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The Incident Pattern and Trend of Type 2 Diabetes Among Adults in Akwa Ibom State, South-south Nigeria

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Abstract: *Background*: Epidemiologic data indicate that the incident characteristics of type 2 diabetes mellitus (T2DM) are proper metrics to accurately define the true trajectory of the metabolic disorder. However, this is poorly characterized among Nigerians with T2DM. Hence, the current study evaluated the incident characteristics (pattern/trend) of T2DM among adult inhabitants of Akwa Ibom State, South-south Nigeria. *Methods*: A retrospective survey of incident adult-onset T2DM in the University of Uyo Teaching Hospital (UUTH) was conducted using 5-year (2014-2018) hospital medical data. Records of eligible cases were identified, relevant data retrieved on a well-designed research pro forma at the point of diagnosis, and acquired data analyzed using descriptive/comparative statistics. *Results*: A total of 47,357 adults with varied medical conditions presented in UUTH during 2014-2018 of whom 2,198 (mean age: 55.09±11.86 years) were diagnosed with T2DM, giving an overall crude incident rate (CIR) of 4.64% (95% Confidence Interval [CI]: 3.61-6.91) and age-standardized incidence rate (ASIR) of 5.36% (95%CI: 3.96-7.45). An increasing trend of the annual incident cases, CIR, and ASIR of T2DM was observed during the period (p trend <0.001). The increase was obvious among both genders, young adults, middle-aged, urban dwellers, tertiary-level educated, paralleling the rising low physical activity, overweight, and obesity (p trend <0.05). However, a decreasing trend of the CIR and ASIR was observed among the rural-dwellers (p trend <0.05). *Conclusion*: The incidence of adult-onset T2DM has assumed an upward trend among inhabitants of Akwa Ibom State, South-south Nigeria. Public health measures are urgently recommended to stem this trend.

Keywords: Diabetes, Diabetes Mellitus, Incident Type 2 Diabetes Mellitus, T2DM

1. Introduction

The current global burden of type 2 diabetes mellitus (T2DM) has assumed a pandemic dimension [1, 2] This has primarily been driven by the increasing obesogenic living environment, associated changes in lifestyle, and the increasing overweight/obesity epidemic occasioned by rapid globalization/urbanization [1, 2] Data suggests a more gloomy prediction of the metabolic disorder among the low- and middle-income countries (LMIC) based on the current trend [2] In Nigeria, the burden of T2DM has also been on the upward trend among adults in recent time [3, 4]. Two previous studies reported among adult inhabitants in Akwa Ibom State, South-south Nigeria, had documented one of the highest T2DM burdens in the country [5, 6]. However, these previous studies reported on the disease prevalence trends, which some authors have argued could depict a misleading trajectory of the metabolic disorder and as such is an inadequate metric to evaluate the trend dynamics of T2DM [7, 8].

The incidence of T2DM assesses the rate at which new cases have developed over time among the population at risk while the prevalence defines the total proportion of the population that have T2DM over time including the incident cases [7]. Hence, T2DM prevalence could rise as the incidence rises, or as mortality falls or as survival improves. Moreover, data suggest that the incidence trend of T2DM, unlike its prevalence trend, is influenced by the effects of changes in population exposure to risk factors and could reliably define the impact of public health measures geared towards T2DM [8]. The incidence pattern and trend of T2DM within the LMIC including Nigeria is scarce with the majority reporting on the disease prevalence trend [4, 9]. To date, no data exist on the incidence pattern and trend of T2DM in Akwa Ibom State of southern Nigeria which has one of the highest prevalence rates of T2DM metabolic disorder in the country.

The current study retrospectively evaluated the 5-year incident pattern and trend of T2DM by time and other socio-demographic characteristics among adult inhabitants of Akwa Ibom State, southern Nigeria.

2. Materials and Methods

2.1. Design, Setting and Site

This was a retrospective, cross-sectional and descriptive study executed in the University of Uyo Teaching Hospital (UUTH) situated within the central urban city of Uyo. Uyo is the state capital of Akwa Ibom State in the southern part of Nigeria. UUTH is the only government‐owned tertiary health facility in the state which serves as a major referral center for all the other primary, secondary and privately-owned health facilities scattered over the local government areas of the state. Therefore, to a very large extent, the demographics of the patient attendees of UUTH is a fair representation of the entire Akwa Ibom state.

2.2. Ethical Considerations

The ethical approval of the study was obtained from the Research Ethics Committee of UUTH following the review of the study protocols and the study was executed in compliance with the principles embodied in the Helsinki Declaration.

2.3. Tools and Target Populations

The study was carried out using anonymized hospital data, obtained from the Department of Health Information Management, of all the eligible adults diagnosed with T2DM.

2.4. Data Acquisition

Data was acquired from the medical case files using trained research assistants. Case files of all the medical cases managed during the study period were first counted. Secondly, the files of the diabetic cases were carefully retrieved. The case files of those diagnosed with type 2 diabetes were subsequently extracted. Lastly, all the relevant data at the point of initial T2DM diagnosis were abstracted which included: age, sex, educational cadre attained, marital union, areas of residence, occupation, family history of diabetes, alcohol/cigarette consumption history, systolic/diastolic blood pressure values, body mass index (BMI), the month and year diagnosed.

A well-designed and structured survey pro forma with columns under the earlier mentioned variable headlines were used to extract data.

2.5. Eligibility Criteria

Criteria for inclusion were eligible medical records of all patients diagnosed with incident adult-onset (≥18 years of age) T2DM in UUTH over 5 years spanning from 1st of January 2014 to 31st of December 2018). Criteria for exclusion were records of those with type 1 diabetes, those with incomplete data, records of those aged <18 years old, pregnant cases, and those diagnosed outside the study period (2014–2018).

2.6. Laboratory Protocols

During the period under survey, all specimen collection and laboratory protocols were carried out following standardized guidelines. Venous fasting plasma glucose (FPG) and random plasma glucose (RPG) were determined using the glucose oxidase/peroxidase principle in fluoridated plasma. Glycated hemoglobin AIc (HbA1c) was assayed using the immuno-turbidimetric principle with whole blood specimens collected in ethylene-diamine-tetra-acetic specimen tubes. All analyses were carried out on Selectra Pro M (ELITech Grp, Holland) automated chemistry analyzer.

2.7. Laboratory Diagnosis

During the period under study, laboratory diagnosis of T2DM was made based on the 1999 World Health Association (WHO) and the 2010 American Diabetes Association (ADA) diagnostic criteria.

a. Based on the 1999 WHO diagnostic criteria, T2DM was diagnosed if one or more of the following laboratory parameters is obtained among any suspected case: 1. FPG ≥ 7.0 mmol/l, 2. RPG ≥ 11.1 mmol/l, and 3. Two-hour OGTT ≥ 11.1 mmol/l.

b. Based on the 2010 ADA diagnostic criteria, T2DM was diagnosed if HbA1c level is ≥ 6.5% among any suspected case.

2.8. Operational Definitions of Study Variables

1. Cases of T2DM were defined as those who met the following characteristics: (a) Diagnosed by the specialist endocrinologist in UUTH during 2014-2018. (b) Nil history of being on insulin therapy since diagnosis. (c) Persistency on non-insulin oral anti-hyperglycemic medications since diagnosis.

2. Age was arbitrarily categorized as young adult (≤44 years), middle-aged (45-64 years), or elderly (≥65 years).

3. Physical activity levels was classified as high, intermediate or low based on the categories of accelerometry-

derived occupational activity as detailed by Steeves and colleagues [10].

4. BMI obtained from weight in meters divided by square of height in meters was stratified as underweight (<18.5), normal (18.5-24.9), overweight (25-29.9), or obese (≥30).

5. An incident case was defined by the first occurrence of T2DM episode fulfilling the clinical and laboratory definition of T2DM and at least 2 years of diabetes-free observation before diagnosis.

2.9. Data Management/Statistical Analysis

Data were managed using the Statistical Package for Social Sciences software version 23 (IBM Corp., Armonk, NY, USA) and depicted in frequency tables and graphs. The non-categorical variables were summarized using means/standard deviations. Categorical variables were summarized using proportions expressed as numbers/frequencies; between-group comparisons were determined using the Chi-squared test. Incident rates were computed from the total number of incident T2DM cases divided by the total number of the incident medical cases presenting in the study center in each year under study at 95% confidence intervals (CI). The 95% CIs was derived using the formula: (Incidence rate ± 1.96 × standard error) [11].

The incident rates (crude and age-adjusted) and incident rates percentage change (IRPC) were used to quantify T2DM incidence trend during the observation period. The age-standardized incident rate (ASIR) was calculated using the direct standardization method according to the last population census in Nigeria conducted in 1991. Regression models were employed to evaluate the linear trend of the incident rates and the incident proportions of explanatory variables. To calculate the IRPC, the difference between the IRPC of the preceding year (old) and the subsequent year (new) was first obtained, then the product was divided by the absolute IRPC value of the subsequent year (new), and the obtained value was multiplied by 100%. A two-tailed test was used to evaluate statistical significance, and a probability value (p-value) of<0.05 was considered statistically significant.

Table 1. *Baseline clinical and socio-demographic characteristics of T2DM subjects (n=2,198) at diagnosis.*

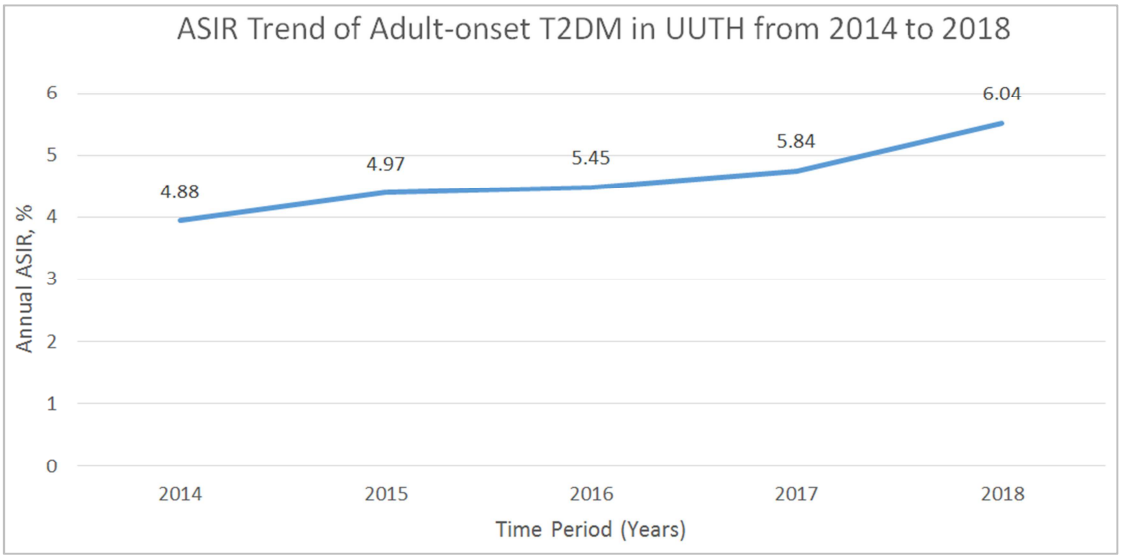
Variables	Categories of variables	Mean ± SD/n (%)	p-value
Mean age, years	-----	55.11 ± 11.86	----
Age groups, years			<0.001*
	≤ 44 (young adults)	517 (23.5)	
	45-64 (middle-aged)	1061 (48.3)	
	≥ 65 (elderly)	620 (28.2)	
Gender			<0.001*
	Males	1003 (45.6)	
	Females	1195 (54.4)	
Place of residence			<0.001*
	Urban	1512 (68.8)	
	Rural	686 (31.2)	
DM family history			0.009*
	Yes	760 (34.6)	
	No	665 (30.3)	
	NAD	773 (35.2)	
Educational status			<0.001*
	Primary	446 (20.3)	
	Secondary	546 (24.8)	
	Tertiary	936 (42.6)	
	No formal education	270 (12.3)	
Occupation			0.016*
	Government employee	684 (31.1)	
	Farmers	108 (4.9)	
	Self-employed (Small/medium-scale business/traders)	824 (37.5)	
	Retired	476 (21.7)	
	Student/unemployed/others	106 (4.8)	
Physical activity level			<0.001*
	High	834 (37.9)	
	Intermediate	131 (9.2)	
	Low	1196 (52.8)	
Body mass index, kg/m^2			<0.001*
	Normal (18.5-24.9)	440 (20.0)	
	Overweight (25.0-29.9)	667 (30.3)	
	Obese (≥ 30.0)	625 (28.4)	
	NAD	466 (21.2)	

*Statistically significant; SD: Standard deviation; NAD: No available data

Table 2. *Annual incident characteristics of adult-onset T2DM in UUTH from 2014 to 2018.*

Year	2014	2015	2016	2017	2018	p for trend	Total
Total incident medical cases, n	7,463	9,997	10,172	10,312	9,413	----	47,357
Total incident T2DM cases, n	294	439	456	490	519	<0.001*	2,198
CIR, %	3.94	4.39	4.48	4.75	5.51	<0.001*	4.64
95% CI, CIR	2.61-5.17	3.32-6.11	3.41-6.28	3.55-6.77	3.71-7.09	----	3.61-6.91
ASIR**, %	4.48	4.97	5.45	5.84	6.04	0.003*	5.36
95% CI, ASIR	2.97-5.33	3.44-6.76	4.51-6.78	4.88-7.31	4.98-8.33	----	3.96-7.45
ASIRPC, %	---	+10.25	+2.01	+5.68	+13.79	<0.001*	---

*Statistically significant; T2DM: Type 2 diabetes mellitus; CI: confidence interval; CIR: Crude incidence rate; ASIR: Age-standardized incidence rate; **The age-standardized incident rate was calculated using the direct standardization method according to the last population census in Nigeria conducted in 1991; ASIRPC: Age-standardized incidence rate percentage change



ASIR: Age-standardized Incidence Rate

Figure 1. *ASIR trend of adult-onset T2DM in UUTH from 2014 to 2018.*

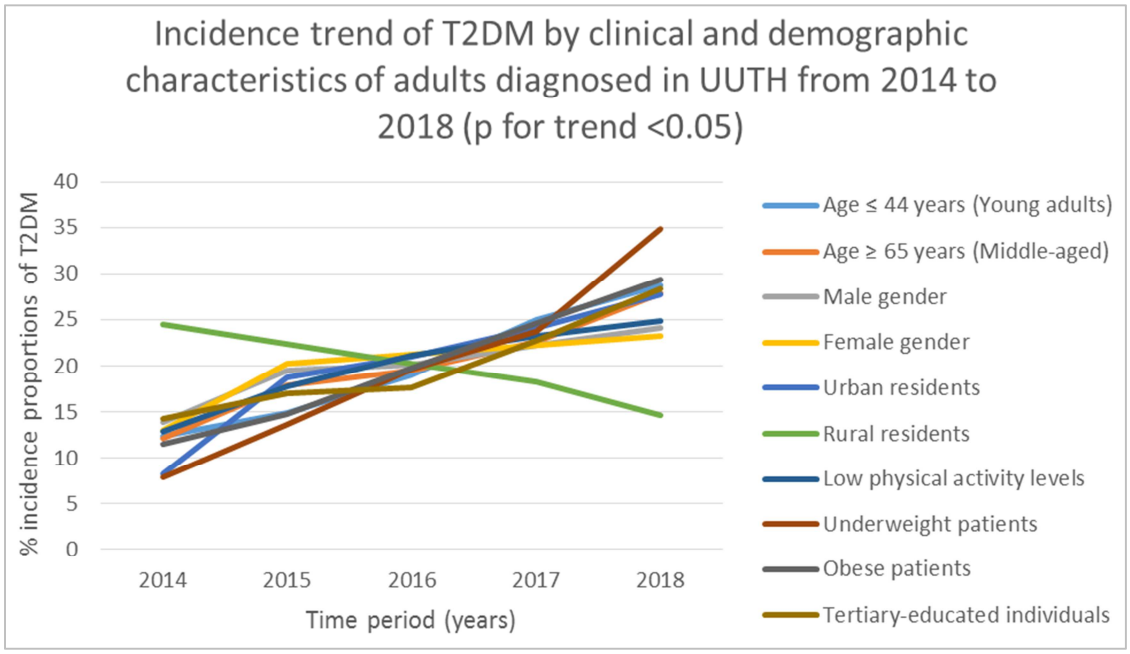


Figure 2. *The incidence trend pattern of T2DM by clinical/demographic characteristics among adults diagnosed in UUTH from 2014 to 2018.*

Table 3. *Distributions of annual incident proportions by clinical/socio-demographic characteristics of T2DM in UUTH from 2014 to 2018.*

Year	2014	2015	2016	2017	2018	p for trend
Age group, years, n (%)						
≤ 44 (young)	64 (12.4)	77 (14.9)	98 (19.0)	129 (25.0)	149 (28.8)	<0.001*
45-64 (middle-aged)	155 (14.6)	251 (23.7)	237 (22.3)	221 (20.8)	197 (18.6)	0.055
≥ 65 (elderly)	75 (12.1)	111 (17.9)	121 (19.5)	140 (22.6)	173 (27.9)	<0.001*
Gender, n%						
Male	139 (13.9)	197 (19.5)	202 (20.1)	224 (22.3)	24.1 (24.1)	<0.001*
Female	155 (13.0)	243 (20.3)	254 (21.3)	266 (22.3)	277 (23.2)	<0.017*
Place of residence, n (%)						
Urban	126 (8.3)	285 (18.8)	317 (21.0)	365 (24.1)	419 (27.7)	0.018*
Rural	154 (24.5)	154 (22.4)	139 (20.3)	125 (18.2)	100 (14.6)	0.010*
Educational status						
Primary	87 (19.5)	96 (21.5)	94 (21.1)	87 (19.5)	82 (18.4)	0.211
Secondary	51 (9.3)	121 (22.2)	162 (29.7)	116 (21.2)	96 (17.6)	0.075
Tertiary	133 (14.2)	159 (17.0)	165 (17.6)	213 (22.8)	266 (28.4)	0.034*
No formal education	23 (8.5)	63 (23.2)	35 (13.0)	74 (27.4)	75 (27.8)	0.097
DM family history, n (%)						
Yes	20 (2.6)	183 (24.1)	179 (23.4)	212 (27.9)	167 (22.0)	0.062
No	131 (19.7)	119 (17.9)	129 (19.4)	134 (20.7)	152 (22.9)	0.143
Physical activity level, n (%)						
High	133 (15.9)	207 (24.8)	158 (18.9)	167 (20.0)	169 (20.3)	0.071
Intermediate	11 (5.4)	26 (12.8)	53 (26.1)	52 (25.6)	61 (30.0)	0.094
Low	150 (12.9)	206 (17.7)	245 (21.1)	271 (23.3)	289 (24.9)	<0.001*
Body mass index, n (%)						
Normal	11 (25.2)	71 (16.1)	112 (25.5)	87 (19.8)	59 (13.4)	0.058
Overweight	53 (7.9)	91 (13.6)	131 (19.6)	159 (23.8)	233 (34.9)	<0.001*
Obese	72 (11.5)	92 (14.7)	123 (19.7)	154 (24.6)	184 (29.4)	<0.001*

*Statistically significant; T2DM: Type 2 diabetes mellitus; CI: confidence interval.

3. Results

During the 2014-2018 period, a total of 47,357 adults with various medical conditions presented in UUTH. Of that total, 2,198 adults whose basic characteristics are depicted in Table 1, were diagnosed with T2DM during that period, representing an overall adult T2DM crude incidence rate (CIR) of 4.64% (95% Confidence Interval [CI]: 3.61-6.91) but an age-standardized incidence rate (ASIR) of 5.36% (95%CI: 3.96-7.45) (Table 2).

The incident characteristics of T2DM during the observation period are shown in Table 2 and highlighted in Figure 1.

Depicted in Table 1, the majority of the adults diagnosed with incident T2DM were predominantly middle-aged (n=1061, 48.3%), females (n=1195, 54.4%), urban dwellers (n=1512, 68.8%), those with positive DM family history (n=760, 34.6%), those with tertiary educational status (n=936; 42.6%), self-employed (engaged small/medium-scale businesses/trading) (n=834; 35.5%), low physically active (n=1196, 52.8%), the overweight/obese (n=667, 30.3%) ($p<0.05$).

Table 2 shows the annual number of incident medical cases, incident T2DM cases, CIR, ASIR and the ASIR annual percentage change of adult-onset T2DM in UUTH from 2014 to 2018. The CIR in 2014, 2015, 2016, 2017, and 2018 was 3.94% (95% CI: 2.61-5.17), 4.39 (95%CI: 3.32-6.11), 4.48% (95% CI: 3.41-6.28), 4.75% (95% CI: 3.55-6.28), and 5.51% (95% CI: 3.71-7.09), respectively (Table 2). While the ASIR was 4.48% (95% CI: 2.97-5.33), 4.97% (95%CI: 3.44-6.76), 5.45% (95%CI: 4.51-6.78), 5.84% (95%CI: 4.88-7.31), and 6.04% (95%CI: 4.98-8.33) in 2014, 2015, 2016, 2017 and 2018, respectively (Table 2).

A significantly increasing trend of incident cases, CIR and ASIR of T2DM was observed between 2014 and 2018 (p trend < 0.001) (Table 2). The highest ASIR annual percentage change (+13.79%) occurred between 2017 and 2018 (p for trend <0.001) following a sharp decline between the 2015 and 2016 periods (Table 2). Thereafter, a steady increasing trend of ASIR percentage change was observed from 2016 to 2018 (Table 2).

Figure 1 graphically depicts the increasing trend of annual ASIR of adult-onset T2DM cases in UUTH from 2014 to 2018.

Table 3 shows the annual incident proportions of T2DM by clinical/socio-demographic characteristics during the study period. Significantly increasing T2DM incident trend was observed among those aged ≤ 44 (young adults), those aged 45-64 (middle-aged), both genders (males and females), urban dwellers, those who had attained tertiary educational status, low physical activity and the overweight/obese individuals (p trend < 0.005) (Table 3). The increasing proportions of the physically inactive, overweight and obese incident T2DM cases coincided with the rising annual percentage change of incident T2DM from 2016 to 2018 (Tables 2 and 3). In contrast, a significantly decreasing trend of incident T2DM was observed among those who dwelt in rural centers (p trend < 0.05) (Table 3).

Figure 2 depicts the incidence trend pattern of adult-onset T2DM (with statistical significance) by clinical/demographic characteristics among adults diagnosed in UUTH from 2014 to 2018.

4. Discussion

This current study highlighted the 5-year incident pattern and trend of T2DM among adult inhabitants of Akwa Ibom State, a region with one of the highest burdens of DM in Nigeria.

In comparison with previous literature, [5, 12-24] the majority of the diagnosed incident T2DM during the study period were predominantly middle-aged (45-64 years), females, urban dwellers, those with positive DM family history, the tertiary-level educated, the small/medium-scale business individuals and traders, the low physically active and the overweight/obese individuals.

In a recent Endocrine Society report, LeRoith and colleagues had surmised that the peak age of incident T2DM was between 45-60 years [12]. It is also projected that more than 70% of incidents of T2DM will occur in developing countries in the nearest future with the majority of those diagnosed being middle-aged (age 45-65) [13]. These reports [12, 13] concurs with the findings of this study. The direct effect of aging on metabolic regulation, age-related insulin resistance primarily associated with adiposity, sarcopenia, physical inactivity, and the decline of pancreatic islet function and proliferative capacity had previously been described as factors driving the prominence of incident T2DM among the middle-aged [12, 24].

In the current study, the females predominated among those diagnosed with incident T2DM, which compares with local reports [5, 15], but contrast with some foreign reports [8, 16]. Decreased physical activity, muscle mass, glucose tolerance, and the increased obesity incidence and hormonal influences on insulin secretion/sensitivity are contributing variables linked with the disproportionate incidence of T2DM among females [17].

Most of those diagnosed with incident T2DM dwelt in the urban center at the time of diagnosis, which is in tandem with most reports within the studied region [5, 18]. Physical inactivity, unhealthy dietary patterns, high socioeconomic status, and overweight/obesity are all interacting variables linking urbanization to the incidence of T2DM [19]. In contrast, Wang and colleagues recently documented higher incident T2DM cases among rural dwellers among adults in Zhejiang Province, China [16].

The risk of incident T2DM is amplified in individuals with an established family history of DM, which was corroborated in the current study [20, 21]. The exact link between family history and T2DM remains controversial in the literature. In the EPIC-InterAct Study, the link between family history and T2DM was not explained by anthropometric, lifestyle or genetic risk factors [20]. However, Cederberg and colleagues surmised that a family history of T2DM increases the risk of obesity and obesity complications including an increased propensity to accumulate ectopic (non-subcutaneous) fat leading to incident T2DM [21].

A significant proportion of incident T2DM was reported among the majority of our studied population with tertiary-level educational status which agrees with recent findings documented among adult T2DM patients in LMIC by Seiglie and colleagues [22]. This contrasts with data from high-income societies where lower educational status is documented to increase the risk of incident T2DM [23]. In LMIC societies, tertiary educational status is an established indicator of a higher socio-economic position known to influence incident T2DM [22].

In accord with previous Nigerian studies, most of the incident T2DM cases were self-employed adults engaged in small/medium-scale businesses/trading at the point of diagnosis [24, 25]. This occupational factor may be a proxy for poor-health-seeking dynamics reported to predict and influence incident T2DM [26]. As previously documented and consistent with the findings of the present study, most of the study cohorts had low physical activity levels at diagnosis. [24] This may partly explain the high overweight/obesity rate observed among the present sample.

The conclusions from our study showed that the cumulative total ASIR of T2DM was 5.36 (95% CI: 3.96-7.45) during the 5-year observation period. Data is very limited on T2DM incidence studies among Nigerians [5, 18]. In one of the very few incidence studies reported in Nigeria by Balogun and colleagues, CIR of 8.87% per 1000-person-years (CI: 6.45-12.90) was documented [18]. This study [18], restricted to only the elderly DM patients, was limited by self-reported DM diagnosis. However, our ASIR is higher than the 0.8% incident rate reported previously from Uyo, Nigeria by Ekpeyong and colleagues; although their documented rate was not age-standardized [5].

In the current study, the annual incidence of T2DM showed an increasing trend during the study period. Evidence of increasing incident T2DM trend in this study is consistent with recent existing local and foreign studies [27-29].

In a previous local study conducted in South-eastern Nigeria, Chukwu and colleagues had noted an increasing trend of incident T2DM from 2008 to 2012 [15]. In a recent report from the Global Burden of Disease (GBD) Study 2017, it was observed that both the incident cases and the age-standardized incident rates of T2DM increased significantly from 1990 to 2017 which was more pronounced within the geographical zone of Sub-Sahara Africa.

The increasing T2DM incidence trend also paralleled the rising low physical activity, overweight, and obesity among our studied cohorts. This finding is consistent with the literature which further highlights the significant roles played by various behavioral factors (e.g. physical inactivity) and nutritional disorders (e.g. overweight/obesity) in the current epidemic of T2DM ravaging the LMIC [9, 28]. This finding is supported by the fact that the most profound annual percentage change of the incident T2DM, noted in the current study, occurred from 2016 to 2018 which coincided with the period with the highest rates of low physical activities, overweight, and obesity documented among our studied population.

During the observation period, the incident T2DM trend was increasingly pronounced among the young adults, middle-aged, both genders, urban dwellers, and the tertiary-

level educated which corroborates national, regional, and global findings and projections [5, 8, 12-18, 22, 29, 30].

In a review of global epidemiologic data of T2DM conducted in 2019 by Khan and colleagues, the authors had conclusively surmised that T2DM is rapidly evolving majorly among young adults compared to older adults [29]. Similarly, Luk et al and Wang et al had recently documented rising incidence of T2DM among young adults in Hong Kong and China, respectively [8, 16]. The rising incidence of T2DM among young adults has been adduced to the rising epidemic of overweight/obesity in this age group [30].

In contrast, a decreasing trend of incident T2DM was observed among the rural dwellers during the observation period. Similar observations have been reported in two previous Nigerian studies [15, 18] but contrast with a recent report documented in China [16]. This finding may not be unconnected with the rapid economic development and the current rural-urban migration on-going within the studied region which was extensively documented in a recent report [31].

The strength of the present study is based on its large sample size and the being the first T2DM incidence study in the region, which could serve as primary data for future incidence studies. However, the study was limited by a few factors which do not, in any way, undermine its significance. First, it is a retrospective study based on secondary data which may have led to the under-reporting of the number of incident T2DM cases in the study. Secondly, it was a solely hospital-based and single-centered study whose findings may not reflect the entire population in the study region.

5. Conclusion

The current study highlighted the incidence pattern and trend of adult-onset T2DM among adult inhabitants of Uyo in Akwa Ibom, South-south Nigeria who had presented in UUTH over a 5-year (2014-2018) period. The study showed a significantly increased incidence of T2DM over the five years which was most evident among the young adults, middle-aged, both genders, urban dwellers, tertiary-level educated and paralleled the rising low physical activity, overweight, and obesity incidence among the study population. However, a decreasing incident trend was observed among those who dwelt in the rural areas. From the foregoing, public health measures and DM-targeted policies are urgently recommended to stem this current trend of T2DM in the region.

Disclosure Statement

The authors have no conflict of interest to declare.

Ethics Statement

The study protocol was approved by the Institutional Research Ethics Committee (approval reference number 2019/282.

Author Contribution

All the authors were involved substantially in the concept and design of the study, acquisition, analysis, and interpretation of the data, drafting the article, revising the article critically for its intellectual content, and in the final approval of the version to be published.

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