SOCIO-CLINICAL DETERMINANTS OF PATTERN OF GLYCATED HAEMOGLOBIN AMONG TUBERCULOSIS PATIENTS ATTENDING DOTS CLINIC IN NORTH-CENTRAL, NIGERIA

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ABSTRACT

Background: Several factors such as obesity and smoking among others have been associated with deranged glycated haemoglobin (*HbA1c*) in TB patients. Hyperglycaemia, measured by *HbA1c*, showed a significantly higher risk of unfavourable TB treatment outcomes. This study examined the influence of some factors on *HbA1c* among TB patients attending DOTS clinic of the University of Ilorin Teaching Hospital.

Methodology: A hospital-based cross-sectional study involving 180 consenting TB patients that were selected using systematic sampling technique from February to July, 2022. Those with diagnosed Diabetes Mellitus were excluded. Data were collected using semi-structured questionnaires. Blood samples were collected for *HbA1c* estimation using turbidimetric method. *HbA1c* was categorized as DM (≥ 6.5%), prediabetes (*HbA1c* ≥5.7% - 6.4%) and normal (<5.7%) using American Diabetes Association criteria. Statistical Product and Service Solutions, version 23 was used to analyse data. P-value was <0.05.

Results: The pattern of the *HbA1c* was normal (75%), pre-diabetes (8.9%) and DM (16.1%). The pattern of *HbA1c* was significantly associated with smoking (p= 0.037). Logistic regression analysis showed that smoking (OR 0.240, 95% CI 0.069 – 0.826) is less likely to predict suboptimal *HbA1c* (*HbA1c* ≥5.7%) but physical activity (OR 1.877, 95% CI (0.914 – 3.854)) showed that those who are inactive were about two times at risk of developing suboptimal Hb1AC. Body mass index, duration of treatment, HIV status, family history of DM and type of TB had no statistically significant association with *HbA1c*.

Conclusion: A quarter of TB patients had deranged *HbA1c* (Pre-diabetes and undiagnosed DM), this suggests the need for regular screening to mitigate the potential effects on their health. Physical activity protects against developing deranged *HbA1c* and this emphasizes the need for TB patients to be active.

Keywords: Socio-clinical, Pattern, Primary, Tuberculosis, Glycated

Introduction

Existing data suggest that certain socio-clinical factors such as HIV status, smoking history, family history of diabetes mellitus (DM), level of physical activity, duration of anti-TB treatment and body mass index are associated with occurrences of diabetes mellitus (DM) and prediabetes (PD) among tuberculosis (TB) patients.[1-7] Findings from Thapa *et al* found that older age, tobacco smoking, high-income status and self-history of systemic hypertension were significantly associated with DM among TB patients.[8] Similarly, a cohort study in Iran involving 317 new TB cases found that 24% had DM with glycated haemoglobin (*HbA1c*) ≥6.5% with the most influencing factors being older age, family history of DM and a higher prevalence of cavities on chest x-rays with marked changes in the level of *HbA1c* in the first 3 months of anti-TB treatment.[9]

However, a better understanding of the impact of these socio-clinical factors on the pattern of *HbA1c* among patients receiving healthcare services in a primary care setting such as Directly Observed Therapy Short-course (DOTS) is critical to improving the management of patients with TB. *HbA1c* has been recommended for diagnosis of DM and monitoring of glycaemic control.[10,11] *HbA1c* determination is convenient in primary care settings among TB patients as it is not affected by day-to-day plasma glucose

A growing percentage of Nigerians are elderly due to the country's demographic transition, which is marked by rising life expectancy and falling fertility rates.[7] The healthcare system faces a significant challenge in managing the complex needs of an aging population, particularly chronic discomfort, which requires immediate attention. However, despite its vital role in guiding healthcare planning and policy, there is a dearth of information on the prevalence and pattern of chronic pain among Nigerian older persons. There are substantial gaps in our knowledge of the larger epidemiological trends because previous research has mostly concentrated on certain subpopulations or situations.[8,9,10,11]

Numerous factors, including biological, psychological, and social ones, affect patterns of chronic pain.[12] These elements are made more complex in Nigeria by differences in access to healthcare, the role of traditional medicine, and cultural norms that affect how people perceive and report pain. For example, underreporting may result from stoicism in the face of pain and formal medical intervention may be delayed if non-traditional treatments are used.[13] As a result, managing chronic pain in the elderly calls for a sophisticated strategy that takes into account both biological treatments and these sociocultural nuances.

There are also clear trends in the location of pain and its underlying causes in the elderly. Musculoskeletal pain, such as osteoarthritis and persistent back pain, frequently predominates, with neuropathic and visceral pain coming next.[14, 15,16,17] However, due to variances in lifestyle, genetic predispositions, and career history, there are discrepancies between populations. Conditions like persistent low back pain and joint degeneration are anticipated to be common in Nigeria, where a large number of older people have worked in physically demanding jobs throughout their lives.[18]

In addition to having an impact on the individual, chronic pain places a heavy financial and social strain on families and communities.[19] Providing care for senior people with chronic pain frequently requires a significant time and financial commitment, which increases the burden on households, especially in environments with limited resources.[20] Furthermore, the psychological effects on caregivers and the productivity loss linked to chronic pain highlight the wider societal ramifications of this condition.[21] These issues are especially noticeable in Nigeria, where unofficial caregiving is still the major way that older people are supported, making it necessary to incorporate chronic pain management into larger public health programs.

There are still many gaps in knowledge and practice because of the paucity of research in Nigeria, despite the growing awareness of chronic pain as a public health issue. The prevalence, distribution, and drivers of chronic pain in the elderly have not been thoroughly examined in many studies, which makes it difficult for healthcare professionals to effectively address the problem.[22] Furthermore, the management of chronic pain is made more difficult by differences in healthcare access, especially between urban and rural locations, as older people in rural communities frequently encounter major obstacles to receiving the proper care.

The objective of this research is to enhance comprehension of the effects of chronic pain on this susceptible group by combining the available literature and offering fresh perspectives on the clinical, sociodemographic, and cultural elements affecting chronic pain. Additionally, we also determine its association with sociodemographic variables and pain-related characteristics.

Methods:

Study area

This study was conducted at the General Outpatient Clinic of Federal Medical Centre Bida, located in the ancient town of Bida, the headquarters of Bida Local Government Area. Bida is the second-largest city in Niger State and has a population density of 3,764 per square kilometre. The indigenous Nupe-speaking ethnic group primarily engages in brass works, trading, and farming, with Islam as the predominant religion.

Study site

The Federal Medical Centre, Bida (FMCB), established in 1997, is the highest health facility in Niger State, offering a wide range of services in various medical and surgical specialties. The centre provides clinical experience training for nursing students, internships for pre-registration house officers, and accredited postgraduate training in Family Medicine, Obstetrics and Gynaecology, Surgery, Internal Medicine, Paediatrics, and diagnostic Radiology. The Family Medicine department has eight consultant Family Physicians who supervise its activities, including the outpost. The department has subunit clinics, including the General Outpatient Clinic, National Health Insurance Authority (NHIA), Directly Observed Treatment Short Course (DOTS), Antiretroviral Therapy Clinic, Skin Clinic, Non-Communicable Disease (NCD), and National Youth Service Corps clinic. The General Outpatient Clinic serves as the initial point of contact for most patients, conducting vital sign checks and referring them for appropriate treatments when needed. The Family Medicine

variations or need for fasting and preparatory dietary cautions.[10] The present study aimed to examine socio-clinical factors associated with patterns of *HbA1c* among tuberculosis patients attending DOTS clinic in the University of Ilorin Teaching Hospital (UITH).

Methodology

This hospital-based descriptive cross-sectional study was conducted in DOTS clinic of the University of Ilorin Teaching Hospital (UITH), Ilorin, Kwara state. A systematic random sampling technique was used to select a total of 180 TB patients. Inclusion criteria were all consenting patients (18 years old and above) attending TB clinic, UITH. Exclusion criteria include patients diagnosed with major psychiatric disorders or acutely ill patients requiring emergency care to avoid inappropriate response and patients known with haemoglobinopathies, iron deficiency anaemia, chronic kidney disease, and chronic liver disease to avoid inaccurate Hb1Ac results.

Sample Size was calculated using Leslie Kish's formula for estimating minimum sample size.[12,13]

$$n = Z^2pq/d^2$$

Z = standard normal deviation, usually set at 1.96 which corresponds to 95% confidence level.

p = proportion in the target population estimated to have a particular characteristic.

Prevalence of DM among tuberculosis patients was 13.6% as reported in a hospital based cross-sectional study in Port Harcourt, Nigeria by Ojule et al was used.[14]

p = 0.136

q = 1- p=0.864

d = degree of accuracy desired usually set at 0.05

$n=\approx (1.96)2\ (0.136)\ (0.864)/(0.05)^2$

n= 180

A semi-structured questionnaire was used to obtain information on demographic information. Socio-clinical factors examined in this study were HIV status, smoking, physical activity, BMI, duration of treatment of TB, family history of DM, type of TB. About 5mls of venous blood via venipuncture into an ethylene-diamine-tetra-acetic acid (EDTA) sample bottle was collected from each participant to determine the level of *HbA1c*. The same was sent to the University of Ilorin Teaching Hospital Chemical Pathology Laboratory for *HbA1c* analysis. As recommended by National Institute for Clinical Excellence (NICE), the *HbA1c* were categorized into: 1) <6% as normal 2) 6-6.4% as prediabetes (PD) 3) ≥ 6.5% as diabetes (DM).[16,17]

Data were analysed using Statistical Packages for Social Sciences (SPSS-23). Frequency tables and percentages were used to present categorical data. Mean and standard deviation were calculated for the continuous variables. Chi-square was used to determine the level of significant association between categorical variables. Logistic regression analysis was done to test the strength of the significant associations. Level of statistical significance used was $p<0.05$.

Result

Socio-demographic Characteristics of the Participants

Table 2 showed the pattern of *HbA1c* among respondents. It showed that 75% of the participants had normal level (*HbA1c* <6%), 8.9% were prediabetic (*HbA1c* 6-6.4%) and 16.1% were diabetic (*HbA1c* ≥ 6.5%).

Table 1: Socio-demographic Characteristics of the Participants (N=180)

Variables	Frequency	Percentage (%)
Age Groups		
≤ 20	23	12.8
21 – 40	95	52.8
41 – 60	49	27.2
>60	13	7.2
Mean ± SD	37 ± 15.01	
Range	18 – 95	
Gender		
Male	129	71.7
Female	51	28.3
Religion		
Christianity	28	15.6
Islam	150	83.3
Traditional	2	1.1
Marital Status		
Married	104	57.8
Single	76	42.2
Divorced/Separated	0	0.0
Type of family		
Monogamous	118	65.6
Polygamous	62	34.4
Level of education		
Tertiary	56	31.1
Secondary	66	36.7
Primary	34	18.9
No formal education	24	13.3
Occupation		
Civil servant	16	8.9
Private workers	136	75.6
Unemployed	28	15.5
Ethnicity		
Hausa	17	9.4
Yoruba	148	82.2
*Others	15	8.3

Baruba, Nupe, Ibo, Fulani

Table 2: Pattern of HbA1c among Respondents

Variables	Frequency (N=180)	Percentage (%)
Normal	135	75.0
Prediabetes (PD)	16	8.9
Diabetes (DM)	29	16.1

Table 3: Distribution of Socio-clinical Parameters of the respondents (N=180)

Variables	Frequency	Percentage
Smoking		
Yes	34	18.9
No	146	81.1
Pack years (n=34)		
< 4	12	35.2
4 – 8	11	32.4
> 8	11	32.4
Mean ± SD	6.29 ± 5.49	
Range	0.04 – 17	
Physical activity		
Active	130	72.2
Inactive	50	27.8
B M I		
Underweight	90	50.0
Normal	84	46.7
Overweight	6	3.3
Obese	0	0.0
Duration of treatment for TB (Months)		
≤ 2	68	37.8
3 – 6	92	51.1
> 6	20	11.1
Mean ± SD	3.64 ± 2.54	
Range	0 – 10	
HIV Status		
Positive	15	8.3
Negative	165	91.7
Family history of DM		
Yes	18	10.0
No	162	90.0
Type of TB		
Pulmonary	161	89.4
Extra-pulmonary	19	10.6

Table 3 showed the socio-clinical characteristics of the respondents. Most (81.1%) of the respondents were non-smokers. The smoker participants smoked between 0.04 and 17 packed years with a mean of 6.29 ± 5.49. Among the 34 (18.9% of the participants) smokers, 12 (35.2%) smoked <4 packed years, 11 (32.4%) smoked between 4-8 packed years and 11 (32.4%) smoked >8 packed years. Close to three-quarter (72.2%) of the participants were active while just 50 (27.8%) were inactive. Half (50%) of the participants were under weight and just 3.3% were overweight. None of them were obese. Marginally above half (51.1%) of the participants had used anti-TB medications for 3-6 months and 37.8% of them used it for ≤ 2 months. Only 20 (11.1%) had used anti-TB drugs for > 6 months. The duration of treatment ranged from 0 to 10 months with a mean of 3.64 (SD± 2.54). Most (91.7%) of the participants were negative for HIV. Just one in ten (10%) of the participants had family history of DM. The majority (89.4%) of the participants had pulmonary TB while just 10.6% had extra pulmonary TB.

Table 4: Association between pattern of HbA1c and Socio-clinical Parameters among the Participants (N=180)

Variables	Normal (%) n1= 135	Pre-DM (%), n2=16	DM (%), n3=29	χ^2	P-value
Smoking					
Yes	31 (91.2)	0 (0.0)	3 (8.8)	6.570	**0.037***
No	104 (71.2)	16 (11.0)	26 (17.8)		
Pack years					
< 4	12 (100.0)	0 (0.0)	0 (0.0	3.217[y]	0.522
4 – 8	8 (72.7)	0 (0.0)	3 (27.3)		
> 8	11 (100.0)	0 (0.0)	0 (0.0		
Physical activity					
Active	102 (78.4)	14 (10.8)	14 (10.8)	10.898	**0.004***
Inactive	33 (66.0)	2 (4.0)	15 (30.0)		
Body Mass Index					
Underweight	69 (76.7)	10 (11.1)	11(12.2)	3.825	0.430
Normal	62 (73.8)	6 (7.1)	16 (19.1)		
Overweight	4 (66.7)	0 (0.0)	2 (33.3)		
Duration of treatment for TB (Months)					
≤ 2	49 (72.0)	8 (11.8)	11 (16.2)	1.394	0.845
3 – 6	71 (77.2)	6 (6.50	15 (16.3)		
> 6	15 (75.0)	2 (10.0)	3 (15.0)		
HIV Status					
Positive	13 (86.7)	0 (0.0)	2 (13.3)	1.830	0.653[f]
Negative	122 (73.9)	16 (9.7)	27 (16.4)		
Family history of DM					
Yes	14 (77.8)	2 (11.1)	2 (11.1)	0.442	0.802
No	121 (74.7)	14 (8.6)	27 (16.7)		
Type of TB					
Pulmonary	120 (74.5)	14 (8.7)	27 (16.8)	0.543	0.841[f]
Extra-Pulmonary	15 (79.0)	2 (10.5)	2 (10.5)		

*significant p value <0.05. f= Fisher's exact test, y= Yate's correction for continuity

Table 4 showed the association between the pattern of *HbA1c* and socio-clinical variables among the participants. Smoking and physical activity (p-value of 0.037 and 0.004 respectively) were the factors associated with pattern of *HbA1c*. BMI, duration treatment, HIV status, family history of DM and type of TB had no statistically significant relationship with the pattern of *HbA1c*.

Table 5: Logistic Regression Analysis of Smoking and Physical Activity as Predictors of Prediabetes and diabetes Mellitus among the Participants. (N=180)

Variables	B	Odd ratio	95 % C I	p-value
Smoking				
Yes	-1.429	0.240	0.069 – 0.826	**0.024***
No	R C			
Physical activity				
Inactive	0.629	1.877	0.914 – 3.854	0.086
Active	RC			

*Significance, RC= reference category

Table 5 is a logistic regression analysis showing that smoking is less likely to predict PD and DM among TB patients and this is statistically significant. However, the odd ratio of developing PD and DM among inactive TB patients was 1.877. Hence, the risk of developing PD and DM among inactive TB patients was about 1.9 times more than the active TB patients.

Discussion

The proportion of smokers among TB patients in this present study was 18.9%. This is slightly lower than the findings by Marshall *et al* in Pakistan and Bangladesh where it was reported that 22.5% of TB patients were smokers.[18] The slight difference may be due to the variation in geographical location or study design. In Nigeria, TB disease has been attributable to smoking.[19]

Furthermore, most participants (72.2%) were active regarding physical activity. This is in contrast to the report by Ekeke *et al* where almost half (49.8%) of the TB patients were physically considered inactive.[3] Reason for this may not be unconnected with the fact that most participants (75.6%) in this study are private workers whose job require higher level of activities. A plausible reason could also be due to the different study design, sample size and populations studied.

Results from this present study also revealed 3.3% of the participants were overweight and almost half (46.7%) had normal weight, while half of the participants were underweight. This finding is closely related to the outcome of Anyanwu *et al* study where 5.9% of their participants was either overweight or obese, and 52.7% had normal weight and 41.3% were underweight.[20]

Approximately 1 in 10 (8.3%) of the present study participants were positive for HIV. This is comparable to the report of 12.9% of HIV positive TB patients reported in a secondary healthcare centre in Ilorin.[21] Both studies were carried out in DOTS clinics, though different health facilities.

Only 10% of those that participated in the study had family history of DM. This agrees with 11.1% reported by Viswanathan *et al* in India but incomparable with a negligible 0.5% reported by Anyanwu in Oyo state.[6,20,] This may be due to the variation in the sociocultural and other characteristics of the study population. It may also mean that hereditary factors may not be a major contributor to the cause of DM among TB patients, other factors such as age, level of physical activities and smoking status among others may be more prominent. Further research will be needed to ascertain this.

A significant proportion (89.4%) of the respondents in this present study had pulmonary TB. This finding is similar with the findings of Ekeke *et al* who reported 95.3% presence of pulmonary TB among respondent.[3] This is however not surprising because globally pulmonary tuberculosis is overwhelmingly more prevalent than extra-pulmonary tuberculosis and this study conformed to this pattern.[22]

Among the participants, smoking status (p-value 0.037) showed statistically significant association with the pattern of *HbA1c*. About 1 in 10 (8.8%) of the smokers were diabetic while none of the smokers were prediabetic. However, higher percentage of the non-smokers (17.8%) were diabetic while 11% of the non-smokers were prediabetic. This study revealed that smoking is less likely to be a major risk factor for PD and DM. The reason for this finding may be because larger proportion of the participants (81.1%) were non-smokers. It could also be that the other factors such as high level of physical activity (72.2% active participants), low proportion of family history of DM (only 10% with family history of DM) or higher proportion of the participants being ≤40 years of age (65.6% of the participants). Also, Ekeke *et al* found no statistically significant association between smoking and DM among TB patients.[3] Meanwhile, there are previous studies that showed that smoking is a risk factor for DM among TB patients.[2,19]

Furthermore, in this present study, level of physical activities (p-value 0.004) showed statistically significant association with the pattern of *HbA1c*. Among the active participants, 10.8% were prediabetic and 10.8% were diabetic. In the inactive subgroup, just 4.0% of them were prediabetic and as high as 30% of them were diabetic. A previous study by Ekeke *et al* among TB patients has also stated that those who engaged in rigorous activities had less chance of developing DM.[3] This agrees with the finding of the current study in which those who were active had less proportion of DM compared to the inactive group with almost two times risk of having

DM. This showed that activity improved *HbA1c* among TB patients. This may also be because of other factors such as dietary and cultural practices among the active group. Further study will be required to unravel this. However, in logistic regression analysis, being inactive with odd ratio of 1.89 was identified as independent risk factor for PD/DM among TB patients.

Nonetheless, BMI, HIV status, family history of DM, duration of treatment, type of TB showed no statistically significant association with the pattern of *HbA1c* among TB patients. This result is consistent across studies.[6,20]

The strength of this present study lies in the fact that *HbA1c* was used to determine PD and DM which has been recommended for same purpose by National Institute for Clinical Excellence (NICE).[10,11,16,17]

However, this present study was cross-sectional, therefore the various statistically significant observations between the variables tested were not necessarily causal until a longitudinal study is done to confirm the finding.

Conclusion

This study revealed that being active protects against DM among TB patients. It is therefore recommended that all TB patients may be advised to engage in physical activities.

Limitations of the Study

1. It is hospital-based research; hence the findings may not be generalizable.
2. The study was cross-sectional, therefore the various statistically significant observations between the variables tested were not necessarily causal.
3. This study lacks a comparison group that could serve as a reference in accurately estimating the difference in the clinical and lifestyle parameters of adult TB patients and adult patients without TB.

Implication for Clinical Practice

Exploring factors related to the pattern of *HbA1c* among TB patients may help to provide more awareness leading to focused care for TB patients with DM and PD. similarly, understanding the effect of smoking, physical inactivity and other clinical and lifestyle parameters on the glycaemic status of TB patients is relevant to the primary care physicians as this helps in taking informed decisions.

Ethical Approval

Approval to undertake the study was obtained from the Ethical Review Committee of the University of Ilorin Teaching Hospital with ERC number: NHREC/02/05/2010.

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Conflicts of interest: None

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