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BODY COMPOSITION MEASURES AMONG ADULTS IN COASTAL AND URBAN AREAS OF ERNAKULAM DISTRICT, KERALA

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Introduction

Nutritional, demographic, epidemiological and socio-economic transitions are occurring in many developing countries. This "nutritional transition" encompasses changes in a range of risk factors and diseases. Obesity is a complex, multi-factorial disorder that develops from an interaction of social behavioural, cultural, physiological, metabolic and genetic factors[1]. Globally, 6.7 per cent are underweight, 25.7 per cent are overweight and 8.9 per cent are obese[2]. In India, obesity is emerging as an important health problem paradoxically co-existing with under nutrition. The prevalence of obesity in India is 16 per cent in women and 12.1 per cent in men[3].

Obesity may not be as high in India as in the west, but the body composition and metabolism of Indians (and Asians in general) make them especially prone to adiposity and its consequences. Body composition varies among individuals as a result of difference in body density and degree of obesity[4]. Asian Indians have adverse body fat patterning including abdominal adiposity even when the Body Mass Index is within the currently defined normal limits[5].

According to National Nutrition Monitoring Bureau[6], in India, the second highest prevalence of overweight and obesity was observed among men (13.1% and 1.4%) and women (20.4% and 3.6%) in Kerala State. Hence, the present study was undertaken in Ernakulam district, the cosmopolitan city of Kerala State, where the incidence is likely to be higher than other places in Kerala and there is paucity of data with regard to prevalence of obesity and body composition data among the different age groups in coastal and urban areas. The objectives of the present study were

- to determine the prevalence of overweight and obesity among different age groups of population in the urban and coastal areas of Ernakulam district, Kerala State,
- to study the epidemiological factors associated with obesity among selected normal, overweight and obese adults in both areas,
- to determine anthropometric and body composition measures among adults in relation to area and gender and BMI.

Materials and Methods

Selection of locale and sample

Ernakulam district of Kerala State was selected as the locale for the study in the two major social demarcative areas - the urban and coastal areas. A total of 8576 subjects comprising of 4167 from coastal areas and 4409 from urban areas constituting four age groups namely preschool (2-5 years), school going (6-12years), adolescents (13-19 years) and adults (20-60 years) both male and female were selected.

The subjects from the coastal area were selected from Vypin and Njarakkal consisting of 600 and 340 households out of which 440 households and 300 households respectively were selected at random. Adults from the urban areas were selected from 3031 households in Kadavanthara, 2407 households in Edapally and 1747 households in Panampilly Nagar. A total of 250 households were selected from Kadavanthara, 350 from Edapally and 400 from Panampilly Nagar, by random sampling. Individuals from each household fulfiling the age criterion for inclusion were considered for the study. A total of 2048 preschool children, 2127 school going children, 2378 adolescent and 2010 adults comprising of male and female from the coastal areas were included in the study.

Prevalence of obesity

Anthropometric measurements namely height and weight of all the 8576 subjects were recorded. Height was recorded to the nearest cm using a fibre glass tape and weight to the nearest kg using a weighing balance Body Mass Index (BMI) was computed from the height and weight measurements. The subjects were then classified based on their BMI using the Centre for Disease Control (CDC) growth chart percentiles[7] in case of preschool, school going and adolescents and the standards given by James *et al*[8] in case of adults. The results of the survey indicated that the prevalence of overweight and obesity was highest among adults in the urban and coastal area, hence this group was considered for further study and intervention.

Epidemiological factors of obesity among adults

A total of 904 adults comprised the study population inclusive of obese adults (135), a substantial number of overweight (369) and an equal proportion of normal adults (400) both males and females in coastal and urban areas from the survey conducted. A pre tested interview schedule was administered to each of the subjects to elicit information on socio-demographic profile, genetic predisposition, physical activity pattern and dietary intake.

Assessment of anthropometric measures and body composition

Waist circumference, hip circumference and Mid Upper Arm Circumference (MUAC) of the subjects were assessed using a fibre glass tape. Body composition parameters namely per cent of body fat, body water, muscle mass, BMR and visceral fat were assessed using the Tanita Body Fat Analyser (model-UM076) which works on the principle of Bioelectrical Impedance Analysis (BIA).

Statistical analysis of data

The data was consolidated and tabulated and subjected to statistical analysis with appropriate tools using the SPSS 16.0 version. The various statistical tests applied were, Karl Pearson's correlation, chi-square,

factor analysis, one way ANOVA, regression and paired t- test. Factor analysis was carried out to determine the factors that are most closely associated with obesity from among the different epidemiological factors namely socio-economic, physical activity, dietary and anthropometric variables. Regression analysis was carried out to predict the change in BMI with regard to seven anthropometric and body composition parameters namely waist circumference, hip circumference, MUAC and body fat, body water, visceral fat and muscle mass.

Results and Discussion

Prevalence of overweight and obesity

Distribution of subjects by age into the different nutritional classes is given in Table I.

It was noted that prevalence of overweight and obesity increased with increasing age. The prevalence of overweight increased from 5.4 per cent in the preschool age to 30 per cent in adults that is more than five times while obesity increased from four per cent to 6.7 per cent. The increase in prevalence was found to be significant at one per cent level. This observation is on par with the National data in the 10-17 year age group children in Kerala[6].

Factor analysis of the epidemiology of obesity

A total of 16 factors were analysed and it was noted that the four most important factors that influenced obesity were heredity, food habits, life style and physical activity. The results are indicated in Table II.

TABLE I

Age Wise Prevalence of Overweight and Obesity

Age class	Nutritional class				Total	Chi square value
	Under weight	Normal	Over weight	Obese		
Pre-school	664 (32.4)	1194 (58.2)	110 (5.4)	83 (4.0)	2051 (100)	959.2**
School going	632 (29.7)	1256 (59)	142 (6.7)	100 (4.7)	2130 (100)	
Adolescent	484 (20.3)	1629 (68.4)	200 (8.4)	68 (2.9)	2381 (100)	
Adult	307 (15.2)	966 (48.0)	606 (30.0)	136 (6.7)	2014 (100)	
Total	2087	5045	1057	387	8576	

Figures in paranthesis are percentages ** Significant at one per cent level

TABLE II

Factor Analysis of the Epidemiology of Obesity

Factors	Initial	Extraction value
Exercise	1.000	0.929
Duration of exercise	1.000	0.914
Duration of work	1.000	0.804
Duration of leisure	1.000	0.759
Consumption of food out	1.000	0.734
Frequency of food out	1.000	0.678
Heredity	1.000	0.616
Alcohol intake	1.000	0.631
Level of education	1.000	0.578
Occupation	1.000	0.558
Age of obesity	1.000	0.520
Fast food intake	1.000	0.597
Smoking	1.000	0.276
Birth weight	1.000	0.228
Quantity of fats	1.000	0.182
Type of fats	1.000	0.181

Only those factors that have an extracted value of more than 0.550 were found to have a high influence on obesity or were the major risk factors. It was noted that the four most important factors that influenced obesity were heredity, food habits, life style and physical activity. The extracted value of the variable heredity is greater than 0.550 (0.616>.550) which represents the influence of genetic factors in obesity. The variables fast food intake (0.597>0.550), consumption of food out (0.734>0.550), frequency of consumption of food out (0678>0.550) collectively represent food habits. The factors, duration of work (0.804 >.550), duration of leisure (0.759>0.550), exercise pattern, (0.929>0.550) and duration of exercise (0.914>0.550) represent physical activity. Consumption of alcohol represents lifestyle (0.631>0.550) and the socio-economic factors are level of education (0.578>0.550) and occupation (0.578>0.550).

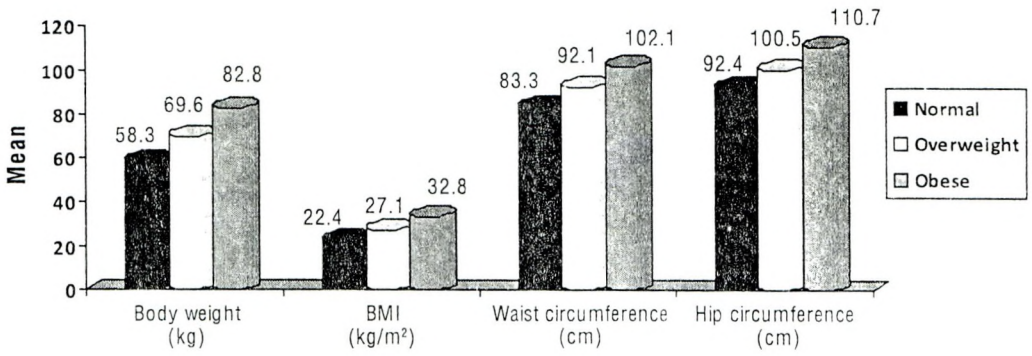

Figure 1
Mean anthropometric measures vs BMI

Among the three factors identified from factor analysis of 16 risk factors of obesity, the factor lifestyle and physical activity seems to be the most influential in the prevalence of obesity.

Anthropometric parameters vs. BMI

Changes in anthropometric parameters that occur with an increase in BMI was determined and is indicated in Figure 1.

It was observed that all parameters except height showed a significant increase in mean value from normal to obese ($p<0.01$). In case of body stature, a significant decrease was noted. Thus with an increase in BMI, there is a proportionate increase in anthropometric parameters such as weight, waist and hip circumferences and hence WHR, all of which may contribute to obesity.

Mean body composition measures among the adults

The comparative data on the body composition parameters of adults from the coastal and urban areas, both male and female are presented in Table III.

TABLE III
Mean Body Composition Measures of the Adults

Measures		Urban (N=474)		Coastal (N=430)
		Standards	Mean ± SD	Mean ± SD
Body fat (%)	M	12 - 20	25.3 ± 6.8	22.8 ± 7.5
	F	20 - 30	34.6 ± 7.1	32.2 ± 7.1
Body water (%)	M	60*	53.5 ± 3.7	55.6 ± 4.7
	F	55*	44 ± 5.7	48.2 ± 5.5
Muscle mass (%)	M	44.7	53 ± 5.7	50.6 ± 5.9
	F	36	41.4 ± 4.1	39 ± 4.9
BMR	M	-	1637 ± 191.4	1498.9 ± 207.6
	F	-	1303.8 ± 115.0	1225 ± 164.6
Visceral fat (kg)	M	1-12*	9.9 ± 3.9	7.6 ± 3.2
	F		6.5 ± 2.9	6.2 ± 2.8
Body fat (kg)	M	10.5*	19.1 ± 7.3	15.9 ± 7.0
	F	15.3*	22.9 ± 7.9	20.1 ± 7.3
LBM (kg)	M	52.9*	54.6 ± 7.3	51.8 ± 6.5
	F	46.8*	41.8 ± 5.3	40.8 ± 5.7

*Katch and Katch

Area wise, urban adults had a higher mean for all parameters of body composition except body water. Urban adults with a higher body fat had lower hydration levels, while the reverse was true in case of coastal adults. It was also noted that females rather than males have a higher tendency for fat accumulation. This can be attributed to the tendency for females to accumulate fat and the calorie-dense dietary pattern and increased physical inactivity of the urbanites. The mean values of body fat per cent were seen to be above the standards in all groups.

Mean body composition parameters among different BMI classes

Similar to anthropometric measures, a change in the BMI from normal to obese revealed a significant increase in the mean value of all the body composition parameters except for body water which showed a proportionate decrease. Differences in all the parameters were statistically significant at one per cent level. The tendency for body composition parameters to increase with increase in BMI indicates that there is an accompanying potential risk of increased fat accumulation with weight gain.

Incidence of central obesity among the adults

The incidence of abdominal and central obesity among the adults using International and Asian cut-off values were compared and is given in Table IV.

It was seen that the proportion of subjects with abdominal obesity increased significantly when the cut offs were lowered. While only 11.2 per cent males and 57.3 per cent females had central obesity as per International cut offs, it increased nearly fivefold for males (52.4%) and by nearly 22 per cent for females (80.2%), when lowered cut offs recommended for Asians were used. Similarly in case of Waist Hip Ratio (WHR), the incidence increased five fold in case of men from 8.5 per cent to 39.3 per cent and for females from 49.5 to 90 per cent. Another prominent finding was the increased predisposition of females to central obesity.

TABLE IV

Prevalence of Central Obesity among Adults

Variable	Male (n=412)		Female (n=492)	
	Number	Percentage	Number	Percentage
Waist circumference				
(Men>102cm, Women > 88cm)*	46	11.2	280	57.3
(Men ≥ 90cm, Women ≥ 80cm) **	216	52.4	392	80.2
WHR				
(Men ≥ 1.0, Women ≥ 0.90)*	35	8.5	242	49.5
(Men ≥ 0.95,Women ≥ 0.80)**	162	39.3	443	90.0

* International cut-off ** Asian cut-off

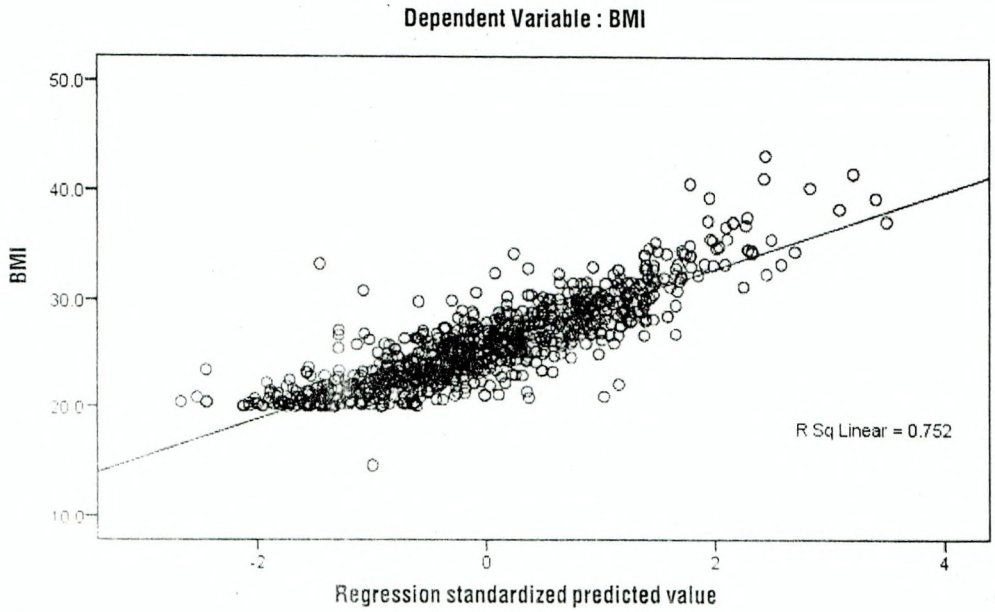

Figure 2
Scatter plot of the regression analysis

Regression analysis for predicting BMI from body composition

The scatter plot of the regression analysis carried out to predict the changes in BMI with regard to seven anthropometric and body composition parameters namely waist circumference, hip circumference, MUAC and body fat, body water, visceral fat and muscle mass is given in Figure 2.

It is seen that the overall model fit as denoted by the F ratio is highly significant (387.44) and the fitted model is able to account for nearly 75 per cent of the variation in BMI of the subjects. All the variables except body water were seen to be statistically significant. The variables body fat and MUAC were observed to influence BMI more than the other variables. The beta coefficients for body fat and MUAC are 0.354 and 0.236 which indicates that for a unit increase in body fat and MUAC there will be a corresponding increase in BMI by 0.354 units and 0.236 units respectively. Body water was seen to cause the least increase in BMI.

Summary and Conclusion

The prevalence of overweight and obesity in urban area was higher than that of the coastal area. There was a concomitant increase in the incidence of overweight and obesity from preschool to adults (fivefold). Increased predisposition of females to central obesity and to accumulate fat and tendency

of males to have a higher muscle mass, lean body mass and increased hydration. With an increase in BMI, there was a proportionate increase in anthropometric parameters such as weight, waist, hip circumference and hence WHR.

The new findings include the fact that mean BMI of adults is nearing the WHO cut-off for overweight for adults (>25) and has surpassed the BMI cut off of >23 indicative of overweight for Asians. A tendency towards a more sedentary activity pattern among adults in coastal areas was observed. Expanding waistline and hence central obesity at lower mean body weight and BMI among adults is gaining ground and is becoming a trend not only in urban but also in coastal area.

Hence it is evident that overweight and obesity is emerging to be a serious epidemic among the urban and coastal population in Ernakulam district of Kerala. The study brings out a positive association between body composition and anthropometric parameters among the overweight and obese adults. The four important epidemiological factors of obesity are heredity, food habits, life style and physical activity. Nutrition education focusing on dietary habits, lifestyle modification and increased physical activity is recommended as a sustainable strategy.

REFERENCES

1. The Practical Guide Identification, Evaluation, and Treatment of Overweight and Obesity in Adults, National Heart, Lung, and Blood Institute NIH Publication, 2005, 4084.
2. Moore, S., Justin, N.H., Sam, H. and John, W.L. Global and National socio-economic disparities in obesity, overweight and underweight status. *J. Obes.*, 2010, 63.
3. National Family Health Survey - III (NFHS) (2005-2006), International Institute for Population Sciences IIPS, Bombay.
4. Venkatramana, Y. Proceedings of the pre conference workshop on assessment of nutritional status and dissemination of new RDA for Indians, National Institute of Nutrition, Hyderabad, ICMR, India, 2009, 57.
5. Viswanathan Mohan and Mohan Deepa, Diabetes and the metabolic syndrome, *Diab. Voice*, 2006, **51**, 12-13.
6. National Nutrition Monitoring Bureau (NNMB), Diet and Nutritional Status of Communities, Technical Reports, National Institute of Nutrition, Hyderabad, India, 2006, 56.
7. CDC Clinical Growth Charts, United States, Centre for Disease Control and Prevention, 2000 Online available at : www.cdc.gov/growthcharts
8. James, P.T., Leach, R., Kalamara, E. and Shayeglin, M. The worldwide obesity epidemic, *Obes. Res.*, 2001, **9**, 228-233.
9. Katch, F.I. and Katch, V.I. Exercise, Physiology, Energy, Nutrition and Human Performance, Philadelphia, Lea and Febiger, 2007, 4th Edn., 543.