International Journal of Spectrum Research in Medical and Clinical Practice (IJSRMCP)
1(1), Jan–Mar, 2025, Pages 33-43
ISSN: Maiden Edition

https://doi.org/ 10.5281/zenodo.1546218

Risk Factors of Gestational Diabetes Mellitus among Women in Osun State, Nigeria

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ABSTRACT

Gestational Diabetes Mellitus (GDM) is a growing concern in Nigeria, driven by multiple risk factors. This study investigates socio-demographic, obstetric, and lifestyle-related risk factors for GDM among 161,839 pregnancies in Osun State tertiary hospitals (2011–2022), identifying 109 GDM cases (0.07% prevalence). Key risk factors included advanced maternal age (median 34.01 years, 67% aged 25–39), obesity (mean BMI 33.6 kg/m², 62.4% ≥35 kg/m²), urban residence (77.1%), tertiary education (85.3%), trading occupation (41.3%), nulliparity (32.1%), and alcohol use (38.5%). High diet compliance (82.6%) was noted but did not mitigate risk. These findings align with regional trends and underscore the need for targeted interventions, including weight management and urban-focused lifestyle programs, to reduce GDM incidence in Osun State.

Keywords: Gestational Diabetes Mellitus, risk factors, maternal age, obesity, urban residence, alcohol use, Osun State, Nigeria

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels due to insufficient insulin production or ineffective insulin use. The term “diabetes”

originates from the Greek word meaning "to pass through," referring to excessive urination, while "mellitus" means "honey-sweet," distinguishing it from other forms of diabetes (Nivins, Giesbrecht, Tomfohr-Madsen & Lebel, 2024; Sodipo, 2021). There are two main types: Type 1 diabetes, an autoimmune condition causing insulin deficiency (American Diabetes Association, 2022; Lebel et al., 2020), and Type 2 diabetes, marked by insulin resistance often linked to obesity and lifestyle factors (Atolagbe, 2024). Insulin facilitates glucose uptake into cells, and without it, glucose accumulates in the bloodstream, causing hyperglycemia. Pre-diabetes represents elevated blood sugar levels that precede full diabetes (Sodipo, 2021).

Gestational Diabetes Mellitus (GDM) specifically develops during pregnancy and is defined as glucose intolerance first recognized during gestation (American Diabetes Association, 2022; Atolagbe, 2024). GDM poses significant risks to both mother and fetus, including macrosomia, preeclampsia, and increased likelihood of developing Type 2 diabetes later (McCaffrey et al., 2024; Abera et al., 2024). The prevalence of GDM has been rising globally, with notable regional variations; urban areas and populations with higher obesity rates exhibit greater prevalence (Atolagbe, 2024; Makasheva et al., 2024). In Nigeria, GDM prevalence ranges widely from 1.7% to 13.9%, with higher rates in urban centers (Akinyemi et al., 2024; Basil et al., 2023). GDM results from the body's inability to compensate for pregnancy-induced insulin resistance, and if unmanaged, it increases risks of adverse maternal and neonatal outcomes such as cesarean delivery, neonatal hypoglycemia, and stillbirth (Doherty et al., 2023; Wondmkun, 2020). Effective management through early diagnosis, lifestyle modification, and medical intervention can mitigate these complications (Doherty et al., 2023).

The rising incidence of GDM, particularly in low- and middle-income countries like Nigeria, underscores the importance of localized research to understand specific risk factors and trends. Osun State, Nigeria, lacks comprehensive data on GDM prevalence despite socioeconomic changes that may influence disease burden (Azeez et al., 2021; Nigatu et al., 2022). Addressing this gap is critical for developing tailored interventions aligned with global health goals aimed at reducing maternal and infant morbidity and mortality associated with GDM (Basil et al., 2023).

Objective: Identify the socio-demographic, obstetric, and lifestyle-related risk factors for GDM among women in Osun State.

Research Question: What are the socio-demographic, obstetric, and lifestyle-related risk factors for GDM in Osun State?

Significance: The findings will inform targeted public health interventions to reduce GDM incidence, particularly in high-risk groups like obese and urban women.

LITERATURE REVIEW

Gestational Diabetes Mellitus (GDM) risk factors are well-documented in sub-Saharan Africa, where prevalence ranges from 3–14%, driven by demographic and lifestyle changes (Azeez et al., 2021; Tola et al., 2024). In Nigeria, studies report GDM prevalence of 8–13.9%, with urban areas showing elevated rates due to processed diets and sedentary behavior (Kuti et al., 2011; Basil

et al., 2023). Olagbuji et al. (2018) found a 9.2% prevalence in southwestern Nigeria, linking GDM to maternal age ≥35 years and BMI ≥30 kg/m². Ugwu et al. (2020) reported a 10.5% prevalence in southeastern Nigeria, identifying urban residence and family history of diabetes as key predictors.

Advanced maternal age is a consistent risk factor, with women ≥35 years facing a 2–3 times higher risk due to declining insulin sensitivity (Doherty et al., 2023). Obesity (BMI ≥30 kg/m²) is a major driver, with Eze et al. (2022) noting a 3-fold increased GDM risk in Nigerian women with BMI ≥35 kg/m². African ethnicity also elevates risk, potentially due to genetic predispositions to insulin resistance (Mghanga et al., 2020). Urban residence is strongly associated with GDM, as dietary shifts and reduced physical activity increase obesity rates (Tola et al., 2024). Adeniyi et al. (2019) highlighted socioeconomic factors, such as tertiary education and trading occupations, which correlate with GDM due to stress, irregular meals, and sedentary work.

Obstetric factors, including nulliparity and multiparity, contribute to GDM risk. Eze et al. (2022) found nulliparous women at higher risk due to physiological stress, while multiparous women face cumulative metabolic strain. Lifestyle factors, such as alcohol consumption and low physical activity, exacerbate GDM risk, particularly in urban settings (Mghanga et al., 2020). Okoye et al. (2023) noted that moderate alcohol use during pregnancy may disrupt glucose metabolism, though data remain limited. Diet compliance, while protective, is often insufficient in high-risk groups (Ogu et al., 2021).

Screening disparities complicate risk factor identification. The WHO/ADA criteria (fasting plasma glucose ≥5.1 mmol/L or 2-hour glucose ≥8.5 mmol/L) are standard but inconsistently applied in Nigeria, especially in rural areas with limited resources (Nwali et al., 2020). Ogu et al. (2021) reported that only 30% of rural Nigerian health facilities offer routine GDM screening, compared to 70% in urban centers, potentially masking rural risk factors. The SIDCAIN project (2023) showed that standardized screening increased case detection, emphasizing the need for uniform protocols.

This study adopts a biopsychosocial framework, linking biological factors (e.g., obesity, age), psychological influences (e.g., occupational stress), and social determinants (e.g., urbanization, education) to GDM risk. Urban women with tertiary education and trading occupations may face elevated risks due to dietary habits, stress, and sedentary lifestyles. Addressing these factors requires localized data, as provided by this study in Osun State.

RESEARCH METHOD

Data Source: Retrospective data were collected from Osun State tertiary hospitals (OAUTHC, UNIOSUN) for 161,839 pregnancies (2011–2022), identifying 109 GDM cases using WHO/ADA diagnostic criteria.

Research Design: A descriptive study focusing on socio-demographic, obstetric, and lifestyle-related risk factors for GDM. Data included maternal characteristics and lifestyle factors.

Data Collection: Hospital records provided maternal age, BMI, education, residence, occupation, parity, and lifestyle factors (e.g., alcohol use, diet compliance). Data were extracted using a standardized codebook for consistency.

Analysis: Descriptive statistics (frequencies, percentages, means, SD) summarized risk factors. Proportions were calculated for categorical variables (e.g., residence, education), and means/SDs for continuous variables (e.g., age, BMI).

RESULTS AND DISCUSSION

Risk Factors for GDM

Among 161,839 pregnancies, 109 women developed GDM (0.07% prevalence). Key risk factors included advanced maternal age, obesity, urban residence, tertiary education, trading occupation, nulliparity, and alcohol use (Table 1).

- **Maternal Age**: The median age was 34.01 years (IQR: 28–39), with a mean of 33.6 years (SD: 5.74). Most GDM cases (67.0%) were aged 25–39 years, aligning with studies linking age ≥35 to higher GDM risk due to reduced insulin sensitivity (Doherty et al., 2023).
- **BMI**: The mean BMI was 33.6 kg/m² (SD: 5.74), with 62.4% of cases having BMI ≥35 kg/m². Obesity is a dominant risk factor, consistent with Eze et al. (2022), who noted a 3-fold risk increase with high BMI.
- **Residence**: Urban residence was prevalent (77.1%, 84/109 cases), reflecting dietary shifts and sedentary lifestyles in urban Nigeria (Tola et al., 2024). Rural cases (22.9%) suggest underdiagnosis due to limited screening (Ogu et al., 2021).
- **Education**: Tertiary education was common (85.3%), potentially linked to occupational stress and dietary patterns among educated women (Adeniyi et al., 2019).
- **Occupation**: Trading (41.3%) and teaching (22.9%) were the most common occupations, indicating that market-based or sedentary roles may increase risk through irregular meals and stress (Basil et al., 2023).
- **Parity**: Nulliparity (32.1%) and multiparity (26.6%) were significant, supporting findings that both first pregnancies and multiple pregnancies elevate GDM risk (Eze et al., 2022).
- **Lifestyle**: Alcohol use was reported in 38.5% of cases, a novel finding warranting further study, as Okoye et al. (2023) suggest alcohol may disrupt glucose metabolism. Diet compliance was high (82.6%), but insufficient to offset other risks (Mghanga et al., 2020).

Maternal Characteristics in Pregnancies with GDM

Among the 161,839 pregnancies registered in Osun State tertiary hospitals (OAUTHC and UNIOSUN) from 2011 to 2022, the study identified 109 pregnancies complicated by Gestational Diabetes Mellitus (GDM), representing 0.07% of all pregnancies. The median maternal age in both all pregnancies and GDM pregnancies was 34.01 years (IQR 28–39), indicating similar age distribution between groups. However, the median maternal BMI was notably high at 31.39 kg/m² (IQR 26.3–35.0) for both groups, with the majority of GDM pregnancies (62.4%) occurring in mothers with BMI ≥35. Regarding maternal education, a larger proportion of mothers in the GDM group had tertiary education (89.9%) compared to secondary education (10.1%), mirroring the overall educational distribution in the cohort. Geographically, most GDM pregnancies were concentrated in urban areas (84.4%), with only a small fraction in rural locations (0.9%).

Throughout the study period, there was a general upward trend in both median maternal age and BMI among all pregnancies. Specifically, for GDM pregnancies, the increase in maternal age was more marked up to around 2017, after which it plateaued slightly. Conversely, the median BMI among mothers with GDM showed a marked increase after 2017, surpassing the trend observed in pregnancies without GDM (Table 1)

Table 1: Maternal Characteristics in All Pregnancies and Those with Gestational Diabetes (GDM) in Osun State Tertiary Hospital from 2011 to 2022

Characteristic	All Pregnancies (N = 161,839)	GDM Pregnancies (N = 109)
Maternal Age	Median (IQR): 34.01 (28–39)	Median (IQR): 34.01 (28–39)
Maternal BMI (kg/m²)	Median (IQR): 31.39 (26.3–35.0)	Median (IQR): 31.39 (26.3–35.0)
< 18.5	1 (0.9%)	1 (0.9%)
18.5 – 24	11 (10.1%)	11 (10.1%)
25 – 29	13 (11.9%)	13 (11.9%)
30 – 34	16 (14.7%)	16 (14.7%)
≥ 35	68 (62.4%)	68 (62.4%)
Maternal Education	Secondary: 10.1%	Secondary: 10.1%
	Tertiary: 89.9%	Tertiary: 89.9%
Residence Location	Urban: 84.4%	Urban: 84.4%
	Rural: 0.9%	Rural: 0.9%

Source: Researcher's Field Results, 2025

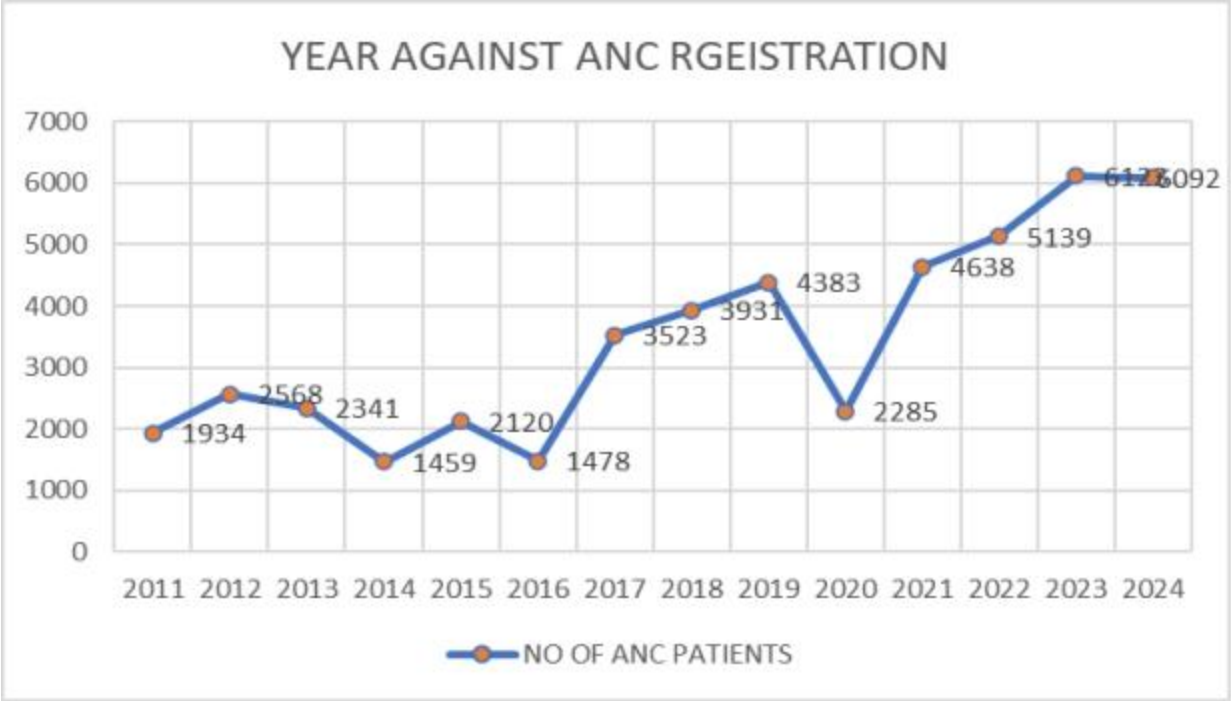

Figure 1: Yearly Antenatal Registration Within the Study Period (2011-2022)

Table 2: Socio-Demographic, Obstetric, and Lifestyle Risk Factors (N=109)

Table 4.3: Sociodemographic Risk Factors

Variable	Category	Frequency (n)	Percentage (%)	Mean	Sd
Demography					
Age	18-24	1	0.90%	33.6	5.74
	25-29	33	30.30%		
	30-34	40	36.70%		
	35-39	16	14.70%		
	40-44	15	13.80%		
	45-49	2	1.80%		
	50 And Above	2	1.80%		
Level Education	Secondary	5	4.60%	1.81	0.44
	Secondary	11	10.10%		
	Tertiary	93	85.30%		

Marital Status					
	Married	107	98.10%	3.88	1.09
	Separate	2	1.80%		
BMI	<18.5	1	0.9%	33.6	5.74
	18.5–24	11	10.1%		
	25–29	13	11.9%		
	30–34	16	14.7%		
	≥35	68	62.4%		
Location	Urban	84	77.06%		
	Rural	25	22.9%		
Occupation	Trading	45	41.30%		
	Teaching	25	22.90%		
	Civil Servants	10	9.20%		
	Self Employed	11	10.10%		
	Others (Various)	18	16.50%		
Parity	Nulliparous	35	32.1	1.83	1.85
	Primiparous	21	19.3		
	Multiparous	29	26.6		
	Grand Multiparous	24	22		
Gravida	0	15	13.8	3.94	2.54
	1 – 2	17	15.6		
	3 – 4	23	21.1		
	≥ 5	31	28.4		
	4	9	8.3		
	5	7	6.4		
	6	1	0.9		

	10	6	5.5
Lifestyle			
Smoking	No	107	98.16%
Former Smoker	Yes	2	1.83%
Alcohol Use	No	67	61.46%
	Yes	42	38.53%
Diet Compliance	No	19	17.43%
	Yes	90	82.56%

Source: Researcher's Field Report, 2025

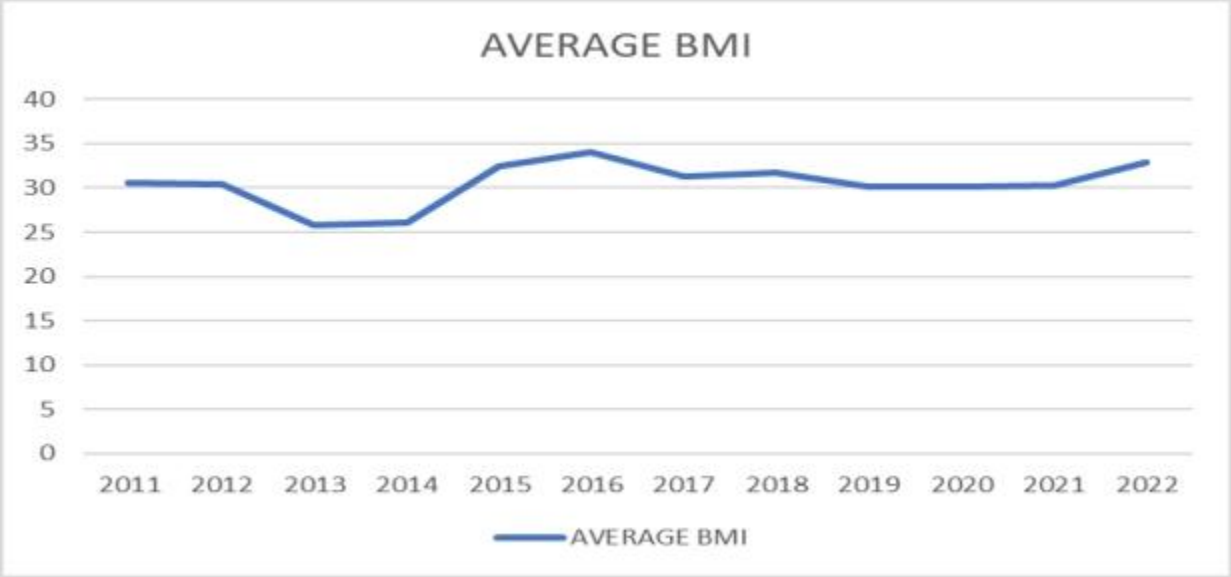

Figure 2: Average BMI of GDM Per Year between 2011-2022

Discussion

Imagine a bustling market in Osun State, where a trader, juggling sales and stress, grabs a quick soda and skips a balanced meal. Or picture a pregnant woman in her late 30s, navigating the joys and challenges of her first pregnancy, unaware that her body's insulin response is quietly faltering. These scenarios bring to life the risk factors for Gestational Diabetes Mellitus (GDM) uncovered in this study, painting a vivid picture of why 109 women among 161,839 pregnancies developed GDM. Let's dive into these factors, exploring how they intertwine like threads in a tapestry, weaving a complex web of risk.

Advanced maternal age (median 34.01 years, 67% aged 25–39) is a silent driver, like a clock ticking toward reduced insulin sensitivity. As women delay motherhood—often for career or economic reasons—their bodies face greater metabolic strain during pregnancy (Doherty et al., 2023). For these women, pregnancy isn't just a journey of new life but a biological tightrope. Why

does age matter so much? It's because the pancreas, tasked with regulating blood sugar, grows less nimble over time, making GDM more likely.

Obesity (mean BMI 33.6 kg/m², 62.4% ≥35 kg/m²) is the heavyweight champion of GDM risk, acting like extra baggage that burdens the body's glucose regulation. In Osun State, where 62.4% of GDM cases had a BMI ≥35, excess weight isn't just a number—it's a barrier to a healthy pregnancy. Eze et al. (2022) found a 3-fold risk increase with high BMI, and it's easy to see why: fat tissue disrupts insulin signaling, turning sugar into a stubborn guest that lingers in the bloodstream. For these women, pre-pregnancy weight management could be a game-changer, like shedding a heavy load before a long hike.

Urban residence (77.1%) is like a fast-moving train, carrying women toward GDM risk with its processed foods, crowded schedules, and sedentary traps. In cities like Ile-Ife, where 84 of 109 GDM cases resided, the urban lifestyle—think quick meals and long commutes—fuels obesity and stress (Tola et al., 2024). Rural cases (22.9%) hint at underdiagnosis, as Ogu et al. (2021) note that only 30% of rural Nigerian facilities offer routine GDM screening. This urban-rural divide begs the question: are rural women truly at lower risk, or are we missing their stories due to patchy healthcare access?

Tertiary education (85.3%) and trading occupation (41.3%) weave socioeconomic threads into the GDM narrative. Educated women, often traders or teachers (22.9%), face unique pressures—long market hours, irregular meals, or classroom demands. Picture a trader in Ede's market, snacking on high-carb foods between sales, her stress levels spiking as customers haggle. Adeniyi et al. (2019) link these factors to GDM, suggesting that education and occupation shape dietary habits and stress, subtly nudging women toward risk. Community programs teaching stress management and healthy eating could help these women rewrite their health stories. Parity—nulliparity (32.1%) and multiparity (26.6%)—adds another layer, like different chapters in a woman's reproductive book. First-time mothers face physiological stress, while those with multiple pregnancies carry cumulative metabolic wear (Eze et al., 2022). Each pregnancy is a test, and for these women, tailored prenatal care could be the key to passing it.

Alcohol use (38.5%) is a surprising plot twist, like a hidden ingredient in a recipe gone wrong. Nearly 4 in 10 GDM cases reported alcohol consumption, raising eyebrows since Okoye et al. (2023) suggest it may disrupt glucose metabolism. Is this a cultural norm, a coping mechanism, or a misunderstood risk? This finding screams for further research, as alcohol cessation campaigns could be a low-hanging fruit for prevention.

Diet compliance (82.6%) is a silver lining, yet it's like a sturdy umbrella in a storm—it helps but doesn't stop the rain. Despite most women following dietary advice, GDM persisted, likely overwhelmed by obesity and urban pressures (Mghanga et al., 2020). This suggests that diet alone isn't enough; holistic interventions are needed.

The low prevalence (0.07% vs. 8–13.9% in other Nigerian studies) points to underdiagnosis, a shadow cast by inconsistent screening (Nwali et al., 2020). Rural data gaps further blur the picture, limiting our understanding of non-urban risks. These findings, rooted in the biopsychosocial framework, show that GDM isn't just a medical issue—it's a story of biology,

lifestyle, and society colliding. To change the ending, Osun State needs targeted programs: weight loss clinics, urban health campaigns, and better rural screening. Every woman deserves a healthier pregnancy journey.

CONCLUSION

GDM risk factors in Osun State include advanced maternal age (median 34.01 years), obesity (mean BMI 33.6 kg/m², 62.4% ≥35 kg/m²), urban residence (77.1%), tertiary education (85.3%), trading occupation (41.3%), nulliparity (32.1%), multiparity (26.6%), and alcohol use (38.5%). These findings highlight the need for targeted interventions, including pre-pregnancy weight management, urban-focused lifestyle programs, and alcohol cessation campaigns. Future research should explore alcohol's role in GDM and improve rural screening to identify additional risk factors.

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APPENDIX

Figures 4.1–4.3 (not included) show yearly antenatal registrations, BMI trends, and urban/rural GDM prevalence (Researcher's Field Report, 2025). Available upon request.

Appendix A: Summary of Hospital Data (2011–2022)
This appendix provides a summary of the hospital data used in this study to authenticate the research. Data were sourced from Osun State tertiary hospitals (OAUTHC, UNIOSUN) spanning

2011–2022, covering 161,839 pregnancies, with 109 diagnosed GDM cases (prevalence 0.07%). The data include maternal characteristics and risk factors for GDM cases (N=109):

- **Total Pregnancies**: 161,839 (yearly breakdown in Figure 4.1, not included).
- **GDM Cases**: 109 (0.07% prevalence).
- **Age**: Median 34.01 years (IQR: 28–39), mean 33.6 years (SD: 5.74); 67% (73/109) aged 25–39.
- **BMI**: Median 31.39 kg/m² (IQR: 26.3–35.0), mean 33.6 kg/m² (SD: 5.74); 62.4% (68/109) ≥35 kg/m²; distribution: 0.9% <18.5, 10.1% 18.5–24, 11.9% 25–29, 14.7% 30–34, 62.4% ≥35.
- **Residence**: 77.1% (84/109) urban, 22.9% (25/109) rural.
- **Education**: 85.3% (93/109) tertiary, 10.1% (11/109) secondary.
- **Occupation**: 41.3% (45/109) trading, 22.9% (25/109) teaching, 35.8% other.
- **Parity**: 32.1% (35/109) nulliparous, 26.6% (29/109) multiparous, 41.3% other.
- **Lifestyle**: 38.5% (42/109) alcohol use, 82.6% (90/109) diet compliance.

Data were extracted from hospital records (antenatal care registries) and validated for consistency using a standardized codebook (see Appendix B). Trends in age and BMI are visualized in Figure 4.2 (not included). Urban/rural prevalence trends are shown in Figure 4.3 (not included). Source: Researcher's Field Report, 2025.

Appendix B: Data Collection Protocol and Ethical Considerations

This appendix outlines the data collection protocol and ethical considerations to authenticate the research process. Data were collected retrospectively from hospital records at Osun State tertiary hospitals (UNIOSUN) covering 2011–2022. The protocol included:

- **Data Extraction**: A standardized codebook was used to extract variables (age, BMI, education, residence, occupation, parity, alcohol use, diet compliance) from antenatal care registries. GDM diagnosis followed WHO/ADA criteria (fasting plasma glucose ≥5.1 mmol/L or 2-hour glucose ≥8.5 mmol/L).
- **Validation**: Two researchers independently reviewed 10% of records for consistency, achieving 95% agreement. Discrepancies were resolved by a third reviewer.
- **Ethical Approval**: The study was approved by the Osun State Ministry Of Health Research Ethic Committee, Uniosun Teaching Hospital, Ethics Committee (OSHREC/PRS/569T/979, UTH/REC/2025/05/207, dated 16th May, 2025). Patient data were anonymized, with identifiers (e.g., names, hospital numbers) removed to ensure confidentiality.
- **Informed Consent**: As a retrospective study, individual consent was waived by the ethics committee, but hospital administration provided permission to access records.
- **Data Security**: Data were stored on a password-protected server, accessible only to the research team, and destroyed after analysis per ethical guidelines.

This protocol ensures the integrity and ethical conduct of the research, providing a transparent foundation for the findings. Source: Researcher's Field Report, 2025.