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Body composition and health status of hypertensive subjects

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Abstract
Hypertension is most commonly prevalent non-communicable disease and responsible risk factor for 57 per cent of all stroke deaths and 24 per cent of all coronary heart disease deaths in India. That's. why it is also known as silent killer. Therefore, to get detailed information regarding the changes occurring in the body in hypertension, the present study was conducted with objective to assess the body composition of hypertensive subjects and their health status also. Assessment of body composition using Bioscan can provide insight of one's health. Total 45 hypertensive subjects were randomly selected and divided into three groups name as control, placebo and experimental group. Each group was composed of 15 hypertensive subjects. After the collection of baseline information, body composition of all hypertensive subjects were assessed with bioscan analyzer and the parameters taken for study were body fat, fat free mass, total body water, extra cellular water, intra cellular water and body cell mass etc. It was found that Fat (%) value were higher among female hypertensive subjects than male hypertensive subjects. The range of body fat in male hypertensive subjects were from 25.53 % to 31.90 % and in female hypertensive subjects were from 40.62% to 48.16 % respectively. It is clear that obese hypertensive subjects had higher amount of adipose tissue and small amount of body protein available for energy as compared to the lean hypertensive subjects. The nature of fat free mass FFM (%) and BCM (Kg) was just reverse from body fat. Male had higher value of FFM (%) than female hypertensive subjects. FFM (%) is directly related with physical performance and BCM with metabolic functions. Both, male and female hypertensive subjects differed non-significantly to each other in Fat (%), FFM (%) and BCM (kg) and in other parameters also mentioned above. On the basis of these findings it can be concluded that through the continuous monitoring of concern parameters of body composition related to the hypertension, the disease risk of the subjects can be reduced and prevented easily to improve their health condition for example: the reduction in body fat led to an improved quality of life, reduced blood pressure and overall subjects felt better and fitter.

Keywords: Hypertension, Body composition, Bioscan analyzer, Health Status, Body Cell Mass

Introduction
For a nation to be healthy, strong and productive, health status of its population must be in good condition. In spite of the progress that our country has made in various fields, the current scenario of the disease burden, is quite disturbing**.** With rapid socio-economic development, decreasing trends of infectious diseases, due to better health care and consequently longer life expectancy, non-communicable diseases are increasing sharply. Non-communicable diseases (NCDs) are the leading cause of adult mortality and morbidity worldwide (http://203.90.70.117//PDS_DOCS/B4793.pdf). Among NCDs, hypertension is the most common non-communicable disease in India. It is the most common factor responsible for Ischemic Heart Diseases (IHD) and Cerebro-vascular accidents (ICMR, 2004) [10]. According to Gupta *et al.,* (2008) [2] in India, hypertension is directly responsible for 57 per cent of all stroke death and 24 per cent of all coronary heart disease deaths (http://wwww.ijmr.org.in cited on 2-10-2012). Recent reports indicate that nearly 1.56 billion adults are predicted to have hypertension by 2025 (Gupta *et al.,* 2008) [2]. In India, 10% of attributable deaths or 7.1 million deaths occur due to hypertension (www.icmr.nic. in cited on 11-8-2012). So, to understand the health status of hypertensive person or the population, assessment of body composition is important. Our bodies are complex by nature and made up of many tissues that change as our body develops, matures and ages. All information related to the body

composition is a part of thorough understanding of the disease and the health status of human beings. The main components of the human body are water, proteins, fat and mineral matter. The percentage of these components may change with age and state of nutrition viz., under nutrition, over nutrition and starvation etc. (www.maltronint.com). By considering all above points, the present study started with the objective to study the body composition and health status of hypertensive subjects.

Materials and Methods

In methodology, a series of activities were done in the study, these were as follows:

Selection of Hypertensive Subjects: Hypertensive subjects were selected with the help of the list of hypertensive subjects. For this, Pantnagar University Hospital, local pathology as well as community persons were approached. Only those hypertensive subjects were selected who voluntarily agreed to participate in the study. Adult hypertensive person either male or female having more than 20 years of age were selected as respondents. All hypertensive subjects were randomly selected. Their written consent was obtained.

Development of Tool for Data Collection: A pre-structured survey schedule was prepared. The survey schedule was pre-tested on non-sample group. After pre-testing, proper modifications were done and the final survey schedule was developed. With the help of final survey schedule baseline information was collected.

Experimental Design for the Study: Total forty five (45) hypertensive subjects were selected. All 45 subjects were divided into genderwise three groups, named as control, placebo and experimental group.

Assessment of Body Composition: For the assessment of body composition of hypertensive subjects, bioscan analyzer was used. The technique used by bioscan analyzer was electrical impedance. This method was a non-invasive, reliable, repeatable and valid estimation for human body composition. (www.maltronint.com).

Method of Measurement: Subjects lie clothed, but without shoes and socks, in the supine position on a stretcher, with limbs not touching the body. Two current electrodes were placed on the dorsal surfaces of the right hand and foot, at the distal metacarpals and metatarsals respectively. Two detector electrodes were placed at the right pisiform prominence of the wrist and between the medial and lateral malleoli at the right ankle. A thin layer of electrode gel was applied to each electrode before it was place on the skin. The resistive component of body impedance between the right wrist and right ankle was then measured to the nearest ohm. The lowest resistance (R) value for an individual was used to calculate the conductivity and hence to predict the fat-free mass. Bioelectrical impedance was safe and convenient and the equipment was portable and relatively inexpensive (Gibson, 1990) [4].

Precautions: Subjects were asked to avoid alcohol and vigorous exercise for 24 to 48 hours before testing. The measurements were taken on subjects approximately two hours after eating (Gibson, 1990) [4].

Results and Discussion:

In the present study, assessment of body composition of all 45 hypertensive subjects were done. All findings are given in tables and discussed below.

Body Composition of Hypertensive Subjects: Parameters of body composition analyzed by bioscan analyzer discussed were body fat, fat free mass, total body water, extra cellular water, intra cellular water and body cell mass etc.

Body Fat: The fat compartment of the body is termed as fat mass (FM) and will vary considerably between individuals in terms of absolute amount. In general, fat mass consists of 20% water and 80% adipose tissue respectively. Table 1 contained the information of the body fat of male and female hypertensive subjects.

Table 1: Body composition measurements of hypertensive subjects by bioscan analyser

Body Composition Parameters	Control group	placebo group	Experimental group	F-Value	Control group	placebo group	Experimental group	F-value
	Male Subjects (n=9)	Male Subjects (n=9)	Male Subjects (n=6)		Female Subject (n=6)	Female Subject (n=6)	Female Subject (n=9)	
Fat (%)	29.96±9.53	25.53±8.97	31.90±5.08	2.21	40.62±6.17	48.16±5.08	45.04±4.82	1.99
Fat (kg)	22.74±13.04	16.77±4.85	26.94±7.83	1.60	24.87±8.43	33.70±11.41	32.19±5.88	1.94
FFM (kg)	47.86±7.60	48.00±4.04	55.72±7.22	3.35	35.29±6.21	34.63±3.59	38.80±2.87	2.15
FFM(%)	70.03±9.53	74.46±5.33	68.09±5.08	1.60	59.37±6.17	51.84±8.97	54.96±4.82	1.99
Total Body Water (l)	37.59±8.33	34.89±3.82	43.38±6.92	3.01	27.92±3.91	29.47±3.39	31.31±1.82	2.36
Total Body Water (%)	54.06±3.69	53.93±2.59	52.68±1.56	0.48	47.15±4.22	43.62±3.56	44.28±2.52	1.92
ECW (l)	16.63±2.78	15.01±1.70	17.84±2.23	2.86	11.50±1.63	11.74±1.28	12.86±1.05	2.37
ECW (%)	45.57±9.27	43.04±1.52	41.47±3.61	0.88	41.21±1.64	39.87±0.90	41.05±2.28	1.01
ICW (l)	20.96±7.48	19.87±2.25	25.54±5.09	2.09	16.42±2.25	17.72±2.14	18.45±1.26	2.08
ICW (%)	54.41±9.26	56.94±1.52	58.51±3.61	0.88	58.77±1.64	60.11±0.90	58.93±2.28	1.01
ECW/ICW	0.89±0.34	0.75±0.04	0.71±0.10	1.348	0.70±0.05	0.66±0.02	0.69±0.06	1.008
BCM(kg)	27.19±6.87	26.41±2.52	32.41±5.34	2.646	20.78±3.22	21.47±2.17	23.12±1.43	2.138

The range of body fat in the groups of male hypertensive subjects were from 25.53 %(placebo group) and to 31.90% (experimental group) and among female hypertensive subjects were from 40.62% (control group) and 48.16 %(placebo group) respectively. Comparing the data of body fat (%) of male and female hypertensive subjects, it is clear that fat (%) value were higher among female hypertensive subjects than male hypertensive subjects. Both, male and female hypertensive subjects belonging to all the three groups i.e. control, placebo and experimental differed non-significantly

to each other in fat (%).

The similar findings were observed in the study of Onimawo *et al.,* (2004) [12] which showed higher percentage of body fat (28±0.1per cent) in females than males (20.8±5.2 per cent). A study conducted by Muralidhara (2006) [11] on the body composition measured by Futrex 5000 –A on young Indians and the result showed that the body fat estimated (13% to 25% in males and 26% to 35% in females) was slightly higher in all groups as compared to 11-16%(males) and 20-26% (females) in some previous reports using other methods in India. The widespread availability of high- energy staple foods such as rice, wheat, edible oil and sugar at relatively low cost has contributed to heavy health burden in India. In the urban affluent segment, an increase in energy intake from fats, refined cereals, and sugar and simultaneous reduction in physical activity have contributed to steep increase in hypertension in all segments of population.

Ghose *et al.,* (2000) [3] observed that there were significant differences between normotensive (NT) and hypertensive (HT) subjects in body fat(%) and also found that hypertensive individuals had significantly enhanced levels of central body fat distribution while studying hypertensive population of Calcutta. In the same study, it was also found that the obese male had twice the amount of adipose tissue on their body and had small amount of body protein available for energy, in the labile amino acid pool and muscle proteins during catabolism, (when the body was starving) as compared to the lean male. In general, when the people gain or lose weight they will add or reduce the amount of fat mass and to a much lesser degree, fat-free mass. Bone mass remained unchanged, with a small loss in protein and water mass. The reduction in body fat led to an improved quality of life, reduced blood pressure and overall subjects felt better and fitter.

Fat Free Mass: The non-fat component of body composition is termed as fat free mass (FFM) and exists primarily as the chief structural and functional component of the human body. Fat free mass has been found to have a high correlation to caloric requirement and physical performance (www.maltronint.com). The fat free mass consists of three components: total body protein, total body water and bone minerals. The FFM compartment consists in proportions of water (72%), protein (21%) and bone minerals (7%). Muscle, vital organs, bone and extracellular fluid are the major component of fat free mass. In healthy persons, the fat free mass has a relatively constant composition. By measuring total body water, total body potassium, total body nitrogen or body density, the proportion of the body composed of fat and the proportion composed of fat-free mass can be estimated. The result of fat free mass of all hypertensive subjects are given in table 1. By analysing all values of FFM (%) it was found that there were wide difference between the values of male and female hypertensive subjects for FFM (%). The nature of findings of fat free mass was just reverse from body fat because male had higher value of FFM(%) than female hypertensive subjects. Male and female hypertensive subjects differed non-significantly in FFM (%).In normal healthy individuals all the body components except fat occur in relatively fixed proportion (Gibson, 1990) [4]. Barakoti, (2010) [1] study revealed similar findings as in the present study i.e. female hypertensive subjects had less percentage of fat free mass than male hypertensive subjects and found that FFM (%) value among male and female hypertensive subjects were 70.0 ± 8.4 and 57.9 ± 11.5% whereas normal male and female subjects had FFM (%) 75.3 ± 9.8 and 69.4 ± 11.9% respectively. Ghose *et al.,* (2000) [3] observed that there were significant differences between normotensive (NT) and hypertensive (HT) subjects in the mean values for fat free mass while studying hypertensive population of Calcutta.

Total Body Water: Water is the most important component of the human body. It serves as a solvent for biochemical reactions and as a transport media. The major component of the human body is water, varies from 70 to 75% at birth and the most abundant constituent of the body, but often neglected. The protein and fat component are relatively small, with the remainder being primarily bone and minerals. Small changes in Total Body Water (TBW) can reduce measurable amount in body weight; therefore, the assessment of Total Body Water is central to measuring body composition**.** As body composition changes with age, fat decreases and lean mass increases, body fluids levels will increase (www.maltronint.com).

Among total body water, two parameters were assessed; (i) TBW (Lt) and (ii) TBW (%).Total body water related information is given in table 1. By comparing the value of total body water (%) and the result shown that the total body water (%) were more among male than female subjects. Both, male and female hypertensive subjects were varied non-significantly in total body water (%). TBW (Lit) was assessed in the study of Barakoti, (2010) [1] and found that TBW (Lt) among male and female hypertensive subjects were 33.8 ± 4..4 and 28.1± 7.2 (lit) whereas normal male and female subjects had 37.2 ± 7.5 and 30.5± 6.7 (Lit) respectively. In the same study, Barakoti, (2010) [1] found regarding TBW (%), among male and female hypertensive subjects were 51.4±6.7 per cent and 46.5 ± 12.4 per cent whereas normal male and female subjects had TBW (%) 55.9 ± 10.5 per cent and 54.5 ± 12.8 per cent respectively. As lean body mass contains most of the water in our body, subject with high fat levels have been found to have low lean and therefore, low water levels.

Extra Cellular Water: Water cannot be viewed as a single entity and it should be described at molecular, cellular and tissue levels of body composition. At cellular level, it is divided into two i.e. ECF and ICF. Information related to extra cellular water of all hypertensive subjects are given in table 1. By observing the data it was found that the ECW (%) among female hypertensive subjects were lower than male subjects. There were no variation in male and female hypertensive subjects in ECW (%) significantly. According to the study of Barakoti, (2010) [1] ECW (Lt) value among male and female hypertensive subjects were 12.0± 3.7 and 9.7 ± 6.1 (Lt) whereas normal male and female subjects had ECW (Lt) was 14.7± 5.4 and 12.2 ± 4.5 (Lt) respectively. Whereas in the same study regarding, the mean value of ECW (%) among male and female hypertensive subjects were 35.1±7.9 per cent and 33.0±9.2 per cent whereas normal male and female subjects had 38.7± 8.6 per cent and 38.9 ± 7.4 per cent respectively. Extracellular Water (ECW) increases in different diseases and oedema is the most common sign of ECW expansion. Monitoring these changes in patients can provide detailed information and understanding of changes occurred in disease.

Intra Cellular Water: Substance changes with disease and contribute significantly to the overall increase in ECW and ICW. Intracellular water is found in the cytosol of every tissue of the body. (www.maltromint.com). Information on Intra Cellular Water (ICW %) was collected and given in

table 1. The result shown that the ICW (%) among male hypertensive was lower than that of female hypertensive subjects. Male hypertensive subjects as well as female hypertensive subjects belong to all the three groups were statistically similar in ICW (%). Barakoti, (2010) [1] conducted a comparative study on normal and hypertensive subjects and it was found that ICW(%) was that among male and female hypertensive subjects ICW (%) was 64.9 ± 7.9 and 66.9 ± 9.2 (%) whereas normal male and female subjects had ICW (%) 61.3± 8.6 and 61.0 ± 7.4 % respectively. Regarding ICW(Lit) in the same study it was found that ICW (Lit) among male and female hypertensive subjects were 21.8±2.9 and 18.4 ± 3.5 whereas among normal male and female subjects had 22.5±3.7 and 18.4± 3.2 (Lit) respectively. Clinical studies have shown that in different disease patient's cellular hydration is an important regulator of protein catabolism. (www.maltromint.com).

ECW/ICW: Extracellular and Intracellular body fluid in both healthy and diseased patient is of significant importance. Estimation of TBW (Total Body Water), ECW(Extra Cellular Water) and ICW(Intra Cellular Water) using Bioscan can provided insight of one's health (www.maltromint.com). Total Body Water can be separated into two parts i.e. extracellular and intracellular water. Although, measurement of Total Body Water has provided important information of body composition during growth, ageing and disease (www.maltromint.com). But, Extracellular and Intracellular water ratio provide more information as compared to separate two value of extra cellular water and intra cellular water (www.maltronint.com). In the present study, it was found that ECW/ICW among male hypertensive subjects were 0.89, 0.75 and 0.71 belonging to control, placebo and experimental group whereas among female hypertensive subjects belonging to same group were 0.70, 0.66 and 0.69 ratio respectively. Male and female hypertensive subjects belonging to all three groups were similar in ECW/ICW. The findings of Barakoti, (2010) [1] regarding ECW/ICW was among male and female hypertensive subjects ECW/ICW was 0.57±0.2 and 0.56±0.6 whereas normal male and female subjects have ECW/ICW were 0.66±0.25 and 0.66±0.22 respectively. ICF is that fluid found within the cell of the body and ECF is that portion outside the cells. In healthy individuals these two fluid compartments are tightly regulated. However under a variety of disease conditions, excess fluid accumulation occurs in Extracellular spaces resulting in oedema (www.maltromint.com).

Body Cell Mass: Body Cell Mass (BCM) is a "cellular level" component of body composition which is considered the actively metabolizing portion of the body. BCM represents cytoplasm, a portion of the body that generates energy and is associated with all major metabolic functions. Body Cell Mass of a normal male is between 41 to 45% of Total Body Weight and in women 30 to 33% of Total Body Weight (www.maltronint.com). In the present study, information on body cell mass was collected and given in table 1. BCM (kg) value was higher in male than female hypertensive subjects and similar as in previous findings there were no significant difference observed in BCM. The findings of Barakoti, (2010) [1] study regarding BCM (kg) of male and female hypertensive subjects were 25.9±2.5(kg) and 20.7± 3.2(kg) whereas of normal male and female hypertensive subjects had BCM(kg) value 27.9 ±4.3 kg and 22.9 ± 7.5 kg respectively**.** Body Cell Mass is an accurate method of establishing a healthy subject nutritional status or a patient's degree of malnutrition. BCM is used for the measurement of energy expenditure and other metabolic function. An important indicator of kidney function and to know the rate at which, waste is removed from our kidneys. High correlation was found using BioScan in the estimation of GFR, avoiding the necessity of 24 hour urine collection or calculating using CC or MDRD formulas. Bone, soft tissue and protein content of the body, inorganic compounds containing an abundance of metals. In clinical patients the assessment of the loss of minerals is important.

Health Profile of Hypertensive Subjects

All information regarding the health profile of hypertensive subjects like prevalence of other diseases, family history of disease, duration of disease, kind of therapy in use etc. were collected and given below in table 2.

Table 2: Health profile of hypertensive subjects

Disease	Control group (n_1=15)	Placebo group ((n_2=15)	Experimental group (n_3=15)	Total (n=45)
Diabetes	6(13.32%)	5(11.11%)	5(11.11%)	16(35.52%)
Heart diseases	4(8.88%)	2(4.44%)	2(4.44%)	8(17.76%)
Family history of disease				
Father	4(8.88%)	1(2.22%)	3(6.66%)	8(17.76%)
Mother	4(8.88%)	3(6.66%)	3(6.66%)	10(22.20%)
Brother	2(4.44%)	2(4.44%)	3(6.66%)	7(15.54%)
Sister	-	1(2.22%)	-	1(2.22%)
All	-	1(2.22%)	1(2.22%)	2(4.44%)
No	5(11.11%)	7(15.54%)	5(11.11%)	17(37.74%)
Duration of disease				
Last 1 to 5yrs	6(13.32%)	9(19.98%)	4(8.88%)	19(42.18%)
Last 5 to 10 yrs	7(15.54%)	3(6.66%)	5(11.11%)	15(33.3%)
Last 10 to 15yrs	2(4.44%)	1(2.22%)	4(8.88%)	7(15.54%)
Last 15 to 20yrs	-	1(2.22%)	2(4.44%)	3(6.66%)
More than 20 yrs	-	1(2.22%)	-	1(2.22%)
Use of medicine				
Yes	13(28.86%)	14(31.08%)	14(31.08%)	41(91.02%)
No	2(4.44%)	1(2.22%)	1(2.22%)	4(8.88%)
Kind of Therapy				
Allopathic	12(26.64%)	12(26.64%)	13(28.86%)	37(82.14%)
Aryuvedic	4(8.88%)	3(6.66%)	1(2.22%)	7(15.54%)
Homeopathic	-	-	-	1(2.22%)

Prevalence of Other Disease (including Hypertension): In the present study, all subjects were hypertensive and along with this, many subjects were suffering with other diseases like diabetes and heart disease also. Overall, approximate 35.52 per cent subjects were diabetic and as per WHO (2005), India is the capital of largest number of diabetics in the world. Regarding heart disease, approximate 8.88 per cent hypertensive subjects of control group and approximate 4.44 per cent subjects of each placebo and experimental group were suffering with heart disease. According to WHO (2012) report, one in three adults worldwide, has raised blood pressure: a condition that causes around half of all deaths from stroke and heart diseases (www.who.int. cited on dated 11-8-2012).

Family History of Disease: Family history of disease related information were also collected and it was found that approximate 18 per cent, 22 per cent, 16 per cent, 2 per cent and 4 per cent of subjects had hypertension due to their father, mother, brother, sister and all their family members respectively and 50 per cent of hypertensive subjects had no family history of the disease. Barakoti (2010) [1] conducted a study in U.S.Nagar district of Uttarakhand state and found that among 100 hypertensive subjects, 31.0 per cent male and 35.7 per cent female had family history of hypertension.

Duration of the Disease: Duration of the disease was divided into five groups given in the table 2 and it was found that majority of the subjects i.e. 42 per cent and 33 per cent of subjects had hypertension from last 5 years and from last 5 to 10 years. Rest others i.e. 16 per cent and 7 per cent of subjects had hypertension from10 to 15 years and 15 to 20 years respectively. Only 2 per cent of subjects had hypertension from more than 20 years belonging to placebo group.

Use of Medicine: Among all hypertensive subjects, 91 per cent of hypertensive subjects used medicine whereas 9 per cent of hypertensive subjects were not using medicine in their regular routine during survey period. Among 91 per cent of medicine user subjects, 29 per cent belonging to control group and 31 per cent belonging to each placebo and experimental group respectively.

Kind of Therapy: In the present study, investigation was also done on the use of kind of therapy. All therapy was grouped into three i.e.
(i) Allopathic
(ii) Aryuvedic
(iii) Homeopathic
It was found that among all hypertensive subjects, 82 per cent of subjects used allopathic type of therapy. In 82 per cent of subjects, 27 per cent of subjects belonging to each, control and placebo group and 29 per cent subjects belonging to experimental group respectively. Subjects preferred the use of ayurvedic type of therapy because they thought that it has no side effects whereas allopathic therapy has side effects. Ayurvedic type of therapy was used by 16 per cent of subjects whereas homeopathic therapy was used by only 2 per cent of hypertensive subjects. Life style activities play very important role in determining the health status of human beings. Habits of good life style practices like regular exercise are milestone for sound health of individuals.

Conclusion

In India, hypertension is directly responsible for half of all deaths from stroke and heart diseases and known as silent killer. So, through the assessment of body composition of individuals, thorough understanding of changes occurring in the body in hypertension can be known to monitor it. As per results of the present study the Body Fat (%) were higher value in female hypertensive subjects. Whereas FFM (%) and BCM(Kg) were higher in value in male hypertensive subjects. So, females were at greater health risk as compared to the male subjects. Because, FFM(%) is directly related with physical performance and BCM(kg) is with metabolic functions. From these findings, it is clear that male subjects were in better health condition as compared to female subjects. In this way, it can be concluded by keeping an eye on different parameters of body composition, the risk condition of the hypertensive subject's health can be controlled and prevented easily.

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