Comparison of Regional Variation Of Body Composition In Type 2 Diabetics And Matched Controls Of An Urban Area Of Gujarat, India Using Bio-Electrical Impedance Method

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Abstract: Background: Obesity and type 2 diabetes are closely related and as such both affect components of body composition which can be studied by various non-invasive tools available. We try to study regional body composition of type 2 diabetics in comparison to matched controls and to correlate differences observed if any. Method: A heterogeneous sample of 60 under treatment type2 diabetics of either sex with known glycaemic and lipidaemic control and equal number of age and sex matched controls were taken from our city. After baseline assessment direct measurement was done by instrument Omron KaradaScan (Model HBF -510, Japan).Using principle of tetra poplar bioelectrical impedance analysis (BIA) we derive regional distribution of subcutaneous fat and skeletal muscle in both groups and compare them for statistical significance. Result: We found significantly more subcutaneous fat in all regions (mean values -trunk 27.30%,leg 36.63%, arm 39.36%) and significantly lesser mass of skeletal muscle in all regions (mean values -trunk 18.57%,leg 33.58%, arm 26.49%) in type 2 diabetics as compared to controls. Females had more subcutaneous fat in all regions as compared to males (average mean difference 10%) and lesser skeletal muscle in all regions compared to males (average mean difference 3%) with significance only for the previous and not the later parameter. Conclusion: BIA reveals that type 2 diabetics have excess subcutaneous fat in all body regions on expense of skeletal muscle with female disadvantage. Body composition analysis can be included as a strategy in managing metabolic derangements of type 2 diabetes.

Key Words: Bio-electrical impedance, body composition, regional distribution, subcutaneous fat, type -2 diabetes.

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Introduction: Type 2 diabetes is now on the verge of becoming pandemic in developing countries like India[1] and obesity has gained state of serious health related issue in South Asian countries.[2] Obesity is often the precursor of type 2 diabetes and its measures are important to regulate even after inception of the same. Regional distribution of fat especially that of trunk[3], is important parameter to be considered in context of insulin resistance. There is a spectrum of Method available to assess body fat and muscle composition as simple as BMI and as advanced as MRI.[4] Bio-electrical impedance analysis (BIA) is a simple, validated[5], cost-effective fairly accurate and objective method to assess distribution of the same and it is really handy one for evaluating type 2 diabetics for whom managing optimum body composition is a part of therapeutic aim and a measure of prognostic betterment. Still there is lack of awareness regarding this tool and parameters being measured by it in our country with no such study being reported from our region. By this study we try to evaluate regional distribution of subcutaneous fat and skeletal muscle in under treatment type 2 diabetics patients in comparison to matched controls.

Material and Method:

Study design:- Present cross sectional observational study was carried out from January 2013 to August 2013 in clinical research lab, department of Physiology, Government medical college, Bhavnagar, Gujarat.

Study sample:- Sample size of 60 for current population and prevalence of disease yield us

95% confidence interval keeping margin for error 5% as calculated by RaoSoft Sample Size calculator software.

Study subjects:-After getting approval from Institutional Review Board and informed consent from participants, the study was carried out in type 2 under-treatment ambulatory diabetics and matched healthy controls. Subjects were recruited from medicine OPD of a tertiary care teaching hospital attached to our college and from private OPDs.

Inclusion criteria- Case: - 60 Type 2 diabetics (34 males and 26 females) were undertaken in age group 30 to 80 years, not taking insulin, taking regular medicines, and having recent investigation for glycaemic or lipidaemic control. To increase heterogeneity we took cases with and without hypertension, with and without statin therapy, with or without family history of type 2 diabetes, coming from various socioeconomic statuses, doing work with varying degrees as to make a fairly representative sample of the population. Control: - We recruited 60 non-diabetic controls from the community who were matched by age, sex, socio economic status and intensity of work being done with cases.

Research method :- Subjects meeting inclusion and exclusion criteria were registered for study with initial assessment in the form of informed consent, personal history, medical history, anthropometric measurement and recent reports of glycaemic controls including FBS,PP2BS and Hb1Ac and lipidaemic control were taken.

Body composition measurement:-After entering age, gender and height taken by standiometer subject was allowed to stand on the instrument after its calibration. A digital, portable non-invasive instrument Omron KaradaScan (Model HBF-510,Japan) working on principle of tetra polar bioelectrical impedance analysis was used that passes electric current of 500 µAmp at frequency 5 kHz to scan the whole body to derive regional body composition.

Statistical analysis: - The data was transferred on Excel spreadsheet and descriptive analysis was expressed as mean ± standard deviation. All calculations were accomplished by Graph Pad InStat 3 software. We evaluated difference between both groups for baseline data, body composition parameters by student t test. Any observed difference was considered statistically significant with P value <0.05.

Result: Table 1 shows comparison of baseline data of case and control group showing that they are well matched in age, gender and height. However BMI was higher in diabetics than matched controls.

Table 2 shows comparison of regional distribution of subcutaneous fat and skeletal muscle between two groups. In general diabetics showed significantly higher subcutaneous fat and lower skeletal muscle mass as compared to controls which are evident for all regions. Table 3 shows effect of gender on body composition in ca group wherein females showed significantly more subcutaneous fat and less skeletal muscle than males.

Table 1: Baseline data of study and control group

Para meters	Case (n=66)	Control (n=66)	p value
Age	53.08 ±10.41	52.85 ±10.80	0.9045
Gender	M=34, F=26	M=34, F=26	
Height (cm)	160.18 ±8.48	159.07 ±6.16	0.4109
Weight (kg)	68.37 ±11.82	59.70 ±9.80	0.0001
BMI (kg/m^2)	27.65 ±6.98	23.91 ±3.39	0.0003

Table 2: Comparing regional distribution of subcutaneous fat(%) between case and control group

	Case	Control	p value
	Mean ±SD	Mean±SD	
Trunk	27.3 ±7.53	22.86 ±6.88	0.0011
Leg	36.63 ±10.52	27.87 ±8.10	0.0001
Arm	39.36 ±11.80	29.02 ±9.21	0.0001

Table 3: Comparing regional distribution of skeletal muscle (%) between case and control group

	Case	Control	p
	Mean±SD	Mean±SD	value
Trunk	18.57 ±3.92	25.9 ±3.92	0.0001
Leg	33.58 ±9.04	37.48 ±8.91	0.0190
Arm	26.49 ±7.24	35.21 ±8.05	0.0001

Table 4: Comparing regional distribution of subcutaneous fat and skeletal muscle (%) between male (n=34) and female (n=26) cases

S/c Fat	Male	Female	p
	Mean±SD	Mean±SD	value
Trunk	24.73±8.13	30.15±5.62	0.0044
Leg	31.23±7.42	42.81±10.23	0.0001
Arm	32.75±10.22	46.91±8.56	0.0001
Skeletal	**Male**	**Female**	**p**
Muscle	**Mean±SD**	**Mean±SD**	**value**
Trunk	19.20±3.42	17.85±4.38	0.1871
Leg	34.89±10.62	32.09±6.67	0.2339
Arm	29.70±6.71	22.82±6.05	0.0001

Discussion: Out of 135 million diabetics around the world nearly one third is in India and it is projected to reach 80.9 million by the year 2025.[6]It is further compounded by obesity that doubles the cost of management.[7] For given BMI, South Asians have greater adiposity and visceral and ectopic adipose tissue accumulation.[8] BMI, though used as a simple mean to define obesity, does not actually demarcate between fatty and fat free mass. Few studies have revealed more adverse fat distribution at BMI > 21 kg/m^2 in South Asians as compared to Caucasians in whom considerable dyslipidemia and dysglycaemia are not seen until BMI exceeds 30 kg/m^2 .[9] With this propensity it seems quite worthful to know body composition and body fat percentage in high risk obese subjects and type 2 diabetics. We found excess subcutaneous fat in all regions of body in type 2 diabetic as compared to matched controls in descending order of arm, leg, trunk. Lesser subcutaneous fat despite overall increase in body fat points that there is probably redistribution of fat from subcutaneous to visceral ectopic loci and visceral fat amplification runs parallel to the increased subcutaneous fat. Increase in subcutaneous and visceral fat is often seen in pre-diabetes and a graded association is seen once the disease has occurred.[10]

Glycaemic control was seen in just 11 out of 60 and lipidaemic control was seen in 24 out of 60 cases with mean duration of diabetes being 7.5 years so it is obvious to look the results observed more cautiously as strict blood sugar control was not observed in most of the cases that is one of the feature of Indian diabetics.[7] Diabetes is not merely a disease of disturbed glucose homeostasis and rather it is "more a disease of lipid than of carbohydrate".[11] The phenomenon of ectopic fat deposition as seen in our case of obese diabetics is proven to be due to alteration of components of the immune system that damages adipose tissues, liver and pancreatic islets that ultimately leads to dyslipidemia and ectopic fat deposition[12], most of which is hormone insensitive. Similarly protein wasting is one of the most serious of all the effects of severe diabetes mellitus that can lead to extreme weakness as well as many derangements in the functioning of organs.[13] The same immune alteration in type 2 diabetics that leads to fatty changes also induces activation of leucocytes, apoptosis and fibrosis that ends in muscle wasting and cachexia. Decreased skeletal muscle mass is also due to higher percentage of intra muscular adipose tissue (IMAT).[14]

On checking gender bias for body composition, it was evident that females have more subcutaneous fat in arms, legs and trunk and lesser muscle mass as compared to male diabetics. However, the gender difference for skeletal muscle was almost similar in diabetics as compared to control group. Asian women carry greater abdominal and visceral fat as compared to whites with similar overall obesity.[15] The underlying explanation is (i) more waist circumference for a given level of BMI compared to men [16](ii) susceptibility to accumulate more abdominal adiposity after menopause. Second is a very valid reason as age of onset of diabetes is around

premenopausal period and the mean age of females on our study was 50 years.[17] As it is evident from few previous studies[18,19] that subcutaneous fat is more important than visceral fat as a predictor for insulin resistance it is easy to understand that females having more subcutaneous fat than males are at higher risk of metabolic disorder. Men tend to accumulate more adipose tissue in the abdomen while women tend to accumulate fat in the gluteal-femoral region, partly due to difference in androgen and/or oestrogen actions in vivo.[20,21] We observed the same distribution pattern and that is one of the cause for female disadvantage in this regard.

It is obvious that type 2 diabetes poses a significant risk to the body composition and balance between fat and protein both in quantity and quality. Skeletal muscle atrophy associated with enhanced subcutaneous fat deposition is an unwanted outcome of the disease and severity of its progression correlates well with extent to which metabolic derangements are kept in check in type 2 dabetes.BIA method helps to know body composition in at risk persons for DM to prevent inception of disease as primary prevention monitor the therapy to guide appropriate interventions. In type 2 Diabetics, to keep metabolic abnormality in check as a mean of secondary prevention and to keep life threatening events minimum by awareness of patients and doctors about body composition. This simple but objective method can be used by practitioners and patients themselves to monitor body composition and therapy would be something beyond doing exercise, taking Oral hypoglycaemic agents, diet restrictions and having hypolipidaemic agents. At least one can monitors the exact change in body composition and patient care may be improved by this.

Conclusion: Type 2 Diabetics of our region, on analysing body composition by BIE, have more subcutaneous fat in all regions of body as compared to matched controls and decline in skeletal muscle mass. Females have more abnormal fat distribution than males. Monitoring of body fat distribution by simple method of BIE offers a mean to be more precise in combating the challenge of treating type 2 diabetes patients.

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