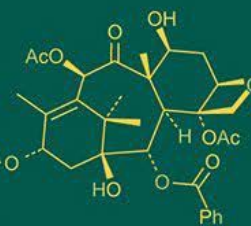
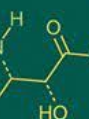
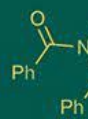
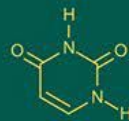
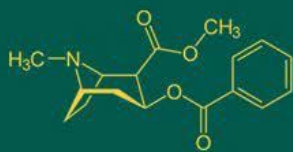


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Age- and gender-specific trends in glucose dysregulation: insights from everight diagnostics, Owerri, South East Nigeria

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Abstract

Background: Glucose dysregulation, such as impaired fasting plasma glucose (IFPG) and type 2 diabetes mellitus, is increasing rapidly in sub-Saharan Africa. Fasting plasma glucose (FPG) data collected from clinics reflected strong right-skewness, underscoring the value of better analytic strategies for evaluating age- and gender-specific screening strategies.

Objective: This study evaluated age- and gender-specific FPG-based patterns among clients of Everight Diagnostics, Owerri, Nigeria, and assessed the predictive value of age and sex on glucose dysregulation.

Method: A cross-sectional analysis was conducted on 1,000 participants (51.2% male; age 1-106 years, mean age 48.76 ± 15.88). Venous blood was collected after ≥ 8 -hour fasting into fluoride-oxalate tubes, centrifuged, and plasma separated. FPG was measured using the Beckman Coulter DxC 700 AU clinical chemistry analyzer with manufacturer-validated glucose reagents, calibrated prior to each run with quality control at multiple levels. Analytical validation included intra- and inter-run precision, linearity, method comparison, and interference assessment. FPG values were reported in mg/dL and classified according to American Diabetes Association thresholds: normal (<100 mg/dL), IFPG (100-125 mg/dL), and diabetes (≥ 126 mg/dL). Data were analyzed using Microsoft Excel and Jamovi. Normality was assessed with Shapiro-Wilk and Kolmogorov-Smirnov tests. Gender differences were evaluated using Welch's t-test and Mann-Whitney U test. Age-related differences were assessed using ANOVA with Tukey HSD, and associations were examined via Pearson and Spearman correlations.

Results: The mean fasting plasma glucose (FPG) level was 113.25 ± 46.93 mg/dL (range: 72.4-507 mg/dL), with a significant positive skewness (4.13) and kurtosis (20.33), further established via the Shapiro-Wilk test ($W = 0.76$, $p < .001$). There were no meaningful differences noted between males (112.92 ± 50.45 mg/dL) and females (109.50 ± 50.34 mg/dL) ($p = .259$). The prevalence rates fell into the following categories: 51.2% normal; 35.2% impaired fasting glucose (IFG); and 13.6% diabetes. A significant association with age group for FPG category was noted, $\chi^2(6) = 26.69$, $p = .0002$, compared to no association with gender, ($p = .318$). Age had a weak yet significant correlation with FPG ($r = 0.134$; $\rho = 0.131$; both $p < .001$). ANOVA showed a significant difference in FPG level across age groups ($F(3,996) = 8.81$, $p < .0001$), with values always resulting in the highest levels for those aged 60+ years. Linear regression analysis showed age was a significant predictor ($B = 0.34$, $p < .001$; $R^2 = .013$). Each additional year of age increased the odds of diabetes by 1.8% as determined by logistic regression of the data ($OR = 1.018$, 95% CI [1.006-1.030], $p = .002$).

Conclusion: FPG did increase significantly with age, regardless of sex, but was highest among older adults. Screening should begin at age 40 years and also include targeted interventions to males, so as to lessen the progression of dysglycemia.

Keywords: Fasting plasma glucose, Glucose Dysregulation, Impaired Fasting Plasma Glucose, Age- and Gender-Specific Trends, Type 2 Diabetes Mellitus

Introduction

Type 2 diabetes mellitus and impaired fasting glucose are rising across low- and middle-income countries, with urbanizing populations in Sub-Saharan Africa (SSA) experiencing particularly steep increases in prevalence and associated complications (Atun *et al.*, 2020). The International Diabetes Federation reports elevated population-level burdens and a persistent diagnosis and treatment gap, while WHO surveillance highlights increasing age-

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specific prevalence and substantial proportions of untreated cases in low-resource settings (IDF, 2021; WHO, 2022). Local analyses and systematic reviews from SSA documented substantial heterogeneity in dysglycemia prevalence that is shaped by urbanization, obesity trends, and inconsistent screening practices (Oguoma *et al.*, 2021; Walker *et al.*, 2023). A critical methodological consideration in these studies is the distribution of fasting blood glucose (FPG). FPG data from both clinical and population samples are frequently right-skewed with heavy tails, meaning a minority of individuals exhibit extreme hyperglycemia (Peer *et al.*, 2023) [12].

Because fasting plasma glucose (FPG) distributions in clinic and population samples are frequently right-skewed with heavy tails, single-measure parametric summaries can underappreciate the burden of extreme hyperglycemia and complicate inference; consequently, careful distributional assessment and appropriate non-parametric or transformed modeling are essential for accurate estimation and policy translation (Worede *et al.*, 2021; Mayega *et al.*, 2022) [15, 10]. Consequently, careful distributional assessment and the use of non-parametric or transformed data modeling are essential for accurate estimation and the development of effective public health strategies.

This study examines age- and gender-specific trends in FPG among 1,000 diagnostic attendees at Everight Diagnostics, Owerri, South East Nigeria, characterizing distributional properties, demographic associations, and the predictive role of age and sex, with the aim of informing locally relevant screening thresholds and resource allocation for early detection.

Materials and Method

Study Design and Population

This cross-sectional study was conducted on 1,000 participants attending Everight Diagnostics, Owerri, South East Nigeria, in 2025. Participants ranged from 1 to 106 years of age, with a balanced gender distribution (51.2% male, 48.8% female). Inclusion criteria required complete records for age, gender, and fasting plasma glucose (FPG), while samples with missing or invalid data were excluded. The study period was from January 2024 to September 2025 and examined FPG trends in individuals who utilized the diagnostic facility

Sample Collection and Preparation

Venous blood was collected after a minimum of eight hours of fasting into fluoride-oxalate tubes to inhibit glycolysis. Samples were centrifuged at $1,500\text{--}2,000 \times g$ for ten minutes within 30 minutes of collection, and plasma was separated. Samples were analyzed immediately or stored at -20°C for short-term preservation, minimizing freeze-thaw cycles to prevent glucose degradation.

Fasting Blood Glucose Measurement

FPG was measured using the Beckman Coulter DxC 700 AU clinical chemistry analyzer with manufacturer-validated glucose reagents. Calibration was performed at the start of each analytical run using Beckman Coulter calibrators spanning the clinical glucose range, and multi-level quality control was included in every run to ensure precision and accuracy (Bush *et al.*, 2019) [4]. Analytical validation included intra- and inter-run precision, linearity, method comparison with a reference assay, and assessment

of interference from hemolysis, icterus, and lipemia (Wang 2020). FPG values were reported in mg/dL and classified according to American Diabetes Association thresholds: normal (<100 mg/dL), impaired fasting glucose ($100\text{--}125$ mg/dL), and diabetes (≥ 126 mg/dL).

Data Processing and Statistical Analysis

Data were collated and cleaned using Microsoft Excel before being imported into Jamovi software (Version 2.3) for statistical analysis. The normality of the FPG distribution was formally assessed using the Shapiro-Wilk and Kolmogorov-Smirnov tests. Given the skewed nature of the FPG data, both parametric and non-parametric tests were employed for group comparisons. Welch's t-test (accounting for potential unequal variances) and the Mann-Whitney U test were used to evaluate gender differences in FPG. Age group differences were analyzed using one-way ANOVA, with post-hoc pairwise comparisons conducted via Tukey's Honestly Significant Difference (HSD) test; the non-parametric Kruskal-Wallis test was used for confirmation.

Associations between categorical variables (FPG category, gender, age group) were examined using Chi-square tests, with Cramer's V calculated to estimate effect size. The relationships between continuous age and FPG levels were quantified using Pearson's and Spearman's correlation coefficients. To model the predictors of FPG, multiple linear regression was performed. The predictive utility of age and gender for diabetes status (binary) and FPG category (multinomial) was evaluated using binary logistic and multinomial logistic regression, respectively. Model fit was assessed using likelihood ratio tests and pseudo R^2 measures (McFadden). For all analyses, a p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the Everight Diagnostic and Laboratory Management Board. As the study used de-identified retrospective laboratory data, individual informed consent was waived in accordance with international ethical principles for secondary data analysis

Results

Demographic Characteristics of the Study Population

The study comprised 1,000 participants, with 512 (51.2%) males and 488 (48.8%) females (Table 1). The age of participants ranged from 1 to 106 years, with a mean of 48.76 ± 15.88 years. The distribution of age was approximately symmetrical (skewness = 0.18) and slightly platykurtic (kurtosis = -0.53), indicating a distribution close to normal with mild variation. The histogram in Figure 1 visually represents this age distribution.

Table 1: Gender Distribution of Study Participants

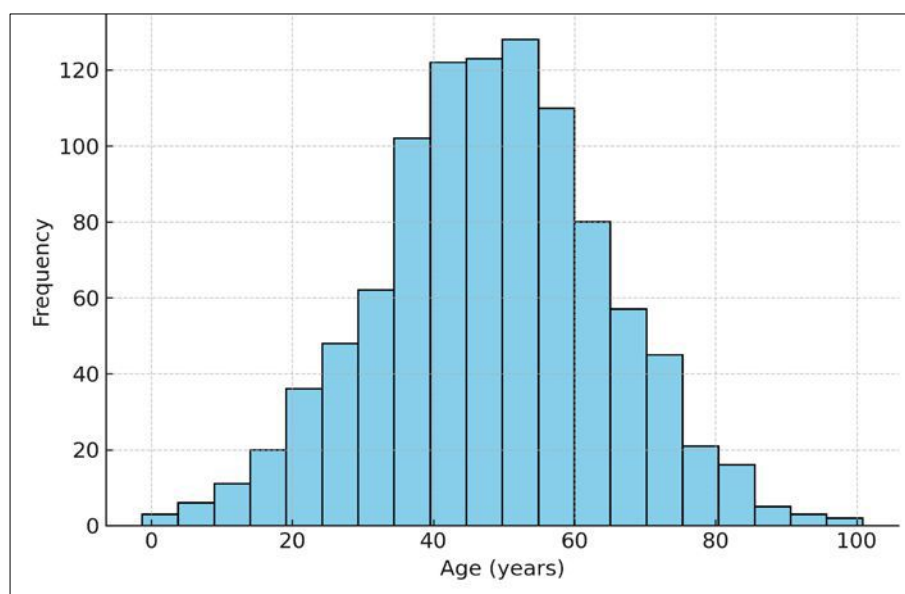
Gender	Frequency (n)	Percentage (%)
Male	512	51
Female	488	49
Total	1,000	100

Age Characteristics

The mean age of the participants was 48.76 years (95% CI: 47.78-49.75), with a median of 48 years and a mode of 50 years. The standard deviation (SD) of 15.88 shows a moderate variability within the participants (Table 2). The age range was 105 years which suggests a wide dispersion in age. The confidence interval (95%) of ± 0.99 years supports the precision of the mean estimate.

Table 2: Descriptive Statistics for Participants' Age

Statistic	Value
Mean	48.76
Median	48
Mode	50
Standard Deviation	15.88
Variance	252.23
Range	105
Minimum	1
Maximum	106
Skewness	0.18
Kurtosis	-0.53
95% Confidence Level	±0.99

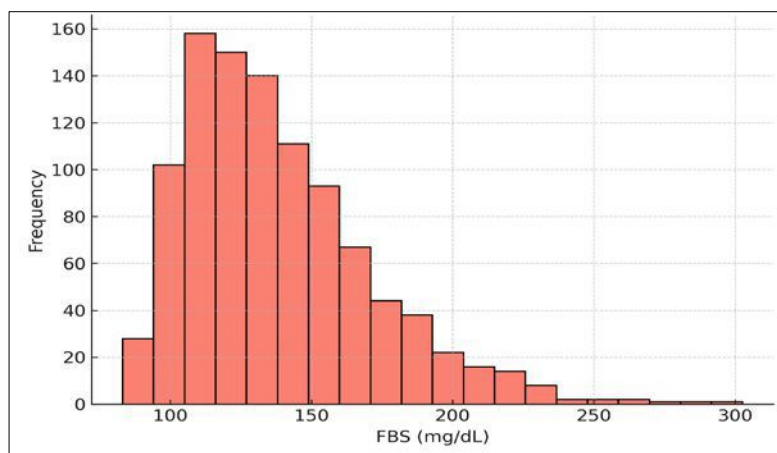
**Fig 1:** Age distribution of participants**Fasting plasma glucose (FPG) Levels**

The mean fasting plasma glucose (FPG) level among participants was 113.25 ± 46.93 mg/dL, with values ranging from 72.4 to 507 mg/dL. The distribution of FPG levels was positively skewed (skewness = 4.13) and leptokurtic

(kurtosis = 20.33), suggesting that a few individuals had extremely high glucose readings (Figure 2). The median FPG was 100.85 mg/dL, while the modal FPG was 92.7 mg/dL (Table 3).

Table 3: Descriptive Statistics for Fasting plasma glucose (FPG) Levels

Statistic	Value (mg/dL)
Mean	113.25
Median	100.85
Mode	92.7
Standard Deviation	46.93
Variance	2,202.54
Range	434.6
Minimum	72.4
Maximum	507
Skewness	4.13
Kurtosis	20.33
95% Confidence Level	±2.91

**Fig 2:** Distribution of fasting plasma glucose levels**Normality Assessment**

The distribution of fasting plasma glucose (FPG) was assessed for normality. The Shapiro-Wilk test, indicated a significant deviation from normality, $W = 0.76$, $p < .001$. Similarly, the Kolmogorov-Smirnov test supported this finding, $z = 0.19$, $p < .001$. These results suggest that FPG values were not normally distributed in the across the study participants (Table 3).

Gender Differences in FPG Levels

Differences in FPG between males and females were examined (Table 3). Levene's test confirmed homogeneity of variances across gender groups ($F = 0.0013$, $p = 0.9713$). Independent samples comparisons showed no significant difference in FPG levels between males ($M = 112.92$ mg/dL, $SD = 50.45$) and females ($M = 109.50$ mg/dL, $SD = 50.34$), as evidenced by both the Welch t -test ($t = 1.1289$, $p = 0.2592$) and the Mann-Whitney U test ($U = 125,978$, $p = 0.3875$).

Table 4: Tests of Normality and Gender Comparisons for Fasting plasma glucose (FPG)

Assessment	Test	Statistic	Value	p-value	Interpretation
Normality	Shapiro-Wilk	W	0.7629	<0.001	Significant deviation from normality
	Kolmogorov-Smirnov	z	0.1877	<0.001	Significant deviation from normality
Homogeneity of Variance	Levene's test	F	0.0013	0.9713	Variances are equal
Gender Comparison	Welch t -test	t	1.1289	0.2592	No significant difference
	Mann-Whitney U test	U	125,978	0.3875	No significant difference
Descriptive Statistics	Males (FPG)	Mean(SD)	112.92 (50.45)	—	—
	Females (FPG)	Mean (SD)	109.50 (50.34)	—	—

Associations with Categorical Variables

Chi-square tests for associations between FPG categories (normal: <100 mg/dL; impaired fasting glucose: 100-125 mg/dL; diabetes: ≥ 126 mg/dL) and demographic variables (Table 4). No significant association was observed between

FPG category and gender ($\chi^2(2) = 2.2949$, $p = 0.3176$). In contrast, a significant association was found with age group (Table 5) ($\chi^2(6) = 26.6934$, $p = 0.0002$), indicating a small-to-moderate effect

Table 5: Distribution of FPG Categories by Gender

FPG Category	Female (n)	Male (n)	Total
Normal (<100 mg/dL)	253	259	512
Impaired fasting glucose (100-125 mg/dL)	170	182	352
Diabetes (≥ 126 mg/dL)	71	65	136

Note. $\chi^2(2) = 2.2949$, $p = 0.3176$.

Table 6: Distribution of FPG Categories by Age Group

FPG Category	0-19 (n)	20-39 (n)	40-59 (n)	60+ (n)	Total
Normal (<100 mg/dL)	20	211	187	94	512
Impaired fasting glucose (100-125 mg/dL)	3	140	141	68	352
Diabetes (≥ 126 mg/dL)	2	39	48	47	136

Note. $\chi^2(6) = 26.6934$, $p = 0.0002$.

Correlation with Age

Bivariate correlation analyses revealed a weak but statistically significant positive association between age (in years) and FPG levels. Pearson's correlation coefficient was

$r = 0.1341$ ($p < 0.001$), and Spearman's rank correlation was $\rho = 0.1307$ ($p < 0.001$), suggesting that FPG tends to increase modestly with advancing age.

Age Group Comparisons

One-way ANOVA revealed significant differences in mean FPG across age groups ($F(3, 496) = 8.8068$, $p < 0.0001$). The non-parametric Kruskal-Wallis test confirmed this finding ($H(3) = 21.9935$, $p = 0.0001$).

Post-hoc pairwise comparisons using Tukey's Honestly Significant Difference (HSD) test are presented in Table 6.

Table 7: Tukey HSD Post-Hoc Comparisons of FPG Across Age Groups

Group 1	Group 2	Mean Difference	p-adj	95% CI Lower	95% CI Upper	Significant
0-19	20-39	4.6118	0.9000	-12.9286	22.1522	No
0-19	40-59	13.0542	0.2872	-4.5328	30.6412	No
0-19	60+	24.8003	0.0042	6.7624	42.8383	Yes
20-39	40-59	8.4424	0.0990	-0.9147	17.7995	No
20-39	60+	20.1885	<0.001	10.6767	29.7004	Yes
40-59	60+	11.7461	0.0043	2.4968	20.9955	Yes

Note: Significant differences ($p < 0.05$) are bolded.

The 60+ age group exhibited significantly higher FPG levels than the 0-19, 20-39, and 40-59 groups. The 40-59 group had higher FPG than the 20-39 group, though this difference did not reach statistical significance at the 0.05 level ($p = 0.099$).

Regression Analysis

A multiple linear regression was conducted to examine whether age and gender predicted fasting plasma glucose (FPG) levels. The dependent variable was FPG, while the independent variables were age and gender (coded numerically).

Model Summary

The overall regression model was statistically significant, $F(2, 997) = 6.70$, $p = .001$, but explained only a small proportion of the variance in FPG, $R^2 = .013$, adjusted $R^2 = .011$, indicating limited explanatory power.

Age was a significant predictor of FPG, with higher age associated with higher FPG ($B = 0.34$, $p < .001$). Gender did not significantly predict FPG ($B = 0.98$, $p = .741$). Overall, the model accounted for only 1.3% of the variance in FPG, suggesting that other factors not included in this model may contribute more substantially to fasting plasma glucose levels.

Table 8: Multiple Linear Regression Predicting FPG from Age and Gender

Predictor	B	SE B	t	p	95% CI
Intercept	96.14	5.08	18.93	<.001	86.17, 106.11
Age	0.34	0.09	3.66	<.001	0.16, 0.52
Gender (0 = female, 1 = male)	0.98	2.96	0.33	.741	-4.83, 6.78

Note: B = unstandardized regression coefficient; SE B = standard error of B; CI = confidence interval.

Logistic Regression Analysis

To examine predictors of diabetes status (binary: 0 = non-diabetic [<126 mg/dL], 1 = diabetic [≥ 126 mg/dL]), a binary logistic

regression model was fitted with age (in years) and gender (0 = female, 1 = male) as independent variables (Table 8). The model was statistically significant (likelihood ratio $\chi^2(2) = 9.50$, $p = 0.009$), indicating that the predictors improved fit over the null model. However, the pseudo R^2 (McFadden) was low (0.012), suggesting that other factors contribute more substantially to diabetes risk. Age significantly predicted diabetes status ($\beta = 0.0177$, $p = 0.002$), with an odds ratio of 1.018 (95% CI [1.006, 1.030]). This indicates that each additional year of age is associated with a 1.8% increase in the odds of being diabetic, controlling for gender. Gender was not a significant predictor ($\beta = -0.0081$, $p = 0.965$), confirming no association between gender and diabetes risk in this sample. The model converged successfully, and standard errors were based on maximum likelihood estimation.

Table 9: Binary Logistic Regression Predicting Diabetes Status from Age and Gender

Predictor	β	SE	Z	p	OR	95% CI for OR
Intercept	-2.7105	0.332	-8.168	<0.001	0.066	[0.035, 0.127]
Age	0.0177	0.006	3.065	0.002	1.018	[1.006, 1.030]
Gender (0 = Female, 1 = Male)	-0.0081	0.184	-0.044	0.965	0.992	[0.692, 1.423]

Note: OR = odds ratio; CI = confidence interval. Likelihood ratio $\chi^2(2) = 9.50$, $p = 0.009$; McFadden pseudo $R^2 = 0.012$. Significant predictors ($p < 0.05$) are bolded. $n = 1,000$; diabetic = 136 (13.6%), non-diabetic = 864 (86.4%).

Multinomial Logistic Regression Analysis

A multinomial logistic regression was performed to predict FPG category (Reference: Normal). The full model significantly improved fit over the null model, likelihood ratio $\chi^2(4) = 42.42$, $p < .001$, with a McFadden R^2 of 0.021. Age significantly increased the odds of being in the IFG category (OR = 1.022, $p < 0.001$) and the Diabetes category (OR = 1.031, $p < 0.001$). Males had 45.6% higher odds of being in the IFG category than females (OR = 1.456, $p = 0.007$), but no significant gender difference was found for the Diabetes category (OR = 1.146, $p = 0.488$) (Table 9).

Table 10: Regression of FPG Category from Age and Gender (Reference category: Normal)

Outcome Category	Predictor	B	SE	z	p	OR	95% CI for OR
Impaired Fasting Glucose	Intercept	-1.3007	0.244	-5.337	<0.001	0.272	[0.169, 0.439]
	Age	0.0221	0.004	4.921	<0.001	1.022	[1.013, 1.032]
	Gender (Male)	0.3752	0.139	2.694	0.007	1.456	[1.107, 1.915]
Diabetes	Intercept	-2.6974	0.354	-7.611	<0.001	0.067	[0.034, 0.135]
	Age	0.0306	0.006	4.877	<0.001	1.031	[1.018, 1.044]
	Gender	0.1361	0.196	0.694	0.488	1.146	[0.780, 1.682]

Note: OR = odds ratio; CI = confidence interval. Likelihood ratio $\chi^2(4) = 42.42$, $p < 0.001$; McFadden pseudo $R^2 = 0.021$. $n = 1,000$. Significant effects ($p < 0.05$) are bolded.

Discussion

The study population consisted of 1,000 individuals, with a gender breakdown of 512 men and 488 women, and a mean age of 48.76 ± 15.88 years. The age distribution peaked at a

unimodal level in the 40-60 year age band. This demographic profile suggests that the sample primarily reflects the urban, working age population that tends to engage private diagnostic services. The demographic

characteristics of the study participants were similar to those in clinic-based and urban cohorts reported from studies conducted in sub-Saharan Africa, where the age distribution was largely centered around mid-life, and with those of working age tending to seek health services at greater rate than adult prime age and older adult (Adeboye *et al.*, 2022) [1]. The demographic pattern supports calls for age-stratified screening policies advocated by international disease burden reports (IDF, 2021; WHO, 2022).

The distribution of FPG was markedly non-normal, characterized by significant positive skewness and kurtosis. This indicates that while most of the population had glucose levels clustered in the normal to pre-diabetic range, a substantive minority exhibited extreme hyperglycemia, dragging the mean upward. This pattern is a hallmark of populations undergoing epidemiological transition, where a high burden of undiagnosed or poorly managed dysglycemia exists alongside a generally normoglycemic population (Peer *et al.*, 2023; Mayega *et al.*, 2022) [12, 10]. The profound deviation from normality, confirmed by formal statistical tests, validates the use of non-parametric analytical techniques in this and similar SSA datasets to avoid biased estimations of effect sizes and prevalence (Worede *et al.*, 2021) [15].

The sampled cohort's fasting plasma glucose (FPG) had a mean of 113.25 ± 46.93 mg/dL, a median of 100.85 mg/dL, conspicuous maximum extremes (as high as 507 mg/dL). The combination of the mean > median, strong right tail, and heavy tails, indicate there is a minority of individuals with significant hyperglycemia that influenced the measure of central tendency and signals a high burden of undiagnosed and/or poorly managed dysglycemia amongst the individuals sampled. These types of distributional evidence mirror urban-sub-Saharan Africa diagnostic cohort and meta-analyses that show elevated mean fasting plasma glucose (FPG) and wide dispersion due to late presenters and a variety of risk exposures. This is consistent with published syntheses, regionally focused, which show a broad prevalence of prediabetes/diabetes in urban-sub-Saharan Africa (Oguoma *et al.*, 2021; Walker *et al.*, 2023) [11, 13].

Results of Formal Normality Tests (Shapiro-Wilk $W = 0.7629$, $p < .001$; Kolmogorov-Smirnov $z = 0.1877$, $p < .001$) revealed a substantial deviation from Gaussian assumptions for FPG. The statistical implication is that applying parametric tests, which rely on normal residuals or symmetric distributions, are likely biased; therefore, non-parametric alternatives (i.e., Mann-Whitney, Kruskal-Wallis) and use of robust variance estimators is warranted and enhances the inferential validity. Empirically, it has been established that many SSA glucose datasets exhibit similar deviations from normality regarding the empirical distributions of glucose measurements, and studies have provided evidence that inappropriately applying parametric models to skewed glucose data can lead to underestimating the prevalence of prediabetes or misestimation of effect sizes (Worede *et al.*, 2021) [15].

A key finding was the absence of a significant difference in mean FPG between males and females. This finding reflects there were no substantial sex differences in glycemic burden among urban diagnostic attendees, and as such gender-neutral screening and prevention policies could be warranted for this context. This null finding adds support to urban SSA analytic work, whereby sex differences in mean

glycemia have been shown to be minor, but past studies, in particular, studies examining older, or rural females, have described modestly elevated female levels in relation to varying care-seeking or menopausal transition (Walker *et al.*, 2023) [13].

This aligns with several recent urban SSA studies that report minimal sex disparities in overall glycemic levels, suggesting that in urban environments, traditional gender-specific risk factors may be converging due to shared lifestyle and environmental exposures (Adeleye *et al.*, 2020) [2].

Thus, this finding is consistent with the literature showing contextual heterogeneity: sex differences are small or non-existent among some urban samples while differences can be present in other populations based on the historical and current age structure, and level of urban/rural status.

However, the multinomial logistic regression revealed a more nuanced picture: males had 46% higher odds of having IFG than females, even after controlling for age. This suggests that the early dysglycemic phase might be a critical window where gender differences are more pronounced, possibly reflecting higher-risk behaviors (such as dietary patterns, alcohol use, or physical inactivity) among men before the progression to frank diabetes, where physiological factors may dominate and diminish the gender gap (Kibirige *et al.*, 2021) [9]. This finding underscores the potential for targeted pre-diabetes screening and lifestyle intervention specifically for adult males.

The most robust and consistent finding across all analyses was the strong, graded association between advancing age and worsening glucose control. The prevalence of diabetes was over 17 times higher in the 60+ age group compared to the 0-19 age group. Correlation and regression analyses consistently showed that age, though a statistically powerful predictor, explains only a small portion of the total variance in FPG. This is a common observation in epidemiological studies and highlights that age acts as a proxy for cumulative beta-cell function decline and lifelong exposure to other risk factors (Chatterjee *et al.*, 2023) [5].

This points to a cumulative risk framework where advanced age alone increases the likelihood of dysglycemia, suggesting a need for age-dependent screening intensity increase (for example, beginning the increased outreach efforts of an intervention at age 40 and older). This age gradient is a well-established observation in many populations and clinics around the world and in SSA in particular, where age is a consistent and significant predictor of impaired fasting glucose and diabetes when adjusting for other covariates (Worede *et al.*, 2021; Walker *et al.*, 2023) [13, 15].

Bivariate correlations (Pearson $r = 0.134$; Spearman $\rho = 0.131$, both $p < .001$) as well as regression analyses (linear: $B_{\text{age}} \approx 0.34$ mg/dL/year; logistic OR ≈ 1.018 per year for binary diabetes) suggest an overall small, but statistically reliable linear increase in both FPG and odds of diabetes for each year of age. The low R^2 values in our regression models strongly imply that other unmeasured variables—such as body mass index (BMI), waist circumference, physical activity, dietary quality, and genetic predisposition—are the primary drivers of individual-level risk. Future studies in this population must incorporate these anthropometric and behavioral metrics to build more accurate predictive models for diabetes risk stratification. This pattern (age being statistically significant but with low

overall variance explained) is common in cohorts with diagnostic purposes and highlights the need to develop and implement some multivariable risk models that incorporate anthropometric and behavioral predictors in an effort to better model risk. (Worede *et al.*, 2023; Kang *et al.* 2021) [15, 8].

Multinomial and logistic models indicated that age raised odds of impaired fasting glucose and diabetes; a small male excess was found in impaired fasting glucose ($OR \approx 1.456$) but not established diabetes. Such data suggest differences between sexes are more evident with early dysglycemic stages and might even be subtle transitions (potentially indicative of the behavioral- or occupational-exposure) before euglycemia transitions into frank diabetes where sexes are similar in this sampled population. The models' low pseudo- R^2 values (McFadden ≈ 0.01 - 0.02) suggests there are still missing predictors; particularly measures of adiposity and lifestyle that, once included, generally improve model performance (Kang *et al.*, 2021; Worede *et al.*, 2023) [15, 8].

The significant age gradient, particularly the marked increase in dysglycemia from age 40 onwards, has direct implications for public health policy. Our data strongly support the implementation of systematic, population-based screening for glucose dysregulation starting at age 40, as recommended by various guidelines for high-risk populations (IDF, 2021). The combination of age-targeted screening, coupled with specific outreach for men in the pre-diabetes stage, could form a cost-effective strategy for early detection and intervention. Community-based programs focusing on weight management and physical activity, integrated with the measurement of other cardiometabolic risk factors like hypertension and dyslipidemia, are essential to curb the rising tide of T2DM in this region (Gouda *et al.*, 2023).

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