

Prevalence Of Irritable Bowel Syndrome, Celiac Disease And Their Manifestations Among Muhimbili University Of Health And Allied Sciences Staff And Students: A Cross Sectional Study

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Research article

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Abstract

Background: Global prevalence of irritable bowel syndrome is high among medical students and health care professionals with significant morbidity. Similarly, the prevalence of celiac disease in irritable bowel syndrome is higher than the general population. These conditions impair quality of life and contribute to social-economic burden. In Tanzania, little is known about irritable bowel syndrome and celiac disease among medical students and health care professionals.

Methods: A cross sectional study was conducted to MUHAS and Mloganzila Academic Medical Center (MAMC) staff and students who fulfilled the online shared Rome IV criteria of irritable bowel syndrome from August to November 2018. A structured questionnaire was used to collect socio-demographic data, anthropometric measurements and clinical manifestations. Blood samples for full blood picture, liver enzymes and Erythrocyte Sedimentation Rate were taken. Celiac disease was tested using anti-tissue transglutaminase antibody test. Qualitative and quantitative data were summarized using frequency distribution tables. Chi-square and fishers exact test were used to study comparison between groups. Logistic regression was used to study associations. Data was analyzed using SPSS version 20.0 and a P value of ≤ 0.05 was considered significant.

Results: Out of 1,321 participants, 192 (14.5%) had irritable bowel syndrome in which 77 (40.1%) were males and 115 (59.9%) were females. Among the 192 participants with irritable bowel syndrome, 3 (1.6%) were positive for celiac disease, 2 (66.7%) were females and 1 (33.3%) was a male. Of the 3 patients with CD, 2 had elevated ALAT and 1 had anaemia. Age (AOR 2.53, 95% C.I 1.57-4.09), sex (AOR 1.67, 95% C.I 1.16-2.41), marital status (AOR 4.95 C.I 2.07-11.82), alcohol intake (AOR 2.47, 95% C.I 1.16-5.23), year of study (AOR 8.49, 95% C.I 5.71-12.64) and sleep duration (AOR 2.24, 95% C.I 1.23-4.06) were found to be independently associated with IBS.

Conclusion: Prevalence of IBS and its associated factors in our study population was similar to findings from studies done elsewhere. Also, our study revealed a low prevalence of celiac disease among IBS participants.

Background

Celiac Disease is an enduring gluten sensitive autoimmune disease affecting the small intestine in genetically predisposed persons (1). Irritable bowel syndrome is a functional gastrointestinal disorder characterized by abdominal pain and altered bowel habits in the absence of a specific bowel pathology (2). CD shares several symptoms that are present in the Rome IV criterion used in the diagnosis of IBS (3). Typically CD presents with chronic diarrhea, weight loss and failure to thrive. Atypically CD presents with iron deficiency, bloating, constipation, chronic fatigue, unexplained elevations in serum aminotransferases, headache, abdominal pain, and osteoporosis (4–7). As a result, IBS-like symptoms may delay CD diagnosis as CD is considered less prevalent in many regions compared to IBS.

Global prevalence of people affected with IBS is of public importance. Evidence has shown that, there is a high prevalence of this condition among medical students and health care professionals (39,40,56). In addition, reports indicate that the prevalence of CD among patients with IBS is higher compared to the general population (3,35,36).

Despite a high prevalence of IBS among medical students and health care professionals worldwide, availability of cost-effective and sensitive rapid screening tools for CD, the prevalence of IBS and CD among MUHAS staff and students remain unknown.

Considering scarcity of data on both IBS and CD in our settings, the results obtained from this study will provide information on prevalence, manifestations of IBS and CD among MUHAS staff and students using a cost-effective and less invasive serological test.

In addition, this study will provide information on the disease burden of IBS and CD among staff and students at MUHAS. Such information may increase awareness about IBS and CD which in turn will lead to early detection and management of patients with these two conditions.

The objectives of the study were as follows:

- To determine the prevalence of IBS among MUHAS staff and students.
- To describe the socio-demographic characteristics and manifestations of IBS among MUHAS staff and students.
- To describe the factors associated with IBS among MUHAS staff and students.
- To determine the prevalence of celiac disease among MUHAS staff and students with IBS.
- To describe the socio-demographic characteristics and manifestations of celiac disease among MUHAS staff and students with IBS.

Methods

Study design

This was a cross-sectional study conducted at MUHAS and Mloganzila Academic Medical Center (MAMC) at Mloganzila campus with a total population of 2,500.

MUHAS is composed of five schools; namely Medicine, Dentistry, Pharmacy, Nursing, and Public Health and Social Sciences, two institutes; Institute of Allied Health Sciences and Institute of Traditional Medicine and twelve directorates.

MAMC is composed of 11 departments; Department of Internal medicine, general surgery, obstetrics and gynecology, pediatrics, orthopedic surgery, emergency, radiology, pharmacy, ophthalmology, psychiatry, and ear/nose/throat.

This setting was chosen as it has a population with wide genetic heterogeneity, a likely population that consumes gluten-containing grains and a population that has shown to have a high prevalence of IBS from literature review.

Inclusion criteria

age of 18 years and above, all who consented to participate in the study.

Exclusion criteria

none consenting persons and females who had dysmenorrhea and Rome IV symptoms.

The study was conducted from August to November 2018. The minimal sample size used was 192 people. A consecutive sampling technique was employed in which all MUHAS health care professional staff and students on their respective areas were recruited until the sample size was attained. Health care professional staffs were introduced to the study through morning departmental meetings on their respective stations while students were introduced to the study after lecture hours. Participants were then required to complete an online survey Google document that was shared in various social network groups of staff and students. A written consent was obtained from the study participants. The survey tool questions were based on ROME IV criteria for irritable bowel syndrome where study participants were required to fill their mobile phone number, respond to the 8 questions in the tool and complete the socio-demographics section.

Then, those who fulfilled the ROME IV criteria of IBS were contacted via mobile phone and completed a second part of the questionnaire as described in the data collection tool that composed of anthropometric measurements and laboratory characteristics (annex IV).

Thereafter, participants were classified into diarrhea predominant IBS (IBS-D) if they had loose, mushy or watery stools in the last 3 month (question 8) without hard or lumpy stools (question 7); constipation predominant (IBS-C), if they had lumpy or hard stools without loose, mushy or watery stools in the last 3 month; Mixed IBS (IBS-M) if they had both hard stools and loose, mushy or watery stool in the last 3 month; and un subtype IBS (IBS-U), if they had neither hard, lumpy nor loose, mush or watery stool in the last 3 month. .

A Celiac Quick test (BIOHIT CELIAC QUICK TEST LOT NO X46.83), an immune-chromatographic test designed for the qualitative detection of antibodies (IgA/IgG/IgM) against human tissue transglutaminase in whole blood sample, was used for screening of CD. Also Full blood picture (FBP), Liver transaminases and erythrocyte sedimentation rate (ESR) were measured in the study participants.

NEGATIVE: Only one BLUE band appears across the result window close to the "C" letter (Control line) of the test cassette. This band must always appear.

POSITIVE: In addition to the BLUE control band, a distinguishable PINK-RED band also appears across the result window close to the letter "T" (Test line) of the test cassette. The intensity of the line depends

on the concentration of antibodies in the sample.

If no BLUE band appeared in the control area, the test was INVALID and was repeated with a new test cassette. Any line or color that appeared after 10 minutes had no diagnostic value.

1.1 Data analysis

The data obtained from the questionnaires was entered into statistical package of social sciences (SPSS) version 20 for Windows for data analysis. Cross checking of filled questionnaires after data collection was done for quality control of data.

The qualitative variables such as: sex, cigarette smoking/alcohol, manifestations CD and IBS were summarized using frequency distribution tables.

Quantitative variables in the study include; ages, number of seropositive and seronegative, were summarized by frequency distribution. Mean and standard deviation were employed for age.

Comparison of categorical variables between groups was performed using chi-square tests or fishers exact test. Logistic regression was employed to study for associations. The level of significance used was $P = 0.05$.

1.2 Ethical Consideration

Permission was sought from MUHAS administration and MUHAS research ethical committee. Informed consent (annex I) was obtained from all participants that a vein puncture will be done to obtain a blood sample that was to be used for this study only.

Results

A total of 1,321 MUHAS staff and students were screened of which 192 participants fulfilled the ROME IV criteria for IBS and were screened for CD. The mean age of study participants was 25

4.04 years where 698 (52.8%) were females. Majority of study participants were single 1054 (79.8%) and students 1161 (87.9%). Ongoing students 982 (74.3%) accounted for greater part of student participants, where the highest number of participants 812 (61.5%) were from school of medicine. School of dentistry had least participants 28 (2.1%). Sleep duration was less than 7 hours in most of the study participants 1046 (79.2%) as described in Table 1 below.

Table 1

The demographic, anthropometric, clinical and laboratory characteristics of study participants among MUHAS staff and students. N = 1321

Characteristics		N (%)
Age	Mean age years SD	25 4.04
Age groups	18–27	992 (75)
	28–37	317 (24)
	38–47	10 (0.8)
	48–57	2 (0.2)
Sex	Female Male	698 (52.8) 623 (47.2)
Marital status	Single/divorced/widow(er) Married/cohabiting	1054 (79.8) 267 (20.2)
Alcohol	Ever	111 (8.4)
Smoking	Ever	7 (0.5)
Occupation	Student Employee	1161 (87.9) 160 (12.1)
School/Institute of students (N = 1161)	Medicine Dentistry Pharmacy Nursing Allied sciences Public health	812 (61.5) 28 (2.1) 84 (6.4) 95 (7.2) 107 (8.1) 35 (2.6)
Year of study (N = 1161)	Ongoing Finalist	965 (83.1) 196 (16.9)
Hours of sleep	7hours > 7hours	1046 (79.2) 275 (20.8)
Clinical manifestations		
Symptoms	Abdominal pain	356 (26.9)
	Constipation	292 (22.1)
	Diarrhea	130 (9.8)

Continuous variables are presented as mean ± standard deviation, while categorical variables are presented as proportions, N: number of participants, Height and weight were used to calculate body mass index (BMI = weight in kg /height in meters²). HB; hemoglobin, MCV; mean cell volume, MCHC; mean cell hemoglobin concentration, ESR; erythrocyte sedimentation rate, ALAT Aspartate aminotransferase, ALAT; Alanine aminotransferase and BMI; body mass index.

Characteristics		N (%)
	Mixed	445 (33.7)
	None	98 (7.5)
Laboratory characteristics N = 192		
HB	Grams/deciliter mean SD	13.2 1.1
MCV	Femtoliters	91.2 5.5
MCHC	Grams/deciliter	31.5 1.3
ESR	Millimeter/hour	4.71 1.6
ALAT	Units/liter	22.9 5.4
ASAT	Units/liter	23.9 4.6
Anthropometric measurements N = 192		
Height (range)	Centimeters mean SD	162.11 6.6
Weight	Kilograms	61.32 7.3
BMI	Kilograms/meter ² (kg/m ²)	23.3 2.6
Continuous variables are presented as mean ± standard deviation, while categorical variables are presented as proportions, N: number of participants, Height and weight were used to calculate body mass index (BMI = weight in kg /height in meters ² . HB; hemoglobin, MCV; mean cell volume, MCHC; mean cell hemoglobin concentration, ESR; erythrocyte sedimentation rate, ALAT Aspartate aminotransferase, ALAT; Alanine aminotransferase and BMI; body mass index.		

Cigarette smoking and alcohol were uncommon among the study participants thus, 7 (0.5%) and 111 (8.4%) in that order.

An alteration of abdominal pain, constipation and diarrhea was the predominant clinical manifestation evident in 445 (33.7%) participants while diarrhea alone was the presenting complaint in 130 (9.8%) participants.

The mean HB, red blood cell indices, liver enzymes and ESR among IBS study participants were within normal limits. The mean BMI among IBS participants was 23±2.6 kg/m².

The prevalence of IBS among MUHAS staff and students was 14.5% as shown in Table 2 below.

Table 2
The prevalence of IBS among MUHAS staff and students
N = 192

Irritable bowel syndrome	IBS (%)	192 (14.5)
	No IBS (%)	1129 (85.5)

The prevalence of CD among MUHAS staff and students with IBS was 1.6% as shown in Table 3 below.

Table 3
The prevalence of celiac disease among MUHAS
staff and students with IBS

Celiac rapid test	Positive (%)	3 (1.6)
	Negative (%)	189 (98.4)

The baseline characteristics in participants with IBS and those with no IBS were similar in terms of alcohol intake and abdominal pain as part of the symptomatology however; those below an age 25 years, females, nonsmokers and with sleep duration less than seven hours were significantly predominant between the two arms. Nevertheless, among students a great part of ongoing students had no IBS. Moreover, among students with IBS ongoing students had less IBS 85 (48.6%) compared to the finalist 90 (51.4%). Furthermore, diarrhea, constipation and abdominal pain alternating with diarrhea and constipation were significantly seen among IBS participants as shown in Table 4 below.

Table 4
**The socio-demographics characteristics and manifestations of IBS among MUHAS staff
and students N = 1321**

Characteristics	No IBS	IBS	P-value
	N = 1129 (%)	N = 192 (%)	
Age	25	671 (59.5) 108 (74.5)	0.001
Sex	Female	583 (51.6) 115 (59.9)	0.034
Alcohol	Never	1041 (92.2) 169 (88)	0.053
Smoking	Never	1125 (99.6) 189 (98.4)	0.068
Hours of sleep	7hours	877 (77.7) 169 (88)	0.001
Study year	Ongoing	880 (89.2) 85 (48.6)	< 0.001
(N = 1161)			
Clinical manifestations			
Symptoms	Abdominal pain (%)	164 (14.5) 192 (100)	0.646
	Diarrhea (%)	86 (7.6) 44 (22.9)	< 0.001
	Constipation (%)	252 (22.3) 40 (20.8)	< 0.001
	Mixed (%)	337 (29.8) 108 (56.3)	< 0.001
	None (%)	290 (25.7)	

A total of seven variables namely age, sex, alcohol, smoking, marital status, year of study and sleep duration were entered in the univariate logistic regression analysis model. Age less than 25 years, female sex, being single, sleep duration less than 7 hours and finalist students were found to increase the probability of IBS.

All variables were entered in multivariate logistic regression analysis. After adjusting for cigarette smoking, age below 25 years (AOR 2.53, 95% C.I 1.57–4.09), female sex (AOR 1.67, 95% C.I 1.16–2.41), single marital status (AOR 4.95 C.I 2.07–11.82), alcohol use (AOR 2.47, 95% C.I 1.16–5.23), final year of study (AOR 8.49, 95% C.I 5.71–12.64) and sleep duration of less than 7 hours (AOR 2.24, 95% C.I 1.23–4.06) were found to be independently associated with IBS as shown in Table 4 below.

There were 3 celiac disease patients among MUHAS staff and students with IBS where 2 (66.7%) were females and 1 (33.3) was a male. All CD patients were below age of 25 years, never smoked cigarette or taken alcohol.

All patients with celiac disease had healthy weight. Bloating was common among CD patients. The predominant IBS subtype among the CD positive patients was diarrhea 2 (66.7%).

One CD patient had mild microcytic hypochromic anemia whilst elevated ALAT evident in 2 patients as shown Table 5.

Table 5

Factors associated with IBS among MUHAS staff and students before and after adjustment N = 1321

Variable		P-value	Crude OR	95% C.I	P-value	Adjusted OR	95% C.I
Age	≤ 25 years	0.005	1.61	1.15–2.24	< 0.001	2.53	1.57–4.09
Sex	Female	0.04	1.40	1.03–1.91	< 0.01	1.67	1.16–2.41
Alcohol	Ever used	0.06	1.61	0.99–2.62	0.02	2.47	1.16–5.23
Smoking	Ever smoked	0.05	4.46	0.99–20.11	0.27	3.29	0.39–27.43
Marital status	Single	< 0.001	2.56	1.56–4.20	< 0.001	4.95	2.07–11.82
Year of study	Finalist	< 0.001	5.16	3.67–7.24	< 0.001	8.49	5.71–12.64
Sleep duration	< 7 hours	0.001	2.11	1.34–3.34	0.01	2.24	1.23–4.06

Table 6

The socio-demographic characteristics and manifestations of celiac disease among MUHAS staff and students with IBS N = 3

Sociodemographic characteristics		Positive celiac rapid test N (%)
Age	≤ 25 years	3 (100)
Sex	Male Female	1 (33.3) 2 (66.7)
Alcohol	Never	3 (100)
Smoking	Never	3 (100)
Clinical characteristics		
IBS subtype	Mixed	1 (33.3)
	Diarrhea	2 (66.7)
Bloating	Sometime Most of the time	2 (66.7) 1 (33.3)
Anthropometric measurements		
BMI	18-24.9 (%)	3 (100)
Laboratory characteristics		
Hemoglobin RBC indices	Normal Low Microcytic hypochromic Normocytic normochromic	2 (66.7) 1 (33.3) 1 (33.3) 2 (66.7)
ASAT	< 40 units/L	3 (100)
ALAT	< 40 units/L ≥ 40 units/L	1 (33.3) 2 (66.7)
ESR	< 15 millimeter/hour	3 (100)
Normal hemoglobin in females was defined as HB ≥ 11.5 g/dl where normal HB in males was defined as HB ≥ 13 g/dl. Normal RBC indices MCV (80–100) MCHC (30–35). Normal ALAT and ASAT (0–40units/L). Normal ESR males < 15 mm/hour and < 20 mm/hour females.		
Cover letter		
To whom it may concern,		
RE: Manuscript submission to BMC gastroenterology		

Sociodemographic characteristics	Positive celiac rapid test N (%)
As caption above reads, I am writing to inform the journal that this work is original and has never been submitted to any other journal for publication. It is an agreement between the author and co-author. The reason we think its valuable publishing the paper is no such kind information has been published from East Africa and as well as Sub Saharan Africa.	
We hope this manuscript will be considered for publications.	
Regards,	
Dr. Adam Gembe.	
Author.	

Discussion

The global prevalence of IBS among medical students and health care professionals is high (8–10). The prevalence of IBS in this study was found to be 14.5%. The finding is relatively consistency with findings among medical students in Saudi Arabia, Iran and health care professionals in Turkey where the prevalence of IBS was 13.7%, 12.6% and 13.5% respectively (9, 11, 12). On the contrary, studies in Asia; Pakistan and China reported high prevalence of IBS among medical students 28.3% and 33.3% respectively whilst prevalence of 28.4% among health care professionals. Anxiety, stress and lack of sleep being the primary triggers (9, 13, 14). In African medical students a relative comparable IBS prevalence to this study was evident in Nigeria and Sudan where the prevalence was 14.4% and 12.9% respectively (15). On the other hand, other studies among Nigerian medical student and nursing staff were consistency with some studies in Asia where the prevalence of IBS was as high as 26.1% and 45.2% in that order (16, 17).

The pathophysiology behind a high prevalence of IBS in medical students is constant nerve-racking environment to meet deadlines, examinations anxiety, long working and studying hours and less hours of sleep (8). Nevertheless, health care professionals are subjected to stressful environment due to the nature of the work and working environment (9). Although not fully defined, in genetically predisposed individual, stressful environment alter the micro biome-gut-brain axis that is key in IBS symptomatology. Stress, enhances the increase in systemic pro inflammatory cytokines and activates the hypothalamus pituitary adrenal axis. In turn, increases levels of corticotrophin releasing factor (CRF) from the hypothalamus that alter gut permeability causing infiltration of inflammatory cells, localized inflammation and mucosal edema. This results in changes in visceral neuromuscular function hence, IBS symptoms (18, 19).

IBS manifests in four major clinical subtypes as describe in literature review. Nevertheless, IBS shows a preponderance of females in their second and third decades of life. It was found that IBS-M subtype was common among MUHAS staff and students (56.3%) largely affecting females (59.9%). Similar findings have been reported in studies in Pakistan, Japan and China (2, 14, 20). While in Iranian medical students

IBS-C was the predominant subtype (81.6%) (21). In African studies findings were similar to Pakistan, Japan and China where IBS-M was predominant (19.6% and 60.7%) (15, 17).

IBS has been shown to be associated with several factors as stipulated in literature review. In this study female gender, age below 25 years, alcohol intake and finalist students were independent predictors of IBS. In the same way, a study among medical students in China found that females were more affected than males (20). On the other hand, another study in China found that alcohol intake was significantly associated with symptoms of IBS (22). On the contrary, a study in Saudi Arabia among medical students IBS was predominant in males however, age and advanced academic levels were predictors of IBS (12). Studies in Turkey, Pakistan and Nigeria among health care professionals have displayed similar findings with studies among medical students in China where being a female was associated with IBS (9, 10, 17).

Evidence shows existence of CD among patients with IBS with variable burden across the globe. In this study, the prevalence of CD in patients with IBS based on the Rome IV criteria was 1.6%. Similarly, studies from Asia and Europe relieved comparable CD prevalence among IBS patients (23, 24). On the contrary, studies from Middle East have shown a higher prevalence of up to 9.6% (25–27). Likewise, similar findings were seen in Mexico where the prevalence of CD in IBS patients was 5.21% (28). Despite few studies in Africa, comparable findings to the middle East and North America were evident among Egyptian IBS patients where the prevalence of CD in IBS was found to be 8% (2). The low prevalence observed in study may be due to the fact that CD is uncommon in the Sub-Saharan Africa.

The manifestation of CD in IBS varies in different populations. In this study, CD was found in two patients with IBS-D subtype and one patient with IBS-M subtype. In the same way among Asians, CD has been seen commonly in patients with IBS-D subtype followed by IBD-M subtype and occasionally in IBS-C subtype (27, 29, 30). Conversely, in Iranian patients CD was found to be prevalent in IBS-U and less prevalent in the IBS-D subtype. A study in Africa has shown CD is common in IBS-D subtypes (24).

Furthermore, CD may present with bloating and weight loss, however, recent evidence has shown a decline in weight loss as a typical CD presentation (31). This study found that all CD patients had bloating and normal body mass index (BMI). In the same way, a study in India had similar findings where a normal mean BMI was evident in CD patients (23). Moreover, similar findings in terms of mean BMI were found in another study in Mexico (28). On the contrary, in Saudi Arabia it was found that patients with CD were underweight compared to those who were negative for CD where as in Jordan, CD patients were overweight (25, 30).

Current evidence shows a preponderance of atypical CD manifestation such as iron deficiency anemia (IDA), asymptomatic elevated liver enzymes and ESR. In this study, two CD patients had elevated ALAT with normal ASAT as well as ESR. IDA was evident in 1 CD patient. Similarly, studies in India and Jordan, IDA was non-significantly evident in the CD patients (23, 30). Another study, in India, a non-significant difference in HB between CD patients versus non CD patients with IBS was found (32). In Africa, Egypt, a significant lower HB was evident in CD patients with IBS but non-significant difference in liver enzymes and ESR among the two arms (2).

IDA in CD occurs as a result of loss of iron in the bowel enterocytes and mal-absorption of daily ingested iron (33). On the other hand, asymptomatic elevation in liver enzymes is due to increased intestinal permeability resulting in translocation of gut bacteria, kupffer cell stimulation, and production of tumor necrosis factor- α (TNF- α), pro-inflammatory cytokine, and reactive oxygen species, resulting in nonalcoholic steatohepatitis (NASH). In addition to, CD share common immunogenic factors and immunopathogenesis with other hepatobiliary disorders such as autoimmune hepatitis, primary biliary cirrhosis and primary sclerosing Cholangitis that may contribute to asymptomatic elevation in liver enzymes (34).

Study Limitations And Strength

It was a single centered study confined to MUHAS and MUHAS teaching hospital therefore; the observed prevalence rates cannot be generalized. CD serologic test can be falsely negative in IgA deficiency, for which this study did not screen. Response bias as study participants were required to complete an online survey.

Conclusions

This study has revealed a high prevalence of IBS (14.5%) comparable to other studies elsewhere. Furthermore, the prevalence of CD among participants with IBS was low (1.6%) in relation to studies done in other parts of the world. The commonest IBS subtype found was IBS-M subtype whereas most CD patients had IBS-D subtype. Age below 25 years, female gender, alcohol, and being finalist student were independent predictors of IBS. IDA was uncommon whilst elevated ALAT being common among CD patients.

Abbreviations

ALAT	-	Alanine aminotransferase
AOR	-	Adjusted odds ratio
ASAT	-	Aspartate aminotransferase
BMI	-	Body mass index
CD	-	Celiac disease
EMA	-	Endomysial antibody
ESR	-	Erythrocyte sedimentation rate
GFD	-	Gluten free diet

HB	-	Haemoglobin
HLA	-	Human leukocyte antigen
IBS	-	Irritable bowel syndrome
IDA	-	Iron deficiency anemia
IFNy	-	Interferon gamma
IgA	-	Immunoglobulin A
IgG	-	Immunoglobulin G
IgM	-	Immunoglobulin M
Kg/m ²	-	Kilogram/meter ²
MAMC	-	Muhimbili Academic Medical Centre
MCV	-	Mean Cell Volume
MCHC	-	Mean Cell Hemoglobin Concentration
MUHAS	-	Muhimbili University of Health and Allied Sciences
OR	-	Odds ratio
PLT	-	Platelets
QoL	-	Quality of life
T1DM	-	Type 1 diabetes mellitus
tTGA	-	tissue transglutaminase
WBC	-	White blood cells

Declarations

Ethics approval and consent to participate

The study was conducted after obtaining permission from the MUHAS institutional review board. Consent was sought from study participants.

Consent for publication

Not applicable.

Availability of data and materials

The data set supporting the conclusion of this article is available from the authors on request.

Competing interests

None.

Funding

This was a non-funded project.

Author's contributions

Dr. Gembe A had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Figures



Figure 1

Negative CD test



Figure 2

Positive CD test