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SOCIO-DEMOGRAPHIC RISK FACTORS FOR COMORBIDITY OF TYPE 2 DIABETES MELLITUS-PRIMARY OPEN ANGLE GLAUCOMA IN IMO STATE NIGERIA

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ABSTRACT

Comorbidity is a major health concern all over the world with a huge number of people diagnosed each day. This research work studied the demographic risk factors for comorbidity of type 2 diabetes mellitus-primary open angle glaucoma(T2DM-POAG) in Imo state, South Eastern Nigeria through a population based case-control study design. The subjects concerned in this study were 198 adults aged, 40 years and above, diagnosed of T2DM-POAG comorbidity (99 cases and matched 99 controls). Variables taken into consideration were: age, sex, educational background, marital status, occupation. Data analyses were performed using IBM-SPSS statistics version 23 for data analyses. Weighted test such as Wald test was used to test for significant factors in the model. The factors were considered significant at 5% level. Odds ratio were computed so as to measure the strength of the association between each of the exposures (the risk factors of interest) and the outcome. Confidence interval (CI) at 95% level was also calculated for each odds ratio. Results showed Occupation such as office clerk and teaching were found to be significant factors of T2DM-POAG comorbidity in both the univariate and the multivariate analysis with higher odds attached to both factors compared to farmers. Age was not found as a significant demographic factor which is quite a surprise, considering the fact that age is an established separate risk factor of diabetes and glaucoma, as well as in both combinations. Educational level was also found to be significant in the adjusted analysis (p=0.011, 95%CI= 0.071 – 0.0708) and the adjusted odds ratios (AOR =0.22) rather indicates lower risk of T2DM-POAG comorbidity compared to the participants with non-formal education. Implications for the control of the comorbidity were discussed in line with the research questions. Research work like this, tend to broaden the perspectives related to factors that play a vital role during the designing of preventive procedures and development of public health interventions regarding T2DM-POAG comorbidity.

KEYWORDS: Comorbidity, Socio-demographic risk factors, Type 2 diabetes mellitus-primary open angle glaucoma comorbidity.

INTRODUCTION

Comorbidity of non-communicable chronic diseases is a major health concern all over the world, since they are associated with high rates of morbidity and mortality and high costs to the public health systems.[21] Type 2 diabetes mellitus-primary open angle glaucoma comorbidity is one of the leading causes of death and visual impairment globally. There appears to be an increase in the incidence of the comorbidity in recent decades.[13] The number of persons with the comorbidity appears to be increasing probably due to population growth, aging, urbanization and lifestyle factors.

Diabetes is a chronic non-communicable endocrine metabolic disease that has caught the attention of public health community researchers with little or no attention paid to the comorbidity of diabetes with other diseases.[12] Primary open angle glaucoma is the major cause of irreversible blindness and other visual impairments.[14]

Despite the increase in T2DM-POAG comorbidity burden, interventions are still poor and epidemiological data are scarce. Several studies have suggested that diabetes may be associated with increased risk of primary open angle glaucoma.[7,2,11,19] whereas some other studies see the two as two incidental disorders in

which the deductible comorbidity case is due to a separate third disorder[17,20]

There is inadequate resources to effectively treat T2DM-POAG comorbidity at the primary healthcare level and also inequitable access to healthcare for treating the complications which arises from T2DM-POAG comorbidity. This makes a strong case for investment in prevention to reduce the future comorbidity burden in Imo State. This study examined the socio-demographic determinants of the comorbidity of type 2 diabetes mellitus primary- open angle glaucoma in Imo state south eastern Nigeria.

MATERIALS AND METHODS

The study was a population based case-control study. Data were obtained from subjects with and without the T2DM-POAG comorbidity. A total of 198 subjects comprising, 99cases and matched 99 controls were recruited into the study through multi-stage sampling technique in the study area. The LGAs, wards, villages and households were randomly selected in the three senatorial zones of Imo State. The sampling involved three stages:

Stage 1: Involved the selection of LGAs to be studied. Two wards from each LGAs were selected using simple random sampling by balloting.

Stage II: Involved the selection of villages, of which one villages each from the each ward were selected using simple random sampling by balloting.

Stage III: Involved the selection of the households/subjects that were studied using multistage sampling method. The households were randomly sampled.

Table 1: Showing the senatorial zones, LGA's, wards, villages and households during the study and their geographic coordinates.

S/N	Senatorial Zone	LGA's	WARD	VILLAGE(S)	HOUSEHOLDS
1	Imo East(Owerri)	Aboh Mbaise Coordinates:5^{o}27'N7^{o}14' E	Amuzu	Amuzunweafor Coordinates:5^{o}27'00.5"N7^{o}14'00.1"E Amuzunwenkwo Coordinates:5^{o}25'25.7"N7^{o}15'16.2"E	20 15
2	Imo West(Orlu)	Nkwerre Coordinates:5^{o}45'0"N7^{o}0 6'0"E	Onusa	Isiawodu Coordinates:5^{o}45'40.4"N7^{o}04'58.1"E Umuogboo Coordinates:5^{o}45'40.4"N7^{o}04'58.1"E	23 15
3	Imo North(Okigwe)	Okigwe Coordinates:5.48^{o}N7.55^{o}E	Ihube	Ihube Coordinates:5.49'09.4"N7^{o}.20'27.1"E	35
TOTAL		3	3	5	108

Socio-demographic data (Age, sex, occupation, marital status, educational level), T2DM, POAG, eye examination and laboratory tests, including glycosylated haemoglobin (as a measure of T2DM and glycemic control) were collected during the study. After collecting socio-demographic data, present and past medical history including type and duration of diabetes, a comprehensive eye evaluation was performed to determine the presence or otherwise of primary open angle glaucoma(POAG). Visual acuity was measured using snellens chart placed at a 6 m distance from the patient. Ophthalmoscopic examination of the eye was performed under dim illumination. Schiotz tonometer was used to measure the IOP of the subjects. Penlight estimation was used to estimate the anterior chamber angle of the subjects who were aged ≥ 40years and who must have lived in Imo State atleast 6months before the commencement of the study.

Data were collected using three instruments:
1. Structured Risk assessment questionnaire
2. Physical measurements
3. Biochemical assessments

Questionnaire Design

A pre-tested, self-administered, structured risk assessment questionnaire based on WHO stepwise approach to chronic disease risk factor surveillance (STEPS) instrument was developed and used to capture data on T2DM-POAG comorbidity. The language of the questionnaire was English and it consisted of the following parts:

Demographic information

This section consisted of questions regarding the following:
1. Identification number(which was used to substitute name and was assigned by the researcher and his team)
2. Age
3. gender
4. marital status
5. Occupation
6. Retirement status
7. Level of education

All subjects who tested positive to T2DM-POAG comorbidity and matched controls(to rule out false

negative results) were sent to endocrine unit and of federal medical centre Owerri and optometric clinic of Imo State University Owerri respectively were confirmatory tests were performed by the physician on the cases and controls enrolled into the study. The study commenced in the month of May 2019 and lasted till December, 2019.

Data Analysis Method

Data analysis was performed using IBM-SPSS statistics version 23 (SPSS Inc. Chicago, USA) for data analyses. Microsoft Excel 2010 was used in drawing charts. Descriptive statistics was used to summarize the data. The frequencies distribution of the variable characteristics were computed by case and control and presented in a table of distribution which were all expressed as the percentage of the distribution. Measured variables were summarized with mean and standard deviation Graphical representations such as bar chart bar was used to represent some of the results.

The risk factors of T2DM–POAG comorbidity were determined in a logistic regression. Which comprised of univariate (unadjusted) and multivariate (adjusted) model. T2DM–POAG comorbidity was used as the model outcome variable in the model while the risk factors assessed were entered as predictor variables in the model. Weighted test such as Wald test was used to test for significant factors in the model. The factors were considered significant at 5% level. Odds ratio were computed so as to measure of the strength of the association between each of the exposures (the risk factors of interest) and the outcome. Confidence interval (CI) at 95% level was also calculated for each odds ratio. Probability value (p) was used to interpret significant risk factors at 5% level hence p less than 5% was considered significant for the risk factors.

RESULTS

A total of 198 subjects were available for analysis with equal number of cases and matched control (99 each).The distribution for demographic characteristics of the subjects is presented on Table 1. The overall age group that contained the highest number of study participants was the 56 -60 years old with 47(23.7%) and was closely followed by the 61 -65 years old with 46 (23.2%) and the 51 - 55 years with 45 (22.7%) respectively. 66-older age group had the least participant with 13(6.6%) and was closely followed by 46-50 age group with 23(11.6%) and finally 40-45 age group with 24(12.1%).

Results showed that 107 (54.0%) males 91 (46.0%) females participated in this study. Clear majority were married 145 (73.2%), 15 (7.6%) were never married while 38 (19.2%) were widowed, divorced/separated. The largest occupation practiced among the participants was teaching 83(41.9%), followed by farming 38 (19.2%) and manual work 27(13.6%). House worker was the least occupation among the participants 12 (6.1%), followed by office clerk 17(8.6%) and others 21(10.6%). Close to half of the study participants attained up to College, vocational school or University (47%), and 16.2% had high school while15.7% and 13.6% had secondary and primary school education level respectively. The participants that had no formal education were 15 (7.6%) of the group.

Table 2: Cases and Control Demographic Distribution for Study Participants.

Demographic Variables	Control (n=99)		Case (n=99)		Total (n =198)	
	Number	(%)	Number	(%)	(n=198)	(%)
Age in years						
40–45	12	12.1	12	12.1	24	12.1
46 – 50	11	11.1	12	12.1	23	11.6
51 – 55	22	22.2	23	23.2	45	22.7
56 – 60	24	24.2	23	23.2	47	23.7
61 – 65	23	23.2	23	23.2	46	23.2
66 or older	7	7.1	6	6.1	13	6.6
Gender						
Male	53	53.5	54	54.5	107	54.0
Female	46	46.5	45	45.5	91	46.0
Marital Status						
Never married	7	7.1	8	8.1	15	7.6
Married	72	72.70	73	73.7	145	73.2
Widowers/ Divorced/ Separated	20	20.2	18	18.2	38	19.2
Occupation						
Farmer	22	22.2	16	16.2	38	19.2
Manual worker	15	15.2	12	12.1	27	13.6
Office clerk	5	5.1	12	12.1	17	8.6
Teacher	32	32.3	51	51.5	83	41.9
House Worker	9	9.1	3	3.0	12	6.1
Others	16	16.2	5	5.1	21	10.6

Retirement Status						
Not retired	79	79.8	76	76.8	155	78.3
Retired	20	20.2	23	23.2	43	21.7
Highest Education Level						
No formal education	8	8.1	7	7.1	15	7.6
Primary school	19	19.2	8	8.1	27	13.6
Secondary school	19	19.2	12	12.1	31	15.7
High school	14	14.1	18	21.0	32	16.2
College/ vocational school/ University	39	39.4	54	54.5	93	47.0

The result showed that most of the demographic characteristics of the study participants were not significant (p >5) at 5% significant level, apart from the occupation of the subjects (P=0.005) (Table 4.3).

Among the different occupation, there were 42.1% in cases and 57.9% in matched control for farmers. For the manual workers, the rate of T2DM-POAG comorbidity was found to be 42.9% in the case group compared to 57.7% in the matched control group, while it was found as 25% in the case group and 75% in the matched control among house workers. But none of the above mentioned occupations were found as a significant risk factor of T2DM-POAG comorbidity.

Significant occupation for T2DM-POAG comorbidity include teaching (p = 0.043) and office clerk that which can be assumed significant (p=0.05). Among the teachers, the cases group recorded 61.9% compared to 38.1% in the matched control. Similarly the case group for the office clerk recorded 70.6% compared to 29.4% in the matched control group. Using farming as a reference group, the odds of having T2DM-POAG comorbidity was found to be more than two times significantly higher (OR=2.23, 95% CI = 1.024 – 4.875) for the teachers compared to that of the matched farmers. On the other hand, the odds of having T2DM-POAG comorbidity was found to be more than three folds higher (OR=3.30, 95% CI = 0.968 – 11.245) for the office clerks compared to that of the matched farmers.

Though education was not found as a significant factor (p>5%), it was slightly being close to significant (p= .051). Those that attained up to high school has 60% cases compared to 40% for the matched control (OR = 1.47). Similarly, 59.8% was found among the cases compared to the matched control at higher odds of 1.61 for the case group compared to that of the matched non-formal education control group.

Similar results were found in the adjusted multivariate result (Table 4.4), with occupation found significant among office clerk (p=0.007, 95%CI= 1.801 – 37.536) and teaching (p=0.011, 95%CI= 1.340 – 9.552). The adjusted odds ratio (AOR) adjusted with age, gender, marital status, retirement status and highest obtained education level, indicates that the odds for T2DM-POAG comorbidity was found higher by over eight folds (AOR = 8.22) in the office clerk subjects compared to matched farmers, and almost four times higher (AOR = 3.58) among teachers compared to matched farmers.

Secondary education was also a significant factor in the adjusted analysis clerk (p=0.011, 95%CI= 0.071 – 0.0708) and the adjusted odds ratios (AOR =0.22) rather indicates lower risk of T2DM-POAG comorbidity compared to the matched participants with non-formal education.

Table 3: Relationship between comorbidity of T2DM-POAG and demographic factors in the study population (Univariate Logistic Regression Method).

Demographic Factors	Total	Control		Case		coef	P	OR	95% CI	
		n	%	n	%				Lower	Upper
Age in years							0.999			
40 – 45	24	12	50.0	12	50.0					
46 – 50	23	11	47.8	12	52.2	-0.080	0.889	0.92	0.301	2.831
51 – 55	45	22	48.8	23	51.1	-0.044	0.930	0.96	0.355	2.577
56 – 60	47	24	51.1	23	48.9	0.043	0.932	1.04	0.390	2.790
61 – 65	46	23	50.0	23	50.0	0.001	1.000	1.00	0.373	2.683
66 or older	13	7	53.8	6	46.2	0.154	0.823	1.17	0.302	4.512
Gender							0.993			
Male	107	53	49.5	54	50.5					
Female	91	46	50.5	45	49.5	0.001	1.000	1.00	.573	1.744
Marital Status							0.930			
Never married	15	7	46.7	8	53.3					
Married	145	72	49.7	73	50.3	-0.027	0.959	0.97	0.347	2.732

Widowers/ Divorced/ Separated	38	20	52.6	18	47.4	0.105	0.860	1.11	0.345	3.575
Occupation							0.005*			
Farmer	38	22	57.9	16	42.1					
Manual worker	27	15	55.9	12	44.4	0.845	0.951	1.03	0.384	2.768
Office clerk	17	5	29.4	12	70.6	0.875	0.050*	3.30	0.968	11.245
Teacher	83	32	38.6	51	61.4	2.039	0.043*	2.23	1.024	4.875
House Worker	12	9	75.0	3	25.0	1.649	0.294	0.46	0.107	1.976
Other	21	16	76.2	5	23.8	0.065	0.165	0.43	0.130	1.417
Retirement Status							0.849			
Not retired	155	79	51.0	76	49.0					
Retired	43	20	46.5	23	53.5	-0.061	0.861	0.94	0.473	1.869
Highest Education Level							0.051			
No formal education	15	8	53.3	7	46.7					
Primary school	27	19	70.4	5	29.6	-0.731	0.273	0.48	0.130	1.780
Secondary school	31	19	61.3	12	38.7	-0.377	0.551	0.69	0.198	2.373
High school	32	14	43.8	18	56.3	0.385	0.540	1.47	0.429	5.035
College/ vocational school/ University	93	39	41.9	54	58.1	0.477	0.393	1.61	0.540	4.814

Asterisks (*) = 5% significant, coef =coefficient, CI= 95% confidence Interval, OR = Odds ratio

Table 4: Relationship between comorbidity of T2DM-POAG and demographic factors in the study population (Multivariate Logistic Regression Method).

Demographic Factors	**Total**	**Control**		**Case**		**coef**	**p**	**AOR**	**95% CI**	
		n	**%**	**n**	**%**				**Lower**	**Upper**
Age in years										
40 – 45 (Ref)	24	12	50.0	12	50.0					
46 – 50	25	13	52.0	12	48.0	0.070	0.929	1.073	.229	5.025
51 – 55	45	23	51.1	22	48.9	0.154	0.839	1.167	.264	5.165
56 – 60	47	23	48.9	24	51.1	-0.122	0.865	.885	.218	3.592
61 – 65	46	23	50.0	23	50.0	-0.603	0.370	.547	.147	2.044
66 or older	13	6	46.2	7	53.8	0.134	0.830	1.143	.338	3.870
Gender										
Male (Ref)	108	54	50.0	54	50.0					
Female	92	46	50.0	46	50.0	-0.041	0.903	.959	.494	1.863
Marital Status										
Never married	16	8	50.0	8	50.0					
Married	146	74	50.7	72	49.3	0.380	0.614	1.463	.334	6.403
Widowers/ Divorced/ Separated	38	18	47.4	20	52.6	-0.171	0.717	0.843	.335	2.119
Occupation										
Farmer (Ref)	38	22	57.9	16	42.1					
Manual worker	28	16	57.1	12	42.9	1.076	0.120	2.93	0.756	11.378
Office clerk	17	5	29.4	12	70.6	2.107	0.007*	8.22	1.801	37.536
Teacher	84	32	38.1	52	61.9	1.275	0.011*	3.58	1.340	9.552
House Worker	12	9	75.0	3	25.0	-0.623	0.492	0.54	0.091	3.167
Other	21	16	76.2	5	23.8	-0.177	0.726	0.84	0.311	2.259
Retirement Status										
Not retired (Ref)	159	79	49.7	80	50.3					
Retired	41	21	51.2	20	48.8	-0.007	0.998	0.993	0.411	2.401
Highest Education Level										
Non-formal education (Ref)	15	8	53.3	7	46.7					
Primary school	24	19	79.2	5	20.8	-.476	0.474	0.621	0.169	2.285
Secondary school	29	20	69.0	9	31.0	-1.495	0.011*	0.224	0.071	0.708
High school	35	14	40.0	21	60.0	-1.075	0.050	0.341	0.116	1.000
College/ vocational school/ University	97	39	40.2	58	59.8	-0.171	0.742	0.843	0.304	2.334

Asterisks (*) = 5% significant, coef =coefficient, CI= 95% confidence Interval, AOR = Adjusted Odds ratio

DISCUSSION

Occupation such as office clerk and teaching were found as significant risk factors for T2DM-POAG comorbidity in both the univariate and the multivariate analysis with higher odds attached to both factors compared to farmers. One interesting thing about this finding is that both types of occupation required less physical exercise or sedentary lifestyle. Sedentary lifestyles have been found to be a significant predictor of T2DM-POAG comorbid,[16] The present finding is in consistent with previous findings which supported the beneficial role of physical exercise to prevent T2DM,[6] POAG,[9] and T2DM-POAG comorbid[16]. Physical activity increases muscle glucose uptake and insulin sensitivity,[3] During exercise, the increased need for metabolic fuel is met partially through an increase in the uptake and utilization of glucose. In addition to the acute effects of physical activity to increase muscle glucose uptake, the period after physical activity is characterized by the muscle being more sensitive to the actions of insulin as shown in rats and human subjects.[5] In addition, raised capillary proliferation in muscles, raised muscle mass, and a higher proportion of more insulin sensitive types of muscle fibres, may all contribute to the beneficial effects of physical activity on insulin sensitivity.[3]

Secondary education was also a significant factor in the adjusted analysis with lower risk of T2DM-POAG comorbidity compared to matched participants with non-formal education. The possible explanation is that higher educations may influence the higher awareness, higher opportunity for prevention and control. Higher educational status may influence the lifestyle factors.[1] Education has been found to be a positive factor in disease prevention, been educated exposes one to learning basic skills in addition to knowledge of disease prevention.[10]

Age was not found as a significant demographic factor which is quite a surprise, considering the fact that age is an established separate risk factor of diabetes,[18] and glaucoma,[8] as well as in both combinations.[4]

Gender was not considered a significant factor for T2DM-POAG comorbidity from the result of this study, this is in agreement with the report of Vincent, 2012, but contradicted,[15] which reported more T2DM in females than males (OR= 2.3, 95%CI=1.3 to 4.1).

CONCLUSION

As little information on T2DM-POAG comorbidity is available in Nigeria, this study contributes to better understanding of the risk factors for this comorbidity. Research work like this, tend to broaden the perspectives related to factors that play a vital role during the designing of preventive procedures and development of public health interventions regarding T2DM-POAG comorbidity. Thus, this particular research work will definitely prove to be fruitful in the field of Epidemiology and Disease control and other research studies related to public Health, concerned with comorbidity of type 2 diabetes mellitus-primary open angle glaucoma.

Recommendation

Increased awareness on preventive measures of T2DM-POAG comorbidity should be advocated.Regular exercise should be promoted and recommended as part of a healthy lifestyle and body weight control for the prevention of T2DM-POAG Comorbidity in Imo State. In addition

This study focused on demographic factors, large-scale prospective cohort studies and randomised control trials should be conducted to determine other plausible dietary (traditional foods such as fish, fruits, and vegetables) factors of T2DM-POAG comorbidity in the future. Similarly, it may be worthwhile to examine the rural/urban differences in T2DM-POAG comorbidity incidence and to perform stratified analyses by residential location.

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