

Original Research Article

Study of the weights of human heart and liver in relation with age, gender and body height

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ABSTRACT

Background: Normal weight of organ is one of the most important indicators to discern between normal and abnormal in the departments of Anatomy, Pathology also as in clinical medicine. Objective of the study was to examine the normal adult internal organ weights and their relationship with age, gender, body height.

Methods: The present study included 100 autopsy cases from the mortuary of Osmania General Hospital, Hyderabad from May 2012 to September 2013. The subjects were selected as per inclusion and exclusion criteria to avoid variations arising out of pathology. The ages ranged from 10 to 60 years and out of which 29 were females and 71 were males. The organs studied were heart and liver.

Results: The weight of organs with mean+standard deviation (SD) was represented for males and females respectively; heart 294+48 / 287+44gms, liver 1404 + 191/ 1283+ 169gms.

Conclusions: A positive relationship was found between organ weight with age and body height in both males and females. Organ weights in males were comparatively higher than females.

Keywords: Age, Body Height, Gender, Heart, Liver, Organ weight

INTRODUCTION

Growth and development are the fundamental properties of life, being the normal function of every individual, the growth of viscera of body proceeds along with the physical development of human being.¹ If any of the factors controlling growth are increased or decreased the normal proportions of the body will be altered by the relative enlargement or reduction of the size of the organ concerned.²

Organ weights are important standard benchmarks in various disciplines of medicine like anatomy, surgery, pharmacology and radiation medicine.^{3,4} For example in pharmacology it is useful for drug trials, in radiation medicine to set limits for radiation exposure, in surgery

liver volume is important not only in determining disease state and disease progression but in estimating segmental liver volume for transplant donors and planning the extent of hepatectomy in cancer patients and in medico legal cases to identify gross pathology of the organ.^{4,5}

Several standard textbooks had given the normal weight of internal organs such as Gray's anatomy and Ludwig.^{6,7} All these are always used for reference; however, most of the indicators were taken from Caucasoid population and there are very few from Asian population such as India, China and Korea.

There is a lot of variation in the organ weights amongst different races and regions of the world. 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 region may not be accurate enough for another.^{3,8} Hence, we conducted present study to know the normal weights of the population of Andhra Pradesh and its relationship with age, gender and body height.

METHODS

The present study was done on the normal organ weights of deceased who were brought to the mortuary of Osmania general hospital, Hyderabad, Telangana, India for the Post mortem examination between the ages of 10-60 years were taken for present study during the period of May 2012 to September 2013. The total study population includes 100 cases of which 71 (71%) were males and 29 (29%) were females, age ranged from 10 to 60 years.

Inclusion criteria

Out of all the cases brought to the Mortuary, the cases satisfying following criteria were selected:

- Only cases of vehicular accident, hanging and fall from height were selected, where there is death within 24 hours of the act and there was no evidence of gross pathology or trauma to the major internal organs
- The post-mortem examination was conducted within 8-10 hours of death.

Exclusion criteria

- Time since death > 24 hours
- Burns
- Drowning
- Decomposed bodies
- Organ with gross morphological changes

Details regarding post mortem examination number (PME No.), age, gender, cause of death and time since death etc. were noted down from the inquest requisition brought by the police and recorded as per procedure.

The mortuary technician under the supervision of forensic expert conducting the autopsy measured the height of the subject. After breaking rigor mortis individual subject length was measured in supine position from head to heel with a measuring tape.

After recording all the external and internal findings the internal organs (heart, liver) were removed individually from deceased as per standard autopsy protocol and procedure as described in current methods of autopsy practice by Ludwig, 2nd edition.⁷ Washed under running tap water to remove blood, bile etc. drained completely.

After draining individual organ, it is weighed with the help of Standard electronic weighing machine with the standard deviation+1 gm.

Statistical methods were simple percentage calculations (like mean, standard deviation etc.) Ethical permission was obtained from the institutional scientific and ethical committee.

RESULTS



Figure 1: Weighing of the heart on standard electronic weighing machine with SD \pm 1gm

Study findings were tabulated for each organ for variations with age, gender, body height, for reasons due to limitations of circumstances; body weight could not be measured. Total study population includes 100 cases of which 71 (71%) were males and 29 (29%) were females, the age ranged from 10 to 60 years.



Figure 2: Weighing of the liver on standard electronic weighing machine with SD \pm 1gm

In males (n=71), the mean weight of the heart was 294.07+48.97gms with the range 105-390gms, the mean weight of the liver was 1,404.49+191.48gms with the range 811-1,725gms. In females (n=29), the mean weight of the heart was 287.10+44.38 with the range is 190-342gms and the mean weight of the liver was 1,283.34+169.34gms with the range of 725-1,700gms. The weight of viscera (heart, liver) was comparatively higher in males.

Table 1: Correlation of gender with weight of heart and liver.

Gender	No. Of cases	Variables	Weight of heart (in grams)	Weight of liver (in grams)
Male	71	Range	105-390	811-1700
		Mean	294.07	1404.49
		Sd	48.97	191.48
Female	29	Range	190-342	725-1700
		Mean	287.10	1283.34
		Sd	44.38	169.57

Table 2: Correlation of age with weight of heart and liver.

Age in years	No. of cases	Variables	Weight of heart (in grams)	Weight of liver (in grams)
11-20	13	Range	105-325	836-1385
		Mean	245.46	1254.61
		Sd	58.38	163.94
21-30	29	Range	190-333	725-1700
		Mean	280.24	1311.03
		Sd	38.98	196.06
31-40	24	Range	216-365	1164-1700
		Mean	289	1381.70
		Sd	40.80	109.84
41-50	14	Range	275-384	1206-1700
		Mean	316.66	1410.13
		Sd	27.19	196.50
51-60	19	Range	228-390	940-1698
		Mean	325.36	1484.94
		Sd	39.35	224.39

In the age group of 11-20 years, mean weight of the heart was 245.46+58.38gms with the range of 105-325gms and mean weight of the liver was 1,254.61+163.94gms with the range of 836-1,385gms. In the age group of 51-60

years, mean weight of the heart was 325.36+39.35gms with the range of 228-390gms and the mean weight of the liver was 1484.94+224.39gms with the range of 940-1698gms. Maximum weight of the viscera (heart, liver) was observed in 51-60 years age group.

Table 3: Correlation of height with weight of heart and liver.

Height in cms	No. Of cases	Variables	Weight of heart (in grams)	Weight of liver (in grams)
151-160	24	Range	105-333	836-1700
		Mean	269.13	1332.52
		Sd	50.94	183.70
161-170	62	Range	190-384	811-1700
		Mean	282.01	1372.67
		Sd	49.46	204.40
171-180	14	Range	216-356	946-1605
		Mean	283.92	1377.92
		Sd	41.18	168.26

In the height group of 151-160cms, the mean weight of the heart was 269.13+50.94gms with the range of 105-

333gms and the mean weight of the liver was 1332.52+183.70gms with the range of 836-1700gms. In the height

group of 171-180cms, the mean weight of the heart was 283.92±41.18gms with the range of 216-356gms and the mean weight of the liver was 1377.92±168.26gms with the range of 946-1605gms. Comparatively maximum weight of viscera (heart, liver) was observed in 171-180cms.

DISCUSSION

Estimation of normal weight of the internal organs is still going on by two methods. 1) radiological procedures such as ultrasound or computerized tomography (CT scan). 2) weighing the organs from autopsy.

There are both positive and negative aspects to each method. Radiological techniques are time-consuming and impractical in daily use and may also be hazardous. We were interested in the weighing method, directly from autopsies according to standard criteria.

Normal weight

Heart

In the present study, we found that the mean weight of the heart in males was 294.07±48.97gms and that of the females 287.10±44.38 gms.

The finding regarding the weight of the heart in present study is consistent with that of Singh D et al, Sahni D et al, Narongchai P et al, Hayes JA, et al, and much less than Yi-Suk Kim et al, Sheikhaazadi A et al.^{3,9-13} The average weight of the heart in present study was more than that found by Kohli Anil et al.¹⁴

Liver

In the present study, we found that the weight of the liver in males was 1,404.49±191.480gms with the range 811-1,700gms and that of the females 1,283.34±169.57gms with the range of 725-1,700gms.

The findings regarding weight of the liver in present study is consistent with those of Singh D et al, in Chandigarh; Chirachariyavej T et al, in Thailand; Prakash C et al, in Uttarakhand; Mathuramon P et al, in Thailand and much less than the findings of Sheikhaazadi A et al, in Tehran.^{3-5,13,15} Kim Y et al, in Korea; were slightly more than the findings of Tanna JA et al, in Bhavnagar, Gujarat and Anil K et al in North Indians.^{12,14,16} This might be due to dietary habits and socio economic status.

Gender

Heart

In the present study, weight of the heart in males 294.07±48.97gms with the range of 105-390gms was more than that in females 287.10±44.38gms with the range of 190-342gms.

Findings in present study were consistent with those of Hayes JA et al, Singh D et al, Sahni D et al, Anil K et al, Narongchai et al, Mathuramon P et al, Kim Y et al, Sheikhaazadi A et al, Prakash C et al.^{3,5,9-14}

Liver

In the present study, weight of the liver in males 1,404.49±191.48gms was heavier than in females 1,283.34±169.57gms.

The finding in present study regarding the weight of the liver and its relationship with age was consistent with those of Singh D et al, Anil K et al Narongchai et al, Mathuramon P et al⁵, Kim Y et al¹², Sheikhaazadi A et al¹³, Prakash et al^{4, 3-5,10,12-14}.

Age

Heart

In the present study, it was observed that weight of the heart increases with increasing age. Maximum weight of the heart is seen the age group of 51-60 years. Range was 228-390gms and Mean weight of heart was 325.36±39.35gms. The findings in present study regarding relationship of the weight of heart with age was consistent with Singh D et al, Narongchai et al, Mathuramon P et al, Kim Y et al, Sheikhaazadi A et al, Prakash C et al.^{3-5,10,12,13}

Liver

In the present study, it was observed that the weight of the liver increases with increase in age.

The peak weight of the liver was observed in the age group 51-60 years. Range is 940-1698gms and Mean weight is 1484.94±224.39.

The finding in present study regarding the weight of the liver was consistent with Singh D et al, and Sheikhaazadi A et al.^{3,13}

Body height

Heart

In the present study, there is a positive relationship between the body height and weight of the heart. As the height of individual increases the weight of the heart also shows an increase. The findings in present study were closely consistent with Sheikhaazadi A et al, Chirachariyavej T et al, and partially related to Mathuramon P et al.^{5,13,15}

Liver

In the present study, it was observed that there was a positive relationship between the body height and weight

of the liver. As the height increases, the weight of the liver also shows an increase.

The findings in present study regarding the weight of the liver and its relationship with body height was closely consistent with Sheikhzadi A et al, and partially related to Mathuramon P et al.^{5,13}

When comparing our data with other studies previously published, we must consider the distinctive characteristics of the population from one study to another. As height is variable from one individual to another and is highly influenced by the race of the population, (for example, North Indians are comparatively taller than South Indians) one needs to be aware of influencing factors.

CONCLUSION

The normal weight of viscera (heart, liver) in present study population was almost similar with study population of Chandigarh region and comparatively lesser than study population of North India. The normal weight of the viscera was more in males (heart 294gms, liver 1,404gms) as compared with that of females (heart 287gms, liver 1,283gms). The weight of the heart and liver increases with increase in age in both males and females and maximum weight was observed in study population of 51-60 years age group in both the genders. The weight of the heart and liver showing an increasing pattern with increase in height of an individual in both males and females but not much variation was observed in study population with 161-170cms and 171-180cms.

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