



A MORPHOMETRIC STUDY ON HUMAN CADAVERIC PANCREAS IN ASSAMESE POPULATION

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ABSTRACT The seriousness of pancreatic diseases and the utmost importance of its correct diagnosis and treatment are expected to be helpful in correlating the functional capacity for further study in basic science and in decision making in clinical settings especially in transplant surgery of pancreas. Knowledge of normal morphometry of pancreas in living subjects is essential for understanding the segmental resection of pancreas as well as pancreatic imaging. A descriptive and cross-sectional study was conducted in the Department of Anatomy, Forensic Medicine & Pathology of Gauhati Medical College, Guwahati from May, 2016 to December 2019 on 103 specimens of human pancreas from 13 to 78 years age of both sexes. The collected samples were divided into seven age groups: A (10-19 years), B (20-29 years), C (30-39 years), D (40-49 years), E (50-59 years), F (60-69 years) and G (≥ 70 years), for convenient description. The differences between length of pancreas were statistically significant in A vs C, A vs D, A vs E, A vs F, A vs G, B vs C, B vs D, B vs E, B vs F and B vs G. The differences between weight of pancreas were statistically significant in A vs F, B vs C, B vs G, C vs D, C vs F, D vs F, E vs F, E vs G and F vs G. The present study is expected to standardize the morphology of pancreas in Assamese population.

KEYWORDS : Pancreas, Morphometry, Morphology, Specimen, Cadaver

INTRODUCTION

Pancreas is a mixed lobulated pinkish grey coloured gland lying transversely across the posterior abdominal wall extending from the concavity of duodenum to the hilum of spleen forming the stomach bed¹. Being a mixed gland, the pancreas consists of two distinct populations of cells, the exocrine cells constituting 98% of the gland secrete enzymes into the digestive tract, and the endocrine cells 2% of the glandular mass that secrete hormones into the bloodstream². The Endocrine pancreas is a diffuse organ scattered as small nest of cells called islets of Langerhans, which is usually numerous in tail region of the pancreas³. Islets secrete hormones that regulate blood glucose levels⁴. Pancreatic islets may contain a few cells or many hundreds of polygonal cells arranged in short irregular cords that are profusely invested with a network of fenestrated capillaries⁵.

The pancreatic islet function is closely associated with the morphologic changes in islet cells⁶. The most common disease of the endocrine pancreas is diabetes mellitus associated with changes in the size and number of islets^{7,8}. Moreover, male population predominantly suffers from diabetes mellitus⁹. Diabetes is a debilitating condition which can lead to chronic vascular, renal, and ophthalmic disease. Type I or Juvenile Diabetes is caused by the destruction of beta cells within the islets of Langerhans within the pancreas. The most promising research for diabetes mellitus is in producing stem cells where researchers are looking to make possible for diabetics to have a new pancreas⁸. Recently, islet cells were successfully generated in vitro from human pancreatic stem cells⁹. Scientists have made many advances in islet transplantation in recent years. However, most recipients returned to using insulin because the transplanted islets lost their ability to function over time. Besides, the researchers also noted that many transplant recipients were able to reduce their need for insulin, achieve better glucose stability, and reduce problems with hypoglycaemia¹⁰.

Cryopreservation has been shown to enlarge transplanted cell mass, but has been accompanied by reduced viability, where a negative correlation between islet size and viability observed in non-frozen islets¹¹. Post mortem examination of the pancreas in long-term diabetes shows an absence or greatly reduced number of insulin-staining beta

cells; the residual pseudoatrophic islets contain abundant alpha cells and show light fibrosis¹².

Literature on study of human pancreas in terms of length and weight are not available from this part of the country (North East India). The study was done considering the seriousness of pancreatic diseases and the utmost importance of its correct diagnosis and treatment. The results of the present study are expected to be helpful in correlating its functional capacity for further study in basic science and in decision making in clinical settings especially in transplant surgery.

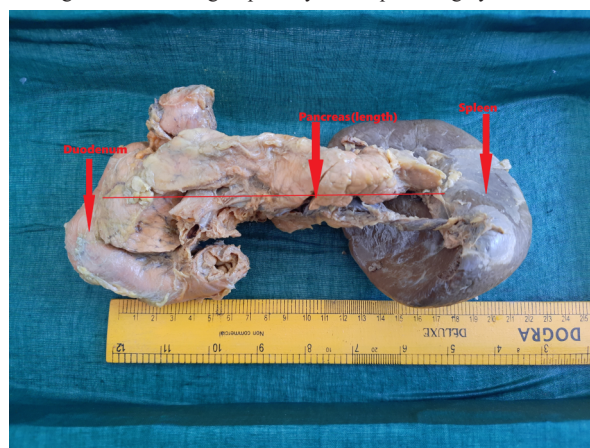


Figure 1: Pancreas, the whole length along with duodenum and spleen. The red line showing the length of pancreas.

MATERIALS AND METHODS

This descriptive and cross-sectional study was conducted in the Department of Anatomy, Forensic Medicine & Pathology of Gauhati Medical College, Guwahati from May, 2016 to December 2019. A total of 103 specimens of human pancreas were collected from 13 to 78 years age of both sexes, excluding any visible signs of pathological changes of the viscera, any doubtful injury in pancreas, death due to known poisoning, pancreatic diseases and specimens of medicolegal

cases. Simple random samplings were used for sampling method. This was done within 12 to 36 hours of death. During collection, approximate age, sex and cause of death were noted from record book. Then each specimen was marked with a code number for individual identification. The specimens were collected along with duodenum and spleen. After removal from the body, unwanted tissues were cleared and gently washed out in normal saline.

Measurement of length: The length of the pancreas was measured immediately after collection of the sample with the help of a meter scale. From the duodenal margin of the head to the tail in its different surfaces was considered as length and the average length was taken.

Measurement of weight: Weight was taken using digital weighing scale. It was first detached from the duodenum and the spleen and it was dried by blotting paper before measuring the weight.

The collected samples were divided into seven age groups: A (10-19 years), B (20-29 years), C (30-39 years), D (40-49 years), E (50-59 years), F (60-69 years) and G (≥ 70 years), for convenient description of their various age related changes (according to Varley et al.).¹³

Statistical analysis of data: Data were collected and appropriate statistical analyses were done by using IBM SPSS version 26. Paired sample t-test was conducted to check for significant difference among the different groups for length and weight. A p-value of less than 0.05 indicates significant between two groups.

Ethical clearance: Written informed consent had been taken in English as well as in local language (Assamese) from the attendants and permission from concerned authority of post mortem cases. The study was approved by the Institutional Ethics Committee of Gauhati Medical College, Guwahati.

RESULTS AND OBSERVATIONS

The results and observations of the present study is shown in tables and bar diagrams as follows

Table – 1 Analysis Report Of Length And Weight Of Pancreas In Group A (10 To 19 Years)

Sl. No	Age in years	Gender	Length(in cm)	Weight(in grams)
1.	19	Male	13.56	87.40
2.	19	Female	11.20	78.40
3.	18	Male	13.56	87.40
4.	16	Male	11.20	78.40
5.	13	Male	11.20	78.40
6.	16	Male	11.40	79.40
Mean	12.02		81.57	
SD	1.20		4.54	
Minimum	11.20		78.40	
Maximum	13.56		87.40	

Table – 2 Analysis Report Of Length And Weight Of Pancreas In Group B (20 To 29 Years)

Sl. No	Age in years	Gender	Length(in cm)	Weight(in grams)
1.	29	Male	14.45	13.64
2.	20	Female	11.50	80.12
3.	22	Female	12.00	80.00
4.	29	Male	14.45	13.64
5.	20	Male	11.50	80.12
6.	22	Male	12.00	80.00
7.	24	Male	11.30	88.40
8.	28	Male	11.80	78.80
9.	26	Male	10.20	72.50
10.	24	Male	14.20	83.50
11.	25	Male	10.20	80.50
12.	25	Male	10.00	82.50
Mean	11.97		69.48	
SD	1.61		26.33	
Minimum	10.00		13.64	
Maximum	14.45		88.40	

Table – 3 Analysis Report Of Length And Weight Of Pancreas In Group C (30 To 39 Years)

Sl. No	Age in years	Gender	Length(in cm)	Weight(in grams)
1.	37	Male	14.60	89.20
2.	32	Male	14.60	90.46
3.	39	Female	14.50	78.50
4.	36	Female	14.30	82.20

5.	39	Male	14.80	89.20
6.	35	Male	14.60	80.60
7.	37	Male	14.60	89.20
8.	32	Male	14.60	90.46
9.	39	Male	14.50	78.50
10.	36	Male	14.30	82.20
11.	39	Male	14.80	89.20
12.	35	Male	14.60	80.60
13.	35	Male	13.24	89.50
14.	35	Male	14.26	88.50
Mean	14.45		85.59	
SD	0.39		4.78	
Minimum	13.24		78.50	
Maximum	14.80		90.46	

Table – 4 Analysis Report Of Length And Weight Of Pancreas In Group D (40 To 49 Years)

Sl. No	Age in years	Gender	Length(in cm)	Weight(in grams)
1.	49	Male	15.00	80.42
2.	45	Female	15.20	82.50
3.	40	Female	15.40	83.20
4.	42	Female	15.20	82.50
5.	49	Male	15.00	80.42
6.	45	Female	15.20	82.50
7.	40	Male	15.40	83.20
8.	42	Male	15.20	82.50
9.	46	Male	14.20	82.50
10.	43	Male	15.28	82.56
11.	42	Male	15.24	82.60
12.	45	Male	12.20	85.50
13.	45	Male	13.30	81.50
14.	46	Male	12.20	84.50
15.	42	Male	13.20	82.00
Mean	14.48		82.56	
SD	1.17		1.31	
Minimum	12.20		80.42	
Maximum	15.40		85.50	

Table – 5 Analysis Report Of Length And Weight Of Pancreas In Group E (50 To 59 Years)

Sl. No	Age in years	Gender	Length(in cm)	Weight(in grams)
1.	59	Male	14.60	83.34
2.	52	Male	15.50	84.20
3.	57	Male	12.60	52.40
4.	54	Female	14.80	78.80
5.	58	Male	15.20	82.50
6.	59	Male	14.60	83.34
7.	52	Male	15.50	84.20
8.	57	Male	12.60	52.40
9.	54	Female	14.80	78.80
10.	58	Male	15.20	82.50
11.	56	Female	14.58	74.50
12.	53	Female	15.20	80.50
13.	55	Male	14.30	110.50
14.	55	Male	14.20	53.50
15.	56	Male	12.50	94.50
16.	50	Male	15.20	82.50
17.	54	Male	14.58	56.80
Mean	14.47		77.37	
SD	0.98		15.61	
Minimum	12.50		52.40	
Maximum	15.50		110.50	

Table – 6 Analysis Report Of Length And Weight Of Pancreas In Group F (60 To 69 Years)

Sl. No	Age in years	Gender	Length(in cm)	Weight(in grams)
1.	66	Female	12.00	50.56
2.	66	Male	13.76	52.50
3.	60	Male	14.50	54.50
4.	66	Female	12.00	50.56
5.	66	Male	13.76	52.50
6.	60	Male	14.50	54.50
7.	62	Female	15.50	50.50
8.	67	Female	13.52	56.50

9.	64	Female	15.50	55.50
10.	61	Male	14.56	94.60
11.	62	Male	14.58	54.58
12.	62	Male	12.50	94.50
13.	60	Male	14.60	54.90
14.	62	Male	13.50	56.50
15.	61	Male	14.60	103.80
16.	67	Male	14.50	64.30
17.	63	Male	14.50	54.50
18.	63	Male	15.50	69.50
19.	65	Male	14.00	59.50
Mean	14.10		62.33	
SD	1.05		16.47	
Minimum	12.00		50.50	
Maximum	15.50		103.80	

Table – 7 Analysis Report Of Length And Weight Of Pancreas In Group G (≥70 Years)

Sl. No	Age in years	Gender	Length(in cm)	Weight(in grams)
1.	70	Female	12.50	92.20
2.	70	Male	14.80	81.80
3.	70	Female	12.50	102.20
4.	70	Male	14.80	101.80
5.	71	Female	13.70	70.80
6.	77	Female	14.20	98.80
7.	71	Female	13.50	100.80
8.	76	Male	15.80	78.70
9.	72	Male	14.20	82.60
10.	78	Male	14.56	54.20
11.	73	Male	16.88	100.60
12.	72	Male	13.89	89.80
13.	74	Male	13.80	83.88
14.	73	Male	14.82	101.70
15.	73	Male	13.50	91.80
16.	71	Male	14.80	58.90
17.	78	Male	15.50	56.56
18.	71	Male	14.20	120.80
19.	72	Male	14.86	131.84
20.	73	Male	14.20	102.60
Mean	14.35		90.12	
SD	1.03		20.03	
Minimum	12.50		54.20	
Maximum	16.88		131.84	

Table – 8 Mean Length And Weight In Total Male And Female Pancreas

Mean	Mean length in cm ± SD	Mean weight in gm ± SD
Total	13.94 ± 1.39	78.27 ± 18.29
Male	13.97 ± 1.39	78.64 ± 19.14
Female	13.86 ± 1.43	77.00 ± 15.28
p-value	0.751	0.707

.SD= Standard Deviation

Table –9 Mean Length (in Cm) Among Different Groups Of Pancreas

Study Group	Mean	SD	Minimum	Maximum
A	12.02	1.20	11.20	13.56
B	11.97	1.61	10.00	14.45
C	14.45	0.39	13.24	14.80
D	14.48	1.17	12.20	15.40
E	14.47	0.98	12.50	15.50
F	14.10	1.05	12.00	15.50
G	14.35	1.03	12.50	16.88

Table –10 Mean Weight (In Grams) Among Different Groups Of Pancreas

Study Group	Mean	SD	Minimum	Maximum
A	81.57	4.54	78.40	87.40
B	69.48	26.33	13.64	88.40
C	85.59	4.78	78.50	90.46
D	82.56	1.31	80.42	85.50
E	77.37	15.61	52.40	110.50
F	62.33	16.47	50.50	103.80
G	90.12	20.03	54.20	131.84

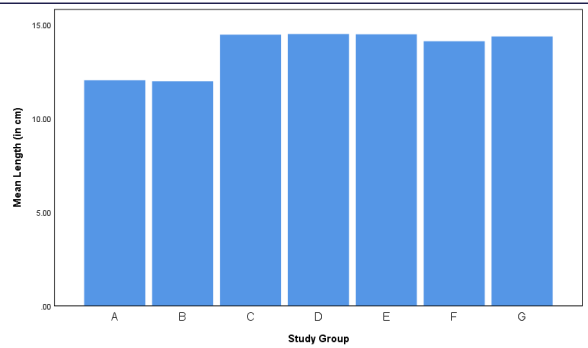


Figure2: Mean values of length(in cm) among different groups

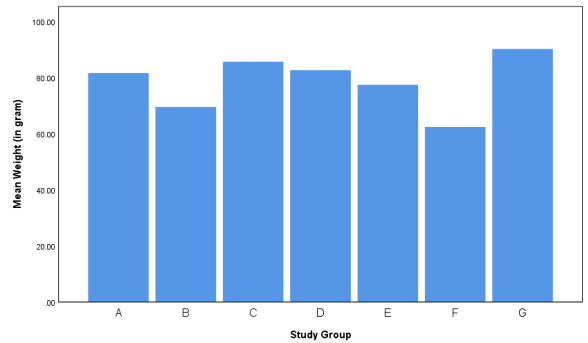


Figure3: Mean values of weight(in grams) among different groups

Table –11 Comparison Of P-values Of Length And Weight Among Different Groups

Comparison between groups	Length p-value	Weight p-value
A vs B	0.944	0.288
A vs C	< 0.001	0.097
A vs D	< 0.001	0.436
A vs E	< 0.001	0.529
A vs F	< 0.001	0.010
A vs G	< 0.001	0.316
B vs C	< 0.001	0.034
B vs D	< 0.001	0.065
B vs E	< 0.001	0.320
B vs F	< 0.001	0.359
B vs G	< 0.001	0.018
C vs D	0.924	0.025
C vs E	0.948	0.068
C vs F	0.243	< 0.001
C vs G	0.734	0.415
D vs E	0.973	0.210
D vs F	0.322	< 0.001
D vs G	0.728	0.155
E vs F	0.285	0.008
E vs G	0.726	0.040
F vs G	0.455	< 0.001

The differences between length of pancreas were statistically significant in A vs C, A vs D, A vs E, A vs F, A vs G, B vs C, B vs D, B vs E, B vs F and B vs G (table 11). In the present study, the mean values of lengths were increased with the age and it was more or less same values after group C (figure2). The minimum and maximum mean values were 11.97±1.61 cm in group B and 14.48± 1.17 in group D respectively, where the maximum value was 16.88cm in group G and minimum value was 10.00 cm in group B(table9).

The differences between weight of pancreas were statistically significant in A vs F, B vs C, B vs G, C vs D, C vs F, D vs F, E vs F, E vs G and F vs G (table 11). In the present study, the mean value of weight was first decreased in group B and again increased in group C. Then, decreased with the age. In the last group G it again increased(figure3). The minimum and maximum mean values were 62.33±16.47gm in group F and 90.12±20.03 gm in group G respectively, where the maximum value was 131.84 gm in group G and minimum value was 13.64 gm in group B(table10).

DISCUSSIONS

In the present study, the total mean length was 13.94 ± 1.39 cm and the mean length of the male and female pancreas were 13.97 ± 1.39 cm and 13.86 ± 1.43 cm respectively. The length of pancreas was in the range of 10-16.88 cm. Mulholland and Simeone¹⁴ have quoted a range of 12-20 cm. However, Kozu et al¹⁵ have quoted the range of the length of the pancreas as 10 - 23 cm long. Sulochana S.¹⁶ found the length of the pancreas was in the range of 9.2 to 24cm and the mean value was 16.38 ± 2.38 cm. The values of the present study was more or less equal to values reported by Williams et al¹⁷, Kimber et al¹⁸, Basmajian¹⁹, Minn²⁰, Edward²¹, Garven²², Last²³, Basmajian²⁴ and Bannister²⁵. In the study of Ahmed F.²⁶ it was 18.2 ± 0.63 cm and 17.2 ± 0.25 cm respectively for male and female among Bangladeshi people and Anacker H²⁷ found that the length of the pancreas varies from 16.5- 27 cm. In the study of KS Basnet et al²⁸ the mean values were little bit lesser than our study in male. They found that the mean lengths in male and female subjects were 13.87 ± 0.8 cm and 13.99 ± 1.5 cm respectively. But, they found the total mean value for length was 14.4 ± 1.2 cm which is more than our value. Gore²⁹ has reported the length of the pancreas as 15-25 cm which was higher than the result of the present study.

In the present study, the mean weight of the male pancreas was 78.64 ± 19.14 gm and the female pancreas was 77.00 ± 15.28 gm which ranges from 13.64 to 131.84 gm. These values were lesser than the study of Ahmed F.²⁶ where they found 94.1 ± 4.67 gm and 91.8 ± 2.33 gm respectively. Ahmed H.H. et al³⁰ found that the maximum mean weight was 122.41 ± 0.27 (gm) and minimum was 75.52 ± 0.28 (gm), the mean weight of pancreas was 87.3 ± 30.6 (gm) for ages ranged from 25-88 years old. They mentioned that their study was a similar study with Caglar V and Kumral B³⁰ among Turkish people. KS Basnet et al²⁸ studied among Nepalese people in the age with a range of 29 to 74 years which was little bit lesser value than our study. They found that the total mean weight of pancreas were 75.94 ± 15.07 gm and the mean weights in male and female subjects were 77.2 ± 15.56 gm and 72.57 ± 15.32 gm respectively. The present study values were lower than that of the values reported by Basmajian¹⁹. Our values were more or less equal to that values reported by Kimber¹⁸, Mann³² and Williams et al¹⁷.

Former researcher had also found the lesser weight of pancreas in females than male³³. The probable reason for the smaller pancreas in female subjects may be their smaller body stature³¹. In the present study also the values of female were lesser than male.

Due to decline in the glandular tissue as well as the fatty connective tissue within the substance of the gland in elderly people and thinning atrophy of the gland is noticeable on CT scanning.³⁴ In the former study also it was mentioned and found the similar result.^{31,33} Researchers had found that lifestyle, occupational and reproductive factors were also associated with causation of diabetes and pancreatic cancer.³⁵ The clinical entities like these have direct association with the reduced pancreatic size.^{36,37} In the former study they mentioned that the reduced length and weight of pancreas in elderly people was suggestive of degenerative change of pancreas with age and some cases might also be subjected to chronic disease.²⁸ But in our study the values were increased in the extreme age.

Due to the chemical action of formaldehyde the result obtained from similar study done on unembalmed body could change in the values of pancreas. But, Schaefer JH³³ observed and commented that there was no change in weight of pancreas after embalming.

CONCLUSIONS

Knowledge of normal morphometry of pancreas in living subjects is essential for understanding the segmental resection of pancreas as well as pancreatic imaging. Pancreatic imaging has improved with the introduction of USG, CT, endoscopic retrograde cholangiopancreatography and selective angiography in recent days. Racial variation and geographical distribution may attribute dissimilarities among different age group. The present study is expected to standardize the morphology of pancreas in Assamese population.

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