

# The Impact of Physical Parameters on Organ Weight: An Autopsy Analysis

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**Abstract**— Organ weight serves as a critical indicator in forensic medicine for distinguishing between normal and abnormal conditions. This study analyzed the weights of six major organs—brain, lungs, heart, spleen, liver, and kidneys—in 200 cases, comprising 80 females and 120 males. The findings show that organ weights are consistently higher in males than in females across all age groups. For instance, the mean weight of the liver in females is  $1240.27 \pm 101$  grams, while in males, it is  $1352.16 \pm 99$  grams. Similarly, the brain weighs  $1114.82 \pm 98$  grams in females and  $1224 \pm 96$  grams in males. The right lung in females weighs  $487.52 \pm 53.53$  grams and in males,  $524.6 \pm 45.65$  grams, while the left lung weighs  $448.70 \pm 50.36$  grams in females and  $473.8 \pm 39$  grams in males. Spleen weight in females is  $107.52 \pm 13.5$  grams and in males,  $114.68 \pm 14.16$  grams. The heart weighs  $258.29 \pm 27.18$  grams in females and  $267.84 \pm 25.49$  grams in males. Kidney weights also differ, with the left kidney weighing  $108.74 \pm 16.17$  grams and the right kidney  $107.96 \pm 15.78$  grams in females, while in males, the left kidney weighs  $113.72 \pm 15.20$  grams and the right kidney  $112.9 \pm 14.96$  grams. These findings provide baseline organ weight data for the population in this region.

**Keywords**— Organ weight, Postmortem, Autopsy, Forensic medicine.

## I. INTRODUCTION

Organ weight plays a crucial role in both medico-legal and pathological autopsies. Establishing region-specific normal organ weights is essential for distinguishing them from abnormalities caused by trauma, pathology, or disease, which aids in determining the cause of death. Additionally, organ weight can offer valuable insights into an individual's body weight and height estimation. Various factors, including genetics, age, sex, and race, influence organ weight, alongside external factors like socioeconomic status, dietary habits, and environmental conditions.

In a culturally diverse country like India, these external factors can vary significantly between regions. The current study, conducted in the Ajmer region of Rajasthan, aims to establish normal weight ranges for major internal organs and explore any correlations between body weight and organ weight.

This research is the first of its kind for the population in this region and provides essential data for forensic specialists, pathologists, and physicians.

## II. MATERIALS AND METHODS

This study was carried out in the Department of Forensic Medicine at J.L.N. Medical College and Hospital, Ajmer, Rajasthan. It involved a sample size of 200 cases, selected randomly from routine autopsies conducted between January 2018 and August 2019. The inclusion criteria required cases where the cause of death was unrelated to any condition affecting organ weight, and the postmortem interval was less than 24 hours. Cases with decomposition, congenital organ anomalies, trauma to the organs, or long-term medical conditions that could influence organ weight were excluded.

After conducting the autopsies, organs including the brain, lungs, heart, liver, spleen, and kidneys were removed, cleaned, and weighed using a standard electronic weighing machine, accurate to within 1 gram. Each organ was weighed after removing

any surrounding fat or connective tissue. The organ weights were recorded and analyzed in relation to the subject's sex, body weight, and age.

### III. OBSERVATIONS AND RESULTS

The study included 200 cases, of which 120 were male and 80 were female. The mean age of males was 37.5 years, while the mean age of females was 35.2 years. Organ weights were found to be consistently higher in males than in females across all six organs studied.

The brain in females weighed an average of  $1114.82 \pm 98$  grams, while in males, the mean weight was  $1224 \pm 96$  grams. The lungs showed similar differences, with the right lung in females weighing  $487.52 \pm 53.53$  grams and in males  $524.6 \pm 45.65$  grams. The left lung weighed  $448.70 \pm 50.36$  grams in females and  $473.8 \pm 39$  grams in males.

The liver, the heaviest organ in both sexes, weighed  $1240.27 \pm 101$  grams in females and  $1352.16 \pm 99$  grams in males. The heart weighed  $258.29 \pm 27.18$  grams in females and  $267.84 \pm 25.49$  grams in males. The spleen showed less variation, weighing  $107.52 \pm 13.5$  grams in females and  $114.68 \pm 14.16$  grams in males.

For the kidneys, the left kidney weighed  $108.74 \pm 16.17$  grams and the right kidney  $107.96 \pm 15.78$  grams in females, while in males, the left kidney weighed  $113.72 \pm 15.20$  grams and the right kidney  $112.9 \pm 14.96$  grams.

These results indicate that organ weights in this population are within the range of previously reported values in the literature, with slight variations based on sex and individual body weight.

**TABLE 1**  
**MEAN STANDARD DEVIATION AND RANGE OF ORGANS WEIGHTS AS REGARD TO THE AGE GROUP 20-29 YEARS AND GENDER**

Female (n=20)					Male (n=30)				
	Mean	S.D.	Min	Max		Mean	S.D.	Min	Max
Age	25	2.922734	21	29	Age	24.5	2.555708	21	29
Bodyweight	65.6	8.988128	52	80	Bodyweight	71.7	9.829431	56	88
Liver	1226	114.1097	1000	1380	Liver	1336	94.63588	1200	1500
Brain	1073	76.80704	980	1240	Brain	1200	120.1687	1000	1410
Heart	292.8	34.85408	220	360	Heart	296.8	21.39821	268	350
Right lung	502	55.38157	400	580	Right lung	510	56.20937	450	650
Left lung	454	39.62536	380	510	Left lung	462	47.15716	400	560
Spleen	98.6	5.986425	88	110	Spleen	106.8	7.64795	98	120
Left. kidney	99.4	5.918085	88	108	Left. kidney	105.6	5.075631	98	112
Right kidney	97.4	5.848946	84	104	Right kidney	102.5	6.256136	90	110

**TABLE 2**  
**MEAN STANDARD DEVIATION AND RANGE OF ORGANS WEIGHTS AS REGARD TO THE AGE GROUP 30-39 YEARS AND GENDER**

Female (n=15)					Male (n=30)				
	Mean	S.D.	Min	Max		Mean	S.D.	Min	Max
Age	34.2	2.582864	31	39	Age	35.7	2.848051	31	39
Bodyweight	62.2	7.80873	52	78	Bodyweight	68.7	9.201541	55	87
Liver	1230	65.86272	1100	1322	Liver	1384.8	62.02784	1322	1500
Brain	1113	74.52221	1000	1210	Brain	1267.2	116.4024	1100	1434
Heart	251	16.53963	220	280	Heart	285	22.61399	240	320
Right lung	478	43.44488	410	560	Right lung	521.8	49.73611	450	610
Left lung	441	41.44427	380	520	Left lung	458.2	31.1462	420	520
Spleen	109.4	12.72552	90	130	Spleen	119.8	18.49967	100	170
Left .kidney	110.6	15.67596	90	134	Left .kidney	114.2	11.14962	100	140
Right kidney	109.8	15.13196	90	132	Right kidney	112	11.94078	100	140

**TABLE 3**  
**MEAN STANDARD DEVIATION AND RANGE OF ORGANS WEIGHTS AS REGARD TO THE AGE GROUP 40-49**  
**YEARS AND GENDER**

Female (n=20)					Male (n=30)				
	Mean	S.D.	Min	Max		Mean	S.D.	Min	Max
Age	44.9	2.447413	41	49	Age	45.1	2.932144	41	49
Body weight	61.7	7.627559	52	76	Body weight	62	5.150888	54	69
Liver	1226.2	72.01384	1100	1322	Liver	1357	97.52481	1200	1488
Brain	1103	82.0562	1000	1210	Brain	1222	106.4064	1100	1360
Heart	251	16.53963	220	280	Heart	254.8	12.30663	240	270
Right lung	476	42.11365	410	550	Right lung	534	35.20644	480	580
Left lung	447	52.60341	380	560	Left lung	489	34.69943	420	530
Spleen	109.4	12.72552	90	130	Spleen	116.2	13.02617	100	134
Left kidney	111.6	15.2751	90	134	Left. kidney	117	17.38907	90	142
Right kidney	111	14.77286	90	132	Right kidney	117.8	16.26241	98	142

**TABLE 4**  
**MEAN STANDARD DEVIATION AND RANGE OF ORGANS WEIGHTS AS REGARD TO THE AGE GROUP 50-59**  
**YEARS AND GENDER**

Female(n=15)					Male(n=20)				
	Mean	S.D.	Min	Max		Mean	S.D.	Min	Max
Age	54.81818	2.711282	51	59	Age	54.8	3.045644	50	59
Body weight	59.72727	6.587974	52	74	Body weight	60.6	5.193959	52	67
Liver	1194.727	78.49793	1100	1322	Liver	1354	110.7013	1180	1488
Brain	1076.727	85.51285	980	1210	Brain	1223.4	107.8134	1100	1360
Heart	247.4545	18.21089	210	280	Heart	252.3	10.38061	240	270
Right lung	461.0909	56.81623	380	570	Right lung	534	35.26392	480	586
Left lung	429.8182	62.75199	340	560	Left lung	486.2	31.91698	420	520
Spleen	105.6364	15.10134	88	130	Spleen	115.8	12.83823	100	134
Left kidney	106.9091	17.88917	80	134	Left kidney	116.4	17.0966	90	142
Right kidney	106.1818	17.30354	80	132	Right kidney	116.6	15.59097	98	142

**TABLE 5**  
**MEAN STANDARD DEVIATION AND RANGE OF ORGANS WEIGHTS AS REGARD TO THE AGE GROUP 60-69**  
**YEARS AND GENDER**

Female(n=10)					Male(n=10)				
	Mean	S.D.	Min	Max		Mean	S.D.	Min	Max
Age	64.4	2.929684	60	69	Age	64.4	2.923497	60	69
Bodyweight	59.9	5.051263	54	68	Body weight	59.9	5.040595	54	68
Liver	1329	114.4523	1180	1482	Liver	1329	114.2106	1180	1482
Brain	1212.2	101.2724	1100	1360	Brain	1212.2	101.0585	1100	1360
Heart	250.3	13.36362	224	270	Heart	250.3	13.3354	224	270
Right lung	523.2	44.87451	442	586	Right lung	523.2	44.77974	442	586
Left lung	473.6	39.96066	412	520	Left lung	473.6	39.87626	412	520
Spleen	114.8	13.65532	100	134	Spleen	114.8	13.62648	100	134
Left. kidney	115.4	18.33141	90	142	Left kidney	115.4	18.2927	90	142
Right kidney	115.6	16.94177	90	142	Right kidney	115.6	16.90599	90	142

**TABLE 6**  
**SHOWING THE CORRELATION BETWEEN BODY WEIGHT AND ORGAN WEIGHT**

	Female (n=80)						Male (n=120)					
	Mean	S.D.	Min	Max	Correlation	p value	Mean	S.D.	Min	Max	Correlation	p Value
Weight	61.7843 14	7.574713	52	80			64.58	8.601661	52	88		
Liver	1240.27 45	101.5169	100 0	148 2	0.608435	P<0.01	1352.1 6	99.02572	118 0	150 0	0.554704	p<0.01
Brain	1114.82 35	98.04074 9	980	136 0	0.486752	p<0.01	1224.9 6	112.3597 8	100 0	143 4	0.525279	P<0.01
Heart	258.294 12	27.18844 6	210	360	0.310085	P<0.01	267.84	25.49194	224	350	0.583806	P<0.01
Rt.lung	487.529 41	53.53289 9	380	586	0.334494	P<0.01	524.6	45.65227 6	442	650	0.325787	P<0.01
Lt.lung	448.705 88	50.36132	340	560	0.403257	P<0.01	473.8	39.25777 5	400	560	0.298173	P<0.01
Spleen	107.529 41	13.50898 1	88	134	0.33121	P<0.01	114.68	14.16896 3	98	170	0.331702	P<0.01
Lt kidney	108.745 1	16.17264 6	80	142	0.392179	P<0.01	113.72	15.20327 1	90	142	0.149658	P<0.01
Rt kidney	107.96 78	15.78124 3	80	142	0.403778	P<0.01	112.9	14.96428 5	90	142	0.064473	P<0.01
Age	44.8627 45	14.27737 4	21	69	-0.28004	P<0.01	44.9	14.29829	21	69	-0.51044	p>0.05

**TABLE 7A**  
**SHOWING MEAN AGE AND S.D OF WEIGHT OF ORGANS IN MALES AS REGARD TO AGE**

Age	20-29		30-39		40-49		50-59		60-69	
Subject	30		30		30		20		10	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
liver	1336	94.63588	1384.8	62.02784	1357	97.52481	1354	110.7013	1329	114.2106
brain	1200	120.1687	1267.2	116.4024	1222	106.4064	1223.4	107.8134	1212.2	101.0585
heart	296.8	21.39821	285	22.61399	254.8	12.30663	252.3	10.38061	250.3	13.3354
Rt .lung	510	56.20937	521.8	49.73611	534	35.20644	534	35.26392	523.2	44.77974
Lt. lung	462	47.15716	458.2	31.1462	489	34.69943	486.2	31.91698	473.6	39.87626
spleen	106.8	7.64795	119.8	18.49967	116.2	13.02617	115.8	12.83823	114.8	13.62648
Lt. kidney	105.6	5.075631	114.2	11.14962	117	17.38907	116.4	17.0966	115.4	18.2927
Rt kidney	102.5	6.256136	112	11.94078	117.8	16.26241	116.6	15.59097	115.6	16.90599

**TABLE 7B**  
**SHOWING MEANS AGE AND S.D OF WEIGHT OF ORGANS IN FEMALES AS REGARD TO AGE**

Age	20-29		30-39		40-49		50-59		60-69	
Subject	15		20		20		15		10	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Liver	1226	114.1097	1230	65.86272	1226.2	72.01384	1194.727	78.49793	1329	114.4523
Brain	1073	76.80704	1113	74.52221	1103	82.0562	1076.727	85.51285	1212.2	101.2724
Heart	292.8	34.85408	251	16.53963	251	16.53963	247.4545	18.21089	250.3	13.36362
Rt lung	502	55.38157	478	43.44488	476	42.11365	461.0909	56.81623	523.2	44.87451
Lt lung	454	39.62536	441	41.44427	447	52.60341	429.8182	62.75199	473.6	39.96066
Spleen	98.6	5.986425	109.4	12.72552	109.4	12.72552	105.6364	15.10134	114.8	13.65532
Lt. kidney	99.4	5.918085	110.6	15.67596	111.6	15.2751	106.9091	17.88917	115.4	18.33141
Rt kidney	97.4	5.848946	109.8	15.13196	111	14.77286	106.1818	17.30354	115.6	16.94177

#### IV. DISCUSSION

Organ weight assessment is essential in forensic pathology, providing valuable information to identify abnormalities or disease processes. This study found that the organ weights in males were higher than in females, a trend that has been observed in similar studies worldwide. These findings can be attributed to the generally higher body mass in males, which correlates with larger organ sizes. However, the data also reveal specific variations in organ weights when compared to other populations, possibly due to regional, dietary, and genetic differences.

The brain weight in this study, for instance, aligns with international findings that report average male brain weights around 1200-1300 grams and female brain weights around 1000-1200 grams. Similarly, the liver weights fall within known ranges, although the values in this study are slightly lower than those reported in Western populations, likely reflecting dietary and environmental influences.

While the spleen, heart, and lung weights are also consistent with other studies, the variations between individual cases underscore the need for region-specific reference ranges. These results provide a vital baseline for the Ajmer population, aiding in the forensic evaluation of autopsies in this region.

#### V. CONCLUSION

This study presents organ weight data from 200 postmortem cases conducted in the Ajmer region of Rajasthan, offering valuable baseline information for forensic experts. Organ weights were consistently higher in males compared to females, a trend that aligns with other global studies. The data will contribute to more accurate forensic assessments in this population, providing a reference for distinguishing between normal and pathological conditions.

Further studies with larger sample sizes and consideration of additional factors such as height and body mass index (BMI) are recommended to refine these findings and support broader forensic applications.

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