An Autopsy Study of Correlation of Organs Weight with Physical Parameters In Fresh Cases

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Abstracts: Background: Organs weight is an important standard benchmark in all discipline of medicine. In forensic medicine, it is very useful to identify pathology during post mortem examination 1, 2, 3 and in case of dismembered bodies or where only organs are found approximate prediction of physical parameters can be made. It is useful in pharmacology for drug trials, in radiation medicine to set a limit for radiation exposure**.** **Aims and Objective:** This study was conducted with objective of establishing correlation between organs weight and physical parameters. **Method:** Significance and strength of correlation is proved by calculating p-value and Pearson's correlation coefficient, further regression equations and mean multiplication factors were derived to calculate physical parameters from organs weight. [Dabhi D NJIRM 2014; 5(5):48-51]

Key Words: Body weight, Body length, BMI4 (Body Mass Index), BSA5 (Body Surface Area), Organs weight.

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Introduction: Various anthropometric measurements as regards to human body are in common use in medical practice for the purpose of identification, determining fitness of an individual, to know the overall status of health, and sometimes to calculate the dose of drug especially in paediatric patients. Recently determining BMI and BSA from body weight and height becomes an important tool in medical science for various purposes.

Human body organs play a significant role in almost all the ancestral branches of medical sciences including forensic science. As any deviation in weight from the normal range may be an indicator of pathological change in the organ and thus helps in interpreting the opinion regarding the cause of death in various pathological conditions.

In this study an attempt has been made to correlate the organs weight with physical parameters in cases of natural deaths, which may be important in Forensic context.

Material and Method: This study was conducted during the period of January 2012 to May 2013 at Department of Forensic Medicine, P.D.U. Govt. Medical College & Hospital, Rajkot. It includes cases from age group of 18-70 years. Cases in which organs were injured, decomposed and disease that affects the organs weight were excluded.

The body was weighed using an electronic weighing machine. First each body was weighed along with stretcher and worn clothes then the weight of stretcher and worn clothes were deducted from that weight to get exact weight of the body. Standard autopsy protocol and procedure as described in standard textbook were employed for removal of various organs[1, 2, 3]. The organs which were included in the study were brain, heart, lungs, liver, spleen, and kidneys. 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 length was measured using standard measuring tape from head to heel by measuring distance between wooden blocks kept at both ends.

Body surface area[5] (BSA) and Body mass index[4] (BMI) were calculated using the following formula.

BSA (kg/m^2) =0.007184 × body weight (kg) $^{0.425}$ × body length (cm) $^{0.725}$

BMI (kg/m^2) = Body weight (kg) / Body length (m) ^{2}

The data were recorded and analysed by SPSS (version17.0) program.

Observations and Results: Table-1 shows that, Out of total 200 cases, 118 (59%) cases were male and 82 (41%) cases were female. Maximum number of total cases 74 (37%) were found in age group of 18-30 years. Minimum number of cases 20 (10%) were found in age group of >60 years. Maximum number of male cases 32 (16%) were found in age group of 41-50 years and Maximum number of female cases 42 (21%) were found in age group of 18-30 years. Table no: 2 and 3 shows descriptive statistics of physical parameters and of weight of organs respectively. They showed that values are higher in male than female.

Table no: 4-7; uses following statistical data, Pearson's correlation coefficient, R^2 values, standard error of estimate and p value for estimation of physical parameters from organs weight. Pearson's correlation coefficient indicates correlation between two sets of data and how well they are related. Its value varies between -1 to +1. Its limitations are that it does not tells which variable is independent and which is dependent. It only tells you that relationship exists between two variables but does not give information regarding slope of linear equation. R^2 (Coefficient of determination) is a proportion of variance (fluctuation) of one variable that is predicted from other variable. Its value varies between 0 to1 and indicates strength of association between variables. Standard error of estimate is measure of accuracy of prediction. P-values indicate the probability of obtaining statistical result at extreme assuming that null hypothesis is true.

In present study, to estimate physical parameters (Body weight, Body length, BMI, BSA) from organs weight Pearson's correlation coefficient was maximum and standard error of estimate was minimum for heart than other organs weight.

Table 1: Distribution of Cases According To Age Groups And Sex

Age Group in (Years)	Male (%)	Female (%)	Total (%)
18-30	32(16%)	42(21%)	74(37%)
31-40	18(9%)	10(5%)	28(14%)
41-50	38(19%)	16(8%)	54(27%)
51-60	18(9%)	06(3%)	24(12%)
>60	12(6%)	08(4%)	20(10%)
Total	118(59%)	82(41%)	200(100%)

Table 2: Mean and Standard Deviation, Of Age, Body Weight, Body Mass Index (Bmi) and Body Surface Area (Bsa) Of Both Sexes

Features	male (Mean ± SD)	female (Mean ± SD)
Body weight (kgs)	60.45 ± 13.11	57.81 ± 10.44
Body length(cms)	162.08 ± 08.32	160.22 ± 07.31
BMI(kg/m2)	22.81 ± 03.68	22.42 ± 03.10
BSA(sq.mtr)	01.64 ± 00.21	01.60 ± 00.17

Table 3: Mean And Standard Deviation Of Organ Weights In Male And Female[1,2,3]

Organs	Male (Mean ± SD)	Female(Mean ± SD)
Brain	1242.32 ± 154.64	1210.00 ± 132.54
Heart	307.25 ± 75.99	296.90 ± 56.07
Right Lung	458.40 ± 127.00	411.37 ± 104.26
Left Lung	401.47 ± 106.51	359.32 ± 100.33
Liver	1349.01 ± 149.54	1220.49 ± 103.52
Spleen	117.00 ± 09.40	107.34 ± 15.43
Right Kidney	123.22 ± 08.47	113.93 ± 10.58
Left Kidney	119.07 ± 08.38	109.88 ± 09.18

Table 4: Level Of Significance of Different Measurements And Linear Regression Formula For Estimation Of Body Weight

PARAMETERS (WEIGHT OF ORGANS)	N	PCC	R^2	SEE	p value	REGRESSION FORMULA
HEART	200	0.82	0.68	6.83	0.01	BW=15.02+ 0.14 x H WT
BRAIN	200	0.73	0.53	8.28	0.01	BW=-15.10 + 0.06x B WT
RIGHT LUNG	200	0.73	0.53	8.31	0.01	BW=27.01 + 0.07 x RL WT
LEFT LUNG	200	0.69	0.47	8.79	0.01	BW=28.96 + 0.07 x LL WT
LIVER	200	0.54	0.29	10.21	0.01	BW=1.17 + 0.04 x L WT
LEFT KIDNEY	200	0.42	0.18	10.98	0.01	BW=-1.82 + 0.53 x LK WT
SPLEEN	200	0.24	0.06	11.77	0.01	BW= 33.28 + O.23 x S WT
RIGHT KIDNEY	200	0.12	0.01	12.07	0.08	BW=56.06 + 0.02 x RK WT

N – Number of cases.
PCC – Pearson's correlation coefficient[6]
R^2= Coefficient of determination[8, 7].
SEE = Standard Error of Estimate[7].
p-value [9].

Table 5: Level Of Significance of Different Measurements and Linear Regression Formula for Estimation of Body Length

PARAMETERS (WEIGHT OF ORGANS)	N	PCC	R^2	SEE	p value	REGRESSION FORMULA
HEART	200	.61	0.38	6.29	0.01	BL=139.54+ 0.07 x H WT
BRAIN	200	.60	0.36	6.35	0.01	BL=120.64 + 0.03 x B WT
RIGHT LUNG	200	.60	0.36	6.39	0.01	BL=143.77 + 1.71 x RL WT
LEFT LUNG	200	.59	0.35	6.40	0.01	BL=143.95 + 0.04 x LL WT
LIVER	200	.32	0.10	7.56	0.01	BL=138.16 + 0.01 x L WT
LEFT KIDNEY	200	.29	0.08	7.65	0.01	BL=134.05 + 0.23 x LK WT
RIGHT KIDNEY	200	.17	0.03	7.87	0.01	BL=158.13 + 0.02 x RK WT
SPLEEN	200	.05	0.00	7.99	0.46	BL= 157.71 + O.03 x S WT

Table 6: Level Of Significance of Different Measurements and Linear Regression Formula for Estimation of Bmi

PARAMETERS (WEIGHT OF ORGANS)	N	PCC	R^2	SEE	p value	REGRESSION FORMULA
HEART	200	.72	0.52	2.39	0.01	BMI=11.59+ 0.03 x H WT
BRAIN	200	.62	0.38	2.72	0.01	BMI=4.66 + 0.01 x B WT
RIGHT LUNG	200	.59	0.35	2.78	0.01	BMI=15.12 + 0.01 x RL WT
LEFT LUNG	200	.54	0.30	2.90	0.01	BMI=15.77 + 0.01 x LL WT
LIVER	200	.51	0.26	2.98	0.01	BMI=07.04 + 0.01 x L WT
LEFT KIDNEY	200	.38	0.14	3.20	0.01	BMI=07.08 + 0.13 x LK WT
SPLEEN	200	.27	0.07	3.33	0.01	BMI= 14.38 + O.07 x S WT
RIGHT KIDNEY	200	.05	0.003	3.46	0.47	BMI=22.25 + 0.003 x RK WT

Table 7: Level Of Significance of Different Measurements and Linear Regression Formula for Estimation of BSA

PARAMETERS (WEIGHT OF ORGANS)	N	PCC	R^2	SEE	p value	REGRESSION FORMULA
HEART	200	.83	0.68	0.11	0.00	BSA=0.90+ 0.002 x H WT
BRAIN	200	.75	0.56	0.13	0.00	BSA=0.37 + 0.07 x B WT
RIGHT LUNG	200	.73	0.54	0.13	0.00	BSA=1.09 + 0.001 x RL WT
LEFT LUNG	200	.70	0.49	0.14	0.00	BSA=1.11 + 0.001 x LL WT
LIVER	200	.52	0.27	0.16	0.00	BSA=0.71 + 0.001 x L WT
LEFT KIDNEY	200	.41	0.17	0.18	0.00	BSA=0.66 + 0.008 x LK WT
SPLEEN	200	.21	0.04	0.19	0.00	BSA= 1.25 + O.003 x S WT
RIGHT KIDNEY	200	.14	0.02	0.19	0.05	BSA=1.56 + 0.001 x RK WT

Summary And Conclusion: For approximate prediction of physical parameters from organs weight, regression equations and mean multiplication factors were derived.

Out of all organs weight, heart weight provides maximum strength of association, minimum standard error of estimate and accurate approximate prediction of physical parameter followed by brain, right lung, left lung, liver, left kidney, right kidney and spleen.

Mean multiplication factors are ratio of the physical parameters (BW, BL, BMI,BSA) to organs weight.

Multiplication factor = Physical parameters / Variable (i.e. organs weight). Mean multiplication factors to derive physical parameters from organs weight are as in following table.

Physical Parameter —> / Organs	Body weight		Body length		BMI		BSA	
	Male	Female	Male	Female	Male	Female	Male	Female
Heart	0.1998	0.1936	0.5597	0.5558	0.0767	0.0768	0.0055	0.0054
Brain	0.4840	0.4770	0.1323	0.1337	0.0184	0.0185	0.0013	0.0013
Right lung	0.1365	0.1460	0.3837	0.4165	0.0526	0.0572	0.0037	0.0040
Left lung	0.1559	0.1697	0.4375	0.4831	0.0602	0.0665	0.0043	0.0047
Liver	0.0447	0.0473	0.1213	0.1320	0.0169	0.0183	0.0012	0.0013
Left kidney	0.5065	0.5275	1.3664	1.4695	0.1971	0.2047	0.0138	0.0146
Right kidney	0.4882	0.5068	1.3172	1.4115	0.1859	0.1966	0.0133	0.0140
Spleen	0.5174	0.5498	1.3942	1.5327	0.1957	0.2123	0.0140	0.0152

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