

Standard Data of the Morphometric Parameters of the Pancreas in the Iranian Population

Shabnam Mohammadi¹, Arya Hedjazi^{2*}, Maryam Sajjadian³, Masoumeh Fazli³, Naser Ghoroubi³, Maliheh Dadgar Moghadam⁴, and Maryam Mohammadi⁵

¹ Neurogenic Inflammation Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

² Legal Medicine Research Center, Legal Medicine Organization, Tehran, Iran

³ Mashhad Legal Medicine Research Center, Legal Medicine Organization, Mashhad, Iran

⁴ Department of Community Medicine, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

⁵ Department of Public Health, School of Health, Shahid Beheshti University of Medical Sciences, Tehran, Iran

* **Corresponding author:** Arya Hedjazi, Legal Medicine Research Center, Legal Medicine Organization, Tehran, Iran. Email: Arya_hedjazi@yahoo.com

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Abstract

Background: The pancreas is a mixed gland associated with the digestive system. To the best of our knowledge, there is no study on normal pancreatic standards in the Iranian population.

Objectives: Hence, the aim of this study was to examine the morphometry of the pancreas in terms of length, width, weight, and variations of cadavers in Khorasan Razavi province.

Methods: A total of 312 cadavers (67 female/ 245 male) were included in the study between May 2014 and August 2015, in the Legal Medicine Organization, Mashhad, Iran. Demographic values were obtained from ever fresh Iranian cadaver. Length, width and weight of pancreas were measured using standard tools. Pancreas were observed carefully, whether any variations were present. Collected data were analyzed using SPSS software.

Results: Three hundred twelve cadavers with a mean age of 42.48 ± 21.39 were enrolled to the study. The mean values of the pancreas length, width, weight, and index of the pancreas were 15.22 ± 5.09 cm, 8.21 ± 4.38 cm, 3.41 ± 0.69 , 72.68 ± 23.77 grams, and 1.24 ± 0.57 , respectively. The variation of pancreaticoedodenal duct was in 2.6% of cases (n=8). There was no significant difference between the morphometric values of the pancreas between males and females ($P>0.05$). The width and index of pancreas was correlated statistically with BMI, body height and weight ($P<0.05$). A correlation with body height and weight was found for the pancreas length and weight ($P<0.05$).

Conclusion: Understanding the anatomy of the normal pancreas is useful for both anthropologists and anatomists. Besides, it provides good information for pancreatic segmental resection for surgeons.

Keywords: Human, Length, Pancreas, Variation, Weight, Width

1. Background

The pancreas lies horizontally from the duodenum to the spleen and consists of four parts: The head, neck, trunk and tail (1). The main pancreatic duct is in the body, neck and head of the pancreas. The accessory pancreatic duct is in the lower part of the pancreas head and both ducts are discharged into the duodenum (1). The pancreas serves as two glands in one: A digestive exocrine gland and a hormone-producing endocrine gland. The exocrine glands secrete digestive enzymes, while the endocrine part forming the islets of Langerhans and is involved in the regulation of blood glucose (2). During the embryonic period, the pancreas is created from two endodermic buds. The Ventral bud makes the lower portion of the pancreas head and hook-like process, while the dorsal bud makes the rest of the pancreas. The main pancreatic duct is formed from the distal part of the main pancreatic duct and accessory pancreatic duct. The proximal portion of the main pancreatic duct disappears or remains as a small duct (3).

The length of the pancreas is about 12 to 15 cm (4-6). In America, the length of the pancreas has been

reported to be between 10 to 23 cm (7), 7.1 cm in Europe (8), and between 14.4 to 19.3 cm in Asia (9-11). Besides, the pancreatic weight was found to be 91.8 g in America (12) and between 75.94 to 103.25 g in Asia (9, 11, 13-15). To the best of our knowledge, there is no study on normal pancreatic standards in the Iranian population.

2. Objectives

Therefore, the aim of this study was to examine the morphometry of the pancreas in terms of length, width, weight, and variations of cadavers in Khorasan Razavi province.

3. Methods

This was a cross-sectional study on 312 cadavers (104 female, 446 male) was conducted in the dissection saloon of the Legal Medicine Organization, Mashhad, from May 2014 to August 2015. This research was approved by the Ethics Research Committee of Mashhad Legal Medicine Organization (ethical code: 93033).

Inclusion criteria were as follows: Iranian

cadavers with no history of poisoning, alcohol consumption, smoking, drug abuse, or diabetes; no sign of decomposition; and no evidence of trauma or abnormality of the pancreas. Height, weight, age and gender of fresh Iranian cadavers were recorded. Pancreas weight is divided by body weight for obtaining the index of pancreas. Also, weight (kg)/height (m²) was considered as body mass index (BMI).

Three hundred twelve cadavers were categorized based on age: Group A (0- 9 years), Group B (10- 19 years), Group C (20- 29 years), Group D (30- 39 years), Group E (40- 49 years), Group F (50- 59 years), Group G (60- 69 years), Group H (70- 79 years), Group I (80-89 years), and Group J (90- 99 years).

During routine dissection in the dissection saloon, the pancreas was removed from abdominal cavity. The length of pancreas was measured from the duodenal margin of pancreatic head to the tail of pancreas using a standard Vernier caliper. Width of the pancreas was measured at four different parts: Head, neck, body and tail. The mean of the three measurements was taken as the overall width of pancreas. The digital scale displayed weight of pancreases in grams. The pancreas ducts were observed carefully, whether any variations were present. Dimensions of pancreas were measured by an expert anatomist.

Statistical analysis was performed using SPSS software (SPSS Inc., Chicago, IL, USA). Values were presented as mean ± SD. P values were considered

less than 0.05. After assuming normality of data using the Kolmogorov-Smirnov test, the correlations were assessed using the Pearson correlation coefficients. The comparison between groups was performed with t-test and ANOVA test.

4. Results

Demographic parameters of cadavers are shown in Table 1. Three hundred twelve Iranian cadavers (67 females/ 245 males) with a mean age of 42.48 ± 21.39 years were enrolled to the study. The values obtained for height ranged between 48 and 182 cm, with an average of 159.17±24.66 cm. The weight of the cadavers ranged from 2.5 to 120 kg, with an average of 61.59±15.41 kg. The mean body mass index was 22.31 ± 20.31 kg/m².

The mean values of the pancreas length, width, weight and index in the cadavers were 15.22±5.09 cm, 3.41±0.69 cm, 72.68±23.77grams and 1.24±0.57, respectively (Table 2). The longest pancreases were observed in Groups C, while the shortest was in Group A. The smallest width of the pancreas was observed in cadavers 0-9 years old, while the greatest width of the pancreas was found in cadavers 60-69 years old. The weight of the pancreas was heaviest in the ninth decade, while it was lightest in the first of life. The index of the pancreas was the largest in Group A, and least in Group G. The variation of pancreaticoduodenal duct was in 2.6% of cases (n=8). This variation was found in 6 males and 2 females (Figure 1).

Table 1. Demographic value of Iranian cadavers (N=312) in Razavi Khorasan province, Iran

Age groups	Gender (female/male)	Height (m)	Weight (kg)
<10	7/9	119.38±33.60	22.38±23.40
10-19	4/25	161.33±13.12	59.73±18.17
20-29	13/34	164.44±6.21	64.50±6.81
30-39	8/44	160.04±25.44	66.79±9.70
40-49	11/51	164.00±8.80	64.40±6.72
50-59	7/24	165.97±5.27	64.82±5.55
60-69	6/30	165.41±4.85	67.15±6.60
70-79	7/16	165.74±6.98	63.87±6.23
80-89	3/7	164.46±4.03	60.23±6.88
90-99	1/5	162.00±1.41	54.00±2.82

Values are presented as mean± SD or number.

Table 2. Length, width, and weight of the pancreas of Iranian cadavers in different age groups

Age groups	Length (cm)	Width of pancreas (cm)				Weight (g)	Index (%)
		Head	Neck	Body	Tail		
<10	7.94±4.43	2.56±1.40	2.06±0.77	2.31±0.92	1.88±0.64	33±25.59	1.98±1.78
10-19	14.85±4.40	4.40±0.70	3.55±0.99	3.39±0.62	2.50±0.56	74.43±21	1.39±0.76
20-29	17.3±3.96	4.57±0.78	3.95±0.81	3.28±0.63	2.41±0.61	79.88±24.20	1.22±0.27
30-39	16.32±4.89	4.58±0.77	3.64±0.71	3.43±0.65	2.46±0.56	75.26±19.18	1.19±0.37
40-49	15.39±4.28	4.45±0.66	3.74±0.85	3.44±0.65	2.42±0.60	74.23±19.57	1.15±0.36
50-59	15.58±4.34	4.44±0.68	3.76±1.04	3.43±0.71	2.41±0.57	74.61±18.08	1.13±0.30
60-69	16.11±21.89	4.72±0.85	3.84±0.90	3.57±0.80	2.68±0.76	73.59±17.75	1.12±0.31
70-79	14.30±3.69	4.15±0.88	3.62±0.76	3.41±0.77	2.69±0.79	78.13±16.79	1.26±0.31
80-89	16.27±5.08	4.54±0.74	3.63±0.79	3.14±0.53	2.28±0.45	76.13±16.79	1.22±0.27
90-99	14±0.70	4.99±0.74	4±0.70	3.4±0.41	2.3±0.57	85±11.31	1.39±0.38

Values are expressed as mean± SD. Comparison between groups was made using ANOVA and Tukey test.



Figure 1. (A-D) are images of the pancreas in adults. A yellow arrow is drawn around the atresia of accessory pancreaticoduodenal duct.

Table 3. Length, width, weight, and index of the pancreas of Iranian cadavers of different genders

Morphometric characterizes	Gender		P value
	Female	Male	
Length (cm)	14.27±5.69	15.49±4.89	0.084
Width (cm)	3.27±0.89	3.45 ± 0.63	0.14
Weight (g)	69.98±25.15	73.42±23.38	0.294
Index	1.33±0.43	1.22±0.60	0.161
BMI	22.26±5.30	25.62±22.72	0.231

Values are presented as mean± SD. Independent samples T-Test was used to compare values

Table 4. Correlation (r) between morphological parameters of pancreas and demographic values

morphological parameters	Age	Height	Body weight	BMI
Length (cm)	0.027	0.396**	0.393**	0.072
Width (cm)	-0.052	0.517**	0.580**	0.137*
Weight (g)	-0.056	0.414**	0.443**	0.078
Index	-0.010	-0.254**	-0.462**	-0.122*

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

As shown in Table 3, there was no significant difference between the morphometric values of the pancreas between males and females ($P>0.05$). The width and index of pancreas was correlated statistically with BMI, body height and weight (Table 4). A correlation with body height and weight was found for the pancreas length and weight ($P<0.05$).

Correlations were assessed using Pearson correlation coefficients.

5. Discussion

In the present study, the mean values of the pancreas length and width in the cadavers were

15.22±5.09 cm and 3.41±0.69 cm, respectively. In Gray's anatomy and Bloom and Fawcett's histology, pancreas length is listed as between 12 to 15 cm (4-6). In addition, in Last's anatomy, the pancreas length was expressed as 15 cm (5). In an endoscopic study conducted in America, pancreas length was found to be between 10 to 23 cm while the width of the pancreas head was between 8 to 3.5 cm and the width of the pancreatic body was 3.3 cm (7). In another study in Belgrade, using CT scans, 220 patients (98 females and 118 males) between the age range of 21 to 81 years were examined. The pancreatic length was 7.1 cm and pancreatic thickness was 2.2 cm (8). In another study on Nepal's population, the mean length of the pancreas was 14.4

cm; while in women it was 13.99 cm and 13.87 cm in men (9). In another study conducted by Soluchana et al. (2012) in India, pancreas length and width of 100 cadaver (88 males and 12 females) were studied and the age range was between 61 to 23 years. Pancreatic dimensions were measured with tape and calipers. The mean length of pancreas was 16.38 cm with range of 9.2 to 24 cm. The width of the head, neck, body and tail of the pancreas was 5, 3, 3.7 and 2.7 cm, respectively (10).

Ara et al. in the Bangladesh population showed that the length of pancreas increased with increasing age (16). On the other hand, Schaefer in Minnesota of America and Basnet in Asia reported that the length of pancreas decreases with increasing age (9,17). However, a significant relationship between age and the pancreas length was not found. This may be due to genetic and nutritional factors which affect the length and weight of the pancreas (18).

In Thailand, the results of autopsies of 499 patients (269 men and 230 women) with an age range of 15- 60 years showed that the weight of the pancreas was 97 g in men and 88 g in women (13).

The mean weight of pancreas was 94.1 grams in Bangladeshi men and 91.8 grams in Bangladeshi women. This value was 77.2 g in men in Nepal population and 72.57 g in women in Nepal population (9). Only there is one study in the literature about pancreatic weight of Iran's population in 1222 autopsy (914 men and 308 women) from 15 to 88 years in Tehran. The mean weight of pancreas was 88 grams for men and 80.4 grams in women.

In Bangladesh and Nepal, the average length of the pancreas was significantly more in men than women (9,11). In our study, the length and width of the pancreas in men was more than that of women, although, this difference was not statistically significant.

The weight of pancreas was estimated to be 100 to 150 g (6). Besides, in America, the pancreatic weight was found to be 91.8 g (12) while in Turkey it was 87.3 g (14). The mean value of the pancreas weight in the cadavers was 72.68 ± 23.77 g. Correlation with body height and weight was found for the pancreas weight.

In Thailand, the results of autopsies of 499 patients (269 men and 230 women) with an age range of 15 to 60 years showed that the weight of the pancreas was 97 g in men and 88 g in women. In Bangladeshi men and women, the mean pancreas weight was 94.1 g and 91.8 g, respectively. This value was 77.2 g in men and 72.57 g in women of Nepal population (9,11,13).

There is only one study in the literature as regards the pancreatic weight of the Iranian population, based on 1,222 autopsies (914 men and 308 women) from 15 to 88 years in Tehran. The mean weight of pancreas was 88 g for men and 80.4 g for women (15).

In our study, the mean value of the pancreas weight was 72.68 ± 23.77 g which is lower than the studies earlier mentioned. This may be due to genetic and nutritional factors that affect both the length and weight of the pancreas (18). In our study, there was no significant difference between the pancreatic weight of men and women. Similarly, in Banset's study, a significant difference was found between the genders in terms of pancreas weight (19). Some studies showed no significant relationship between pancreas weight and some demographic characteristics such as height, weight and BMI (13,14,20). On the other hand, other studies found no significant relationship between demographic values, especially age with pancreatic weight (14,15,21). In our study, a correlation with body height and weight was found for the pancreas weight.

Variation of pancreas duct reported in approximately 4–14% of autopsies, 9% at Magnetic resonance cholangiopancreatography and 3–8% at Endoscopic Retrograde CholangioPancreatography (12). In this study, the variation of pancreaticoduodenal duct was in 2.6% of cases (n=8). The variations of pancreatic ducts are due to formation of main and accessory pancreatic duct in the embryonic period (3).

To the best of our knowledge, studies have been performed on the standards of the normal pancreas in an Iranian population and it is one of the strengths of this study. A limitation of this study is the small sample size of women as compared to men. In addition, a proper and more appropriate investigation on the vascular pattern and pancreas duct length is recommended for future purposes. Understanding the anatomy of the normal pancreas is useful for both anthropologists and anatomists. Besides, it provides good information for pancreatic segmental resection for surgeons. However, for better results, studies with a large sample sizes are required in various region of our country.

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Conflicts of interest

None.

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