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Intestinal Parasitic Infections among Diabetes Mellitus Patients Attending Murtala Muhammad Specialist Hospital (Mmsh), Kano, Kano State

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Authors' contributions

This work was carried out in collaboration among all authors. Author LM were involved in study design, data collection and manuscript writing. Authors JJK and RCM supervised data collection process, authors AY and EP were involved in manuscript revision. All authors read and approved the final manuscript.

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ABSTRACT

Background: Diabetes mellitus (DM) is a group of metabolic diseases in which a person has high blood glucose, either because the body does not produce enough insulin or because cells do not respond to the insulin that is produced. Defects in immune system are associated with different parasitic infection. Intestinal parasitic infection (IPI) is still a major health problem in different regions of the world, especially in tropical and subtropical areas. The aim of this study is to determine intestinal parasitic infections among diabetes mellitus patients attending Murtala Muhammad specialist hospital (MMSH), Kano.

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Materials and Methods: The study is a comparative case control study and was carried out at Murtala Muhammad Specialist Hospital. A total of 184 participants were recruited. 138 diabetic patients and 46 non-diabetic individuals (control group) with data on socio-demographic characteristics collected from both groups. The participants were instructed on how to collect the sample. The samples were processed macroscopically and microscopically by direct wet preparation and formalin-ether concentration technique. The data was analyzed using descriptive statistical model in Statistical Package for the Social Sciences (SPSS version 23).
Results: Infection with *S. stercoralis* (29.7%), hookworm (13.0%), *E. histolytica* (5.1%) and mixed infection with "hookworm and *S. stercoralis*" and "*E. histolytica* and hookworm" were found to be in 2 (1.5%) each were found in the case group, this is summed up to a total of 50.8%, while in the control group, *E. histolytica* (6.5%) and *G. lamblia* (2.2%) were found giving a total of 8.7%. Out of the 50.8% in the case group, 51.4% and 48.6% were male and female respectively. In this study, it was concluded that DM patients are at high risk of infection with intestinal parasites than normal population p=0.512 (50.8 and 8.7).
Conclusion: This investigation reveals that male participants were found to be more infected with intestinal parasites than females which could be as a result of Life style. Vegetable wash, life modification, walking barefooted source of water, and animal rearing did not significantly affect the prevalence of IPIs in DM patients p=0.512. It was concluded that DM patients are at higher risk of infection with intestinal parasites than normal population.

Keywords: Diabetes mellitus; immunocomprised; S. stercoralis; E. histolytica; G. lamblia; Murtala Specialist Hospital Kano.

ABBREVIATIONS

IDDM :Insulin Dependent Diabetes Mellitus
IPIs :Intestinal Parasitic Infections
MMSH :Murtala Muhammad Specialist Hospital
NE :Number Examined
N I:Number Infected
NIDDM :Non-Insulin Dependent Diabetes Mellitus
SPSS :Statistical Package for the Social Sciences
P value : Probability Value
X^2 : Chi Square

1. INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases in which a person has abnormal high blood glucose, either because the body does not produce enough insulin or because cells do not respond to the insulin that is produced [1]. This abnormal high blood sugar produces the classical symptoms of polyuria, polydipsia, and polyphagia. Diabetes is one of the most frequent metabolic diseases that is widely distributed in various populations. Its prevalence appears to be increasing rapidly [2].

Diabetics, particularly insulin dependent diabetes mellitus (IDDM) and the 'poorly controlled' patients are considered as immunocomprised, though it is not easy to clearly characterize the immunologic deficiencies [2].

An immunocompromised host is generally defined as a person who has one or more defects in the normal defense mechanisms that protect him or her from infectious agents predisposing the individual to an increased risk of severe life threading infections [3]. Defects in immune system are associated with different parasitic infection [3], The commonest parasites causing morbidity and/or mortality in the immunocompromised patients were those of the Gastrointestinal tract (GIT) (*Cryptosporidium parvum, Cyclospora cayetanensis, Microspora, Isospora belli, Giardia lamblia* and *Strongyloides stercoralis*), Reticuloenotelial system (RES) (*Toxoplasma gondii* and *Leishmania donovani*) and the free living amoebae [4]. *C. parvum* is an opportunistic infection in the gastro-intestinal tract of both animals and humans [3].

Intestinal parasitic infections (IPIs) are still major health problem in different regions of the world, especially in tropical and subtropical areas. Intestinal parasitic infections (IPIs) have been a big concern for low-income countries as they are the major cause of high morbidity and mortality [5]. IPIs may be transmitted by hand -to- hand contact, fecal contamination of food, through water or environmental surfaces. These infections represent socioeconomic and hygiene status of a society [6]. About one third of the world, that is, more than 2 billion people are infected with intestinal parasites. Approximately 300 million people are severely ill with these

worms and, of these, at least 50% are school age children [7].

The aim of the study was to determine the intestinal parasitic infections among diabetes mellitus patients attending Murtala Muhammad specialist hospital (MMSH), Kano.

2. METHODS

2.1 Study Design

This is a case control study and the research was carried-out at Murtala Muhammad Specialist Hospital that is situated within Kano metropolis. It is situated in the Sahelian geographic region, south of the Sahara. Kano city is in Kano state which is located in North-western Nigeria and is the second largest city in Nigeria after Lagos.

2.2 Inclusion Criteria

Subjects to be included in the study are;

1. Patients that are known to be diabetic attending diabetic clinic
2. People that are apparently healthy without any condition that will bring their immunity down.

2.3 Exclusion Criteria

All patients of immunocompromise states like; HIV patients, Patients that have organs transplant, Steroid therapy, Leukemic patients, Multiple myeloma patients, Cancer, Splenectomy patients, Old age and Patients of primary immune deficiency like; Chediak-Higashi Syndrome, ataxia-telangiectasia, DiGeorge syndrome, Wiskott-Aldrich syndrome, Bruton's disease.

2.4 Data Collection

Socio-demographic data was collected using a structured interviewer administered questionnaire. The prospective respondents attending the diabetics clinic were approached and requested to participate in the study. Detailed information about the study was given to the clients before participation. Both verbal and written consent was obtained before enrollment.

2.5 Sample Collection

The participants were instructed on how to collect the sample. Stool specimen was collected from each participant in a wide-open mouth, dry, sterilized, leak proof, tight lid plastic container containing a small spoon and 10% formalin for preservation and also labelled with an identification number [8].

2.6 Sample Storage

The samples were stored in refrigerator at 5°C immediately after collection to prevent desiccation [9].

2.7 Sample Processing

2.7.1 Macroscopy

The specimen was examined physically for color, consistency, presence of blood and worms.

2.7.2 Microscopy

Direct wet preparation using both saline and iodine methods were employed [8]

2.8 Concentration Method

2.8.1 Formal ether concentration technique

Faecal particles, 10% formaline and ether or ethyl acetate were mixed and centrifuged at 600g (about 2000 rpm) Cysts, oocysts, eggs, and larvae were fixed and sedimented and the faecal debris was separated in a layer between the ether and the formol water. Faecal fat was dissolved in the ether [8].

2.8.2 Statistical analysis and interpretation

Data was summarized and entered into excel worksheet. The summarized data was analyzed using descriptive statistical model in Statistical Package for the Social Sciences (SPSS) version 23. The data were presented in tables.

3. RESULTS

3.1 Data of Case and Control Group

A total of 184 participants were recruited. 138 diabetic patients and 46 non-diabetic individuals (control group) with data on socio-demographic characteristics collected from both groups. Among the 138 diabetic participants, 71(51.4%) were males while 67(48.6%) were females, their age ranges are from 27-78 years with the mean age of 52.2 years and standard deviation of 10.0. Among the 46 participants in the control group, 34(73.9) were males while 12(26.1%) were

females, their age ranges are from 22-40 years with the mean age of 28.5 and standard deviation of 4.6. The case group used in this study showed that 25(18.1%) were from Kano municipal, 45(32.6%) from Dala, 33(23.9%) from Gwale, 1(0.7%) from Yan kaba, Nasarawa, 8(5.8%) from Tarauni, 5(3.6%) from Fagge, 9(6.5%) from Kumbotso, 2(1.4%) each from Kankiya, Munjibir and Babura, Jigawa, and 3(2.2%) each from Aujara jahun and Dawakin tofa. All the control group were from Kano municipal, Dala, Gwale, Tarauni and Fagge. 133(96.4%) of the case group were from Hausa ethnic group and the remaining 5(3.6%) were from Fulani ethnic group. 3(2.2%) of the case group were single, 108(78.3%) were married and 27(19.5%) were separated while 26(56.5%), 19(41.3%) and 1(2.2%) of the control group were single, married and separated respectively. The occupation of 9(6.5%), 84(60.9%), 11(8.0%) and 1(0.7%) were civil servants, trader, farmer and student respectively, while 33(23.9%) have other occupation. 2(4.3), 34(73.9) and 6(13.0) of the control group were civil servant, trader and student respectively while 4(8.7) have other occupations (Table 1).

3.2 IPIS Case Group (Diabetes Mellitus Patients)

Table 2 shows the prevalence of IPIs among case group, it shows that, out of 138(100%) patients recruited in the study, 41(29.7%) were found to be infected with S. stercoralis , which is the highest among the group followed by hookworm with 18(13.0%), then E. histolytica with 7(5.1%). Mixed infection with “hookworm and S. stercoralis “; and “E. histolytica and hookworm” were found to be in 2(1.5%) each. So, in general, 70(50.8%) out of the 138 DM patients under the study were found to be infected with IPs (Table 2).

Table 1. Distribution of data of case and control group

Variables	Diabetes n (%)	Control n (%)
Gender		
Male	71(51.4)	34(73.9)
Female	67(48.6)	12(26.1)
Age (Mean±SD)	52.2±10.0	28.5±4.6
Address		
Kano municipal	25(18.1)	1(2.2)
Dala	45(32.6)	36(78.3)
Gwale	33(23.9)	3(6.5)
Aujara, jahun	3(2.2)	
Yan kaba, Nasarawa	1(0.7)	
Tarauni	8(5.8)	5(10.9)
Fagge	5(3.6)	1(2.2)
Kumbotso	9(6.5)	
Kankiya	2(1.4)	
Munjibir	2(1.4)	
Babura, jigawa	2(1.4)	
Dawakin tofa	3(2.2)	
Marital status		
Single	3(2.2)	26(56.5)
Married	108(78.3)	19(41.3)
Separated	27(19.5)	1(2.2)
Ethnic		
Hausa	133(96.4)	46(100)
Fulani	5(3.6)	
Education level		
Primary	32(23.2)	12(26.1)
Secondary	38(27.5)	20 (43.5)
Tertiary	14(10.1)	13 (28.3)
Uneducated	54(39.1)	1(2.2)
Occupation		
Civil servant	9(6.5)	2(4.3)
Trader	84(60.9)	34(73.9)
Farmer	11(8.0)	
Student	1(0.7)	6(13.0)
Others	33(23.9)	4(8.7)

Table 2. prevalence of IPIs among case group (diabetes mellitus patients)

Parasites	NE	NI	Prevalence (%)
Larvae of *S. stercoralis*	138	41	29.7
Ova of *hookworm*	138	18	13.0
E. histolytica	138	7	5.1
Ova of *hookworm* and larvae of *S. stercoralis*	138	2	1.5
E. histolytica and *hookworm*	138	2	1.5
Total	138	70	50.8

Key: NE=Number examined, NI= Number infected

Table 3. Prevalence of IPIs among control group (apparently healthy people)

Parasites	NE	NI	Prevalence (%)
G. lamblia	46	1	2.2
E. histolytica	46	3	6.5
Total	46	4	8.7

Key: NE=Number examined, NI= Number infected

Table 4. Distribution of risk factors for IPIs among case group

Variable	NE	NI	Prevalence (%)	*P-value*
Gender				
Male	71	36	51.4	0.670
Female	67	34	48.6	
Total	138	70	100	
Educational level				
Primary	32	19	27.1	0.461
Secondary	38	18	25.7	
Tertiary	14	6	8.6	
Uneducated	54	27	38.6	
Total	138	70	100	
Animal rear				
Cat	26	12	17.1	0.343
None	22	11	15.7	
Cattle	2	1	1.4	
Dog	5	4	5.7	
Sheep	44	23	33.9	
Bird	39	19	27.1	
Walking barefooted				
Always	11	7	10	0.283
Rarely	72	35	50	
Often	44	22	31.4	
Never	11	6	8.6	
Total	138	70	100	
Vegetable wash				
Yes	136	69	98.6	0.983
No	2	1	1.4	
Total	138	70	100	
Source of water				
Borehole	95	43	61.4	0.126
Well	43	27	38.6	
Total	138	70	100	
Type of toilet				
Pit latrine	90	46	65.7	0.977
Water closet	48	24	34.3	
Total	138	70	100	

Key: NE=Number examined, NI= Number infected, X^2= Chi square value

3.3 IPIS among Control Group (Apparently Healthy People)

In contrast to the case group, 4(8.7%) people out of the 46(100%) that participated as the control group in the research were found to be infected with IPs, *E. histolytica* 3(6.5%) and *G. lamblia* 1(2.2%) (Table 3).

3.4 Risk Factors for IPIS among Case Group

Of the 138(100%) diabetic patients that participated in the study, 70(50.8) were found to be infected with IPs. 12(17.1%) out of the 26(18.8%) that rear cat were infected, 4(5.7%) of 5(3.6%) that rear dog were infected, 23(33.9%) of 44(31.9%) that rear Sheep were infected, 19(27.1%) of 39(28.3%) that rear bird were infected and 1(1.4%) of 2(1.4%) that rear cattle were infected, 22(15.9%) patients don't rear any animal and 11(15.7%) out of them were infected.

11(8.0%) always walk barefooted and 7(10%) out of them were infected, 72(52%) rarely walk barefooted and 35(50%) of them were infected, 22(31.4%) were infected out of 44(31.9%) that often walk barefooted and 6(8.6%) were infected out of 11(8.0%) that never walk barefooted. 136(98.6%) wash their vegetable before eating while 2(1.4%) don't and 69(98.6) and 1(1.4%) out of them were infected respectively. Of the 95(68.8%) that use borehole as their source of water, 43(61.4%) were infected, 27(38.6%) out of 43(31.2%) that use well were infected. 90(65.2%) use pit latrine as their type of toilet while 48(34.8%) use water closet and 46(65.7%) and 24(34.3%) were infected respectively (Table 4).

3.5 Risk Factors for IPIS among Control Group

Table 5 shows the risk factors associated with IPIs among control group, it shows that, out of the 46(100%) people that participated as the control group, all the 4(100%) people that are infected are found to be those that rear cat (out of 22(47.8%), 13(28.3%) rear other animals and none of them were infected and 11(23.9%) don't rear any animal and they were not infected either. A total of 4(100%) people were found to be infected, 2(50%) each of 22(47.8%) and 24(52.2%) that walk barefooted rarely and often respectively. All the infected 4(100%) also use water closet as their type of toilet, wash their vegetable before eating and use borehole as their source of water (Table 5).

3.6 Diabetes Management and Intestinal Parasitic Infections

Base on diabetes management, 69(98.6%) of the 135(97.8%) diabetic mellitus patients respondent were observed to have used life modification to manage their condition and they were infected with IPs, however, 1(1.4%) out of 3(2.2%) that do not use any life modification were infected. Furthermore, of the 138(100%), 113(81.9%) use dietary modification and 57(81.4%) out of them were infected, 18(13.0%) use exercise and 9(12.9%) out of them were infected, out of 4(2.9%) that use other methods of modification, 3(4.3%) were infected. 3(2.2%) do not use any method of modification and 1(1.4%) of them were infected.

It was also observed that of the 130(94.2%) respondent that use anti-diabetic drug, 68(97.1%) were infected, 8(5.8%) did not use any drug and 2(2.9%) of them are infected. From our results also 49(35.5%) monitor their glucose one per month, while 58(42.0%) twice per month, 23(16.7%) trice per month, 4(2.9%) four times per month and 4(2.9%) five times per month, and among them 24(34.3%), 34(48.6%), 10(14.3%), 1(1.4%) and 1(1.4%) were infected respectively, the risk factors were summarized in (Table 6).

4. DISCUSSION

Protozoa and helminths are among the most important pathogens that are known to cause severe infections in immunocompromised individuals, DM patients are also classified as immunocompromised [10]. In this work we assessed the rate of parasitic infection in patients with DM and the control group, we found that, it was about 6 times greater in patients with DM than apparently healthy people. This is in agreement with a previous study in two cities near Tehran (Karaj and Savojbolagh) Iran, in which the rate of intestinal parasitic infections in patients with DM was reported to be more [11]. In another study conducted in Egypt, patients with DM were examined among other immunocompromised groups, and high rate of parasitic infection was recorded among them [12]. The results indicate that, the immunological clearance of parasites and commensals from intestine might have been impaired in DM; however, the exact mechanism is not clear. Resolving of intestinal parasite is dependent on both innate and adaptive immune responses, however, cell-mediated immunity, specifically T-cells, plays the main role in pathogen clearance

from intestine [13]. These results are in contrary to the study of Akinbo [14] with overall prevalence of 18.7% group, a study of South east Turkey (47%) [15] and an overall prevalence of 10% by Tangi [16] of intestinal parasitic infection was observed among diabetic patients. The difference in these studies may be attributed to geographical location. Also, there is sufficient evidence indicating that the incidence of certain infections in these patients increased opportunistic hypothesis [16].

Three different parasites were identified in the experimental group, two helminths (S. *stercoralis* and hookworms) and one protozoa (E. *histolytica*) and two different parasites were recorded in the control group, all of which were protozoans (E. *histolytica* and G. *lamblia*). This differs from the study by Tangi [16] where five different intestinal parasites were identified from the study, three protozoan (*E. histolytica, B. hominis and Cryptosporidium parvum)* and two helminths (Ascaris and hookworm).

This investigation reveals that, male participants recorded more infection (51.4%) with intestinal parasites than females (48.6%) in the case group, consequently, males(100%) and females (0%) in the control group, this is contrary to the research of Tangi [16] who discovered that more female participants were infected (10.5%) with intestinal parasites than males (8.9%) due to their reason that females are more engaged in farming and domestic work which exposes them to these intestinal parasites. People that are uneducated in the case group in this study have the highest prevalence of the IPIs (38.6%), while in the control group, people with secondary level of education have the highest prevalence (50%). This difference in the number and type of parasites can be as a result of geographical location as the study was conducted at Buea and Limbe, two important cities in the Fako division and South West (SW) region of Cameroon. Also, in this study, we recorded high prevalence of helminths relative to protozoans, which was

Table 5. Distribution of risk factors for IPIs among control group

Variables	NE	NI	Prevalence (%)	*P-value*
Gender				
Male	34	4	100	0.462
Female	12	0	0	
Total	46	4	100	
Educational level				
Primary	12	1	25	0.957
Secondary	20	2	50	
Tertiary	13	1	25	
Uneducated	1	0	0	
Total	46	4	100	
Animal rearing				
Cat	22	4	100	0.781
Dog	1	0	0	
Sheep	3	0	0	
Birds	9	0	0	
None	11	0	0	
Total	46	4	100.0	
Walking barefooted				
Rarely	22	2	50	0.511
Often	24	2	50	
Total	46	4	100.0	
Toilet types				
Pit latrine	8	0	0.00	0.631
Water closet	38	4	100	
Total	46	4	100.0	
Vegetable wash				
Yes	46	4	100.00	
Source of water				
Borehole	39	4	100	0.675
Well	7	0	0.00	
Total	46	4	100.0	

Key: NE=Number examined, NI= Number infected, X^2= Chi square value

Table 6. Relationship between diabetes management and intestinal parasitic infections

Variables	NE	NI	Prevalence (%)	*P-value*
Life modifications				**0.805**
Yes	135	69	98.6	
No	3	1	1.4	
Total	138	70	100.0	
Type of modification				**0.512**
Exercise	18	9	12.9	
Dietary	113	57	81.4	
Others	4	3	4.3	
None	3	1	1.4	
Total	138	70	100	
Anti- diabetics drugs				**0.512**
Yes	130	68	97.1	
No	8	2	2.9	
Total	138	70	100.0	
GLC monitoring per month				**0.997**
Once per month	49	24	34.3	
Twice per month	58	34	48.6	
Trice per month	23	10	14.3	
Four times	4	1	1.4	
Five times	4	1	1.4	
Total	138	70	100.0	

Key: NE=Number examined, NI= Number infected, X^2= Chi square value

contrary to the study of Tangi [16] where helminths were the least prevalent intestinal parasite in there study, the difference could be due to the massive drug administration of anti-helminthics by the government of Cameroon to all citizens to help eradicate intestinal helminths in the nation, but intestinal protozoa may still pose a threat. Vegetable wash and walking barefooted did not significantly affect the prevalence of intestinal parasitic infections in DM patients. The type of toilet also did not significantly affect the prevalence of intestinal parasitic infections (*P*=0.977). This differ with the study of Akinbo [14] where IPIs has significant association with the type of toilet (*P*= <0.0001). Source of water did not significantly affect the IPIs (*P*=0.126). This was in line with the study of Akinbo et al. [14] where source of water did not affect IPIs (*P*=0.353). Among animal breeders, there is no significant association (*P*= 0.343) between the sheep breeders and bird breeders each of which recorded IPIs of 33.9% and 27.1% prevalence of infection respectively.

Dietary modification, despite been the commonest form of modification in DM patients has no significance with IPIs as 81.4% of participants who modify their diet were also infected (*p*=0.512).

5. CONCLUSION

The study highlighted that DM patients have high risk of IPIs due to the immunosuppression, though aimed at finding if DM patients have more risk of IPIs than normal. Though vegetable wash, life modification, source of water, rearing of animal and walking barefooted has no significant effects on the prevalence of IPIs.

CONSENT AND ETHICAL APPROVAL

Ethical approval to conduct the research was obtained from the Research Ethics committees of Kano State Ministry of Health on the 2nd June, 2020 and was approved on the 11th August, 2020 with the number MMHSZ/0324/III/. After explaining the purpose of the study, informed written consent to participate in the study was provided by all participants. Participation was entirely voluntary. Anonymity and confidentiality were guaranteed and maintained.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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