J Indian Acad Forensic Med. July-September 2014, Vol. 36, No. 3 **ISSN 0971-0973**

Original Research Paper

Autopsy Study of Organ Weights in Relation to Body Weight and Body Length of Adult Cases in Jamnagar Region

[1]Divyesh K. Vadgama, [2]Mahesh M. Trangadia, [3]Rahul A. Mehta, [4]B.D. Gupta

Abstract

This study was conducted at mortuary of M. P. Shah Government Medical College Jamnagar during the period of February 2010 to November 2010. In the present study 449 cases (272 Male, 177 Female) were included. Body weight (BW), body length (BL), body mass index (BMI) and body surface area (BSA) was measured to correlate with organ weights. Statistical analysis was done and compared with standard Indian texts and the earlier studies. In males, there were 5 organ weights except spleen that have positive correlation with BW. In females, weights of all organs except spleen were correlated positively with BW. In males, weights of both lungs had positive correlation with BL and weights of the brain, liver, spleen and both kidneys have negative correlation with BL. In females, heart and both lungs had positive correlation with BL. All organ weights were positively correlated with BMI and BSA except weight of spleen.

Key Words: Organ weights, Body weight, Body length, Body mass index, Body surface area

Introduction:

Human body organs play a significant role in almost all the ancestral branches of medical sciences including Forensic sciences, as any deviation in weight from the normal range suggests some pathological change in the organ and thus helps in interpreting the opinion regarding the cause of death in various pathological conditions. [1, 2]

The reason for this is the variation in the dietary habits, climatic conditions, daily water, intake, customs and genetic predisposition of different population groups. Hence the normal organ weights of a particular region may not be accurate enough for another. Organ weights also play a significant role in estimation of body height and weight of an individual. [1]

Weighing of organs at autopsy is not merely an exercise but has great medico-legal importance. [2] Standard textbooks of foreign authors [3, 4] give the organ weights of the western population, which are not suitable for Indian population.

Corresponding Author:

[4]Professor and HOD, Dept. of Forensic Medicine,
M. P. Shah Government Medical College,
Jamnagar. (Gujarat)-361008
E-mail: bdgujn@yahoo.com
[1]Assist. Prof, Dept. of Forensic Medicine
P.D.U. Medical College, Rajkot (Gujarat)
[2,3]Assist. Prof, Dept. of Forensic Medicine
M. P. Shah Govt. Medical College, Jamnagar
DOR: 20.02.2014 DOA: 22.07.2014

Some textbooks by Indian authors [5-9] mentioned the organ weights, among them only Mathiharan & Kannan [5] quoted the Indian population organ weights with its reference.

Parikh [6] mentioned the organ weight of Indian population but did not mention any reference. Remaining authors [7-9] did not clarify that organ weights belongs to Indian or western population. So in our study, we tried to generate the Indian data from Jamnagar region. Adding of data of this study in pool of India data may in the end modify prevailing Indian data.

Material and Method:

This study was conducted at mortuary of M. P. Shah Govt. Medical College Jamnagar during the period of February 2010 to November 2010. In the present study 449 cases of adults (272 Male, 177 Female) were included. Body weight, body length, BMI and BSA were measured to correlate with organ weights.

In the present study all the cases were included except those cases in which studied organ were injured or decomposed. The organs which were included in the study were brain, heart, liver, spleen, both lungs and both kidneys.

Standard autopsy protocol and procedure as described in standard textbook [3, 7] were employed for removal of various organs.

After removing the extraneous tissues and draining of the blood, the organs were washed with water and then weighed using an electronic weighing machine. Body was weighed along with stretcher & worn clothes then the weight of stretcher & worn clothes were

deducted from that weight to get exact weight of the body. The body length was measured from head to heel by measuring distance between wooden block kept on both end of body. Body length was measured by standard measuring tape.

Body surface area (BSA) and Body mass index (BMI) was calculated by using following formulas: [10-12]

- BSA (kg/m^2) =0.007184 × body weight (kg) $^{0.425}$ × body length (cm) $^{0.725}$
- BMI (kg/m^2) = $\frac{\text{Body weight (kg)}}{\text{Body length (m)}^2}$

The data were collected and Statistical analysis was done by SPSS (version17.0) program. The Pearson's correlation was performed in analyzing the relationship of organ weights with BW, BL, BSA and BMI.

Observation:

In this study we record mean weight of various organ with SD of both male and female in grams. (Table 1) Correlation of organ weights and BW of male were shown in the value of r and p, there were liver, spleen and left kidney weight of male and spleen weight of female that p value were higher than 0.05, therefore they were not related with the BW. (Table 2)

Present study showed that in male there were 5 organ weights that have positive correlation with BW. Out of that brain, heart, right lung were significant at p<0.01 and left lung and right kidney were significant at p<0.05.

While in female except spleen, all other organ weights have been shown positive correlation with BW and they were significant (p<0.01).In our study correlation of organ weights and BL of female were shown in the value of r and p, there were heart weight of male and brain, liver, spleen and both kidney weight of female that p value were higher than 0.05, therefore they were not correlated with the BL.

In male, weight of both lung have positive correlation with BL and were significant at p<0.01. Weight of the brain, liver, spleen and both have negative correlation with BL and significant at p<0.01. (Table 3) In female, heart and both lung have positive correlation with BL and they were significant at p<0.01. All organs weights were positive correlated with BMI and BSA except spleen weight. There were significance at p<0.01. (Table 4)

Discussion:

1) Correlation between Organ Weights and Body Weight

- **Brain:** In our study brain weight was positive correlated to BW in both sexes, which were statistically significant at p <0.01.

According to Mathuramoon et al [13] and Chirachariyavej et al, [14] brain weight was positive correlated to BW in case of males only, which was statistically significant at p<0.01. But in females, brain weight was not correlated to BW.

- **Heart:** In our study heart weight was positive correlated to BW in both sexes, which were statistically significant at p <0.01. [13] According to Chirachariyavej et al, [14] heart weight was positive correlated to BW in case of males only, which was statistically significant at p <0.01. But in females, heart weight was not correlated to BW.
- **Liver:** In this study liver weight was positive correlated to BW in case of females only, which was statistically significant at p <0.01. In males, liver weight has negative correlation with BW, but it was not significant statistically contrary to Mathuramoon et al [13] and Chirachariyavej et al, [14] liver weights were positive and statistically significant correlation to BW in both sexes.
- **Spleen:** Present study showed that spleen weight was negative correlated to BW in male and positive correlated to BW in females. But they were not significant statistically. According to Chirachariyavej et al, [14] spleen weight was positive correlated to BW in both sexes, which was statistically significant at p <0.05 in male and significant at p <0.01 in female.

  Sprogoe-Jakobsen et al,[11] study showed that the spleen weight was correlated to BW while Mathuramoon et al [13] found that spleen weight was positive correlated to BW in male only, which was statistically significant at p <0.01.
- **Lungs:** In our study right lung weight was positive and statistically significant (p<0.01) correlation to BW in both sexes.

  But left lung weight was positive correlated to BW in both sexes, which was statistically significant at p <0.05 in males and significant at p <0.01 in females.

  According to Chirachariyavej et al, [14] lung weights were positive correlated to BW in male only, which was statistically significant at p <0.05. It might due to inter individual variation and terminal pulmonary edema and congestion, which differ from one individual to other.

  Mathuramoon et al [13] study showed that lung weights were positive correlated to BW in males only, which was statistically significant at p <0.01.

- **Kidneys:** Right kidney weight was positive correlated to BW in both sexes, which were statistically significant at p <0.05 in males and significant at p <0.01 in females in this study and left kidney weight was positive correlated to BW in females only, which was statistically significant at p <0.01. this is similar to other studies. [13, 14]

2) Correlation between Organ Weights and Body Length

- **Brain:** In our study brain weight was negative correlated to BL in both sexes, which was statistically significant at p<0.01 in males. But it was not significant statistically in female, consistent with other studies. [13,14]
- **Heart:** In this study heart weight was positive correlated to BL in both sexes but it was statistically significant at p <0.01 in males only. According to Chirachariyavej et al, [14] heart weight were positive correlated to BL in both sexes, but it was not statistically significant.

Mathuramoon et al [13] found that heart weight was positive correlated to BL in males, which was statistically significant at p <0.01but it was negative correlated to BL and was not statistically significant in females.

- **Liver:** Liver weight was negative correlated to BL in males, which was statistically significant at p <0.01. But in case of females, it was positive correlated to BL and was not significant statistically in this study.

While other studies showed that liver weights were positive correlated to BL in both sexes, but it was statistically significant at p <0.01 in case of males only. [13, 14]

- **Spleen:** In our study spleen weights were negative correlated to BL in both sexes, but it was statistically significant at p <0.01 in males only contrary to Chirachariyavej et al [14] who found that spleen weights were positive correlated to BL in both sexes, but was not significant statistically.

Mathuramoon et al [13] showed that spleen weights were positive correlated to BL in both sexes, but it was statistically significant at p <0.01 in case of males only. According to Sprogoe-Jakobsen et al [11] the spleen weight was correlated to BL.

- **Lungs:** In this study both lung weights were positive correlated to BL in both sexes, which were statistically significant at p <0.01. According to Chirachariyavej et al [14] both lung weights were positive correlated to BL in both sexes, but it was statistically significant at p <0.05 in case of males only. But Mathuramoon et al, [13] showed that both lung weights were positive correlated to BL in males, which was statistically significant at p <0.01 in males only. In case of females, both lung weights were negative correlated to BL and was not significant statistically.
- **Kidneys:** Both kidney weights were negative correlated to BL in males, which were statistically significant at p <0.01.

In case of females, both kidney weights were positive correlated to BL, but it was not significant statistically. According to Chirachariyavej et al [14] both kidney weights were positive correlated to BL in both sexes, but it was statistically significant at p <0.05 in case of males only.

Mathuramoon et al [13] found that both kidney weights were positive correlated to BL in both sexes, which were statistically significant at p <0.01 in case of male and significant at p <0.05 in case of female.

3) Correlation of Organ Weights with BMI and BSA:

In our study, all organ weights were positive correlated with BMI and BSA except spleen weight. There were significance at p<0.01. According to Sprogoe-Jakobsen et al [11] the spleen weight was positive correlated with BMI and BSA in both sexes.

Conclusion:

Present study concluded that in males, there were 5 organ weights except spleen that have positive correlation with BW. Out of these, weights of brain, heart and right lung were significant at p <0.01 and weights of left lung and right kidney were significant at p <0.05. In females, weights of all organs except spleen were correlated positively with BW and significant at p <0.01.

Weights of both lung had positive correlation with BL and were significant at p <0.01 in males while weights of the brain, liver, spleen and both kidneys have negative correlation with BL and significant at p <0.01.

In females, heart and both lungs had positive correlation with BL and they were significant (p <0.01).

All organ weights were positively correlated with BMI and BSA except weight of spleen. They were significant at p <0.01.

References:

1. **Singh Dalbir, Bansal YS, Sreenivas M, Pandey AN, Tyagi S.** Weights of Human Organs at Autopsy in Chandigarh Zone of North-West India. JIAFM. 2004; 26(3): 97-99.
2. **Kohli Anil, Aggrawal NK.** Normal Organ Weights in Indian Adults. Medico-legal Update. 2006 April-June; 6(2): 49-52.

3. **Saphir O.** Autopsy Diagnosis and Technique. 3rd Ed. New York: Paul B. Hoeber, Inc.; 1951. 435-40.
4. **Saukko P, Knight B.** Knight's Forensic Pathology. 3rd ed. Hoddr Arnold; 2004. 606-8.
5. **Mathiharan K, Kannan K.** editor. Modi A Textbook of Medical Jurisprudence and Toxicology. 24th ed. Nagpur: LexisNexis Butterworth's Wadhwa; 2012. 332-33.
6. **Parik CK.** Medico-legal Postmortems in India Guidelines for crime investigation. Bombay: Medical Publication; 1985. 167
7. **Reddy KSN.** The Essentials of Forensic Medicine and Toxicology. 29th ed. Hyderabad: K. Sugana Devi; 2010. 604, 619-20.
8. **Vij K.** Textbook of Forensic Medicine and Toxicology Principles and Practice. 5th ed. Elsevier; 2012. 584.
9. **Bhisora CP, Chaudhary SKR.** Practical Manual of Forensic Medicine and Toxicology. Pune: New Central Book Agency (P) Ltd; 2009. 13.
10. **William F.** Ganong's Review of Medical Physiology. Appleton and Lange: Connecticut; 1989. 236-260.
11. **Sprogoe-Jakobsen S, Sprogoe-Jakobsen U.** The Weight of the normal Spleen. Forensic Sci Int. 1997; 88(3): 215-223.
12. BMI Classification- Global database on Body mass index. World Health Organization. available from: http://apps.who.int/bmi/index.jsp?intro Page=intro_3.html
13. **Mathuramoon P, Chirachariyavej T, Peonim V, Rochanawutanon M.** Correlation of Internal Organ Weight with body weight and length in normal thai adults. J Med Assoc Thai. 2009; 92(2): 250-258.
14. **Chirachariyavej T, Ouyswat K, Sanggarnjanavanich S, Tiensuwan M, Peonim V, Sirikulchayanonta V.** Normal internal organ weight of Thai adults correlated to body length and body weight. J Med Assoc Thai. 2006; 89(10): 1702-11.

Table 1: Organ weight in the form of Mean ± SD of male and female (n=449)

Organ	MALE	FEMALE
Brain	1115 ± 84.14	1058.20 ± 79.50
Heart	283.79 ± 58.01	237.71 ± 49.05
Liver	1235.09 ± 209.54	1145.98 ± 103.45
Spleen	98.25 ± 60.49	85.18 ± 26.52
Right Lung	550.68 ± 126.07	503.84 ± 108.04
Left Lung	463.88 ± 121.51	419.76 ± 99.23
Right Kidney	122.61 ± 26.62	113.37 ± 25.10
Left Kidney	116.64 ± 24.21	108.15 ± 24.19

Table 2: Correlation between Organ Weights and Body Weight

Organ	Male (n=272)		Female (n=177)	
	R	p-value	r	p-value
Brain	0.318**	0.000	0.480**	0.000
Heart	0.549**	0.000	0.634**	0.000
Liver	-0.031	0.611	0.387**	0.000
Spleen	-0.063	0.304	0.113	0.136
Right Lung	0.203**	0.001	0.364**	0.000
Left Lung	0.134*	0.027	0.356**	0.000
Right Kidney	0.148*	0.014	0.252**	0.001
Left Kidney	0.086	0.158	0.307**	0.000

Table 3: Correlation between Organ Weights with Body Length

Organ	Male (n=272)		Female (n=177)	
	r	p-value	r	p-value
Brain	-0.166**	0.006	-0.143	0.057
Heart	0.017	0.783	0.157**	0.037
Liver	-0.227**	0.000	0.072	0.338
Spleen	-0.265**	0.000	-0.109	0.150
Right Lung	0.229**	0.000	0.431**	0.000
Left Lung	0.171**	0.005	0.330**	0.000
Right Kidney	-0.161**	0.008	0.058	0.444
Left Kidney	-0.206**	0.001	0.059	0.438

Table 4: Correlation of Organ Weights with BMI and BSA

Organ	BMI	BSA
	R	r
Brain	0.445**	0.368**
Heart	0.597**	0.575**
Liver	0.180**	0.097**
Spleen	0.090	-0.34
Left lung	0.162**	0.292**
Right lung	0.184**	0.354**
Left kidney	0.258**	0.168**
Right kidney	0.264**	0.188**

* Correlation is significant at p<0.05, ** Correlation is significant at p<0.01, - = Negative correlation, r= Correlation coefficient