DM) is a growing global health concern, particularly due to its long asymptomatic phase. Undiagnosed T2DM may persist for many years, leading to complications before clinical diagnosis. Prediabetes is also an important condition, as it predicts the risk of developing diabetes several years before the clinical-specific signs appear. Studies in developed countries, such as the US, showed that about 85% of individuals with prediabetes are unaware of their condition [1].

Early identification of at-risk individuals, especially during the prediabetic stage, is critical for preventing the progression of β-cell dysfunction. While useful, traditional diagnostic markers, such as fasting plasma glucose (FPG) and hemoglobin A1c (HbA1c) may fail to detect early metabolic alterations.

Focusing on 1h-PG was recommended starting on the simple fact that the blood glucose will be higher after 1 hour, compared to classical measurements of 2h-PG. Thus, even with normal further glycemic parameters, glycemia peaks can be observed [2].

Several recent studies have shown that 1-hour postload plasma glucose (PG) is a stronger predictor of dysglycemia than fasting plasma glucose (FPG), 2-hour PG, or glycated hemoglobin (HbA1c) [3]. Additionally, 1-hour PG has been found to predict not only type 2 diabetes but also cardiovascular disease and mortality risks [4–8].

Moreover, the CATAMERI study indicated that individuals with normal glucose tolerance but an elevated 1-hour PG level of ≥8.6 mmol/L faced a higher risk of developing chronic kidney disease [9], metabolic dysfunction-associated steatotic liver disease [10], increased vascular stiffness [11], and early carotid atherosclerosis [12]. Elevated 1-hour PG levels were also linked to lower insulin clearance [13], reduced INS sensitivity, decreased β-cell function [14], an adverse inflammatory profile [15], and increased whole blood viscosity [16, 17].

As type 2 diabetes can be prevented or delayed by many years, data suggests that optimization of lifestyle alone can lower the risk of progression from prediabetes to diabetes within 10 years, so early screening and diagnosis should be our primary target in the long term [18].

This study seeks to evaluate the utility of 1h-PG as a diagnosis tool for early dysglycemia in a population of nondiabetic patients in Constanța.

Material and methods

This prospective study was conducted at the Diabetes Center of Constanța Emergency Hospital. Data were collected from 231 nondiabetic individuals over three years (April 2021 to May 2024).

The inclusion criteria followed adult patients undergoing OGTT screening without a prior diabetes diagnosis but with a body mass index (BMI) of over 25 kg/m^2, considering that they present an elevated metabolic risk in direct correlation with increased body weight. Other conditions that can raise the risk of developing dysglycemia were also permitted and noted but were not considered inclusion criteria.

Data collected included demographics (age, gender), family history, lifestyle factors, body mass index (BMI), waist circumference and other relevant conditions.

Patients were instructed to follow their normal diet and to fast for 12 hours before presenting to the testing. They were also recommended to avoid medications that could influence glucose levels. Plasma glucose levels were measured at 0 (fasting for 12 hours), 30, 60 (1h-PG), and 120 minutes (2h-PG) after a 75 g glucose load.

All patients included in the study were informed and gave their informed consent for participation in the study.

To check the study's statistical relevance, the logistical regression test was applied. This test showed the differences between classic (FPG, 2h-PG) and 1h-PG regarding predictability in the diagnosis of PDM and DM.

The study analyzed 1h-PG values to assess their predictive power compared to FPG and 2h-PG levels.

Results

Of the 231 participants, 38% were male and 62% were female, with the majority falling in the 40–65 age range.

Nearly 33% of patients presented with symptoms related to dysglycemia (increased appetite, recent weight gain, fatigue, sweating, recurrent skin infections/gum bleeding, brain fog) and 53% had a family history of T2DM.

Lifestyle analysis revealed that 86% of participants were physically inactive. Almost all of the patients included in the study admitted to being uncareful with their food intake and admitting to an unhealthy diet; this was correlated with high BMI and waist circumference in the group.

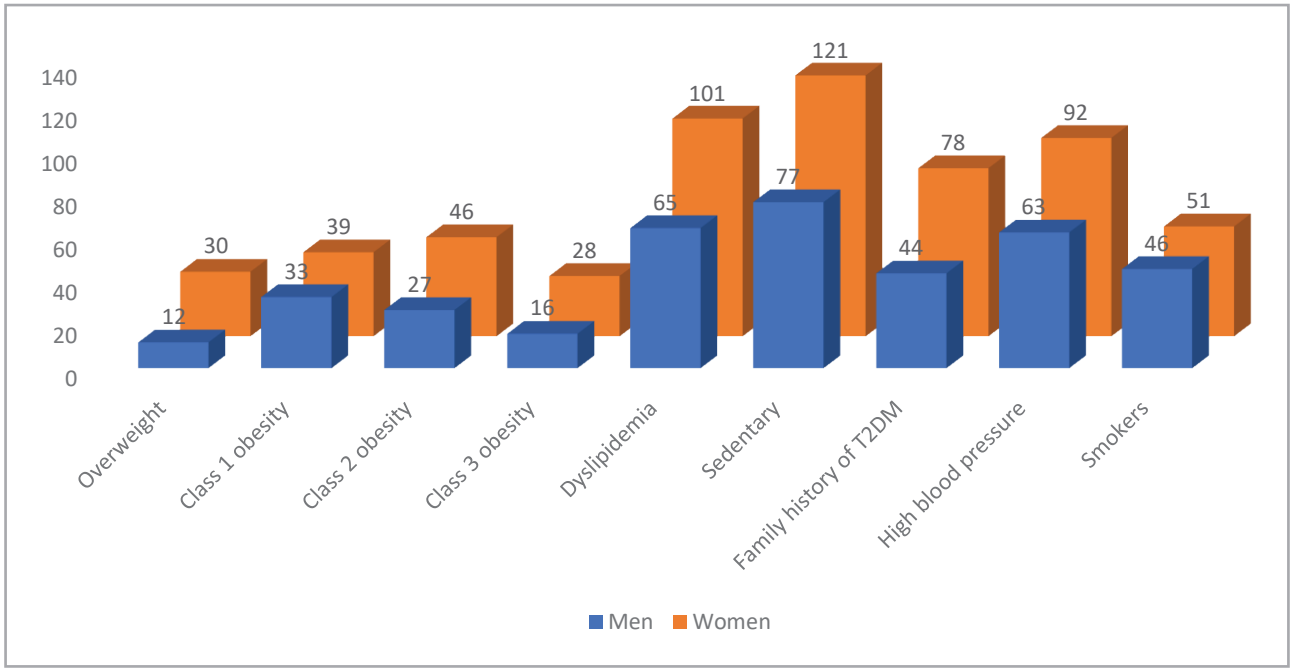


Figure 1: Distribution of associated risk factors for T2DM in the study group (men-n 88, women-n 143).

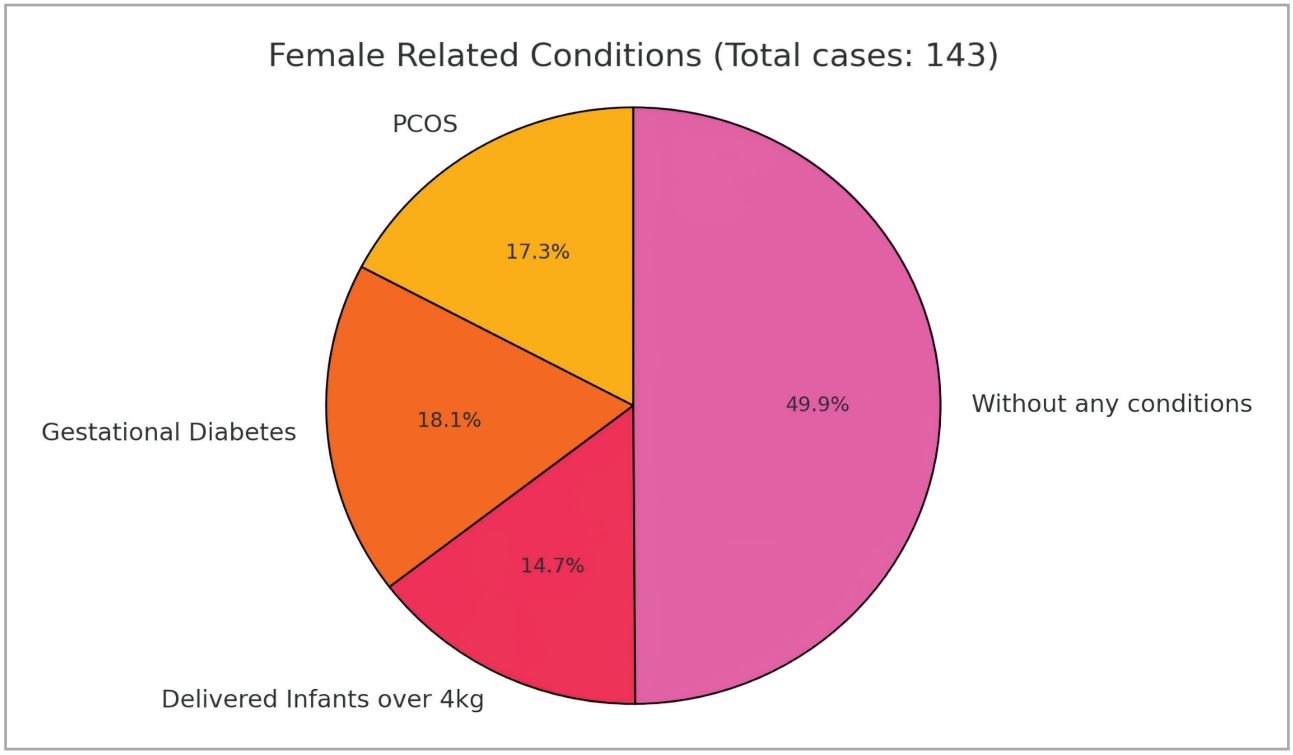
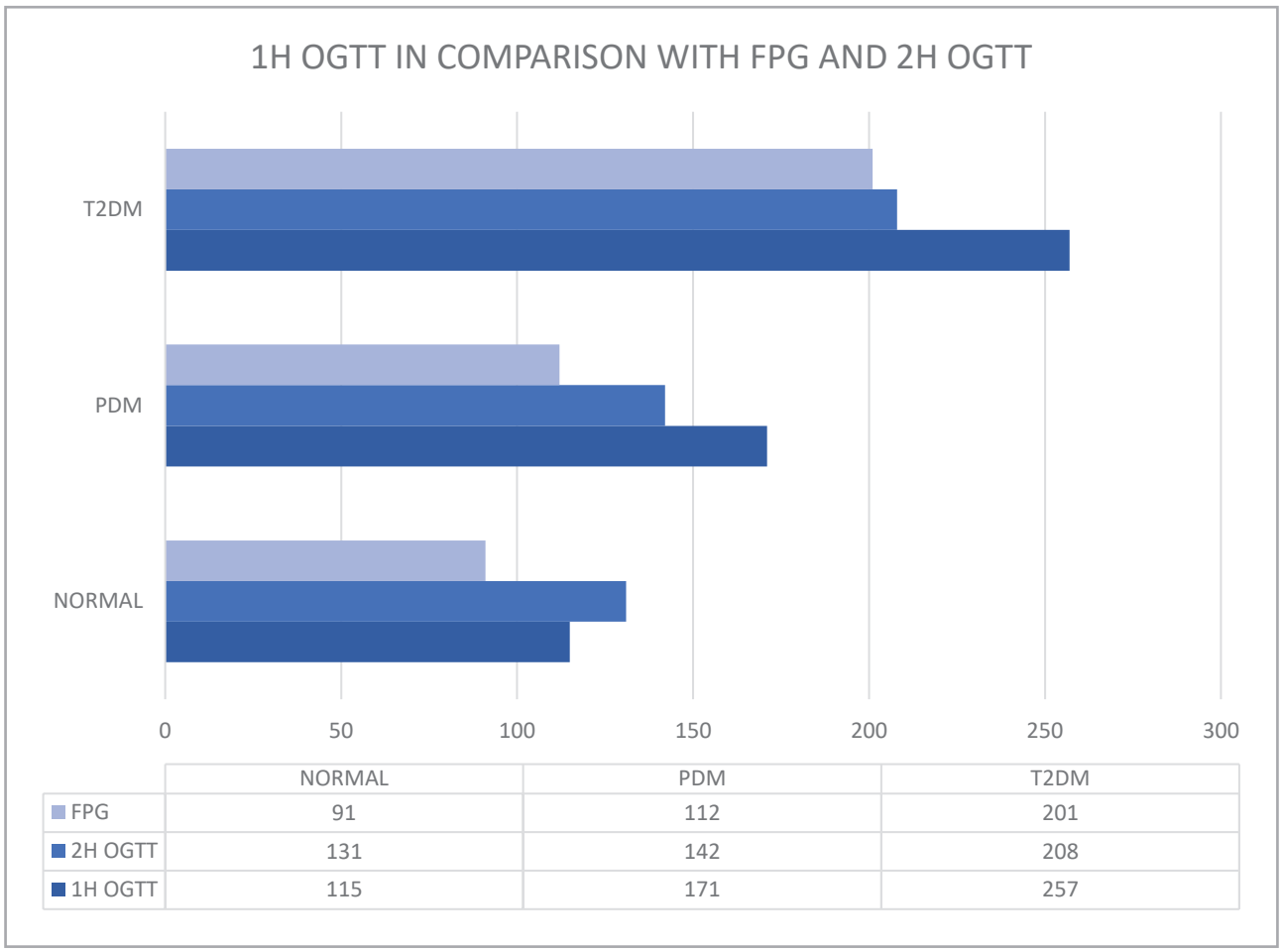


Figure 2: Female-specific associated conditions with a higher risk of T2DM.



	NORMAL	PDM	T2DM
FPG	91	112	201
2H OGTT	131	142	208
1H OGTT	115	171	257

Figure 3: Median values for FPG, 1H and 2H glycemia after glucose load, highlighting the different patterns between nondiabetic, prediabetic and newly discovered diabetic patients.

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The study group highlighted many associated conditions that raise the risk for dysglycemia and are representative of the metabolic syndrome. As inclusion criteria in this study were determined by BMI over 25 kg/m^2, overweight and obese patients were included, but the ratio of overweight patients is much less than that of obese patients. Over half of the patients presented with a family history of diagnosed type 2 diabetes (Figure 1).

About half of the female patients included in the study presented specific conditions associated with a higher risk of developing dysglycemia. This high number is most probably sustained by the inclusion criteria of overweight and obese patients, but still, 50.1% of the entire lot is representative of the presence of an increased risk of T2DM development (Figure 2).

When analyzing glucose levels, the 1h-PG was significantly elevated in patients with prediabetes and T2DM compared to FPG and 2h-PG values. Specifically, patients classified as prediabetic had a mean 1h-PG of 171 mg/dL, compared to 112 mg/dL for FPG and 142 mg/dL for 2h-PG. In patients with newly diagnosed T2DM, the mean 1h-PG reached 257 mg/dL, surpassing the diagnostic thresholds for FPG and 2h-PG (Figure 3).

Glycemic patterns, as shown on 2H OGTT, revealed different blood glucose variations in direct relation to the metabolic status of the tested patients.

The euglycemic patient group showed a steadily increasing glycemia throughout the 2h monitoring, with the maximum values at about 131 mg/dl after 120 minutes.

The prediabetic patients showed similar glycemia peaks at 1 hour but with differences between the 2 other relevant conditions: FPG and 2H glycemic values. Some patients had normal FPG and 2H glycemic values but with clear PDM values at 1h, showing the relevance of higher 1h glycemia, otherwise considered normal.

Another interesting finding is that newly discovered T2 DM could be diagnosed solely based on the glycemic peak at 1 hour, as FPG were normal or in the PDM range, with media of 2h glycemic values also in the PDM range. Following classical FPG at 2h glycemic monitoring, higher 1h glycemic values could be missed, thus, T2 DM diagnosis (Figure 4).

The classification of the study lot showed 5 groups, with 2 of them represented by diagnoses based exclusively on 1h OGTT for PDM and T2DM. These diagnoses represented a total of 33% of the cases, which would have been otherwise missed.

Of all patients studied, only 21% presented normal FPG, 1h and 2h OGTT glycemic values.

Classical diagnosis methods via FPG and 2h OGTT values showed prediabetes for 28% of the cases and 18% for T2DM (Figure 5).

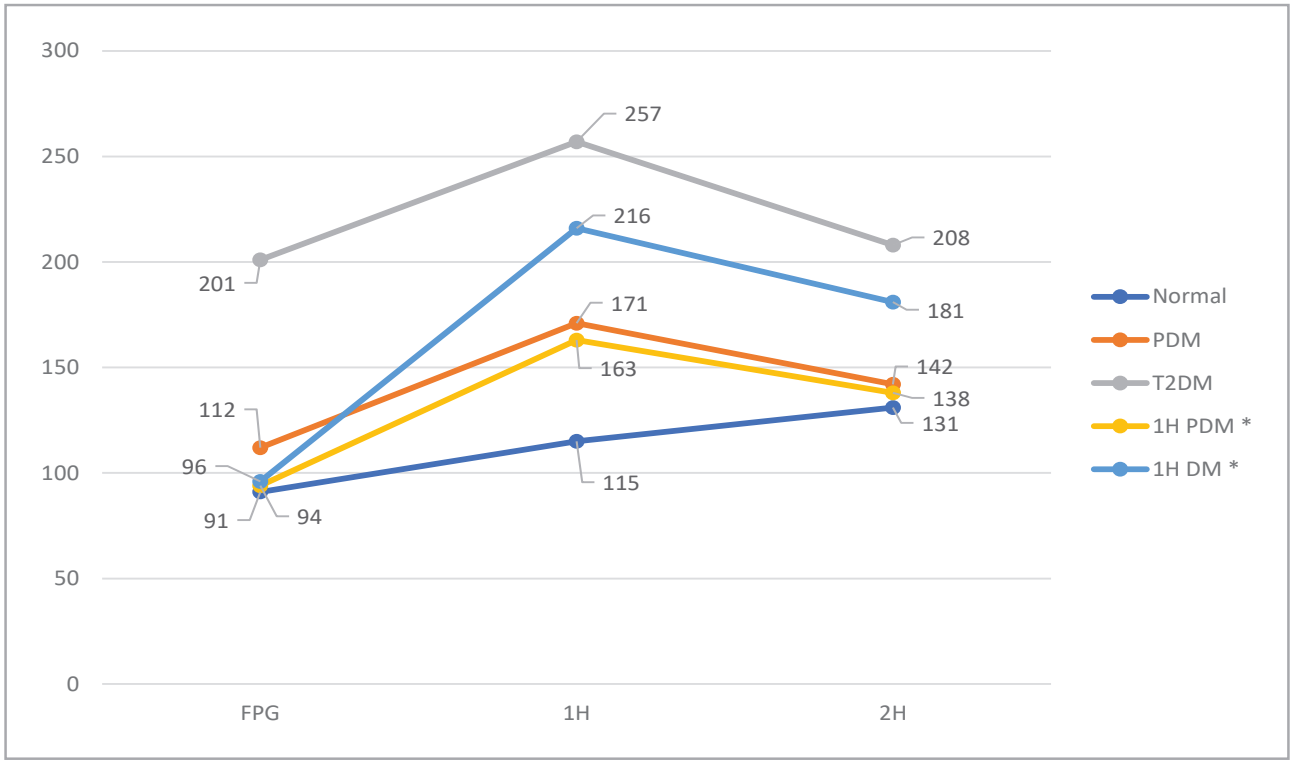

Figure 4: Median values of glycemic patterns for normal, PDM, T2DM and newly diagnosed PDM and DM are solely based on 1H glycemia (with classical FPG and 2H glycemia as non-PDM and non-DM values).

The model's accuracy on the test set was 100%, meaning that it successfully classified all cases correctly.

The model's coefficients are:

- FPG: 0.0137;
- 1h-PG: 0.2189;
- 2h-PG: 0.0319.

These coefficients suggest that the 1-hour glucose level (1h-PG) has a greater influence on predicting the diagnosis (PDM/T2DM) than FPG and 2h-PG, confirming its relevance as an indicator (Figure 6).

Discussion

Our findings support the growing evidence that the 1h-OGTT is a superior diagnostic tool for identifying individuals at high risk of T2DM. Consistent with other studies, our results show that 1h-PG detects metabolic disturbances earlier than FPG or 2h-PG. For instance, a recent study by Bergman *et al.* demonstrated that a 1h-PG threshold of ≥155 mg/dL predicts future diabetes and cardiovascular events with greater sensitivity than traditional markers [19]. Similarly, Ferrannini *et al.* found that adding 1h-PG to screening models significantly improved the predictive accuracy for T2DM, particularly in younger, asymptomatic individuals [20].

The present results once again showed the magnitude of undiagnosed metabolic conditions in our society, raising attention to the need for even greater screening and early diagnosis methods to improve long-term outcomes and avoid metabolic complications.

In our study, 1h-PG identified prediabetes and diabetes in a significant portion of patients missed by FPG and 2h-PG criteria. This aligns with findings from previous research, which highlighted that relying solely on HbA1c or FPG could miss up to 30–40% of high-risk individuals. Thus, incorporating 1h-PG into routine screening, especially for individuals with high BMI and a family history of T2DM, may provide a more effective strategy for early intervention.

The importance and relevance of the 1h-PG in clinical practice and diagnosis of PDM and T2DM were also noted and promoted in a very recent (March 2024) statement of the International Diabetes Federation, which could translate into an important moment for future diagnosis criteria and diabetes management strategies [21].

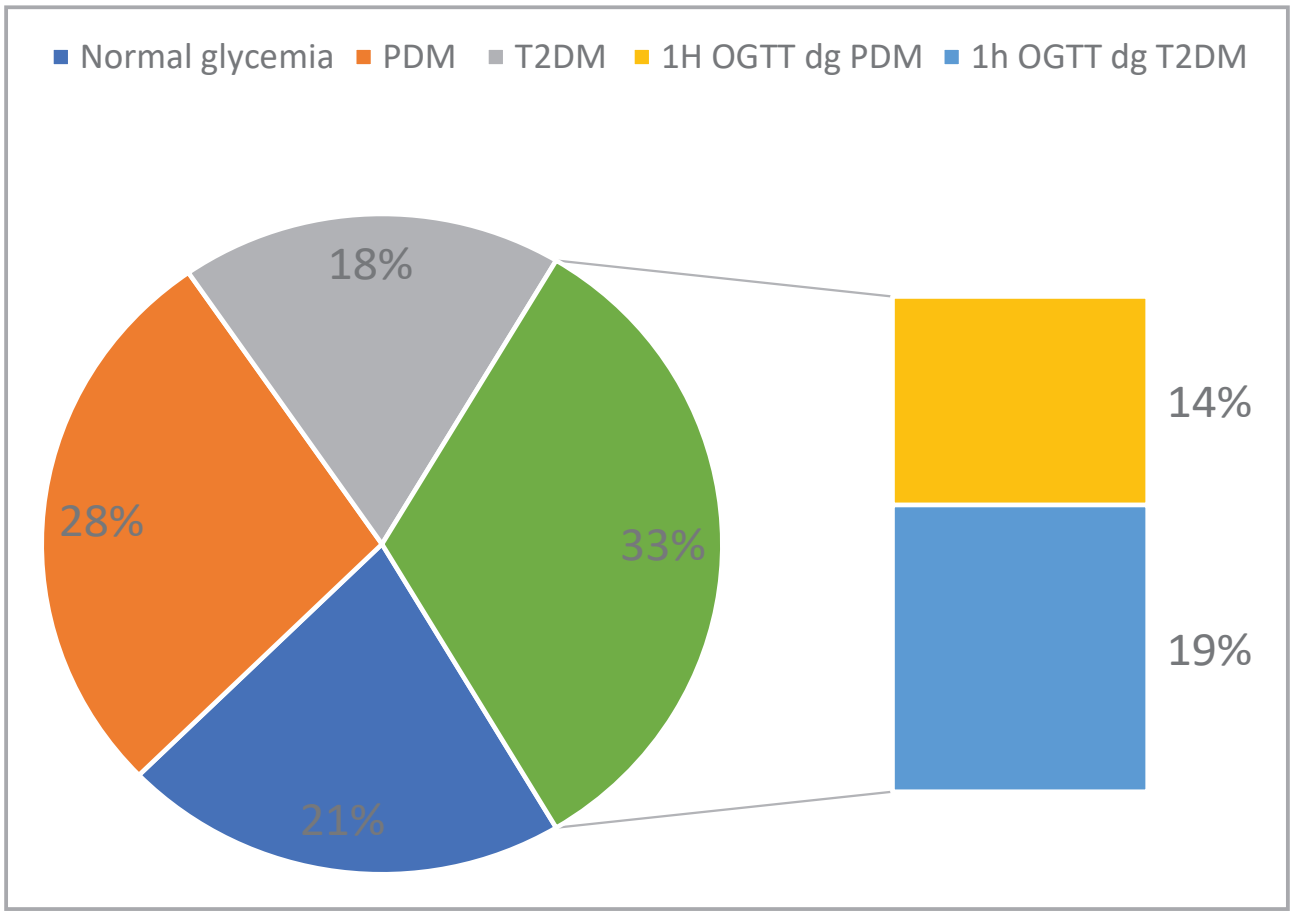

Figure 5: The ratio of different diagnoses and criteria used in the study group: normal, PDM, T2DM, 1h diagnosed PDM and 1h diagnosed T2 DM.

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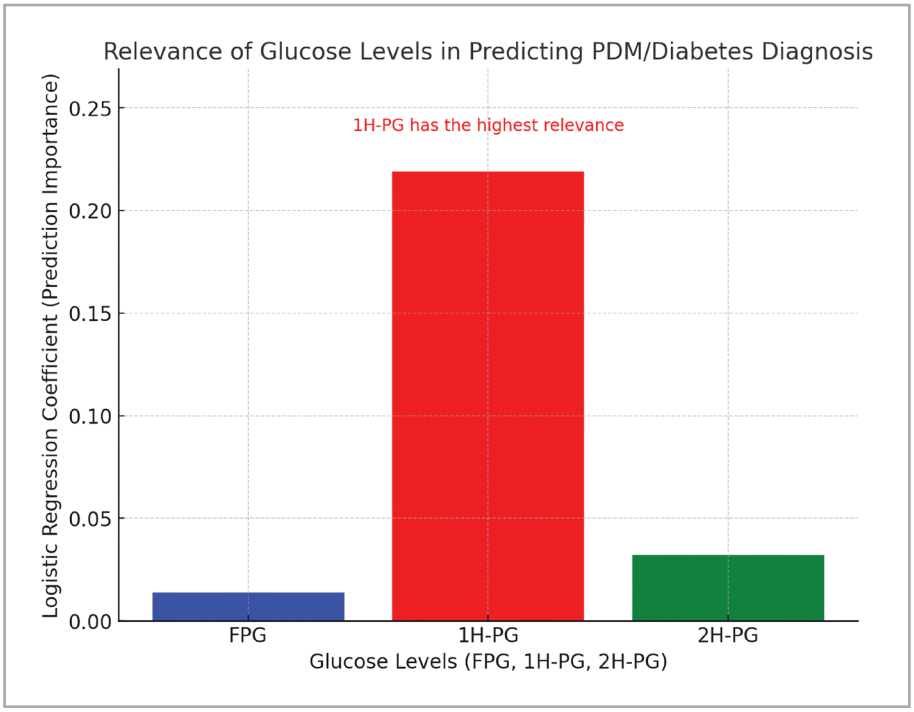

Figure 6: Logistic regression testing for comparing the predictability of FPG, 1H-PG and 2H-PG in diagnosing PDM/DM.

Conclusion

This study reinforces the importance of the one-hour glucose measurement during OGTT as a key indicator for early detection of T2DM. Compared to FPG and 2h-PG, the 1h-PG demonstrates higher sensitivity and specificity in identifying individuals at risk, offering an opportunity to intervene earlier and potentially reduce the progression of diabetes.

As recently confirmed by the IDF, future screening protocols should consider incorporating 1h-PG, particularly in high-risk populations, to improve early diagnosis and prevent diabetes-related complications.

Screening and prevention actions should be improved as the majority of the population with PDM and DM remains undiagnosed, increasing the metabolic and cardiovascular complications risk.

Conflict of interest

The authors declare no conflict of interest.

Ethics approval

The approval for this study was obtained from the Ethics Committee of the Emergency Clinical County Hospital of Constanta, Romania (approval ID: 38/ 18. 12.2020).

Consent to participate

Written informed consent was obtained from all the participants.

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