OPEN ACCESS

Int. Res. J. of Science & Engineering, 2018; Vol. 6 (5): 161-180 http://www.irjse.in
ISSN: 2322-0015

ORIGINAL ARTICLE

Body Composition Analysis of Undergraduate Students Using Bioelectrical Impedance Analysis method and their counseling on diet and lifestyle

Gupta Swaroopa Rani N

Department of Chemistry, Brijlal Biyani Science College Amravati, Maharashtra, India
Email: swargupta@yahoo.com

Manuscript Details
Received : 15.07.2018
Accepted: 12.09.2018
Published: 30.09.2018

ISSN: 2322-0015

Editor: Dr. Arvind Chavhan

Cite this article as:
Gupta Swaroopa Rani N. Body Composition Analysis of Undergraduate Students Using Bioelectrical Impedance Analysis method and their counseling on diet and lifestyle. *Int. Res. Journal of Science & Engineering,* 2018, 6 (5): 161-180.

© The Author(s). 2018 Open Access
This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

ABSTRACT

Present paper deals with body composition analysis of undergraduate students using bioelectrical impedance analysis method and their counseling on diet and lifestyle. Bioelectrical impedance analysis method involves determination of Body Weight, Body Fat Percentage, Segmental Subcutaneous Fat Percentage (Whole Body, Trunk, Arms and Legs), Visceral Fat percentage, Segmental Skeletal Muscle Percentage (Whole Body, Trunk, Arms and Legs), Resting Metabolism, Body Mass Index and body Age. Results are interpreted in terms of ideal weight, overweight, underweight, Period required for weight Loss / Gain at the rate of 1.5 kg per month, Period required for wt maintenance, Fat %, Subcutaneous Fat % (Trunk), Visceral Fat %, Skeletal Muscle % (Whole body), RM, BMI, Body Age. It also highlights correct weight reduction and instructions for better health improvement and weight loss, weight gain and weight maintenance programme. For ideal weight management and for a more accurate and precise body composition analysis full Body Sensing Technology Karada Scan Body Composition Monitor – HBF-375 is used. Karada Scan measures body resistance by using weak current flowing through both hands and both feet (Bioelectrical Impedance / Biological resistance method). Tissues with more water content in human body tend to conduct electricity (such as muscle and vein) easily. Fat tissue almost conducts no electricity. The body feature is used to calculate percentage of fat tissue and non fat tissue. Current flowing through human body is very weak (50 KHz, 500μA), which is not stimulant and is very safe to human body. In order to obtain body fat and other data from resistance between both hands and both feet, the five items, i.e. resistance value, height, weight, age and gender are required, which are obtained in accordance with basic human data collected by the company independently. There is little scope for technician error as such, but factors such as eating, drinking and exercising must be controlled since hydration level is

an important source of error in determining the flow of the electric current to estimate body fat. It is important to know our biological age. If we know where the problems exist, we can initiate the lifestyle modifications necessary to improve our health and increase our vitality. Maintaining an ideal weight can help prevent obesity or weight loss and other diseases, and lead a longer life. We should build up non-fat physique by increasing skeletal muscle and improving resting metabolism. Complementing exercise along with a proper diet is the key to a healthy lifestyle. In today's world, exercising routine is regarded imperfect without vital elements called Bodybuilding supplements. They act as a fuel for our body and boost sporting performance. Herbalife is a world leader in the wellness industry. Their products do detoxification and cleansing of body systems from the inside, weight management, supplementation, anti-aging, prevent future diseases. Among these are Aloe Plus Tablet, Afresh, Cell -U -Loss Tablet, Personalized Protein Powder, Nutritional Shake Mix, Multivitamin Mineral and Herbal Tablet, Cell Activator Tablet, Activated Fiber Tablet for better weight management. .

Key words : Height, Weight, Fat %, Subcutaneous Fat %, Visceral Fat %, Skeletal Muscle %, RM, BMI, Body Age.

INTRODUCTION

Bioelectrical impedance analysis (BIA) is a commonly used method for estimating body composition, and in particular body fat. Since the advent of the first commercially available devices in the mid-1980s the method has become popular owing to its ease of use, portability of the equipment and it's relatively low cost compared to some of the other methods of body composition analysis. It is familiar in the consumer market as a simple instrument for estimating body fat. BIA actually determines the electrical impedance, or opposition to the flow of an electric current through body tissues which can then be used to calculate an estimate of total body water (TBW). TBW can be used to estimate fat-free body mass and, by difference with body weight, body fat [1].

Many of the early research studies showed that BIA was quite variable and it was not regarded by many as providing an accurate measure of body composition. In recent years technological improvements have made BIA a more reliable and therefore more acceptable way of measuring body composition. Nevertheless it is not a "gold standard" or reference method. Like all assessment tools, the result is only as good as the test done. Although the instruments are straightforward to use, careful attention to the method of use (as described by the manufacturer) should be given.

Simple devices to estimate body fat, often using BIA, are available to consumers as body fat meters. These instruments are generally regarded as being less accurate than those used clinically or in nutritional and medical practice. They tend to under-read body fat percentage [2].

Dehydration is a recognized factor affecting BIA measurements as it causes an increase in the body's electrical resistance, so has been measured to cause a 5 kg underestimation of fat-free mass i.e. an overestimation of body fat [3].

Body fat measurements are lower when measurements are taken shortly after consumption of a meal, causing a variation between highest and lowest readings of body fat percentage taken throughout the day of up to 9.9% [4]. Moderate exercise before BIA measurements lead to an overestimation of fat-free mass and an underestimation of body fat percentage due to reduced impedance [5]. For example moderate intensity

exercise for 90–120 minutes before BIA measurements causes nearly a 12 kg overestimation of fat-free mass, i.e. body fat is significantly underestimated [6]. Therefore it's recommended not to perform BIA for several hours after moderate or high intensity exercise [7].

BIA is considered reasonably accurate for measuring groups, or for tracking body composition in an individual over a period of time, but is not considered sufficiently accurate for recording of single measurements of individuals [8].

The accuracy of consumer grade devices for measuring BIA has not been found to be sufficiently accurate for single measurement use and is better suited for use to measure changes in body composition over time for individuals [9].

Bioelectrical impedance analysis (BIA) is widely used in clinics and research to measure body composition. However, the results of BIA validation with reference methods are contradictory, and few data are available on the influence of adiposity on the measurement of body composition by BIA. BIA is a good alternative for estimating %BF when subjects are within a normal body fat range. BIA tends to overestimate %BF in lean subjects and underestimate %BF in obese subjects [10].

Bioelectrical impedance analysis (BIA) is a promising tool in the evaluation of body composition in large population studies because it is fast, is inexpensive, and does not require extensive operator training or cross-validation. The empiric nature of the relation between resistance and reactance measured by BIA and body composition has led to the development of equations that translate the raw data into liters of body water or kilograms of fat-free mass (FFM) or fat mass. These equations may not be easily transferred from one population to another if the populations differ significantly in important determinants of body composition such as age, obesity, and illness. Review of two recent studies from the Framingham Heart Study in which BIA was first compared with dual-energy X-ray absorptiometry (DXA) as a validation technique, and then compared with the body mass index (BMI, in kg/m2) as an alternative estimate of body fat. BIA was a good predictor of DXA-derived FFM ($r = 0.85$-0.88, $P < 0.001$) and was superior to BMI as an estimator of body fat [11].

Over the past decade, considerable attention has been paid to accurately measuring body composition in diverse populations. Recently, the use of air-displacement plethysmography (AP) was proposed as an accurate, comfortable, and accessible method of body-composition analysis. AP is an accurate method for assessing body composition in healthy adults. Future studies should assess further the cause of the individual variations with this new method [12].

Obesity continues increasing at epidemic levels worldwide, as does the number of genetic studies that focus on obesity. Body mass index (BMI) is often used to characterize weight phenotypes and obesity status due to its simplicity. Refined measurements of body composition may be needed to understand variations in gene expression. This study explores gene expression when individuals are characterized as overweight based on BMI versus body fat percent. Individuals were recruited to a natural history protocol at the National Institutes of Health. Twelve Caucasian participants with the highest and lowest BMI were included. Whole-body air displacement plethysmography was performed to calculate body fat percent, and BMI was calculated. Fasting whole blood was collected and RNA extracted. Quantitative real time PCR array was used to determine expression of 96 obesity related genes. The PCR array from participants with high BMI compared to low BMI showed dysregulation of four genes: peroxisome proliferator-activated receptor gamma coactivator 1-alpha (*PPARGC1A*), pro-opiomelanocortin (*POMC*), growth hormone secretagogue receptor (*GHSR*), and leptin (*LEP*), whereas participants with high body fat compared to low body fat showed dysregulation of one gene: *PPARGC1A*. This research showed differential gene expression and clinical indices depending on method of weight Classification [13].

The study aims to improve accuracy of Bioelectrical Impedance Analysis (BIA) prediction equations for estimating fat free mass (FFM) of the elderly by using non-linear Back Propagation Artificial Neural Network (BP-ANN) model and to compare the predictive accuracy with the linear regression model by using energy dual X-ray absorptiometry (DXA) as reference method. When compared the performance of developed prediction equations for estimating reference FFM_{DXA}, the linear model has lower r^2 with a larger SD in predictive results than that of BP-ANN model, which

indicated ANN model is more suitable for estimating FFM [14].

Although international interest in classifying subject health status according to adiposity is increasing, no accepted published ranges of percentage body fat currently exist. Empirically identified limits, population percentiles, and scores have all been suggested as means of setting percentage body fat guidelines, although each has major limitations. A convenient sample of 1626 adults with BMIs ≤35 was evaluated. Independent percentage body fat predictor variables in multiple regression models included 1/BMI, sex, age, and ethnic group (*R* values from 0.74 to 0.92 and SEEs from 2.8 to 5.4% fat). The prediction formulas were then used to prepare provisional healthy percentage body fat ranges based on published BMI limits for underweight (<18.5), overweight (≥25), and obesity (≥30). This proposed approach and initial findings provide the groundwork and stimulus for establishing international healthy body fat ranges [15].

Several studies have raised the suspicion that the body mass index (BMI) cut-off for overweight as defined by the WHO may not adequately reflect the actual overweight status. The present study looked at the relationship between BMI and body fat per cent (BF %) / health risks (hypertension and type 2 diabetes) in male residents of Lucknow city, north India to evaluate the validity of BMI cut-off points for overweight. The study subjects showed higher body fat percentage and risk factors like hypertension and type 2 diabetes at normal BMI range proposed by the WHO. The cut-off for BMI was proposed to be 24.5 kg/m^2 for our study population. If overweight is regarded as an excess of body fat and not as an excess of weight (increased BMI), the cut-off points for overweight based on BMI would need to be lowered. However, the confidence of estimate of the BMI cut-off in the present study may be considered with the limitations of BI analysis studies [16].

Body composition assessment in patients with chronic renal failure is of paramount importance since studies have demonstrated the association of protein-energy malnutrition with an increased morbidity and mortality in this population. However, practical and sensible indicators of body compartments are still needed for clinical purposes. Thus, we aimed to evaluate the simple methods of skinfold thicknesses (SKF) and bioelectrical impedance analysis (BIA), using dual-energy X-ray absorptiometry (DEXA) as a reference method, for the assessment of body fat in patients on long-term haemodialysis therapy [17].

Analysis of body composition such as body weight, BMI, body fat percentage, segmental subcutaneous fat & skeletal muscle percentage (whole body, trunk, legs and arms), resting metabolism, visceral fat level and body age is done by bioelectrical impedance technique and results are interpreted and corresponding instructions for better health improvement is given. Body composition analysis of teaching and nonteaching staff members of Brijlal Biyani Science College Amravati Maharashtra India using bioelectrical impedance analysis method is done [18].

For ideal weight management and for a more accurate and precise body composition analysis full Body Sensing Technology Karada Scan Body Composition Monitor – HBF-375 is used which measures body composition-weight, body fat percentage, visceral fat level, subcutaneous fat and skeletal muscle percentage, RM, BMI and Body age. This analysis technique is based on Bioelectrical impedance method [19].

Various Measuring techniques are available for determining body fat percentage, such as Underwater (Hydrostatic) weighing, Near-infrared interactance, Dual energy X-ray absorptiometry (DEXA Scan), Body average density measurement, Bioelectrical impedance analysis, Anthropometric methods such as Height and circumference methods and Skinfold methods, Ultrasound, from BMI etc [20].

Present paper deals with body composition analysis of undergraduate students using bioelectrical impedance analysis method and their counseling on diet and lifestyle. Bioelectrical impedance analysis method involves determination of Body Weight, Body Fat Percentage, Segmental Subcutaneous Fat Percentage (Whole Body, Trunk, Arms and Legs), Visceral Fat percentage, Segmental Skeletal Muscle Percentage (Whole Body, Trunk, Arms and Legs), Resting Metabolism, Body Mass Index and Body Age. Results are interpreted in terms of ideal weight, overweight / underweight, Period required for weight Loss / Gain at the rate of 1.5 kg per month, Period required for weight maintenance, Fat %, Subcutaneous Fat % (Trunk), Visceral Fat %, Skeletal Muscle % (Whole body), RM,

BMI and Body Age. It also highlights correct weight reduction and instructions for better health improvement and weight Loss, weight gain and weight maintenance programme.

METHODOLOGY

Body composition analysis of 138 undergraduate students of Brijlal Biyani Science College Amravati Maharashtra India using bioelectrical impedance analysis method is done during 8th February to 13th February 2016. For ideal weight management and for a more accurate and precise body composition analysis full Body Sensing Technology Karada Scan Body Composition Monitor – HBF-375 as shown in Figure 1 is used which measures body composition- Body Weight, Body Fat Percentage, Segmental Subcutaneous Fat Percentage (Whole Body, Trunk, Arms and Legs), Visceral Fat percentage, Segmental Skeletal Muscle Percentage (Whole Body, Trunk, Arms and Legs), Resting Metabolism, Body Mass Index and Body Age. The general principle behind bioelectrical impedance analysis is that two or more conductors are attached to a person's body and a small electric current is sent through the body. The resistance between the conductors provides a measure of body fat between a pair of electrodes, since the resistance to electricity varies between adipose, muscular and skeletal tissue. Fat-free mass (muscle) is a good conductor as it contains a large amount of water (approximately 73%) and electrolytes, while fat is anhydrous and a poor conductor of electric current.

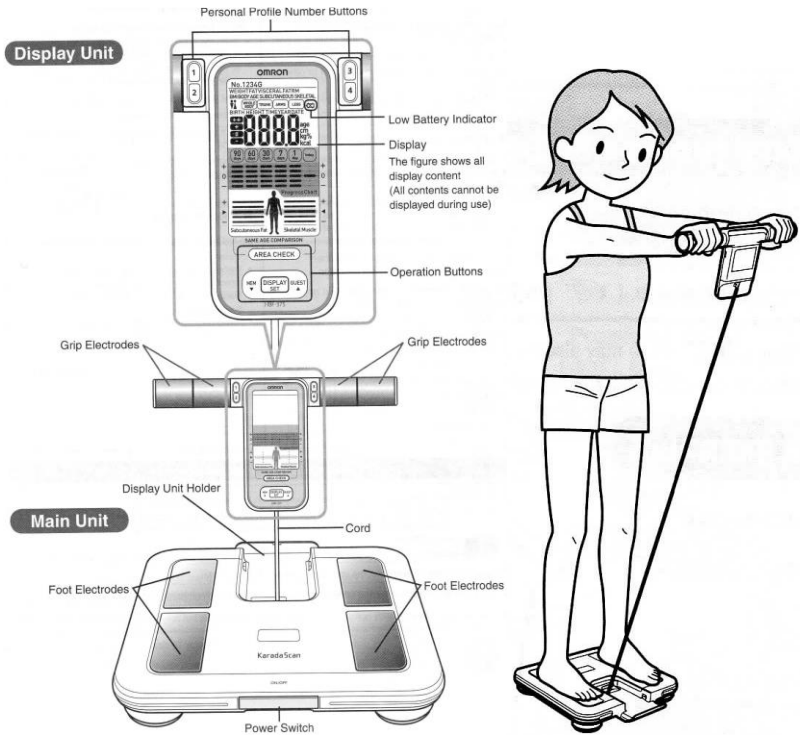

Fig 1. Omron Body Composition Scale Karada Scan HBF-375

Each (bare) foot may be placed on foot electrodes, and grip electrodes may be held in each hand. Karada Scan measures whole body resistance by using electrode of both hands and both feet. Therefore, it is less subject to variation of water content distribution in human body.

In order to obtain resistance value necessary to calculate body fat and to ensure stability of measurement results, one should basically keep their arm and body at 90^0 and straighten their arms when performing measuring.

Karada Scan measures body resistance by using weak current flowing through both hands and both feet (Bioelectrical Impedance / Biological resistance method). Tissues with more water content in human body tend to conduct electricity (such as muscle and vein) easily. Fat tissue almost conducts no electricity. The body feature is used to calculate percentage of fat tissue and non fat tissue. Current flowing through human body is very weak (50 KHz, 500μA), which is not stimulant and is very safe to human body. In order to obtain body fat and

other data from resistance between both hands and both feet, the five items, i.e. resistance value, height, weight, age and gender are required, which are obtained in accordance with basic human data collected by the company independently.

There is little scope for technician error as such, but factors such as eating, drinking and exercising must be controlled since hydration level is an important source of error in determining the flow of the electric current to estimate body fat. The instructions for use of instruments typically recommends that measurements should not be done soon after drinking or eating or exercising, or when dehydrated. Instruments require details such as sex, age and height to be entered, and use formulae taking these into account; for example, men and women store fat differently around the abdomen and thigh region.

BMI: Body mass index is defined as the individual's body mass divided by the square of his or her height. The formulae universally used in medicine produce a unit of measure of kg/m^2.

BMI = Weight (Kg) / [height (m)] ^{2}

The WHO regards a BMI of less than 18.5 as underweight and may indicate malnutrition, an eating disorder, or other health problems, while a BMI greater than 25 is considered overweight and above 30 is considered obese.

Body fat: Body fat includes essential body fat and storage body fat. Essential body fat is necessary to maintain life and reproductive functions. The percentage of essential body fat for women is greater than that for men, due to the demands of childbearing and other hormonal functions. The percentage of essential fat is 3–5 % in men, and 10-16 % in women. Storage body fat consists of fat accumulation in adipose tissue, part of which protects internal organs in the chest and abdomen.

Body fat percentage = [Body fat Mass (Kg) / Body weight (Kg)] × 100

Visceral Fat : In humans, adipose tissue is located beneath the skin (subcutaneous fat), around internal organs (visceral fat), in bone marrow (yellow bone marrow) and in breast tissue.

BMR (RMR) : Basal metabolic rate (BMR), and the closely related resting metabolic rate (RMR), is the amount of energy expended daily by humans and other animals at rest. The release, and using, of energy in this state is sufficient only for the functioning of the vital organs, the heart, lungs, nervous system, kidneys, liver, intestine, sex organs, muscles, and skin.

BMR generally decreases with age and with the decrease in lean body mass (as may happen with aging). Increasing muscle mass increases BMR. Illness, previously consumed food and beverages, environmental temperature, and stress levels can affect one's overall energy expenditure as well as one's BMR.

Skeletal muscle : Skeletal muscle is a form of striated muscle tissue existing throughout the human body, and which is under control of the somatic nervous system; that is to say, it is voluntarily controlled. It is one of three major muscle types, the others being cardiac and smooth muscle. As their name suggests, most skeletal muscles are attached to bones by bundles of collagen fibers known as tendons. If we strengthen skeletal muscle and improve basal metabolism, we will not get fat easily.

Skeletal muscle percentage = [Skeletal muscle Mass (Kg) / Body weight (Kg)] × 100

Body Age: Biological age depends on how time and lifestyle have affected organs and cells compared to other people of chronological age. Factors of biological aging include changes in the physical structure of the body as well as changes in the performance of motor skills and sensory awareness. Chronological age is current age in years, calculated from birth date.

It means we may be 40 years old, but we have the health and body of a 50 year old. Or, on the flip side, we may be 55 years old and have the health and body of a 38 year old. There is a direct link between vitality and behavioral changes. Healthy living equals slow aging, where unhealthy lifestyle choices equal rapid aging.

This is why it is important to know our biological age. If we know where the problems exist, we can initiate the lifestyle modifications necessary to improve our health and increase our vitality. If we have been taking care of ourselves, the test may show that our biological age is 5 to 10 years younger than our calendar age. However, this parameter may show our real age to be several years

older than our actual age, in which case it will give us recommendations on how to improve our health in specific ways, such as with better nutrition, exercise, supplements, more sleep, etc. Health reviser's Biological

Table 1. Interpretation of Body composition result

Interpretation of Body Composition Report						
Body Fat %	**Gender**		**Low**	**Normal**	**High**	**Very High**
	Female		Up to 19.9	20-29.9	30-34.9	35 & more
	Male		Up to 9.9	10-19.9	20-24.9	25 & more
Trunk Fat %				**Normal**	**High**	**Very high**
				<15	16-18	18+
Visceral Fat %				**0 (Normal)**	**+ (High)**	**++ (Very High)**
				0.5-9.5	10.0-14.5	15.0-30.0
Skeletal Muscle %	**Gender**	**Age**	**-(Low)**	**0 (Normal)**	**+ (High)**	**++ (Very High)**
	Female	18-39	< 24.3	24.3-30.3	30.4-35.3	≥ 35.4
		40-59	< 24.1	24.1-30.1	30.2-35.1	≥ 35.2
		60-80	< 23.9	23.9-29.9	30.0-34.9	≥ 35.0
	Male	18-39	< 33.3	33.3-39.3	39.4-44.0	≥ 44.1
		40-59	< 33.1	33.1-39.1	39.2-43.8	≥ 43.9
		60-80	< 32.9	32.9-38.9	39.0-43.6	≥ 43.7
BMI			**Under wt**	**Normal**	**Over wt**	**Obese**
			Up to18.4	18.5-24.9	25-29.9	30 & more

Table 2. Date of Birth of Undergraduate Students

Case No.	Date of Birth	Case No.	Date of Birth	Case No.	Date of Birth	Case No.	Date of Birth	Case No.	Date of Birth	Case No.	Date of Birth
1	04.10.1992	24	03.09.1995	47	28.04.1996	70	26.08.1996	93	16.11.1996	116	02.04.1997
2	04.09.1993	25	12.09.1995	48	28.04,1996	71	29.08.1996	94	24.11.1996	117	03.04.1997
3	07.09.1993	26	23.09.1995	49	01.05.1996	72	03.09.1996	95	25.11.1996	118	14.04.1997
4	05.01.1994	27	02.10.1995	50	13.05.1996	73	05.09.1996	96	26.11.1996	119	22.04.1997
5	05.05.1994	28	06.11.1995	51	22.05.1996	74	11.09.1996	97	28.11.1996	120	30.04.1997
6	24.08.1994	29	11.11.1995	52	27.05.1996	75	20.09.1996	98	04.12.1996	121	03.05.1997
7	04.09.1994	30	14.11.1995	53	27.05.1996	76	24.09.1996	99	10.12.1996	122	27.05.1997
8	14.10.1994	31	18.11.1995	54	05.06.1996	77	29.09.1996	100	20.12.1996	123	10.05.1997
9	22.12.1994	32	28.11.1995	55	11.06.1996	78	02.10.1996	101	22.12.1996	124	29.05.1997
10	21.02.1995	33	02.12.1995	56	18.06.1996	79	02.10.1996	102	31.12.1996	125	09.06.1997
11	04.03.1995	34	28.02.1995	57	20.06.1996	80	07.10.1996	103	02.01.1997	126	13.06.1997
12	27.03.1995	35	29.01.1996	58	22.06.1996	81	11.10.1996	104	07.01.1997	127	26.06.1997
13	09.04.1995	36	20.02.1996	59	07.07.1996	82	12.10.1996	105	09.01.1997	128	30.06.1997
14	28.04.1995	37	23.02.1996	60	08.07.1996	83	17.10.1996	106	16.01.1997	129	17.07.1997
15	09.05.1995	38	26.02.1996	61	09.07.1996	84	18.10.1996	107	20.01.1997	130	20.07.1997
16	28.05.1995	39	05.03.1996	62	24.07.1996	85	21.10.1996	108	21.01.1997	131	24.07.1997
17	14.06.1995	40	06.03.1996	63	24.07.1996	86	22.10.1996	109	01.02.1997	132	28.07.1997
18	16.06.1995	41	02.04.1996	64	25.07.1996	87	23.10.1996	110	01.03.1997	133	30.07.1997
19	29.06.1995	42	05.04.1996	65	25.07.1996	88	23.10.1996	111	10.03.1997	134	12.08.1997
20	30.06.1995	43	12.04.1996	66	31.07.1996	89	25.10.1996	112	13.03.1997	135	15.08.1997
21	12.07.1995	44	15.04.1996	67	01.08.1996	90	26.10.1996	113	17.03.1997	136	24.08.1997
22	20.7.1995	45	18.04.1996	68	01.08.1996	91	11.11.1996	114	24.03.1997	137	24.08.1997
23	26.08.1995	46	28.04.1996	69	11.08.1996	92	14.11.1996	115	29.03.1997	138	20.08.1998

Table 3. Body composition analysis of undergraduate students using bioelectrical impedance analysis method

Case No	Male / Female	Age	Height cm	Weight Kg	Fat %	Subcutaneous Fat %				Visceral Fat %	Skeletal Muscle %				RM Kcal	BMI	Body Age
						Whole Body	Trunk	Arms	Legs		Whole body	Trunk	Arms	Legs			
1	Female	23	148	68	38	36	31	52	51	12	22	17	22	36	1351	31	45
2	Female	22	149	40	26	20	17	38	32	1.5	26	22	32	37	971	18	18
3	Male	22	173	78	26	18	17	27	27	9.5	32	24	38	49	1720	26	41
4	Male	22	176	59	12	8.2	6.8	14	13	2.5	38	33	42	55	1479	19	18
5	Male	22	169	57	18	17	12	28	26	1.5	33	27	36	46	1291	20	18
6	Male	21	165	61	17	12	11	18	18	5.5	35	29	40	52	1478	22	25
7	Female	21	159	48	34	25	23	48	40	1.5	25	21	29	35	1071	19	23
8	Male	21	171	69	20	14	12	21	20	7	34	28	40	52	1611	24	30
9	Male	21	186	68	15	10	8.5	16	15	3	38	32	42	55	1632	20	19
10	Female	21	160	45	31	23	21	44	36	1	26	22	31	35	1045	18	18
11	Female	21	154	39	28	20	17	39	32	0.5	27	23	33	35	949	16	18
12	Female	21	148	40	27	21	18	39	33	1.5	26	22	32	36	968	18	18
13	Female	21	157	60	34	29	25	48	44	5	24	19	26	37	1255	25	34
14	Female	21	160	60	35	29	25	49	44	4.5	24	19	26	36	1249	23	34
15	Female	21	155	56	36	29	26	50	45	4	24	19	26	36	1189	23	33
16	Female	21	150	44	35	26	24	49	41	2.5	24	20	29	33	1012	20	24
17	Male	21	159	42	19	12	9.8	19	18	1	36	29	42	53	1166	17	18
18	Male	21	161	52	30	24	21	43	37	2	26	22	30	38	1155	20	24
19	Female	21	148	52	31	27	23	44	41	4.5	24	20	28	37	1141	24	31
20	Female	21	166	51	27	21	18	39	34	1.5	28	23	32	37	1142	18	18
21	Female	20	155	41	30	22	19	43	34	1	26	22	32	34	976	17	18
22	Male	20	171	56	14	9.5	7.9	16	15	2.5	37	32	42	54	1414	19	18
23	Female	20	150	45	32	25	22	45	39	2.5	25	21	29	35	1035	20	23
24	Female	20	157	48	27	22	18	40	35	2	27	23	31	38	1092	19	20
25	Female	20	152	38	20	16	12	31	27	0.5	29	25	36	39	953	16	18
26	Female	20	160	49	34	25	23	47	40	2	25	21	29	35	1098	19	23
27	Male	20	164	58	24	16	14	25	25	5	33	26	40	50	1401	22	25
28	Female	20	158	52	29	24	20	41	37	2.5	26	22	30	38	1161	21	25
29	Female	20	157	54	31	26	22	44	39	3	26	21	29	38	1173	22	28
30	Female	20	155	44	22	19	15	34	30	1.5	28	24	34	39	1055	19	18
31	Female	20	153	43	25	20	16	37	32	1.5	27	23	33	38	1023	19	18
32	Female	20	152	40	30	22	19	42	34	1	26	22	32	35	959	17	18
33	Female	20	167	51	23	19	15	35	31	1	29	24	33	39	1156	18	18
34	Female	20	148	33	30	20	19	42	31	0.5	26	23	34	34	855	15	18
35	Female	20	154	44	26	21	17	38	33	1.5	27	23	32	38	1042	19	18
36	Male	20	180	57	12	7.8	6.2	14	13	1.5	39	34	44	56	1449	18	18
37	Male	20	163	56	17	12	10	19	18	4.5	35	29	41	52	1404	21	21
38	Female	20	162	45	27	20	17	39	33	1	28	24	33	37	1051	17	18
39	Male	20	175	72	25	17	15	26	25	6.5	33	25	39	50	1636	24	33
40	Female	20	169	51	24	19	15	36	31	1	29	25	33	40	1159	18	18
41	Female	20	149	36	24	18	15	36	30	0.5	27	24	34	36	914	16	18
42	Female	20	155	64	33	30	26	45	43	6.5	25	19	26	38	1321	27	36
43	Female	20	159	50	27	22	18	39	34	2	27	23	31	38	1124	20	21

44	Female	20	155	54	32	27	23	46	41	3.5	25	20	28	37	1168	22	29
45	Female	20	159	45	32	23	21	45	37	1	26	22	31	35	1033	18	18
46	Male	20	171	51	17	11	9.3	18	17	1.5	37	30	43	54	1328	18	18
47	Female	20	159	51	25	22	18	37	34	2.5	28	23	32	39	1154	20	22
48	Female	20	157	67	36	32	28	51	48	7	23	18	23	36	1342	27	39
49	Male	20	171	56	16	11	9.2	18	17	2.5	36	30	42	53	1402	19	18
50	Male	20	162	42	11	6.9	5.3	13	12	0.5	38	33	44	55	1181	16	18
51	Female	20	152	36	25	18	15	36	29	0.5	28	24	35	36	912	16	18
52	Female	20	155	47	24	21	17	36	32	2	28	23	32	39	1094	20	19
53	Male	20	163	81	28	20	19	28	28	14	30	23	36	48	1752	30	44
54	Male	20	169	51	7.9	5.6	––	11	9.5	1.5	39	35	44	56	1348	18	18
55	Female	20	171	58	27	22	18	39	35	1.5	28	23	31	39	1259	20	22
56	Female	20	156	58	31	27	24	45	41	4.5	25	20	27	38	1242	24	32
57	Female	20	157	47	28	22	19	41	35	1.5	27	22	31	37	1073	19	19
58	Female	20	149	39	34	24	22	47	37	1.5	25	21	31	33	941	18	18
59	Female	19	155	43	27	21	17	39	33	1.5	27	23	33	31	1013	18	18
60	Male	19	179	48	13	8.6	6.6	15	14	0.5	40	34	45	57	1291	15	18
61	Male	19	173	51	13	8.7	7	15	14	1	38	33	44	55	1341	17	18
62	Female	19	158	55	31	26	22	44	39	3.5	26	21	28	37	1190	22	29
63	Female	19	150	40	29	22	19	41	34	1	26	22	32	35	958	18	18
64	Female	19	154	43	27	21	18	40	34	1.5	26	23	32	37	1017	18	18
65	Female	19	159	49	25	21	17	37	33	1.5	28	23	32	39	1118	19	19
66	Male	19	165	52	20	13	11	21	20	3	35	28	41	52	1326	19	18
67	Female	19	158	42	30	21	19	42	34	1	27	23	32	35	995	17	18
68	Female	19	153	37	23	17	14	34	28	0.5	28	25	35	36	932	16	18
69	Female	19	150	45	30	24	21	43	37	2.5	25	21	30	36	1040	20	22
70	Female	19	169	46	20	16	12	32	28	0.5	30	26	36	40	1091	16	18
71	Female	19	157	42	28	21	18	40	33	1	27	23	33	36	1006	17	18
72	Female	19	162	76	40	35	32	56	54	8.5	22	17	20	35	1462	29	44
73	Female	19	172	48	18	15	11	30	26	0.5	31	27	37	41	1129	16	18
74	Female	19	166	61	30	25	21	42	38	3	27	21	28	39	1294	22	28
75	Female	19	152	53	29	26	22	42	38	4	26	21	29	38	1169	23	28
76	Female	19	152	56	36	30	27	50	46	4.5	23	19	26	36	1182	24	33
77	Female	19	155	39	23	18	14	35	29	0.5	28	25	35	38	974	16	18
78	Female	19	155	44	24	20	16	36	32	1.5	28	23	33	39	1042	18	18
79	Male	19	172	46	––	––	––	––	––	––	41	––	46	58	––	16	––
80	Male	19	165	50	19	12	10	20	19	2.5	36	29	42	53	1303	18	18
81	Female	19	159	47	28	22	18	40	34	1.5	27	23	32	37	1073	18	18
82	Female	19	161	84	41	38	34	57	57	12	22	16	18	36	1576	32	49
83	Female	19	162	72	37	33	29	51	49	7.5	24	18	22	37	1428	28	41
84	Female	19	167	76	36	32	28	50	47	6.5	24	18	22	37	1492	27	41
85	Female	19	150	47	29	24	20	41	37	2.5	26	21	30	37	1069	21	23
86	Male	19	170	50	16	11	8.6	17	16	1.5	37	31	43	54	1316	17	18
87	Female	19	153	45	25	21	17	37	33	1.5	27	23	32	38	1056	19	18
88	Female	19	155	37	21	16	13	33	27	0.5	29	25	36	37	946	16	18
89	Female	19	155	72	34	33	28	47	45	9.5	25	19	24	39	1443	30	41
90	Female	19	160	45	24	19	15	36	31	1	28	24	34	39	1068	18	18
91	Female	19	153	48	28	23	20	41	36	2.5	26	22	31	37	1093	21	22

92	Female	19	150	60	37	32	28	52	49	6.5	23	18	24	35	1238	27	37
93	Female	19	159	44	22	18	14	34	29	1	29	25	35	39	1043	17	18
94	Female	19	160	49	28	22	19	41	35	1.5	27	23	31	37	1110	19	19
95	Female	19	150	50	27	24	20	39	36	3	26	22	30	39	1125	22	24
96	Female	19	155	42	22	18	14	34	30	1	28	24	34	39	1018	18	18
97	Male	19	168	58	12	8.8	7.5	15	13	4	37	32	42	54	1454	21	18
98	Female	19	158	43	26	20	17	38	32	1	27	24	33	37	1027	17	18
99	Male	19	165	49	16	11	8.8	18	17	2	36	31	43	54	1285	18	18
100	Female	19	160	55	28	24	20	41	37	3	27	22	30	39	1205	22	26
101	Female	19	160	60	30	27	22	43	39	4	26	21	28	39	1279	24	31
102	Female	19	156	45	27	21	18	39	34	1.5	27	23	32	38	1055	19	18
103	Male	19	170	58	8	6	--	11	9.2	3.5	39	35	43	56	1473	20	18
104	Female	19	154	69	37	34	30	52	50	9	23	18	22	36	1380	29	41
105	Male	19	171	53	20	13	11	20	20	2	36	29	42	53	1347	18	18
106	Female	19	159	52	31	25	21	44	39	2.5	26	21	29	36	1144	21	24
107	Female	19	155	60	30	28	23	43	40	5	26	21	28	39	1268	25	32
108	Female	19	157	46	28	22	19	41	35	1.5	27	23	32	37	1063	19	18
109	Female	19	153	39	30	21	19	42	34	1	26	23	33	35	950	17	18
110	Female	19	153	32	21	15	11	32	25	0.5	29	26	37	36	853	14	18
111	Female	19	157	52	27	23	19	39	35	2.5	27	22	31	39	1160	21	23
112	Female	19	152	46	27	22	19	39	35	2	26	22	31	38	1063	20	20
113	Female	19	164	51	31	23	21	44	38	1.5	26	22	30	36	1132	19	21
114	Female	19	154	34	24	17	14	35	28	0.5	28	25	36	36	879	14	18
115	Female	19	153	53	31	26	22	44	40	3.5	25	21	28	37	1156	23	28
116	Female	19	165	51	28	22	19	41	36	1.5	27	23	31	37	1141	19	19
117	Female	19	153	57	34	29	26	48	44	4.5	24	19	26	36	1201	24	33
118	Female	19	161	42	17	15	10	29	26	0.5	31	27	37	40	1030	16	18
119	Female	19	154	38	19	16	11	31	27	0.5	29	26	36	39	963	16	18
120	Male	19	170	53	9	6.4	5.1	12	11	2	39	34	43	56	1389	18	18
121	Female	19	150	52	31	27	23	44	40	4	25	20	28	37	1139	23	28
122	Female	19	155	43	21	18	14	32	29	1	29	25	35	40	1038	18	18
123	Male	19	170	52	15	10	8.5	17	16	2	37	31	43	54	1342	18	18
124	Female	19	153	47	26	22	18	38	34	2	27	23	32	39	1080	20	20
125	Female	19	151	39	23	18	14	35	30	1	28	24	34	38	962	17	18
126	Male	19	174	78	27	19	17	28	28	9	32	24	38	49	1726	26	38
127	Female	19	165	44	24	18	15	36	30	0.5	29	25	35	39	1042	16	18
128	Female	19	157	43	26	20	16	38	32	1	27	24	33	38	1017	17	18
129	Female	18	156	38	25	18	15	37	30	0.5	28	24	35	37	946	16	18
130	Female	18	160	51	26	22	18	38	34	2	28	23	32	39	1154	20	21
131	Female	18	155	39	27	20	17	39	31	0.5	27	24	34	36	963	16	18
132	Female	18	151	43	26	21	17	38	33	1.5	27	23	32	37	1016	19	18
133	Female	18	168	43	20	15	11	31	27	0.5	30	27	37	39	1049	15	18
134	Female	18	156	46	27	21	18	39	34	1.5	27	23	32	37	1066	19	18
135	Female	18	160	55	28	24	20	40	36	2.5	27	22	30	39	1197	21	25
136	Female	18	163	43	22	17	13	34	29	0.5	29	25	35	39	1039	16	18
137	Female	18	158	40	20	16	12	32	27	0.5	29	26	36	39	987	16	18
138	Male	17	170	52	14	9.4	7.8	16	15	2	37	32	43	54	1356	18	18

Age test is a sensitive indicator of health disorders that allows us to make an early decision, so that hopefully health issues never become a problem.

Body age varies according to body composition and resting metabolism, even if our height and weight is the same.

Interpretation of Body composition result is shown in Table 1. Date of Birth of Undergraduate Students is shown in Table 2. Body composition analysis of undergraduate students of Brijlal Biyani Science College Amravati Maharashtra India using bioelectrical impedance analysis method is shown in Table 3.

RESULTS AND DISCUSSION

Ideal weight : The ideal BMI is 22. Maintaining an ideal weight can help prevent obesity or weight loss and other diseases, and lead a longer life. The ideal weight for BMI of 22 is calculated as follows.

Ideal Weight (Kg) = 22 × [height (m)]^2

However this method of ideal weight calculation may not be applicable for professional athletes and body builders, who have higher muscles ratio in their bodies.

Correct Weight Reduction: If we lose weight by going on a diet instead of doing exercise and neglecting nutrition balance, even if our weight is reduced, resting metabolism will decrease as muscle (Skeletal muscle) decreases and we are more likely to become fatter. We should build up non-fat physique by increasing skeletal muscle and improving resting metabolism.

Interpretation of body composition analysis report of undergraduate students is shown in table 4.

Table 4. Interpretation of body composition analysis report of undergraduate students

Case No	Ideal wt (Kg) = 22 × [ht (m)]^2	Over wt / Under wt Kg	Period required for wt Loss/Gain at the rate of 1.5 kg per month	Period required for wt Maintenance	Fat %	Subcutaneous Fat % (Trunk)	Visceral Fat %	Skeletal Muscle % (Whole body)	RM Kcal	BMI	Body Age
1	48.2	↓ 19.6 Kg Over wt	13 Month	13 Month	↓ Very High	↓ Very High	↓ High	↑Low	↑	↓ Obese	↓
2	48.8	↑ 8.8 Kg Under wt	6 Month	6 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
3	65.8	↓ 12.2 Kg Over wt	8 Month	8 Month	↓ Very High	↓ High	Normal	↑ Low	↑	↓ Over wt	↓
4	68.1	↑ 9.2 Kg Under wt	6 Month	6 Month	Normal	Normal	Normal	Normal	↑	Normal	↑
5	62.8	↑ 5.6 Kg Under wt	4 Month	4 Month	Normal	Normal	Normal	↑ Low	↑	Normal	↑
6	59.9	↓ 0.7 Kg Over wt	0.5 Month	0.5 Month	Normal	Normal	Normal	Normal	↑	Normal	↓
7	55.3	↑ 7.6 Kg Under wt	5 Month	5 Month	↓ High	↓ Very high	Normal	Normal	↑	Normal	↓
8	64.3	↓ 4.8 Kg Over wt	3 Month	3 Month	Normal	Normal	Normal	Normal	↑	Normal	↓
9	76.1	↑ 7.8 Kg Under wt	5 Month	5 Month	Normal	Normal	Normal	Normal	↑	Normal	↑
10	56.3	↑ 10.9 Kg Under wt	7 Month	7 Month	↓ High	↓ Very high	Normal	Normal	↑	↑ Under wt	↑
11	52.2	↑ 13.6 Kg Under wt	9 Month	9 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
12	48.2	↑ 8.3 Kg Under wt	5.5 Month	5.5 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
13	53.9	↓ 6 Kg Over wt	4 Month	4 Month	↓ High	↓ Very high	Normal	Normal	↑	Normal	↓
14	56.3	↓ 3.4 Kg Over wt	2 Month	2 Month	↓ High	↓ Very	Normal	↑ Low	↑	Normal	↓

						high					
15	52.9	↓ 3.2 Kg Over wt	2 Month	2 Month	↓ Very high	↓ Very high	Normal	↑ Low	↑	Normal	↓
16	49.5	↑ 5.3 Kg Under wt	3.5 Month	3.5 Month	↓ Very high	↓ Very high	Normal	↑ Low	↑	Normal	↓
17	55.6	↑ 13.7 Kg Under wt	9 Month	9 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
18	56.7	↑ 4.5 Kg Under wt	3 Month	3 Month	↓ Very high	↓ Very high	Normal	↑ Low	↑	Normal	↓
19	48.2	↓ 3.9 Kg Over wt	3 Month	3 Month	↓ High	↓ Very high	Normal	Normal	↑	Normal	↓
20	60.6	↑ 10 Kg Under wt	7 Month	7 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
21	52.9	↑ 12.1 Kg Under wt	8 Month	8 Month	↓ High	↓ Very high	Normal	Normal	↑	↑ Under wt	↑
22	64.3	↑ 8.6 Kg Under wt	6 Month	6 Month	Normal	Normal	Normal	Normal	↑	Normal	↑
23	49.5	↑ 4.3 Kg Under wt	3 Month	3 Month	↓ High	↓ Very high	Normal	Normal	↑	Normal	↓
24	54.2	↑ 6.5 Kg Under wt	4 Month	4 Month	Normal	↓ Very high	Normal	Normal	↑	Normal	–
25	50.8	↑ 13.1 Kg Under wt	9 Month	9 Month	↑ Low	Normal	Normal	Normal	↑	↑ Under wt	↑
26	56.3	↑ 7 Kg Under wt	5 Month	5 Month	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
27	58.8	↑ 1.3 Kg Under wt	1 Month	1 Month	↓ High	Normal	Normal	↓ High	↑	Normal	↓
28	54.9	↑ 2.5 Kg Under wt	2 Month	2 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
29	53.9	↑ 0.2 Kg Under wt	7 Days	7 Days	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
30	52.9	↑ 8.5 Kg Under wt	6 Month	6 Month	Normal	Normal	Normal	Normal	↑	Normal	↑
31	51.2	↑ 8.2 Kg Under wt	5.5 Month	5.5 Month	Normal	↓ High	Normal	Normal	↑	Normal	↑
32	50.8	↑ 11.1 Kg Under wt	7.5 Month	7.5 Month	Normal	↓ Very High	Normal	Normal	↑	↑ Under wt	↑
33	61.4	↑ 10.8 Kg Under wt	7 Month	7 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
34	48.2	↑ 15.2 Kg Under wt	10 Month	10 Month	↓ High	↓ Very High	Normal	Normal	↑	↑ Under wt	↑
35	52.2	↑ 7.9 Kg Under wt	5 Month	5 Month	Normal	↓ High	Normal	Normal	↑	Normal	↑
36	71.3	↑ 14.4 Kg Under wt	10 Month	10 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
37	58.5	↑ 2.4 Kg Under wt	2 Month	2 Month	Normal	Normal	Normal	Normal	↑	Normal	↓
38	57.4	↑ 12.6 Kg Under wt	8.5 Month	8.5 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
39	67.4	↓ 4.6 Kg Over wt	3 Month	3 Month	↓ High	Normal	Normal	↑ Low	↑	Normal	↓
40	62.8	↑ 11.9 Kg Under wt	8 Month	8 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
41	48.8	↑ 12.8 Kg Under wt	8.5 Month	8.5 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
42	52.5	↓ 11.3 Kg Over wt	7.5 Month	7.5 Month	↓ High	↓ Very High	Normal	Normal	↑	↓ Over wt	↓
43	55.6	↑ 6 Kg Under wt	4 Month	4 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
44	52.9	↓ 0.9 Kg Over wt	1 Month	1 Month	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
45	55.6	↑ 10.9 Kg Under wt	7 Month	7 Month	↓ High	↓ Very High	Normal	Normal	↑	↑ Under wt	↑

46	64	↑ 12.9 Kg Under wt	9 Month	9 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
47	55.3	↑ 4.1 Kg Under wt	3 Month	3 Month	Normal	↓ High	Normal	Normal	↑	Normal	↓
48	54.2	↓ 12.3 Kg Over wt	8 Month	8 Month	↓ Very High	↓ Very High	Normal	↑ Low	↑	↓ Over wt	↓
49	64	↑ 8.5 Kg Under wt	6 Month	6 Month	Normal	Normal	Normal	Normal	↑	Normal	↑
50	57.7	↑ 16.2 Kg Under wt	11 Month	11 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
51	50.8	↑ 15 Kg Under wt	10 Month	10 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
52	52.9	↑ 5.6 Kg Under wt	4 Month	4 Month	Normal	↓ High	Normal	Normal	↑	Normal	↑
53	58.5	↓ 22.4 Kg Over wt	15 Month	15 Month	↓ Very High	↓ Very High	Normal	↑ Low	↑	↓ Obese	↓
54	62.8	↑ 12.2 Kg Under wt	8 Month	8 Month	↑ Low	--	Normal	Normal	↑	↑ Under wt	↑
55	64.3	↑ 6.4 Kg Under wt	4 Month	4 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
56	53.5	↓ 4.9 Kg Over wt	3 Month	3 Month	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
57	54.2	↑ 7.5 Kg Under wt	5 Month	5 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↑
58	48.8	↑ 9.6 Kg Under wt	6 Month	6 Month	↓ High	↓ Very High	Normal	Normal	↑	↑ Under wt	↑
59	52.9	↑ 10.3 Kg Under wt	7 Month	7 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
60	70.5	↑ 22.7 Kg Under wt	15 Month	15 Month	Normal	Normal	Normal	↓ High	↑	↑ Under wt	↑
61	65.8	↑ 14.7 Kg Under wt	10 Month	10 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
62	54.6	↓ 0.3 Kg Over wt	7 Days	7 Days	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
63	49.5	↑ 10 Kg Under wt	7 Month	7 Month	Normal	↓ Very High	Normal	Normal	↑	↑ Under wt	↑
64	52.2	↑ 9.2 Kg Under wt	6 Month	6 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
65	55.6	↑ 6.7 Kg Under wt	4.5 Month	4.5 Month	Normal	↓ High	Normal	Normal	↑	Normal	–
66	59.5	↑ 7.7 Kg Under wt	5 Month	5 Month	Normal	Normal	Normal	Normal	↑	Normal	↑
67	54.9	↑ 13.1 Kg Under wt	9 Month	9 Month	Normal	↓ Very High	Normal	Normal	↑	↑ Under wt	↑
68	51.5	↑ 14.7 Kg Under wt	10 Month	10 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
69	49.5	↑ 4.3 Kg Under wt	3 Month	3 Month	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
70	62.5	↑ 16.5 Kg Under wt	11 Month	11 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
71	54.2	↑ 12 Kg Under wt	8 Month	8 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
72	57.7	↓ 17.9 Kg Over wt	12 Month	12 Month	↓ Very High	↓ Very High	Normal	↑ Low	↑	↓ Over wt	↓
73	65.1	↑ 17.3 Kg Under wt	11.5 Month	11.5 Month	↑ Low	Normal	Normal	↓ High	↑	↑ Under wt	↑
74	60.6	↓ 0.4 Kg Over wt	14 Days	14 Days	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
75	50.5	↓ 2.7 Kg Over wt	2 Month	2 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
76	50.8	↓ 4.9 Kg Over wt	3 Month	3 Month	↓ Very High	↓ Very High	Normal	↑ Low	↑	Normal	↓
77	52.9	↑ 13.5 Kg Under wt	9 Month	9 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑

78	52.5	↑ 8.5 Kg Under wt	6 Month	6 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
79	65.1	↑ 19.2 Kg Under wt	13 Month	13 Month	–	–	Normal	↓ High	↑	↑ Under wt	–
80	59.9	↑ 9.8 Kg Under wt	6.5 Month	6.5 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
81	55.6	↑ 9.1 Kg Under wt	6 Month	6 Month	Normal	↓ Very High	Normal	Normal	↑	↑ Under wt	↑
82	57	↓ 26.8 Kg Over wt	18 Month	18 Month	↓ Very High	↓ Very High	Normal	↑ Low	↑	↓ Obese	↓
83	57.4	↓ 14.7 Kg Over wt	10 Month	10 Month	↓ Very High	↓ Very High	Normal	↑ Low	↑	↓ Over wt	↓
84	61.4	↓ 14.5 Kg Over wt	10 Month	10 Month	↓ Very High	↓ Very High	Normal	Normal	↑	↓ Over wt	↓
85	49.2	↑ 2.5 Kg Under wt	2 Month	2 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
86	63.6	↑ 13.4 Kg Under wt	9 Month	9 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
87	51.5	↑ 6.4 Kg Under wt	4 Month	4 Month	Normal	↓ High	Normal	Normal	↑	Normal	↑
88	52.9	↑ 15.5 Kg Under wt	10 Month	10 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
89	52.9	↓ 19.3 Kg Over wt	13 Month	13 Month	↓ High	↓ Very High	Normal	Normal	↑	↓ Obese	↓
90	56.3	↑ 10.9 Kg Under wt	7 Month	7 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
91	51.5	↑ 3.5 Kg Under wt	2 Month	2 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
92	49.5	↓ 10.3 Kg Over wt	7 Month	7 Month	↓ Very High	↓ Very High	Normal	↑ Low	↑	↓ Over wt	↓
93	55.3	↑ 11.8 Kg Under wt	8 Month	8 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
94	56.3	↑ 7.4 Kg Under wt	5 Month	5 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	–
95	49.5	↓ 0.4 Kg Over wt	14 Days	14 Days	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
96	52.9	↑ 10.8 Kg Under wt	7 Month	7 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
97	61.7	↑ 3.9 Kg Under wt	3 Month	3 Month	Normal	Normal	Normal	Normal	↑	Normal	↑
98	54.9	↑ 11.6 Kg Under wt	8 Month	8 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
99	59.9	↑ 11.4 Kg Under wt	8 Month	8 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
100	56	↑ 0.9 Kg Under wt	1 Month	1 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
101	56.3	↓ 4 Kg Over wt	3 Month	3 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
102	53.5	↑ 8.3 Kg Under wt	5.5 Month	5.5 Month	Normal	↓ High	Normal	Normal	↑	Normal	↑
103	63.2	↑ 5.4 Kg Under wt	4 Month	4 Month	↑ Low	–	Normal	Normal	↑	Normal	↑
104	52.2	↓ 17.1 Kg Over wt	11.5 Month	11.5 Month	↓ Very High	↓ Very High	Normal	↑ Low	↑	↓ Over wt	↓
105	64.3	↑ 11.6 Kg Under wt	8 Month	8 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
106	55.6	↑ 3.8 Kg Under wt	2.5 Month	2.5 Month	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
107	52.5	↓ 7.2 Kg Over wt	5 Month	5 Month	↓ High	↓ Very High	Normal	Normal	↑	↓ Over wt	↓
108	54.2	↑ 8.2 Kg Under wt	5.5 Month	5.5 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↑

109	51.5	↑ 12.5 Kg Under wt	8 Month	8 Month	Normal	↓ Very High	Normal	Normal	↑	↑ Under wt	↑
110	51.5	↑ 19.9 Kg Under wt	13 Month	13 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
111	53.9	↑ 2 Kg Under wt	1.5 Month	1.5 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
112	50.5	↑ 4.6 Kg Under wt	3 Month	3 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
113	59.2	↑ 8.4 Kg Under wt	6 Month	6 Month	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
114	51.8	↑ 18.2 Kg Under wt	12 Month	12 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
115	51.5	↓ 1.2 Kg Over wt	1 Month	1 Month	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
116	59.9	↑ 9 Kg Under wt	6 Month	6 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	–
117	51.5	↓ 5.1 Kg Over wt	3.5 Month	3.5 Month	↓ High	↓ Very High	Normal	↑ Low	↑	Normal	↓
118	57	↑ 15.2 Kg Under wt	10 Month	10 Month	↑ Low	Normal	Normal	↓ High	↑	↑ Under wt	↑
119	52.2	↑ 14 Kg Under wt	9 Month	9 Month	↑ Low	Normal	Normal	Normal	↑	↑ Under wt	↑
120	63.6	↑ 10.4 Kg Under wt	7 Month	7 Month	↑ Low	Normal	Normal	Normal	↑	↑ Under wt	↑
121	49.2	↓ 2.5 Kg Over wt	2 Month	2 Month	↓ High	↓ Very High	Normal	Normal	↑	Normal	↓
122	52.4	↑ 9.4 Kg Under wt	6 Month	6 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
123	63.6	↑ 11.9 Kg Under wt	8 Month	8 Month	↑ Low	Normal	Normal	Normal	↑	↑ Under wt	↑
124	51.5	↑ 4.7 Kg Under wt	3 Month	3 Month	Normal	↓ High	Normal	Normal	↑	Normal	↓
125	50.2	↑ 11.4 Kg Under wt	8 Month	8 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
126	66.6	↓ 11.8 Kg Over wt	8 Month	8 Month	↓ Very High	↓ High	Normal	↑ Low	↑	↓ Over wt	↓
127	59.9	↑ 16.2 Kg Under wt	11 Month	11 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
128	53.9	↑ 11.3 Kg Under wt	7.5 Month	7.5 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
129	53.5	↑ 15.5 Kg Under wt	10 Month	10 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
130	56.3	↑ 5.1 Kg Under wt	3 Month	3 Month	Normal	↓ High	Normal	Normal	↑	Normal	↓
131	52.9	↑ 13.6 Kg Under wt	9 Month	9 Month	Normal	↓ High	Normal	Normal	↑	↑ Under wt	↑
132	50.2	↑ 7.5 Kg Under wt	5 Month	5 Month	Normal	↓ High	Normal	Normal	↑	Normal	↑
133	62.1	↑ 18.8 Kg Under wt	12.5 Month	12.5 Month	↑ Low	Normal	Normal	Normal	↑	↑ Under wt	↑
134	53.5	↑ 7.5 Kg Under wt	5 Month	5 Month	Normal	↓ High	Normal	Normal	↑	Normal	↑
135	56.3	↑ 1.8 Kg Under wt	1 Month	1 Month	Normal	↓ Very High	Normal	Normal	↑	Normal	↓
136	58.5	↑ 15.3 Kg Under wt	10 Month	10 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
137	54.9	↑ 15.1 Kg Under wt	10 Month	10 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑
138	63.2	↑ 11 Kg Under wt	7 Month	7 Month	Normal	Normal	Normal	Normal	↑	↑ Under wt	↑

Table 5. Correct Weight Reduction in Case No. 82

Month	Weight Kg	Fat %	Subcutaneous Fat % (Trunk)	Visceral Fat %	Skeletal Muscle % (Whole body)	BMI	Body Age
0	84	41	34	12	22	32	49
1	82.5	39.9	32.9	11.8	22.4	31.5	47.3
2	81	38.8	31.8	11.6	22.8	31	45.6
3	79.5	37.7	30.7	11.4	23.2	30.5	43.9
4	78	36.6	29.6	11.2	23.6	30	42.2
5	76.5	35.5	28.5	11	24	29.5	40.5
6	75	34.4	27.4	10.8	24.4	29	38.8
7	73.5	33.3	26.3	10.6	24.8	28.5	37.1
8	72	32.2	25.2	10.4	25.2	28	35.4
9	70.5	31.1	24.1	10.2	25.6	27.5	33.7
10	69	30	23	10	26	27	32
11	67.5	28.9	21.9	9.8	26.4	26.5	30.3
12	66	27.8	20.8	9.6	26.8	26	28.6
13	64.5	26.7	19.7	9.4	27.2	25.5	26.9
14	63	25.6	18.6	9.2	27.6	25	25.2
15	61.5	24.5	17.5	9	28	24.5	23.5
16	60	23.4	16.4	8.8	28.4	24	21.8
17	58.5	22.3	15.3	8.6	28.8	23.5	20.1
18	57	21.2	14.2	8.4	29.2	23	18.4
Normal Value	**57**	**20-29.9**	**<15**	**0.5-9.5**	**24.3-30.3**	**18.5-24.9**	**19**

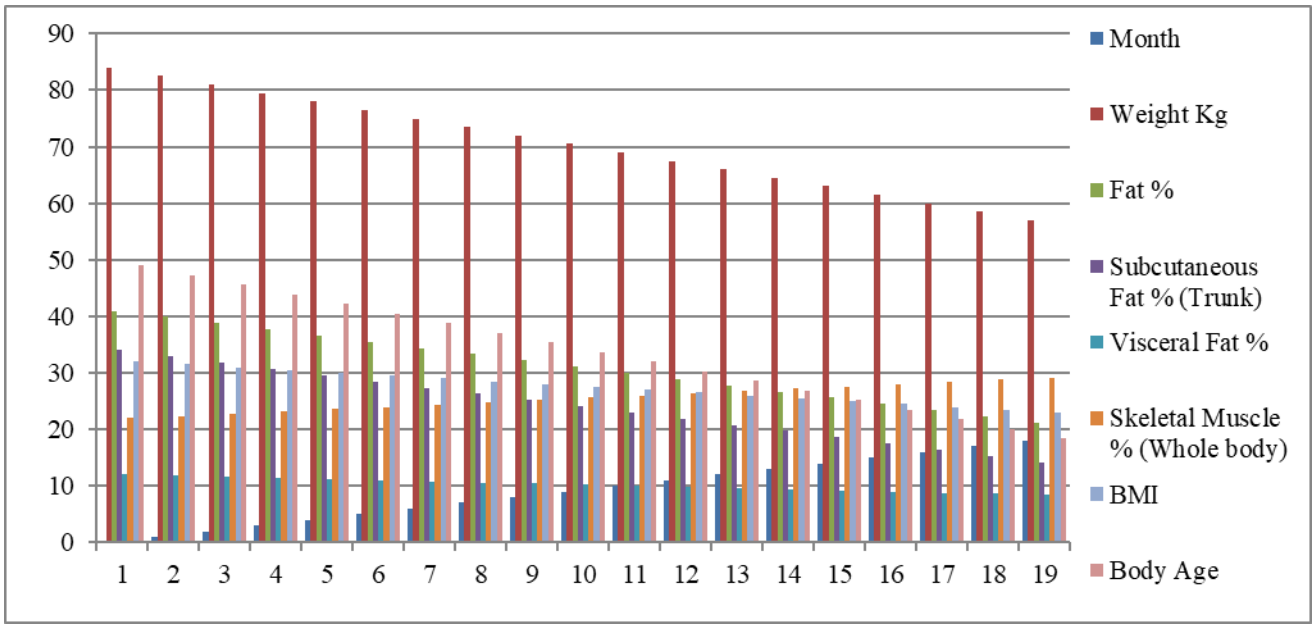

Figure 2 Correct Weight Reduction in Case No. 82

In table 4 sign ↑ indicates corresponding value should increase and sign ↓ indicates corresponding value should decrease during weight loss or weight gain programme.

In case number 1 – Fat %, subcutaneous trunk Fat % and visceral fat % has to be decreased and whole body skeletal muscle % and RM has to be increased so that BMI and body age can be decreased. And has to undergo 13 month weight loss programme (at the rate of 1.5 kg

per month) to decrease 19.6 Kg weight. And has to undergo 13 month weight maintain programme.

In case number 2 - Subcutaneous trunk Fat % has to be decreased and RM has to be increased so that BMI and body age can be increased. And has to undergo 6 month weight gain programme to increase 8.8 Kg weight. And has to undergo 6 month weight maintain programme.

In case number 3 – Fat % and Subcutaneous trunk Fat % has to be decreased and whole body skeletal muscle % and RM has to be increased so that BMI and body age can be decreased. And has to undergo 8 month weight loss programme to decrease 12.2 Kg weight. And has to undergo 8 month weight maintain programme.

In case number 4 - RM has to be increased so that body age can be increased and has to undergo 6 month weight gain programme to increase 9.2 kg weight. And has to undergo 6 month weight maintain programme.

In case number 5 - Whole body skeletal muscle % and RM has to be increased so that body age can be increased. And has to undergo 4 month weight gain programme to increase 5.6 Kg weight. And has to undergo 4 month weight maintain programme.

Likewise interpretation of body composition analysis report of other cases (undergraduate students) can be done. Correct Weight Reduction in Case No. 82 is shown in Table 5 and Figure 2.

Weight Loss, weight gain and weight maintenance programme: Research shows that complementing exercise along with a proper diet is the key to a healthy lifestyle. This further keeps an individual away from many chronic diseases like diabetes, hypertension, coronary heart disease, obesity, osteoporosis, ill mental health, cancers, stroke and back injury. In today's world, exercising routine is regarded imperfect without vital elements called Bodybuilding supplements. They act as a fuel for our body and boost sporting performance. Bodybuilding supplements are dietary supplements to enhance weight gain, promote weight loss, replace meals and improve performance. They are specially prepared to complement the diet and provide essential nutrients like vitamins, minerals, fatty acids, amino acids, etc. that may be missing or found in insufficient quantities in one's diet.

Herbalife is a world leader in the wellness industry, in business for more than 29 years. They are the pioneer in meal replacement and weight management programme. The company has a range of inner nutritional products suitable for all age groups. They have 3 entries in the Guinness book of world records - They created the maximum number of millionaires in the world; Their Company has trained 10,242 people across the world on a single conference call and; One overweight person Mr. Jim Poore lost 182.5 Kg by using Herbalife products in 19 months. Their products do - detoxification and cleansing of body systems from the inside; weight management; supplementation; anti-aging; and prevent future diseases. Among these are Aloe Plus Tablet, Afresh, Cell -U -Loss Tablet, Personalized Protein Powder, Nutritional Shake Mix, Multivitamin Mineral and Herbal Tablet, Cell Activator Tablet, Activated Fiber Tablet for better weight management.

Aloe Plus Tablet Soothes, cleanses and supports digestive system; Helps to gently dispose of toxins accumulated in the body; Better absorption of nutrients; Aloe vera and other herbs enhances digestion and boosts immunity.

Afresh An invigorating and refreshing energy drink powered by 'Guarana', a Brazilian plant from the Amazon. Its seed contains a substance similar to caffeine known as Guaraine that provide an energetic boost; Available in 4 flavors of Lemon, Peach, Elaichi and Ginger; Can take this drink mix hot or cold; Rich in antioxidants; It can be prepared by taking 1 gm (1 spoon) of Afresh powder in 200 ml (One glass) Hot or Cold water.

Cell -U -Loss Tablet Reduces the appearance of unsightly dimpled; Helps eliminate excess body fluid; Herbal blend of plant - based nutrients.

Personalized Protein Powder Helps to build and maintain lean muscle mass. Protein supplement to satisfy our hunger; Soy and whey protein and essential amino acids.

Nutritional Shake Mix A Nutritious meal with vitamins, minerals and essential nutrients; Protein and healthy fiber help support weight management; Available in 3 delicious flavors of Mango, Chocolate and Vanilla.

Milk Shake It can be prepared by taking 1 spoon of Personalized Protein powder and 2 spoon Nutritional Shake Mix in 250 ml chilled non fat milk. Shake till uniform mixture.

Multivitamin Mineral and Herbal Tablet Essential vitamins, minerals and antioxidants; Supports our immune system; Compliments the nutrition available in Nutritional Shake Mix.

Cell Activator Tablet Powerful antioxidants; Improves nutrient absorption; Enhances vitality and energy.

Activated Fiber Tablet Cleanses and supports the digestive system and reduces fat absorption which leads to better weight management; Adequate dietary fiber is essential for good health. Includes citrus and oat to increase our fiber intake.

Table 6 shows weight loss, weight gain and weight maintenance programme.

Table 6. Weight loss programme, weight gain programme and weight maintenance programme

Programme	Time	Activity / Product	Time / Amount
Weight Loss Programme	Early Morning	Morning Walk	1 Hour
		Aloe Plus Tablet	1 tablet
		Afresh	200 ml (One glass)
		Cell -U -Loss Tablet	1 tablet
		Exercise and Yoga	1 Hour
	Morning	Personalized Protein Powder	250 ml milk shake
		Nutritional Shake Mix	
	Afternoon	Multivitamin Mineral and Herbal Tablet	1 tablet
		Cell Activator Tablet	1 tablet
		Healthy Lunch	
	Evening	Bicycle ride (Cycling)	1 Hour
		Activated Fiber Tablet	1 tablet
		Personalized Protein Powder	250 ml milk shake
		Nutritional Shake Mix	
Weight Gain Programme	Early Morning	Morning Walk	1 Hour
		Aloe Plus Tablet	1 tablet
		Afresh	200 ml (One glass)
		Exercise and Yoga	1 Hour
	Morning	Personalized Protein Powder	250 ml milk shake
		Nutritional Shake Mix	
	Afternoon	Healthy Lunch	
		Multivitamin Mineral and Herbal Tablet	1 tablet
		Cell Activator Tablet	1 tablet
	Evening	Bicycle ride (Cycling)	1 Hour
		Healthy dinner	
		Activated Fiber Tablet	1 tablet
	Night	Personalized Protein Powder	250 ml milk shake
		Nutritional Shake Mix	
Weight Maintenance Programme	Early Morning	Morning Walk	1 Hour
		Aloe Plus Tablet	1 tablet
		Afresh	200 ml (One glass)
		Exercise and Yoga	1 Hour
	Morning	Personalized Protein Powder	250 ml milk shake
		Nutritional Shake Mix	
	Afternoon	Healthy Lunch	
		Multivitamin Mineral and Herbal Tablet	1 tablet
		Cell Activator Tablet	1 tablet
	Evening	Bicycle ride (Cycling)	1 Hour
		Healthy dinner	
		Activated Fiber Tablet	1 tablet

Table 7:

Female + Male			Female			Male		
BMI	**No. out of Total 138**	**No. out of 100 %**	**BMI**	**No. out of Total 106**	**No. out of 100 %**	**BMI**	**No. out of Total 32**	**No. out of 100 %**
Under weight	61	44.2	**Under weight**	46	43.4	**Under weight**	15	46.9
Normal	63	45.7	**Normal**	49	46.2	**Normal**	14	43.8
Over weight	10	7.2	**Over weight**	8	7.5	**Over weight**	2	6.3
Obese	4	2.9	**Obese**	3	2.8	**Obese**	1	3.1
Total	138	100	**Total**	106	100	**Total**	32	100

CONCLUSION

For ideal weight management and for a more accurate and precise body composition analysis full Body Sensing Technology Karada Scan Body Composition Monitor – HBF-375 can be used. Karada Scan measures body resistance by using weak current flowing through both hands and both feet (Bioelectrical Impedance / Biological resistance method). Tissues with more water content in human body tend to conduct electricity (such as muscle and vein) easily. Fat tissue almost conducts no electricity. The body feature is used to calculate percentage of fat tissue and non fat tissue. Current flowing through human body is very weak (50 KHz, 500μA), which is not stimulant and is very safe to human body.

There is little scope for technician error as such, but factors such as eating, drinking and exercising must be controlled since hydration level is an important source of error in determining the flow of the electric current to estimate body fat. The instructions for use of instruments typically recommends that measurements should not be done soon after drinking or eating or exercising, or when dehydrated. Instruments require details such as sex, age and height to be entered, and use formulae taking these into account; for example, men and women store fat differently around the abdomen and thigh region.

It is important to know our biological age. If we know where the problems exist, we can initiate the lifestyle modifications necessary to improve our health and increase our vitality. Maintaining an ideal weight can help prevent obesity or weight loss and other diseases, and lead a longer life. We should build up non-fat physique by increasing skeletal muscle and improving resting metabolism.

Complementing exercise along with a proper diet is the key to a healthy lifestyle. In today's world, exercising routine is regarded imperfect without vital elements called Bodybuilding supplements. They act as a fuel for our body and boost sporting performance. Herbalife is a world leader in the wellness industry. Their products do detoxification and cleansing of body systems from the inside, weight management, supplementation, anti-aging, prevent future diseases. Among these are Aloe Plus Tablet, Afresh, Cell -U -Loss Tablet, Personalized Protein Powder, Nutritional Shake Mix, Multivitamin Mineral and Herbal Tablet, Cell Activator Tablet, Activated Fiber Tablet for better weight management.

Interpretation of body composition analysis report of undergraduate students (Female + Male) shows that underweight person is 44.2 %; normal person is 45.7 %; Overweight person is 7.2 % and obese person is 2.9 %.
Interpretation of body composition analysis report of undergraduate students (Female) shows that underweight person is 43.4 %; normal person is 46.2 %; Overweight person is 7.5 % and obese person is 2.8 %.

Interpretation of body composition analysis report of undergraduate students (Male) shows that underweight person is 46.9 %; normal person is 43.8 %; Overweight person is 6.3 % and obese person is 3.1 %.

REFERENCES

1. Kyle, Ursula G.; Bosaeus, Ingvar; De Lorenzo, Antonio D.; Deurenberg, Paul; Elia, Marinos; Gómez, José Manuel; Heitmann, Berit Lilienthal; Kent-Smith, Luisa et al.. "Bioelectrical impedance analysis—part I: review of principles and methods". *Clinical Nutrition,* 2004, 23 (5): 1226 43. doi:10.1016/j.clnu. 2004.06.004.
2. Body fat scales review and compare". 10 January 2010. Retrieved 11 January 2010.

3. Lukaski HC, Bolonchuk WW, Hall CB, Siders WA . "Validation of tetrapolar bioelectrical impedance method to assess human body composition (PDF). *J. Appl. Physiol.* 1986; 60 (4): 1327–32. PMID 3700310.

4. Slinde F, Rossander-Hulthén L. Bioelectrical impedance: effect of 3 identical meals on diurnal impedance variation and calculation of body composition". *Am. J. Clin. Nutr.*, 2001; 74 (4): 4748. PMID 11566645.

5. Kushner RF, Gudivaka R, Schoeller DA. "Clinical characteristics influencing bioelectrical impedance analysis measurements". *Am. J. Clin. Nutr.* 64 (3 Suppl): 1996; 423S–427S. PMID 8780358.

6. Abu Khaled M, McCutcheon MJ, Reddy S, Pearman PL, Hunter GR, Weinsier RL. Electrical impedance in assessing human body composition: the BIA method. *Am. J. Clin. Nutr.* 1988; 47 (5): 789–92. PMID 3364394.

7. Dehghan M, Merchant AT. Is bioelectrical impedance accurate for use in large epidemiological studies?". *Nutr J*, 2008; 7:26. doi:10.1186/1475-2891-7-26. PMC 2543039.

8. Buchholz AC, Bartok C, Schoeller DA. The validity of bioelectrical impedance models in clinical populations. *Nutr Clin Pract,* 2004; 19 (5): 433–46. PMID 16215137.

9. Peterson JT, Repovich WES, Parascand CR. Accuracy of Consumer Grade Bioelectrical Impedance Analysis Devices Compared to Air Displacement Plethysmography. *Int J Exerc Sci,* 2011; 4 (3): 176–184.

10. Sun G, French CR, Martin GR, Younghusband B, Green RC, Xie YG, Mathews M, Barron JR, Fitzpatrick DG, Gulliver W, Zhang H. Comparison of multifrequency bioelectrical impedance analysis with dual-energy X-ray absorptiometry for assessment of percentage body fat in a large, healthy population. *Am J Clin Nutr*. 2005 Jan;81(1):74-8.

11. Roubenoff R. Applications of bioelectrical impedance analysis for body composition to epidemiologic studies. *Am J Clin Nutr*. 1996 Sep; 64(3 Suppl):459S-462S.

12. Biaggi RR, Vollman MW, Nies MA, Brener CE, Flakoll PJ, Levenhagen DK, Sun M, Karabulut Z, Chen KY. Comparison of air-displacement plethysmography with hydrostatic weighing and bioelectrical impedance analysis for the assessment of body composition in healthy adults. *Am J Clin Nutr*. 1999 May; 69(5):898-903.

13. Virginia Lynn Peterson, Angela C. Martino, Arseima Y. Del Valle-Pinero, Nayan S. Patel, Xiongce Zhao, Wendy A. Henderson. Weight Phenotype Diagnostic Test Method: Body Mass Index or Body Fat Percent for Gene Expression. *The Open Obesity Journal*, 2012, 4, 18-22

14. Kuen-Chang Hsieh, Yu-Jen Chen, Hsueh-Kuan Lu, Ling-Chun Lee, Yong-Cheng Huang and Yu-Yawn Chen. The novel application of artificial neural network on bioelectrical impedance analysis to assess the body composition in elderly. *Nutrition Journal,* 2013, 12:21

15. Dympna Gallagher, Steven B Heymsfield, Moonseong Heo, Susan A Jebb, Peter R Murgatroyd, and Yoichi Sakamoto. Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index1·2·3.The American *Journal of Clinical Nutrition*.

16. Chandrasekharan Nair Kesavachandran, Vipin Bihari and Neeraj Mathur. The normal range of body mass index with high body fat percentage among male residents of Lucknow city in north India. *Indian J Med Res*. 2012 January; 135(1): 72–77.

17. Kamimura MA, Avesani CM, Cendoroglo M, Canziani ME, Draibe SA, Cuppari L. Comparison of skinfold thicknesses and bioelectrical impedance analysis with dual-energy X-ray absorptiometry for the assessment of body fat in patients on long-term haemodialysis therapy. *Nephrol Dial Transplant*. 2003 Jan;18(1):101-5.

18. S. N. Gupta, Body Composition Analysis of Staff members of College Using Bioelectrical Impedance Analysis Method, *International Journal of Chemical Engineering and Applications*, 2014, 5(3) 259-265. ISSN 2010-0221.

19. Gupta SN. Bioelectrical Impedance Analysis and its Interpretation, *International Research Journal of Science & Engineering*, 2014; Vol. 2 (5): 171-176. ISSN: 2322-0015 .

20. Gupta SN. Different measuring techniques for body fat analysis, *International Research Journal of Science & Engineering*, 2015; Vol. 3 (3): 98-106. ISSN: 2322-0015 .

© 2018 | Published by IRJSE