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SONOGRAPHIC DIMENSIONS OF PANCREAS AMONG APPARENTLY HEALTHY PEDIATRICS IN KANO METROPOLIS, NIGERIA.

[1] **Mohammed Sidi,** [1]**Mustapha Barde,** [1]**Abuhuraira Abdulmumin,** [*]**Aliyu Abdullahi Hassan**

[*]*Radiology department, Aminu Kano Teaching Hospital, Kano.*
[1]*Department of Medical Radiography, Faculty of Allied Health Sciences, Collage of Health Sciences, Bayero University Kano*

Corresponding author
Aliyu Abdullahi Hassan
xray2rad16@gmail.com +2348065959323

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ABSTRACT

Background: Many pancreatic pathologic processes causes an increase in pancreatic size in pediatric population. Hence, establishing normal reference values is crucial for accurate diagnosis and management of pancreatic diseases.

Aim: This study was aimed at assessing the sonographic dimensions of pancreas among apparently healthy pediatrics in Kano Metropolis, Nigeria.

Materials and Methods: This was a prospective and cross-sectional study conducted in Kano Metropolis from February 2021 to July 2021. Using convenient sampling method, a total of 427 subjects were recruited in the study. An ultrasound machine with a 3.5MHz curvilinear probe was used as the instrument for data collection. The subjects were scan in supine position, the pancreatic measurements were taken and recorded. The data were analyzed using IBM SPSS Version 23.0. The statistical level of significance was set at $p < 0.05$.

Results: The mean anterior posterior dimensions of pancreatic head, body and tail for pediatric male and female subjects were; 0.90±0.09 cm, 0.81±0.08cm and 0.97±0.09cm and 1.01±0.09cm, 0.79±0.09cm and 0.95±0.09 respectively. There was a significant strong positive correlation of pancreatic dimensions with the age, height, weight, BMI and BSA ($r > 0.50, p < 0.05$).

Conclusion: Normal reference values of the pancreatic dimensions were established among pediatrics in Kano Metropolis. There was a significant strong positive correlation of pancreatic dimensions with the anthropometric variables.

Introduction

Pediatrics is a specialty that encompasses children's physical, psychosocial, developmental and mental health. According to national institute of child health and human development (NICHD) in 2011 defined pediatric age stages into six standard groups; neonate (1 – 27days), infancy (1 – 12months), toddler (13 – 24months), preschool age (2 – 5years), school age (6years to 11years) and adolescence (12 – 18years).[1][2] Pediatrics have a longer life span and are susceptible to many disease processes as a result of immature nature immune system, as such exceptional medical care is of paramount important to reduce or avoid disease

stress during the childhood.[3]

Pancreas is a non-encapsulated organ that is located posterior to the stomach, it extends from descending portion of duodenum to the splenic hilum. It lies in the perirenal space of retroperitoneum which is separated from great vessel by a fascia of zukerkandl.[4] It develops from dorsal and ventral primordia, which usually fuse in utero.[5] It has four parts; the head with uncinate process, neck, body and the tail. The organ has dual function; it serves as both exocrine and endocrine organ, hence, it is made up of two tissue namely; the acini or alveolar cells and the islet of Langerhans. The acini are concern with the production and secretion of digestive juice while the islet of Langerhans is mainly an endocrine secretion.[6]

The dimensions of the pancreas vary directly with age, it is reported that it continues to grow until approximately the age of 25 years. Also, normal pancreas across individuals seems to show a great variation in size likely due to variation in weight, height and BMI.[7] In pediatrics pancreatic head and tail are usually similar in size and larger than the neck and body.[5] An increase in size of any part of the pancreas show presence of disease process and it could be of life threatening. Many pancreatic disease processes in pediatric causes an increase in pancreatic size and large spectrum of these pathologies can be identified and monitored using ultrasound, although they are relatively uncommon during childhood as compared to adult.[8] Pancreatitis (acute and chronic), cystic fibrosis, simple cyst, nesidioblastosis, insulinoma, Burkitt lymphoma and Cushing disease are among the most common pathologies affecting pediatric pancreas.[8][9]

Plain radiography has a limited role in the evaluation of pancreatic disease except in cases of calcification in chronic pancreatitis. Contrast enhanced computed tomography is most efficient method of pancreas evaluation especially in tumor staging and differentiation, however it is associated with higher radiation hazard, high cost, possibility of contrast reaction and relatively less availability especially in underdeveloped countries. Magnetic resonance such as MRCP plays a vital role in the investigation of pancreas, but it has limited role in individuals with little retroperitoneal fat due to difficulty in differentiating bowel loops from pancreas, also high cost, claustrophobia and lack of availability are among it disadvantages.[10] Ultrasound is a non-invasive method for pancreas evaluation particularly in pediatric subjects. This may be due to less fatty tissue deposit, they possessed larger left hepatic lobe for optimal acoustic window. Furthermore, it is associated with ionizing radiation, more accessible, and cost effective as compared to all other imaging methods.[8]

In standard practice every population should have a documented reference values for pancreatic dimension in pediatrics for the diagnosis of pathological conditions. Kano state has a population of over 13.4 million with 2.2 million under 18 years.[11] However, intensive literature review shows that there is a paucity of data on normal pancreatic dimension among pediatrics in the study area. The reference values used in the study area were established from the population. This may lead to false positive diagnosis which in turn affect the management and treatment for a particular pathology at certain stage of pediatric development. The findings of this study will serve as a guide to radiologist, radiographers and physicians in the diagnosis and management of pathological conditions affecting pediatrics. This study was aimed at establishing sonographic reference values for pancreatic dimensions among apparently healthy pediatric in Kano metropolis.

Materials and methods

This was a cross-sectional study conducted at some selected hospitals including; Asiya Bayero Pediatrics Hospital, Murtala Muhammad Specialist Hospital, 465 Air force-based Hospital and other primary health care hospitals in Kano metropolis Nigeria, from March 2021 to July 2021. An ethical clearance to conduct the study was obtained from the Human Research and Ethics Committee of the Kano State, Ministry of Health. An informed consent was obtained from the subjects or the subject's guardians. A convenient sampling method was employed; 427 apparently normal pediatric subjects within Kano metropolis were studied involving 205 males and 222 females within the age range of 0 – <18years. The sample size was obtained using Cochran formula as shown below:

$$n = \frac{Z^2\ pq}{d^2}$$

Where n= minimum sample size

z= percentage point of distribution at 95% confidence interval (1.96)

p= prevalence from other previous study = 50% (0.5)

q = 1-p (complimentary probability) = 0.5
d = maximum sample size error = 5% (0.05)
n= (1.96)2*0.5*0.5/ (0.5)2
n=3.8416*0.25/0.0025
n= 0.9604/0.0025
n = 385

The sample size has increased to 427 in order to increase the accuracy of the obtained result.

The subjects were divided into 6 age groups: <4weeks, >1month <12month, 12 – 24month, 24 – 60month, 5 – 13years and 13 – 18years for both males and females involving 15, 20, 20, 50, 50 and 50 subjects respectively for males and 15, 20, 50, 50, 50 and 37 subjects respectively for females. Subjects with any form of disease condition and excessive bowel gas were excluded. Ultrasound scans were performed using Siemens SONOLINE Prima (Serial Number; BBE0617) diagnostic ultrasound system coupled with 3.5MHz curvilinear transducer. The inter and intra-observer variability was tested and there was high agreement in either case. During the inter-observer variability testing two qualified radiographers with further training on ultrasound perform the scan and measure the pancreas independently at interval of at least 15 minutes between measurements without knowing the result of one another. Meanwhile, for testing the intra-observer variability, only one radiographer performs the scan and the pancreas measurements was taken on sperate occasions at interval of at least 15 minutes between the measurements. There is no special pre-examination preparation required; however, old age children are instructed to take nothing per oral for about 3 hours prior to the examination for better visualization. The subject lie supine on the table, the radiographer was on the right side of the subject. In a situation where by subject cannot comply due to anxiety was reassured or supported by relatives. The ultrasound gel was applied on the upper abdominal region. A 3.5MHz curvilinear probe was placed centrally at xiphoid in transverse plane with correct gain selection.[12] Using left lobe as an acoustic window, the pancreas was examined thoroughly by moving the transducer side by side from up down to costal margin with the patient in full inspiration were possible and with appropriate beam angulation caudally. This helps to visualize aorta and celiac axis which are considered as an important landmark for pancreas demonstration. Visualization of duodenum, gastroduodenal artery, and common bile duct are useful landmarks in identifying the lateral margin of the pancreatic head, while visualization of the superior mesenteric vessels, left renal vein, and inferior vena cava helps to delineate the borders of the body and tail of the pancreas.[12][13] Subsequently the transducer was then placed in longitudinal plane to also asses the head, body and tail of the pancreas.[5] In a situation where bowel gas obscured the visualization, 2-3 cup of water was given to the subject to fill the stomach for better acoustic window. The measurement was taken along the pancreas at its widest antero-posterior diameter of the head, body, tail and then recorded in data capture sheet as shown in figure below.

Figure 1: Sonogram shows pancreatic dimension of a 6year old boy.

The sex, age, height and weight for each subject were also recorded in the data capture sheet. The Body Mass Index (BMI) and Body Surface Area (BSA) were derived using the formula below.

BMI= Weight (kg)/height (m^2)

BSA= $\sqrt{Height(cm)x\ weight(kg)/3600}$ (Mosteller formula)

Shapiro-Wilk test was used in carrying out the normality test on the obtained data and the data passed the test, therefore parametric data analysis was used. Both the descriptive and inferential statistics were employed for the data analysis. The mean, standard deviation and range were obtained using descriptive statistics. The independent two-sample t-test was used to compare male and female pancreatic dimension dimensions. The correlation between the pancreatic dimension and anthropometric variables was obtained using Pearson's correlation method. The data were analyzed using Statistical Package for the Social Sciences (IBM SPSS) Version 23.0. The statistical level of significance was set at $p<0.05$.

Results

The mean age of 427 pediatric subjects was 4.72 years, height ranged from 0.48 to 1.58 m and weight ranged from 3.77 – 43.61 kg, BMI ranged from 16.25 to 18.1 kg/m^2, BSA ranged from 0.22 to 1.38 m^2. Table 1 shows that the mean ± SD of age, height, weight, BMI and BSA for <4weeks male subject were 2.8 ± 0.41 weeks; 0.48 ± 0.20 m, 3.77 ± 0.48 Kg, 16.32 ± 1.42 Kg/m^2 and 0.22 ± 0.02 m^2 respectively, for >1 month < 12 months were 7.65 ± 3.00 months; 0.64 ± 0.05 m, 7.85 ± 1.03 kg, 16.75 ± 0.57 Kg/m^2 and 0.39 ± 0.04 m^2 respectively, for 12 – 24 months were 17.7 ± 2.96 months; 0.61 ± 0.06 m, 7.73 ± 1.14 Kg, 20.54 ± 1.76 Kg/m^2 and 0.36 ± 0.04 m^2 respectively, for 24 – 60 months were 45.44 ± 6.87 months; 0.85 ± 0.03 m, 14.21 ± 1.19 Kg, 19.85 ± 0.97 Kg/m^2 and 0.58 ± 0.03 m^2 respectively, for 5 – 13 years were 7.30 ± 1.97 years; 1.09 ± 0.10 m, 22.27 ± 4.68 Kg, 18.68 ± 0.16 Kg/$m^2$and 0.82 ± 0.12 m^2 respectively and for 13 – 18 years were 15.42 ± 1.27 years; 1.58 ± 0.09 m, 43.61 ± 5.80 Kg, 17.51 ± 1.53 Kg/m^2 and 1.38 ± 0.13 m^2 respectively.

Table 1: Demographics information of the males' subjects.

Age groups	Anthropometrics variables				
	Age	**Height (m)**	**Weight (Kg)**	**BMI (Kg/m^2)**	**BSA (m^2)**
< 4weeks (n=15)	2.8±0.41	0.48±0.20	3.77±0.48	16.32±1.42	0.22±0.02
>1month < 12months (n=20)	7.65±3.00	0.64±0.05	7.85±1.03	16.75±0.57	0.39±0.04
12 – 24 months (n=20)	17.7±2.96	0.61±0.06	7.73±1.14	20.54±1.76	0.36±0.04
24 – 60 months (n=50)	45.44±6.87	0.85±0.03	14.21±1.19	19.85±0.97	0.58±0.03
5 – 13 years (n=50)	7.30±1.97	1.09±0.10	22.27±4.68	18.68±0.16	0.82±0.12
13 – 18 years (n=50)	15.42±1.27	1.58±0.09	43.61±5.80	17.51±1.53	1.38±0.13

Table 2 shows that the mean ± SD of age, height, weight, BMI and BSA for <4 weeks female subject were 2.67 ± 0.49 weeks; 0.48 ± 0.02 m, 3.76 ± 0.47 Kg, 16.25 ± 1.54 Kg/m2 and 0.22 ± 0.02 m2 respectively, for >1month <12 months were 7.10 ± 2.31 months; 0.67 ± 0.03 m, 7.74 ± 0.06 Kg, 17.28 ± 0.51 Kgm2 and 0.38 ± 0.02 m2 respectively, for 12 – 24 months were 17.85 ± 3.10 months; 0.61 ± 0.06 m, 7.70 ± 1.17 Kg, 21.06 ± 1.74 Kgm2 and 0.36 ± 0.04 m2 respectively, for 24 – 60 months were 44.24 ± 7.22 months; 0.85 ± 0.03 m, 14.31 ± 1.14 Kg, 19.96 ± 1.06 Kg/m2, 0.58 ± 0.03 m2 respectively. For 5 – 13 years were 6.92 ± 1.84 years; 1.06 ± 0.08 m, 20.99 ± 3.23 Kg, 18.65 ± 0.15 Kg/m2 and 0.78 ± 0.09 m2, for 13 – 18 years were 15.19 ± 1.24 years; 1.51 ± 0.08 m, 41.59 ± 5.70 Kg, 18.11 ± 0.91 Kg/m2 and 1.32 ± 0.12 m2 respectively.

Table 2: Demographics information of the females' subjects.

Age groups	Anthropometrics variables				
	Age	Height (m)	Weight (Kg)	BMI (Kg/m^2)	BSA (m^2)
< 4weeks (n=15)	2.67±0.49	0.48±0.02	3.76±0.47	16.25±1.54	0.22±0.02
>1month <12months (n=20)	7.10±2.31	0.67±0.03	7.74±0.06	17.28±0.51	0.38±0.02
12 – 24 months (n=50)	17.85±3.10	0.61±0.06	7.70±1.17	21.06±1.74	0.36±0.04
24 - 60 months (n=50)	44.24±7.22	0.85±0.03	14.31±1.14	19.96±1.06	0.58±0.03
5 – 13 years (n=50)	6.92±1.84	1.06±0.08	20.99±3.23	18.65±0.15	0.78±0.09
13 – 18 years (n=37)	15.19±1.24	1.51±0.08	41.59±5.70	18.11±0.91	1.32±0.12

Table 3 shows the mean ± SD of the pancreatic head, body and tail dimension for <4weeks male subjects were; 0.56 ± 0.07 cm, 0.46 ±0.07 cm and 0.51 ± 0.08 cm respectively, for >1month<12 months were; 0.70 ± 0.09 cm, 0.61 ± 0.10 cm and 0.66 ± 0.09 cm respectively, for 12 – 24 months were; 0.83 ± 0.05 cm, 0.65 ± 0.04 cm and 0.76 ± 0.05 cm respectively, for 24 – 60 months were; 1.01 ± 0.13 cm, 0.80 ± 0.06 cm and 0.94 ± 0.09 cm respectively. For 5 – 13 years were; 1.41 ± 0.12 cm, 1.16 ± 0.12 cm and 1.34 ± 0.12 cm respectively, for 13 – 18 years were; 1.69 ± 0.10 cm, 1.18 ± 0.11cm and 1.63 ± 0.10 cm respectively.

Table 3: Pancreatic dimensions among male subjects.

Age groups	Pancreatic dimensions		
	Head (cm)	Body (cm)	Tail (cm
< 4weeks	0.56±0.07	0.46±0.07	0.51±0.08
>1month< 12months	0.70±0.09	0.61±0.10	0.66±0.09
12 – 2 months	0.83±0.05	0.65±0.04	0.76±0.05
24 – 60 months	1.01±0.13	0.80±0.06	0.94±0.09
5 – 13 years	1.41±0.12	1.16±0.12	1.34±0.12
13 – 18 years	1.69 ±0.10	1.18±0.11	1.63±0.10

Table 4 shows the mean ± SD of the pancreatic head, body and tail dimension for <4weeks female subjects were; 0.55 ± 0.07 cm, 0.44 ± 0.09 cm and 0.51 ± 0.07 cm respectively, for >1 month <12months were; 0.70 ± 0.09 cm, 0.61 ± 0.10 cm and 0.66 ± 0.09 cm respectively, for 12 – 24 months were; 0.82 ± 0.05 cm, 0.63 ± 0.04 cm and 0.73 ± 0.05 cm respectively, for 24 – 60 years were; 1.00 ± 0.12 cm, 0.79 ± 0.05 cm, 0.92 ± 0.08 cm respectively, for 5 – 13 years were; 1.36 ± 0.13cm, 1.13 ± 0.14 cm and 1.30 ± 0.16 cm respectively, for 13 – 18 year were; 1.65 ± 0.10 cm, 1.15 ± 0.10 cm and 1.59 ± 0.10 cm respectively.

Table 4: Pancreatic dimensions among female subjects.

Age groups	Pancreatic dimensions		
	Head (cm)	Body (cm)	Tail (cm
< 4weeks	0.55±0.07	0.44±0.09	0.51±0.07
>1month< 12months	0.70±0.09	0.61±0.10	0.66±0.09
12 – 24 months	0.82±0.05	0.63±0.04	0.73±0.05
24 - 60 months	1.00±0.12	0.79±0.05	0.92±0.08
5 – 13 years	1.36±0.13	1.13±0.14	1.30±0.16
13 – 18 years	1.65 ±0.10	1.15±0.10	1.59±0.10

Table 5 shows that there was no statistical significant difference in pancreatic head dimension between male and female subjects according to their respective age group (p>0.05).

Table 5: Mean and significant difference between the pancreatic head dimension in male and female subjects.

Age groups	Male Mean±SD	Female Mean±SD	Mean difference	*p*-value
< 4weeks	0.56±0.07	0.55±0.06	0.01	0.65
>1month<12 months	0.73±0.09	0.70±0.09	0.01	0.86
12 – 24months	0.83±0.05	0.80±0.05	0.01	0.64
24 – 60months	1.01±0.13	1.00±0.12	0.00	0.95
5 – 13years	1.41±0.12	1.65±0.13	0.05	0.08
13 – 18years	1.69±0.10	1.65±0.10	0.04	0.09

Table 6 shows that there were no statistical significant difference in pancreatic body dimension between male and female subjects according to their respective age group *(p>0.05)*.

Table 6: Mean and significant difference between the pancreatic body dimension in male and female subjects.

Age groups	Male Mean±SD	Female Mean±SD	Mean difference	*p*-value
< 4weeks	0.46±0.07	0.44±0.09	0.01	0.63
>1month<12 months	0.61±0.10	0.60±0.09	0.01	0.86
12 – 24months	0.65±0.04	0.63±0.04	0.01	0.35
24 – 60months	0.80±0.06	0.79±0.06	0.01	0.55
5 – 13years	1.16±0.12	1.13±0.14	0.03	0.21
13 – 18years	1.18±0.11	1.15±0.10	0.02	0.22

Table 7 shows that there only 12- 24 months age group (p=0.03) shows a statistical significant difference in pancreatic tail dimension between male and female. However, was no statistical significant difference between males and females' pancreatic tail dimension for the remaining age groups.

Table 7: Mean and significant difference between the pancreatic tail dimension in male and female subjects.

Age groups	Male Mean±SD	Female Mean±SD	Mean difference	*p*-value
< 4weeks	0.51±0.08	0.50±0.07	0.01	0.87
>1month<12 months	0.66±0.09	0.65±0.09	0.00	0.92
12 – 24months	0.76±0.46	0.73±0.50	0.03	0.03
24 – 60months	0.94±0.09	0.92±0.08	0.01	0.42
5 – 13years	1.34±0.12	1.30±0.18	0.04	0.14
13 – 18years	1.62±0.10	1.59±0.10	0.04	0.10

Table 8 shows significant strong positive correlation in <4weeks male subjects between pancreatic head dimension and age, height, weight BMI & BSA: (r=0.64, p=0.010); (r=0.83, p=0.000); (r=0.90, p=0.000); (r=0.70, p=0.010) & (r=0.92, p=0.000) respectively. In >1 month < 12 months, it shows significant strong positive between pancreatic dimension and age, height, weight & BSA: (r=0.85, p=0.000); (r=0.87, p=0.000); (r=0.90, p=0.000) & (r=0.89, p=0.000) respectively. In 12-24 months, it shows significant strong positive correlation between pancreatic head dimension and age, height, weight & BSA: (r=0.86, p=0.000); (r=0.91, p=0.000) (r=0.85, p=0.000) & (r=0.90, p=0.000) respectively. In 24-60 months, it shows significant strong positive correlation between pancreatic head dimension and age, height, weight & BSA: (r=0.83, p=0.000); (r=0.95, p=0.000); (r=0.85, p=0.000); & (r=0.93, p=0.000) respectively. In 5-13 years, it

shows significant strong positive correlation between pancreatic head dimension and age, height, weight & BSA: (*r=0*.89, *p=0*.000); (r=0.79, p=0.000); (r=0.79, p=0.000) & (*r=0.93*, *p=0*.000) respectively. In 13-18 years, it shows significant strong positive correlation between pancreatic head dimension and age, height, weight & BSA: (*r=0*.97, *p=0*.000); (r=0.90, p=0.000); (r=0.88, p=0.000) & (*r=0.93*, *p=0*.000) respectively.

Table 8: Correlation of pancreatic head dimension and anthropometrics variables among male subjects.

Age groups	Anthropometrics variables									
	Age		Height		Weight		BMI		BSA	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
<4weeks	0.64	0.01	0.83	0.00	0.90	0.00	0.70	0.01	0.92	0.00
>1month<12 months	0.85	0.00	0.87	0.00	0.90	0.00	-0.25	0.29	0.89	0.00
12 – 24months	0.86	0.00	0.91	0.00	0.85	0.00	-0.56	0.01	0.90	0.00
24 – 60months	0.83	0.00	0.95	0.00	0.85	0.00	-0.47	0.75	0.93	0.00
5 – 13years	0.89	0.00	0.79	0.00	0.79	0.00	0.22	0.13	0.93	0.00
13 – 18years	0.97	0.00	0.90	0.00	0.88	0.00	0.14	0.42	0.93	0.00

Table 9 shows significant strong positive correlation in <4weeks male subjects between pancreatic body dimension and age, height, weight BMI & BSA: (*r*=0.55, *p=0*.04); (*r*=0.79, *p=0*.000); (*r*=0.82, *p=0*.000); (*r*=0.61, *p=0*.020); & (*r=0*.86, *p=0*.000) respectively. In >1 month < 12 months, it shows significant strong positive between pancreatic body dimension and age, height, weight & BMI: (r=0.94, p=0.000); (*r=0*.85, *p=0*.000); (r=0.87, p=0.000) & (*r=0.90*, *p=0*.000) respectively. In 12-24 months, it shows significant strong positive correlation between pancreatic body dimension and age, height, weight & BSA: (*r=0*.78, *p=0*.000); (*r=0*.75, *p=0*.000); (*r=0*.75, *p=0*.000) & (*r=0*.76, *p=0*.000) respectively. In 24-60 months, it shows significant strong positive correlation between pancreatic body dimension and age, height, weight & BSA: (*r=0*.70, *p=0*.000); (*r=0*.70, *p=0*.000); (r=66, p=0.000) & (*r=0.70*, *p=0*.000) respectively. In 5-13 years, it shows significant strong positive correlation between pancreatic body dimension and age, height, weight & BSA: (*r=0*.80, *p=0*.000); (r=0.73, p=0.000); (r=0.72, p=0.000) & (*r=0.72*, *p=0*.000) respectively. In 13-18 years, it shows significant strong positive correlation between pancreatic body dimension and age, height, weight & BSA: (*r=0*.91, *p=0*.000); (r=0.86, p=0.000); (r=0.86, p=0.000); & (*r=0.90*, *p=0*.000) respectively.

Table 9: Correlation of pancreatic body dimension and anthropometrics variables among male subjects.

Age groups	Anthropometrics variables									
	Age		Height		Weight		BMI		BSA	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
<4weeks	0.55	0.04	0.79	0.00	0.82	0.00	0.61	0.02	0.86	0.00
>1month<12 months	0.94	0.00	0.85	0.00	0.87	0.00	0.90	0.00	-0.25	0.29
12 – 24months	0.78	0.00	0.75	0.00	0.75	0.00	-0.36	0.12	0.76	0.00

24 – 60months	0.70	0.00	0.70	0.00	0.66	0.00	0.01	0.00	0.70	0.00
5 – 13years	0.80	0.00	0.73	0.00	0.72	0.00	0.21	0.14	0.72	0.00
13 – 18years	0.91	0.00	0.86	0.00	0.86	0.00	0.16	0.00	0.90	0.00

Table 10 shows significant strong positive correlation in <4weeks male subjects between pancreatic tail dimension and age, height, weight BMI & BSA: (*r*=0.63, *p=0.*010); (r=0.82, p=0.000); (*r*=0.86, *p=0.*000); (r=0.64, p=0.010) & (*r=0.*89, *p=0.*000) respectively. In >1 month < 12 months shows significant strong positive between pancreatic tail dimension and age, height, weight & BSA: (r=0.78, p=0.000); (*r=0.*82, *p=0.*000); (r=0.84, p=0.000) & (*r=0.83*, *p=0.*000) respectively. In 12-24 months shows significant strong positive correlation between pancreatic tail dimension and age, height, weight & BSA: (*r=0.*63, *p=0.*000); (*r=0.*74, *p=0.*000); (r=65, p=0.002) & (*r=0.*70, *p=0.*000) respectively. In 24-60 months shows significant strong positive correlation between pancreatic tail dimension and age, height, weight & BSA: (*r=0.*73, *p=0.*000); (*r=0.*74, *p=0.*000); (*r=0.*74, *p=0.*000) & (*r=0.77*, *p=0.*000) respectively. In 5-13 years, it shows significant strong positives correlation between pancreatic tail dimension and age, height, weight & BSA: (*r=0.*83, *p=0.*000); (r=0.74, p=0.000); (*r=0.*73, *p=0.*000) & (*r=0.74*, *p=0.*000) respectively. In 13-18 years, it shows significant strong positive correlation between pancreatic tail dimension and age, height, weight, & BSA: (*r=0.*93, *p=0.*000); (r=0.86, p=0.000); (*r=0.*87, *p=0.*000) & (r=0.92, p=0.000) respectively.

Table 10: Correlation of pancreatic tail dimension and anthropometrics variables among male subjects.

Age groups	**Anthropometrics variables**									
	Age		**Height**		**Weight**		**BMI**		**BSA**	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
<4weeks	0.63	0.01	0.82	0.00	0.86	0.00	0.64	0.01	0.89	0.00
>1month<12 months	0.78	0.00	0.82	0.00	0.84	0.00	-0.26	0.26	0.83	0.00
12 – 24months	0.63	0.00	0.74	0.00	0.65	0.00	-0.52	0.02	0.70	0.00
24 – 60months	0.73	0.00	0.74	0.00	0.74	0.00	0.07	0.64	0.77	0.00
5 – 13years	0.83	0.00	0.74	0.00	0.73	0.00	0.15	0.30	0.74	0.00
13 – 18years	0.93	0.00	0.86	0.00	0.87	0.00	0.21	0.21	0.92	0.00

Table 11 shows significant moderate positive correlation in <4weeks female subjects between pancreatic head dimension and age: (r=0.44, p=0.103). In >1 month < 12 months shows significant strong positive between pancreatic head dimension and age, height, weight & BSA: (r=0.92, p=0.000); (r=0.87, p=0.000); (r=0.86, p=0.000) & (r=0.88, p=0.000) respectively. In 12-24 months shows significant strong positive correlation between pancreatic head dimension and age, height & BSA: (r=0.86, p=0.000); (r=0.62, p=0.000) & (r=0.53, p=0.017) respectively. In 24-60 months shows significant strong positive correlation between pancreatic head dimension and age, height, weight & BSA: (r=0.87, p=0.000); (r=0.92, p=0.000); (r=0.84, p=0.000) & (r=0.91, p=0.000) respectively. In 5-13 years it shows significant strong positive correlation between pancreatic head dimension and age, height, weight & BSA: (r=0.94, p=0.000); (r=0.89, p=0.000); (r=0.88 p=0.000) & (r=0.89, p=0.000) respectively. In 13-18 years, it shows significant strong positive correlation between pancreatic head dimension and age, height, weight, BMI & BSA: (r=0.95, p=0.000); (r=0.90, p=0.000); (r=0.92, p=0.000); (r=0.63, p=0.000) & (r=0.93, p=0.000) respectively.

Table 11: Correlation of pancreatic head dimension and anthropometrics variables among female subjects.

Age groups	Anthropometrics variables									
	Age		Height		Weight		BMI		BSA	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
<4weeks	0.44	0.10	0.01	0.63	0.14	0.61	0.09	0.75	0.16	0.58
>1month<12 months	0.92	0.00	0.87	0.00	0.86	0.00	-0.251	0.29	0.88	0.00
12 – 24months	0.86	0.00	0.62	0.00	0.45	0.05	-0.54	0.02	0.53	0.02
24 – 60months	0.87	0.00	0.92	0.00	0.84	0.00	-0.11	0.43	0.91	0.00
5 – 13years	0.94	0.00	0.89	0.00	0.88	0.00	0.10	0.52	0.89	0.00
13 – 18years	0.95	0.00	0.90	0.00	0.92	0.00	0.63	0.00	0.93	0.00

Table 12 shows significant strong positive correlation in >1month< 12 months female subjects between pancreatic body dimension and age, height, weight & BSA: (r=0.80, p=0.000); (r=0.82, p=0.000); (r=0.82, p=0.000) & (r=0.83, p=0.000) respectively. In 12-24 months, it shows significant strong positive correlation between pancreatic body dimension and age (r=0.52, p=0.019). In 24-60 months, it shows significant strong positive correlation between pancreatic body dimension and age, height, weight & BSA: (r=0.76, p=0.000); (r=0.71, p=0.000); (r=0.72, p=0.000) & (r=0.76, p=0.000) respectively. In 5-13 years it shows significant strong positive correlation between pancreatic body dimension and age, height, weight & BSA: (r=0.79, p=0.000); (r=0.67, p=0.000); (r=0.67, p=0.000) & (r=0.67, p=0.000) respectively. In 13-18 years, it shows significant strong positive correlation between pancreatic body dimension and age, height, weight, BMI & BSA: (r=0.87, p=0.000); (r=0.86, p=0.000); (r=0.89, p=0.000); (r=0.62, p=0.000) & (r=0.89, p=0.000) respectively.

Table 12: Correlation of pancreatic body dimension and anthropometrics variables among female subjects.

Age groups	Anthropometrics variables									
	Age		Height		Weight		BMI		BSA	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
<4weeks	0.17	0.51	0.08	0.79	0.07	0.79	0.04	0.89	0.09	0.77
>1month<12 months	0.80	0.00	0.82	0.00	0.82	0.00	-0.19	0.41	0.83	0.00
12 – 24months	0.52	0.02	0.22	0.24	0.20	0.40	-0.27	0.26	0.23	0.32
24 – 60months	0.76	0.00	0.71	0.00	0.72	0.00	0.03	0.83	0.76	0.00
5 – 13years	0.79	0.00	0.67	0.00	0.67	0.00	0.27	0.06	0.67	0.00
13 – 18years	0.87	0.00	0.86	0.00	0.89	0.00	0.62	0.00	0.89	0.00

Table 13 shows significant strong positive correlation in age ranging from >1month < 12 months female subjects between pancreatic tail dimension and age, height, weight & BSA: (r=0.84, p=0.000); (*r=0.*83, *p=0.*000); (*r=0.83*, *p=0.*000) & (p=0.84, r=0.000) respectively. In 12-24 months, it shows significant strong positive correlation between pancreatic tail dimension and age: (*r=0.*56, *p=0.*006). In 24-60 months shows significant strong positive correlation between pancreatic tail dimension and age, height, weight & BSA: (*r=0.*76, *p=0.*000); (*r=0.*71, *p=0.*000); (*r=*0.72, *p=0.*000) & (*r=0.76*, *p=0.*000) respectively. In 5-13 years, it shows significant strong positive correlation between pancreatic tail dimension and age, weight & BSA: (*r=0.*91, *p=0.*000); (r=0.88, p=0.000); (*r=*0.84, *p=0.*000) & (*r=0.85*, *p=0.*000) respectively. In 13-18 years, it shows significant strong positive correlation between pancreatic tail dimension and age, weight, BMI & BSA: (*r=0.*90, *p=0.*000); (r=0.81, p=0.000); (*r=*0.84, *p=0.*000); (*r=*0.60, *p=0.*000) & (r=0.85, p=0.000) respectively.

Table 13: Correlation of pancreatic tail dimension and anthropometrics variables among female subjects.

Age groups	Anthropometrics variables									
	Age		Height		Weight		BMI		BSA	
	r	*p*	r	*p*	r	*p*	r	*p*	r	*p*
<4weeks	0.28	0.31	0.02	0.49	0.20	0.50	0.11	0.69	0.21	0.46
>1month<12 months	0.84	0.00	0.83	0.00	0.83	0.00	-0.23	0.34	0.84	0.00
12 – 24months	0.59	0.01	0.26	0.28	0.33	0.32	-0.13	0.59	0.25	0.29
24 – 60months	0.76	0.00	0.71	0.00	0.72	0.00	0.03	0.83	0.76	0.00
5 – 13years	0.91	0.00	0.88	0.00	0.84	0.00	0.17	0.24	0.85	0.00
13 – 18years	0.90	0.00	0.81	0.00	0.84	0.00	0.60	0.00	0.85	0.00

Discussion

The findings of the current studies based on the anthropometric variables as shown in Table 1 and 2, were contrary to the findings of the previous studies by Raut *et al.,*[7] who reported the mean age of 6.65 years, height ranged 43 – 166cm, weight ranged 2.6 to 65 kg and BSA ranged 0.18 – 1.54 m^2. The difference may be due to the fact that Raut *et al.,*[7] uses a very large sample size of 1078 as compared to the current study.

The findings of the current study as shown in Table 3 and 4 were similar to the findings of the study conducted by Raut *et al.,*[7] who reported the mean head, body and tail dimension of 0.53 cm, 0.49 cm and 0.51 cm for subjects in <1 month age group; 0.74 cm, 0.70 cm and 0.71 cm for subjects in 1 month – 2 years age group; 0.93 cm, 0.8 cm and 0.91 cm for subject in 1 – 5 years age group; 1.07 cm, 0.98 cm and 1.05 cm for subjects in 5 – 10 years age group; 1.18 cm, 1.04 cm and 1.11 cm for subjects in 10 – 19 years respectively. This similarity may be because the same research design and methods were adopted, also, it may be due to the fact that both the current and the previous studies are conducted in developing countries in which the higher percentage of the population are from low socio-economic background. However, Siegel et al.,[14] reported the findings contrary to the findings of the current study with the mean head, body and tail dimension of 1.0 cm, 0.6 cm and 1.0 cm for subjects in < 1 month age group; 1.5 cm, 0.8 cm and 1.2 cm for subjects in 1month – 1 year age group; 1.7 cm, 1.0 cm and 1.8 cm for subjects in 1 – 5 years age group; 1.6 cm, 1.0 cm and 1.8cm for subjects in 5 – 10 years age group; 2.0 cm, 1.1 cm and 2.0 cm for subjects in 10 – 19 years age group respectively. Siegel et al.,[14] conducted their research in United State of America, as such dietary, racial, environmental and socio-economic differences are obvious facts for the differences Sidi *et al.,*[15] Also, study design and methods adopted in the current study was different from the

previous study. Furthermore, the findings of the current study was also not in conformity with the findings of the study conducted by Ueda,[16] who reported only on head and body dimension. It was also observed that the pancreatic dimensions were progressively increasing with an increase in age among pediatric subjects in kano metropolis, this was inconformity with report of previous studies by Raut *et al.,*[7] *Siegel et al.,[14]* Ueda,[16] (1989).

Furthermore, there was no statistical significant difference in pancreatic dimension between male and female subjects across all age groups in kano metropolis ($p>0.05$). However, statistical significant difference in pancreatic tail dimension was only observed in 12 - 24 months ($p=0.03$) age group between male and female subjects as shown in Table 7.

As shown in Table 8 to 13 the current study reported a significant strong positive correlation between age, height, weight, and BSA and pancreatic head, body and tail among both male and female subject across the entire age groups, except for female subjects in <4weeks age group which shows not significant weak positive correlation with age, height, weight, BMI and BSA. This was similar to the findings of the study by Siegel et al.,[14] who reported a significant positive correlation between age and pancreatic head ($r = 0.50$, $p < 0.0001$), body ($r = 0.35$, $p < 0.0001$) and tail ($r = 0.46$, $p < 0.0001$) among both male and female subjects. Furthermore, not significant weak positive correlation was observed among female subjects also in 24-60months and 5-13years age groups between BMI and pancreatic head, body and tail. Also, not significant weak positive correlation was observed among male subjects in 24-60months, 5-13years and 13-18yeasrs age groups between BMI and pancreatic head, body and tail. However, this study reported that, subjects in >1month <12months and 12-24monthsage groups shows weak not significant negative correlation between pancreatic head, body, tail and BMI only among both male and female subjects.

Conclusion

Sonographic reference values for pancreatic dimension was established among pediatric population of Kano metropolis. There was a statistical significant difference in pancreatic tail dimension between male and female subject in 12-24 months age group. Also, this study confirmed a significant strong positive correlation of pancreatic dimensions with age, height, weight, BMI and BSA.

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