International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Pancreas Sonographic Findings Among Diabetic and Non-Diabetic Patients Attending Muhimbili National Hospital, Tanzania

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Abstract

Background: Diabetic mellitus (DM) patients have various types of morphological changes occurring in the pancreas associated with a decrease in total pancreatic mass and ultrasound is the first-choice imaging modality for the pancreas. There are no documented studies done in Tanzania on ultrasound assessment of the pancreas in DM patients.

Objective: To determine pancreatic sonographic findings among Diabetic Mellitus and non-Diabetes Mellitus patients attending Muhimbili National Hospital diabetic clinic, Tanzania, from October 2017 to March 2018.

Methodology: This was a cross-sectional, hospital-based study conducted at the Radiology Department of Muhimbili National Hospital (MNH) involving DM and non-DM patients who attended the MNH diabetic clinic. Data was collected through a structured questionnaire, including the patient's demographic characteristics, diabetes status, anthropometry measurement (weight, height, and BMI), and pancreas sonographic findings. Calipers on screen were used to measure AP dimensions of the pancreatic head, body, tail, and duct while pancreas echogenicity was evaluated by comparing it with liver echogenicity. SPSS version 20 was used for data analysis. P value of < 0.05 was considered statistically significant at 95% confidence interval. Ethical clearance was obtained from the MUHAS IRB (Institutional Research Board).

Results: A total of 120 patients participated in this study, of which 36 were males and 84 were females. Age ranged from 10-60 years old. Diabetic Mellitus was more prevalent among females than males in both DM type 1 and DM type 2 with 29 (72.5%) and 26(65%) respectively. The study shows that there were significantly lower AP dimensions of the body and tail of the pancreas (P=0.001) and (P=0.0001) respectively, in DM than in non-DM diabetes. There was a strong correlation between the increase in pancreatic head dimension and increased anthropometry measures (weight, height, and BMI) There was a strong significant decrease in the size of the pancreatic body and tail with an increase in duration of illness among Diabetic Mellitus patients in this study (P<0.01). Also, this study revealed significant changes in pancreas echogenicity, whereby DM type 2 was significantly associated with hyperechoic pancreatic head while DM type 1 was significantly associated with iso/hypoechoic pancreatic head.

However, these changes in echogenicity were also age-related. Patients with infections or tumors involving the pancreas were excluded from the study

Conclusion: DM patients had smaller pancreas bodies and tails than non-DM. It was also noted DM type 1 had smaller dimensions of the pancreas (head, body, and tail) when compared to DM type 2 and non-DM. This study also showed increased pancreas head dimensions with increased weight, height, and BMI in DM patients. The present study showed a strong relation between increased duration of diabetic illness with decreased pancreatic body and tail dimensions.

Also, this study showed that the pancreas head echogenicity was significantly hypoechoic and hyperechoic in DM type 1 and DM type 2 respectively however age could be the contributing factor.

Keywords: Pancreas, Sonographic findings, Diabetic patients

Introduction

The pancreas is a retroperitoneal organ developing from a large dorsal embryologic anlage and a ventral anlage. It is not encapsulated and usually lies between duodenal loops and splenic hilum in the anterior pararenal space. Parts of the pancreas include the head, body, tail, and uncinate process. It has a length of about 12.5-15cm with variable thickness and width in its different parts, head (<3.5cm), body (<2.5cm and tail (<2cm) (1,2).

Diabetes Mellitus is a term that describes a group of chronic metabolic disorders that presents with hyperglycemia associated with disturbances in the metabolism of carbohydrates, fat, and protein following a total lack of insulin or its relative absence. There are two types of Diabetes Mellitus, Type 1 known as Juvenile onset DM, and Type 2 known as adult onset DM. Type 1 diabetes is an autoimmune disorder that follows an attack associated with the infiltration of Islets of Langerhans by inflammatory cells and the destruction of pancreatic Beta cells. Type 2 diabetes follows disturbances in the pancreas to produce and release insulin and ineffective use of insulin by the body due to resistance (3,4,5,6,7).

The pancreas produces insulin; however, when it is destroyed or there is a change in insulin metabolism will lead to diabetes (8). Following Diabetes, various types of morphological changes occur. Diabetes type 1 patients have a decrease in total pancreatic mass this is a result of pancreatic atrophy. Almost complete loss of Beta cells is common in autoimmune-mediated or fulminant DM type 1. Pancreatic islet cells occupy 2-4% (fractional) area of the pancreas parenchyma. Total pancreatic volume is determined by the islet endocrine cell mass. In patients with type 2 Diabetes, there is a decrease in Beta cell mass to a variable extent (8,9,10).

Laboratory tests have been used as the main methods to investigate DM. Imaging modalities have been used to study associated complications of the disease in other organs than the pancreas. Changes in the pancreas in DM patients can be evaluated by Ultrasound, MRI, and CT scan. Ultrasound has been preferred as the first-line imaging modality due to its advantages over other imaging modalities which are invasive and expensive, and probable efficacy in predicting the severity of disease (11,12).

Previous studies by ultrasound have shown a smaller size of pancreatic gland in DM patients compared to normal healthy non-DM patients with pancreatic AP dimensions of the body and tail being significantly smaller, being in parallel with the duration of illness (12,13).

There is no literature found on ultrasound assessment of the pancreas in Diabetes Mellitus patients in Tanzania, therefore it is not known how DM patients' pancreas present sonographically. This study aims to determine pancreas changes among diabetic and non-diabetic patients based on ultrasound

Materials and methods

This was a cross-sectional, hospital-based study conducted at the Radiology Department of Muhimbili National Hospital (MNH) from October 2017 to March 2018 involving DM and non-DM patients who attended at MNH diabetic clinic whereby a total of 120 individuals participated.

Ethical clearance was obtained from the Muhimbili University of Health and Allied Sciences Institutional Review Board (MUHAS IRB) before the study was carried out. Informed consent was sought from the adult participant, parents, or guardian for the children.

Data collection

The collection of data was done through structured questionnaires which were filled by an Investigator. The investigator evaluated images initially then verification followed by Senior Radiologist. Data was recorded only when consensus was reached. Data collected included the patient's demographic characteristics, diabetes status, duration of illness, anthropometry measurement (weight, height, and BMI), and pancreas sonographic findings. The Sonographic features collected included pancreatic AP dimensions, echogenicity, contour, and main pancreatic duct diameter of Diabetic and non-Diabetic patients.

Imaging and evaluation

The scan was done after the patients under study fasted for 6-8 hours because stomach food debris may limit the complete examination of the pancreas or result in a false impression. The patient was studied in either supine or sitting/right semi-decubitus. Sitting/right semi-decubitus was employed after the patient was given water to drink about 500-700mls to reduce or displace bowel gas shadows away from the pancreas and improve its visibility. The part of the abdomen that was exposed for scanning was between the xiphisternum and umbilicus then the acoustic gel was applied.

Epigastric anatomical landmarks were used to identify the pancreas. Posterior to it lies the Porto-splenic axis while anteriorly there is the left lobe of the liver and gastric antrum. Superior mesenteric vessels lie posterior to the point of division of the pancreatic head and body while at the dorsum border of the pancreas lies the splenic vein which extends to the spleen. Other related anatomical landmarks include the inferior vena cava and aorta. Anterolateral to superior mesenteric vessels the pancreatic head was identified, while the body was located anterior to the splenic vein just above the superior mesenteric artery at the transverse scan and the tail was found after subcostal left oblique scan toward the splenic hilum.

Calipers on the screen were used to measure AP dimensions of the pancreatic head, body, tail, and duct. A single measurement was taken for each part of the pancreas by the Investigator. The pancreatic duct was visualized as a non-echogenic lumen with parallel echogenic linear walls following a straight course. Normally it became more apparent when it measured more than 2.5mm to 3mm in diameter. The presence of fibrosis and calcification was detected by the intensity of white echotexture. The patient's information and image findings were kept confidential.

RESULTS

Demographic information

A total of 120 individuals participated in this study, of which 36(30%) were males and 84(70%) were females. Among Diabetic patients, females were the majority in both DM type 1 and DM type 2 with

29(72.5%) and 26(65%) respectively. The population's mean age was 35(±17) years. Age ranged from 10-60 years. The majority of the DM type 1 patients were aged 10-19 years 32(80%) while in DM type 2 majority were aged 50+ years 26(65%). Thus two peaks were observed as Table 1 below shows.

Table 1: Demographic characteristics of diabetic and non-diabetic patients (N=120)

Demographic characteristics		Diabetes Mellitus status			Total
		Type 1 N (%)	Type 2 N (%)	Non-DM N (%)	N (%)
	10-19	32(80)	0(0)	6(15)	38(31.66)
	20-29	4(10)	1(2.5)	13(32.5)	18(15)
	30-39	3(7.5)	2(5)	4(10)	9(7.5)
Age group	40-49	1(2.5)	11(27.5)	8(20)	20(16.67)
	50+	0(0)	26(65)	9(22.5)	35(29.17)
Total		40(100)	40(100)	40(100)	120(100)
	male	11(27.5)	14(35)	11(27.5)	36(30)
Sex	female	29(72.5)	26(65)	29(72.5)	84(70)
Total		40(100)	40(100)	40(100)	120(100)

Table 2: Mean differences of sonographic pancreatic anteroposterior dimensions(AP) in DM and non-DM patients. (N=120)

	Diabetes Mellitus status			
AP Dimensions	**Diabetic mean ± SD(range)**	**Non-diabetic mean ± SD(range)**	**N**	**P value**
Head of Pancreas	24.3± 5(12.9-35)	24.9±4.4(17.4-35)	120	0.474
Body of Pancreas	10.3±3.3(4-18.7)	12.3±3.2(7-19.4)	120	**0.001**
Tail of Pancreas	9.1±3.2(3.2-23.4)	12.1±4.7(3.3-23.1)	120	**0.0001**

Concerning the pancreatic anteroposterior(AP) dimensions in DM and non-DM patients. The results showed that there were significantly strong mean differences between AP dimensions of the body and tail of the pancreas (and to a lesser extent the head) in DM and non-DM as shown in Table 2 above.

Table 3: Mean differences of sonographic pancreatic anterior-posterior dimensions in DM type 1, DM type 2 and non-DM patients. (N=120)

AP dimensions	**Diabetes Mellitus status**			
	Type 1 mean ± SD(range)	**Type 2 mean ± SD(range)**	**Non-DM mean ± SD(range)**	**P value**
Head of Pancreas	22.1± 3.8(15-30.3)	26.6±5.1(12.9-35)	24.9±4.4(17.4-35)	**0.0001**
Body of Pancreas	9.5±2.5(5.1-17.1)	11±3.9(4-18.7)	12.3±3.2(7-19.4)	**0.001**
Tail of Pancreas	8.5±2(3.2-12.1)	9.8±4.1(4.6-23.4)	12.1±4.7(3.3-23.1)	**0.0001**

The results showed (table 3 above) that mean differences between AP dimensions of the pancreatic head, body, and tail were significantly lower in patients with DM type 1 and DM type 2 when compared to

those of non-DM patients (P=0.0001), (P=0.001) and (P=0.0001) respectively. The head of the pancreas in DM type 2 was slightly larger in diameter than in non-DM body.

Table 4: Mean differences of anthropometry measurements (Weight, height and BMI) in DM and non-DM patients. (N=120)

		Diabetes Mellitus status			
Anthropometry		DM mean ±SD(range)	Non-DM mean ± SD(range)	P-VALUE	
WEIGHT	59.85±16.74(21-100)		65.85±16.71(28-120)	0.066	
HEIGHT	1.56±0.13(1.09-1.92)		1.59±0.12(1.1-1.8)	0.204	
BMI	24.55±5.86(12.2-43.4)		26.26±7.37(14.2-51.2)	0.170	
TOTAL	61.85±16.9(21-120)		1.57±0.13(1.09-1.92)		

The results showed (Table 4 above) that the means of patient's weight in DM(59.85kg) and non-DM(65.85kg) were not significantly different (P>0.05). Table 4 above also showed no significance in means of patient's height (P=0.204). A similar trend was seen in means of patients' BMI in DM (24.55) and non-DM (26.26) which also showed no significance (P=0.170).

Table 5: Mean differences of anthropometry measurements in DM Type 1, DM Type 2, and non-DM patients. (N=120)

Anthropometry	**Diabetes Mellitus status**			
	Type 1 mean ± SD(range)	**Type 2 mean ± SD(range)**	**Non-DM mean ± SD(range)**	**P value**
Weight (kg)	48.8±11.3(21-73)	70.9±13.8(52-100)	65.8±16.7(28-120)	**0.0001**
Height (m)	1.5±0.2(1.1-1.9)	1.6±0.1(1.5-1.8)	1.6±1.1(1.1-1.8)	**0.001**
Body mass index	21.4±4.3(12.2-36)	27.7±5.6(20-43.4)	26.3±7.4(14.3-51.3)	**0.0001**

The results show that the means of patient's weight of diabetic type 1 (48.8kg), type 2 (70.9kg), and non-DM (65.8kg) were significantly different (P<0.05) as shown in Table 5 above. Table 5 above also shows that the patient's mean height for diabetes type 1 was significantly low (1.5m) compared to that of type 2 and control means (1.6m for both) P<0.05). A similar trend was followed by patients' mean for body mass index in which the mean of diabetes type 1 was significantly lower (21) compared to that of type 2 and control, P<0.05.

Table 6: The correlation of pancreatic anteroposterior dimension (AP) with patient's anthropometry (weight, height and BMI) in DM and non-DM patients. (N=120)

		Weight	Height	BMI
Head	Pearson r	.305**	.181*	.231*
	P-Value	0.001	0.048	0.011
	N	120	120	120
Body	Pearson r	.184*	0.138	0.128

	P-Value	0.044	0.132	0.164
	N	120	120	120
Tail	Pearson r	.256**	0.164	0.176
	P-Value	0.005	0.074	0.054
	N	120	120	120

The results showed that there was a significant positive correlation between the Head of the pancreas with patients' weight (r=0.31, P=0.001), patients' height (r=0.18, P=0.048), and Body Mass Index (r=0.23, 0.011) as depicted in Table 6 above. Table 6 above also shows that the body of the pancreas has a significant increase in size with patients' weight (r=0.18, P=0.044) similar to the tail of the pancreas which also had a significant increase in size with patients' weight (r=0.26, P=0.005

Table 7: Pancreatic anteroposterior (AP) dimensions with duration of illness among DM patients and non-DM patients. (N=120)

AP dimensions	**Diabetes Mellitus time of illness**				**P value**
	Below 5 years mean ±SD(range)	**5-10 years mean ±SD(range)**	**Above 10 years mean ±SD(range)**	**Non-DM mean ±SD(range)**	
Head of Pancreas	23.8± 4.9(12.9-35)	23.5±5.1(16.4-35)	25.4±4.9(19.4-34)	24.9±4.4(17.4-35)	0.386
Body of Pancreas	10.5±3.1(5.1-17.4)	9.4±3.5(4-17.3)	10.8±3.3(5.7-18.7)	12.3±3.2(7-19.4)	**0.006**
Tail of Pancreas	9.4±2.8(3.2-15.5)	8.6±3.7(4.6-23.4)	9.3±3.4(4.6-20)	12.1±4.7(3.3-23.1)	**0.001**

It was found that patient AP dimension of the pancreatic body was lower for those who suffered diabetes mellitus between 5 and 10 years (9.4±3.5mm, P<0.01) as shown in Table 7 above. Table 7 above also shows that a similar trend appeared in the pancreatic tail in which its mean was lower for those who suffered diabetes mellitus between 5 and 10 years (8.6±3.7mm, P<0.01).

Table 8: The correlation between duration of diabetes mellitus illness and AP dimensions in DM and non-DM patients. (N=120)

		Duration of illness	**Head of the pancreas AP diameter in mm**	**Body of pancreas AP diameter in mm**	**Tail of pancreas AP diameter in mm**
Duration of illness	**r**	1	0.112	0.270**	0.263**
	P value		0.225	0.003	0.004
	N	120	120	120	120

The study revealed that there was significance weak correlation (r) between increased duration of illness and AP dimension of body of pancreas among DM patient's (r=0.27, P=0.003). The same is seen in case

of tail of pancreas (r=0.26, P=0.004). No correlation was seen with AP dimension of pancreatic head (r=0.112, P=0.225) as shown in the Table 8 above.

Table 9: Sonographic pancreatic echogenicity changes and pancreatic duct diameter in DM and non-DM patients. (N=120)

		Diabetes Mellitus status			OR (P value)
		Diabetic	**Non-Diabetic**	**Total**	
Pancreas echogenicity	Normal	52 (57.8%)	38 (42.2%)	90 (100%)	**16.1(0.002)**
	Increased	24 (92.3%)	2 (7.7%)	26 (100%)	
	Decreased	4 (100%)	0 (0.0%)	4 (100%)	
	Total	**80 (66.7%)**	**40 (33.3%)**	**120 (100%)**	
Pancreatic duct	Not visualized	69 (69.0%)	31 (31.0%)	100 (100%)	3.5(0.174)
	< or = 2.5mm	9 (50.0%)	9 (50.0%)	18 (100%)	
	> 2.5mm	2 (100%)	0 (0.0%)	2 (100%)	
	Total	**80 (66.7%)**	**40 (33.3%)**	**120 (100%)**	

The results revealed that in diabetic patients the pancreas echogenicity is significantly hyperechoic 24(92.3%, P<0.05) compared to non-diabetic patients as depicted in Table 9 above.
The pancreatic duct diameter was greater than 2.5mm for the diabetic patients however no significance was seen, as shown in Table 9 above

Table 10: Sonographic pancreatic echogenicity changes and pancreatic duct diameter in DM type 1, DM type 2 and non-DM individuals. (N=120)

		Type of Diabetes Mellitus				OR (P value)
		Type 1	**Type 2**	**Normal (Non-DM)**	**Total**	
Pancreas echogenicity	Normal	31 (34.4%)	21 (23.3%)	38 (42.2%)	90 (100%)	**32(0.0001)**
	Increased	5 (19.2%)	19 (73.1%)	2 (7.7%)	26 (100%)	
	Decreased	4 (100%)	0 (0.0%)	0 (0.0%)	4 (100%)	
	Total	**40 (33.3%)**	**40 (33.3%)**	**40 (33.3%)**	**120 (100%)**	
Pancreatic duct	No	35 (35.0%)	34 (34.0%)	31 (31.0%)	100 (100%)	7(0.159)
	< or = 2.5mm	5 (27.8%)	4 (22.2%)	9 (50.0%)	18 (100%)	
	> 2.5mm	0 (0.0%)	2 (100%)	0 (0.0%)	2 (100%)	
	Total	**40 (33.3%)**	**40 (33.3%)**	**40 (33.3%)**	**120 (100%)**	

It was found that among all diabetic patients, those with type 2 had more significantly increased echogenicity 19 (73.1%, P<0.05) while type 1 had more decreased echogenicity as shown in Table 10 above. It was also noted that pancreatic duct diameter was greater than 2.5mm for the type 2 diabetic patients, as shown in Table 10 above.

Table 11: The pancreatic echogenicity with age group in DM and non-DM patients. (N=120)

		Pancreas echogenicity				OR (P value)
		Normal	**Increased**	**Decreased**	**Total**	
Age group (years)	10-19	32 (84.2%)	3 (7.9%)	3 (7.9%)	38 (100%)	**28.9(0.004)**
	20-29	17 (94.4%)	0 (0.0%)	1 (5.6%)	18 (100%)	
	30-39	7 (77.8%)	2 (22.2%)	0 (0.0%)	9 (100%)	
	40-49	15 (75.0%)	5 (25.0%)	0 (0.0%)	20 (100%)	
	50+	19 (54.3%)	16 (45.7%)	0 (0.0%)	35 (100%)	
	Total	**90 (75.0%)**	**26(21.7%)**	**4 (3.3%)**	**120 (100%)**	

The results showed that the increased echogenicity was higher in the age group of 50+ years 16(45.7%) as depicted in Table 11 above.

DISCUSSION

This study was hospital-based cross-sectional whereby a total of 120 individuals participated, among which 80 were Diabetic Mellitus patients and 40 were non-Diabetic. Among DM patients both Type 1 and Type 2 were 40 individuals each.

There were strong significant mean differences between AP dimensions of the body (P=0.001) and tail (P=0.0001) of the pancreas in DM and non-DM in this study which showed smaller dimensions in DM than in non-DM. These findings are consistent with the study by Agabi et al and Silva et al where AP dimensions of the pancreas were also smaller in DM patients than in non-DM. However, in this study, the AP dimension of the pancreas head showed no statistical difference between DM and non-DM (12,22). This could be due to sampling characteristics, and differences in the population genetically and environmental factors (25).

In this study, the mean differences in AP dimensions of the pancreas Head, body, and tails were significantly lower for the patients with diabetes mellitus type 1 (P<0.05) compared to DM type 2 and non-DM. This is in line with studies by Agabi et al, Silva et al and Basiratnia et al which all showed the least pancreas size in DM type 1 compared to DM type 2 and non-DM. Also in this study, the pancreas dimensions of DM type 2 except the pancreas head were significantly lower than non-DM (P<0.05) in agreement with sizes of the pancreas body and tail in studies by Agabi and Basiratnia (12,13,22). The differences in findings in the size of the pancreas head could be due to sampling characteristics, differences in the population genetically, and or environmental factors (25).

There are no significant differences in increased weight (P=0.066) and BMI (P=0.204) among DM and non-DM patients in this study. These findings are contrary to a study by Agabi JO et al which showed a significant difference in increased weight and BMI among DM and non-DM.(12). This could be attributed to different study populations(22).

However, this study showed that the BMI in DM type 1, DM type 2, and non-DM were 21.4±4.3, 27.7±5.6 and 26.3±7.4 respectively which were consistent with the findings by Silva et al which the BMI in DM type 1, DM type 2 and non-DM were 20.9±3.0, 26.4±3.6 and 22.7±3.6 respectively (22).

A significant strong correlation between the increase in the size of the head of the pancreas among DM with patients' weight (r=0.31, P=0.001), patients' height (r=0.18, P=0.048), and Body Mass Index

(r=0.23, P=0.011) was shown in this study was similar to the findings in a study by Agabi JO et al which also demonstrated positive correlation between increased pancreas head dimension, with increased weight (r=0.561, P<0.001), height (0.471, P<0.001) and Body mass index (r=0.402, P<0.001) (12).

Agabi JO et al showed no correlation between the size of the pancreatic body and tail with weight, height, and Body mass index however in this study positive correlation was there with increased weight for both pancreatic body (r=0.184, P=0.044) and tail (r=0.26, P=0.005) (12). The differences in findings could be due to differences in study design and sampling techniques.

There is a strong significant decrease in the size of the pancreas body and tail with duration of illness among Diabetic Mellitus patients in this study (P<0.01). This is in agreement with studies by Rajput R et al and Silva et al which showed decreased pancreas size with a duration of illness of more than 5 years and onwards (9,22).

In the current study, it was shown that there is no significant correlation between change in the size of pancreatic head dimension in DM patients with duration of illness (r=0.112, P=0.225); These findings are similar to findings of a study by Agabi JO et al which also showed no correlation of size of pancreatic head dimension with duration of illness (r=0.075, P=0.361) (12).

Furthermore, this study showed that DM type 2 significantly hyperechoic pancreas (73.1%, P<0.05) while DM type 1 had significantly hypoechoic pancreas (100%, P<0.05). These findings are consistent with the study by Silva et al which showed hypoechoic (72%) and hyperechoic (83.3%) pancreas in DM type 1 and DM type 2 patients respectively(P<0.0001). Moreover, it was shown the pancreas echogenicity changed with age as demonstrated in this study also (22).

However, In a study by Basiratnia no significant difference of pancreas echogenicity was seen among DM type 1, DM type 2, and Non-DM(13). This could be attributed to study design and sample characteristics.

In the current study, no increase in pancreatic duct dilatation was seen among DM type 1 while there was an increase in DM type 2 however it was not statistically significant. The findings are contrary to the study by Rajput R et al which showed increased dilatation of the pancreas duct in patients with DM type 1(9). This could be due to the characteristics of the sample size.

CONCLUSION

Diabetes Mellitus patients have smaller pancreas body and tail than Non-Diabetes Mellitus. Diabetes Mellitus type 1 patients have smaller dimensions of the pancreas (head, body, and tail) than Diabetes Mellitus type 2 and Non-Diabetes Mellitus.

There was a correlation between increased pancreas head dimension with increased weight, height, and Body Mass Index in Diabetes Mellitus patients while the pancreatic body and tail dimension showed a correlation with weight only.

The present study showed a strong relation between increased duration of diabetic illness and with decrease in the pancreas body and tail dimensions.

Also, this study showed that the pancreas echogenicity was hypoechoic and hyperechoic in Diabetes Mellitus type 1 and Diabetes Mellitus type 2 respectively however age could be the contributing factor.

List of abbreviations:

ANOVA, Analysis of Variance: AP, Anteroposterior: BMI, Body Mass Index: CT, Computed Tomography: DM, Diabetes Mellitus: MNH, Muhimbili National Hospital: MRI, Magnetic Resonance

Imaging: IRB, Institutional Research Board: IDF, International Diabetes Federation: SPSS, Statistical Package for Social Sciences: TSH, Tanzania Shillings:

Ethical approval and consent to participate

Ethical clearance was obtained from the Research and Publication Committee of the Muhimbili University of Health and Allied Sciences. Permission to conduct the study at MNH was asked and it was given. The Researcher introduced himself to the subjects and parents or guardians of subjects who were children. An explanation and purpose of the study were made then a request and consent for participation was asked for. For children under 18, an assent form was used. The interview was done in a private room. The images were interpreted initially by the Principal investigator(PI) followed by Senior Radiologists. Data was recorded only when consensus was reached. The patient's information and image findings were kept confidential. Ultrasound is a safe medical imaging modality that uses sound waves to visualize body structures. It does not produce harmful radiation hence no risks to the patients**.**

Availability of data and material

The dataset used and analyzed during the current survey is available from the corresponding author on reasonable request.

Funding

No, any fund was received for this study

Acknowledgment

First, I thank God, the Almighty for the blessings, good health, and guidance that He provided to me throughout this dissertation work to its completion. My gratitude goes as well to my supervisor Dr Ramadhani Kazema, whose advice, guidance, and perseverance have enabled me to complete this thesis successfully. Also, I would like to thank all staff members and fellow students of the Radiology and Imaging Department at MUHAS for making this thesis possible. My sincere appreciation goes to the heads and staff of the Department of Radiology(MNH), Department of Internal Medicine-Endocrinology unit (MNH), and MUHAS management through the Postgraduate studies directorate for permitting me to conduct this study. Finally, I am highly indebted to my parents Mr. Brighton Homeli Mwakyusa, and my mother Mrs. Mary William Macha Mwakyusa for their love, care, prayers, and support throughout this work and my previous education at all levels.

Authors' Contribution

NBM conceptualized and designed the study, supervised the data collection, analyzed the data, interpreted the results, and drafted the manuscript. RK and BM supervised and designed the study, interpreted the results, and drafted the manuscript. All authors read and approved the final manuscript.

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