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Development of obesity over four decades among North Indian females

Satwanti Kapoor[1*], Rashmi Sinha[2], Kajri Tandon[1], Shilpi Gupta[1], Prema Bhasin[1], Deepali Verma[1], Meenal Dhall[1]

[1]*Department of Anthropology, University of Delhi, Delhi, India*
[2]*School of Social Sciences, Indira Gandhi National Open University, Delhi, India*

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Abstract

The aim of the present study was to analyze temporal trends in general obesity and regional obesity from 1978 to 2010 according to various obesity markers. Data was obtained from four cross-sectional studies of diverse ethnic and geographic milieus conducted independently. Data was analyzed to derive mean and standard deviation of the subjects in two age group 18-19 years and 20-45 years for various obesity markers like body mass index (BMI), grand mean thickness (GMT), waist-hip ratio (WHR) and waist height ratio (WHtR). Student t-test was used to reveal the significance of the change in various parameters over time. From 1978 to 2010, BMI increased significantly among the North Indian females and, indeed, at an alarming magnitude in both age groups in the latest population. This trend was similar for almost all obesity markers regardless of age. The drop across these trend lines over time can be attributed to subtle differences in socioeconomic status, ethnic disparities, rural-urban differences or variations in geographic regions. Identifying women, who are at greater risk for weight gain, may help target and design interventions to prevent weight gain in women, the procreator which may also be associated with health complications of their children.

Keywords: *Obesity, socio-economic status, geography, North India*

Introduction

There has been a striking increase in the prevalence of obesity in the 21st century, and this continued rise has been a pan-phenomenon regardless of gender, socio-demographic status, or geographic region, manifesting marked heterogeneity, especially by sex and race (McTigue et al., 2002). Increase in mean BMI and prevalence of overweight/obese are of special concern in Asia because co morbidities tend to occur at lower BMI among Asians (He et al., 1994; Ko et al., 1999) Dramatic trends of increasing obesity are contributing to higher prevalence of non-communicable disease

* Corresponding author: Department of Anthropology, University of Delhi, Delhi 110007, India (**e-mail:** satwanti@yahoo.com)

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morbidity and mortality, particularly from cardiovascular disease and type 2 diabetes. It has been estimated that 30 million people in the Asia-Pacific region suffer from type 2 diabetes (Amos et al., 1997) and its association with obesity is obviously well quoted. Body composition dynamics over the years have lead to a discernible increase in various rising obesity markers of general and regional adiposity. Each of these markers is known to be a distinguished prognosticator of cardiovascular health profile. As obesity increases globally, an early identification of the risk factor of overweight/obesity and fat distribution is of vital importance for future preventive measures because their association to human health with respect to non-communicable diseases is well established. If we go by the projection of future health complications these life style diseases are going to be of utmost burden to future societies (Kapoor et al., 2010). Identifying women who are at greater risk for weight gain for numerous socio-economic and occupational rationales may help target and design interventions to prevent weight retention and obesity in women, the procreators which may also be associated with health complications of their children.

Prospective epidemiological studies are needed to better understand the obesity epidemic trends in India. Increasing obesity in low- and middle-income countries is well documented in cross-sectional studies. However, studies identifying factors that influence individual weight gain patterns over time in relation to the major social and economic changes are very few. Hence, the objectives of our study were to analyze temporal trends in general obesity and regional obesity from 1978 to 2010 according to various obesity markers.

Materials and methods

The present study utilized the data from four cross-sectional studies conducted independently during different time interval 1978 (n=170), 1986 (n=108), 2006 (n=286) and 2010 (n=307) which have previously been described in detail (Kapoor et al., 1980; Sinha et al., 2006; Tandon et al., 2011; Gupta et al., 2011). The present cohorts of female belonged to diverse ethnic and geographic milieus therefore have been stratified accordingly to assess the contextual effect. The former three populations belonged to Khatri and Punjabi Arora ethnicity inhabiting Delhi (1978, 1986) and Uttar Pradesh (2006) provinces while the latter is Baniya population of Delhi (2010). Geographically these cohorts were further stratified into populations inhabiting Delhi region (2010) and Shahjahanpur (2006). Khatris of Delhi (1978) were homemakers and students, Punjabi Arora females (1986) were teachers by occupation while Khatri of Shahjahanpur (2006) and Baniya (2010) belonged to the trading communities. The investigators who conducted the studies independently have been well trained on the technique of anthropometry. The repeatability and reproducibility was checked which permits the comparison of observation collected over a period of time. The principal investigators of the studies were asked to provide summary statistics of the anthropometric measurements such as weight, height, circumference (waist and hip) and skinfold thickness. The adiposity markers analyzed in the study includes body mass index (BMI), grand mean thickness (GMT), waist-hip ratio (WHR) and waist height ratio (WHtR). GMT, a relative measure of adiposity was computed as an average of four skinfold thicknesses (biceps, triceps, subscapular and suprailiac). The data obtained was analyzed further to derive mean and standard deviation in order to stratify the populations into two age group 18-19 years and 20-45 years. Student *t*-test was used to reveal the significance of the change in various parameters over time (Joosse, 2011). The subjects aged 18-19 years were kept as a separate age group because this young group might still retain the characteristic of late adolescence.

Results

Table 1 summarizes the anthropometric characteristics of the participants from four cross-sectional studies conducted during different phases across 1978-2010 years. Within the age cohort 18- 19 years mean weight, height, BMI and GMT increased by 3.41 kg, 2.17cm, 1.32 kg/m^2 and 2.76 mm respectively from 1978 to 2006. WC decreased significantly by 4.1cm while the increase observed in HC was non-significant. WHR and WHtR measures fat distribution rather than general adiposity, however because of changing body proportion during late adolescence the use of these ratios has limited significance. Among females aged 21-45 years, mean weight increased while height decreased across 1978–2010. However, females enrolled in the year 2006 were comparatively lighter and taller than other populations (1986 and 2010). There was a discernible increase in BMI from 1978 to 1986 years (6.04kg/m^2). Decline during 2006 (1.52kg/m^2) subsequently followed an increase from 2006 to 2010 (5.08 kg/m^2). The anthropometric marker of central obesity (WC, HC, WHR and WHtR) also revealed increasing trend across 1978-2010 years. The change in GMT was concurrent to the changes in BMI over this period in both age cohorts. Despite diverse ethnic origin females inhabiting similar geographic region that is Delhi showed discernible increase in adiposity markers over decades. The differences in mean values of obesity markers over time were found to be statistically significant (P<0.001). Figure 1 (a-d) displays the change in weight, height, BMI and GMT over a period of three decades among women.

Table 1: Various anthropometric characteristics of females in two age cohorts from year 1978-2010

	18-19 years			20-45 years						
			t-value			t-value		t-value		t-value
Variables	1978 (N=30)	2006 (N=67)	1978-2006	1978 (N=140)	1986 (N=108)	1978-1986	2006 (N=117)	1986-2006	2010 (N=307)	2006-2010
Weight (kg)	43.33±7.47	50.1±3.48	12.37 ***	47.13±9.34	62.09±12.17	12.37***	58.89±17.36	7.53***	68.1±11.47	6.35***
Height (cm)	152.09±6.68	157.1±2.43	5.42***	154.15±5.52	153.63±4.83	0.94	155.41±4.12	3.37***	152.1±5.51	5.89***
WC (cm)	61.1±6.60	57.0±5.14	3.31***	63.65±6.68	-	-	76.68±21.62	-	92.0±10.51	9.76***
HC (cm)	84.51±6.47	85.0±2.98	0.05	88.43±7.73	-	-	91.37±15.62	-	107.2±10.90	11.77***
BMI (kg/m^2)	18.71±2.81	20.3±0.79	4.29 ***	19.80±3.72	25.84±3.86	14.63***	24.32±7.12	14.63 ***	29.4±4.77	8.47***
GMT (mm)	10.16±4.21	12.92±2.11	4.31 ***	12.15±5.54	20.51±7.52	7.26***	15.67±5.06	11.31***	32.0±6.90	23.31***
WHR	0.72±0.02	0.67±0.01	16.44***	0.72±0.02	-	-	0.83±0.10	-	0.86±0.07	3.47***
WHtR	0.40±0.03	0.36±0.03	6.07****	0.41±0.03	-	-	0.49±0.11	-	0.60±0.07	12.21***

WC=waist circumference; HC=hip circumference; BMI=body mass index; GMT=grand mean thickness; WHR=waist hip ratio; WHtR=waist height ratio

*P< 0.05

***P<0.001

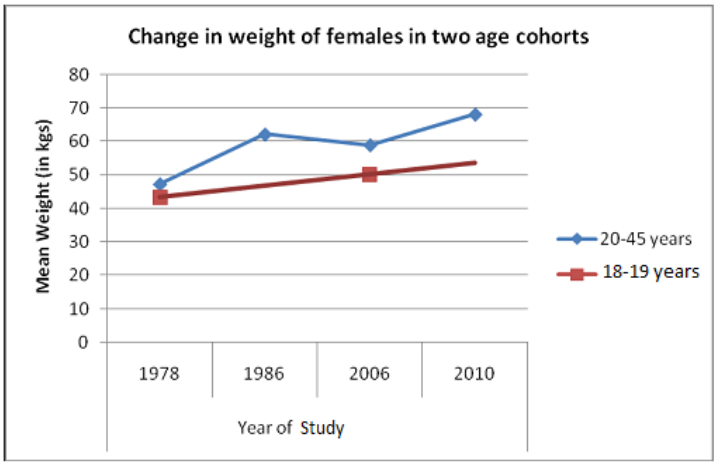

Fig. 1a: Change in weight of females over the years in two age cohorts (18-19 years and 20-45 years).

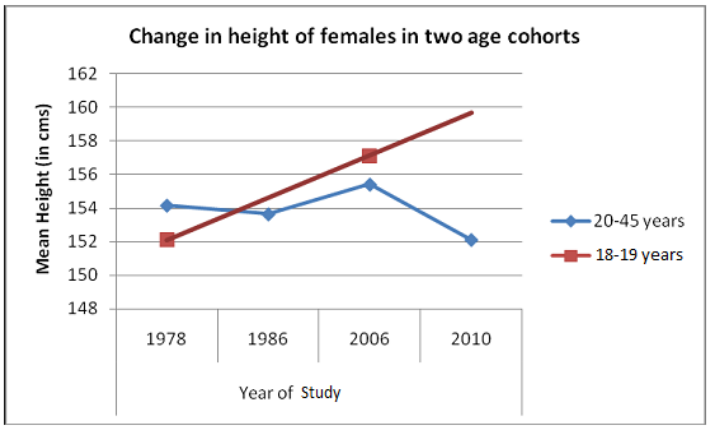

Fig. 1b: Change in height of females over the years in two age cohorts (18-19 years and 20-45 years).

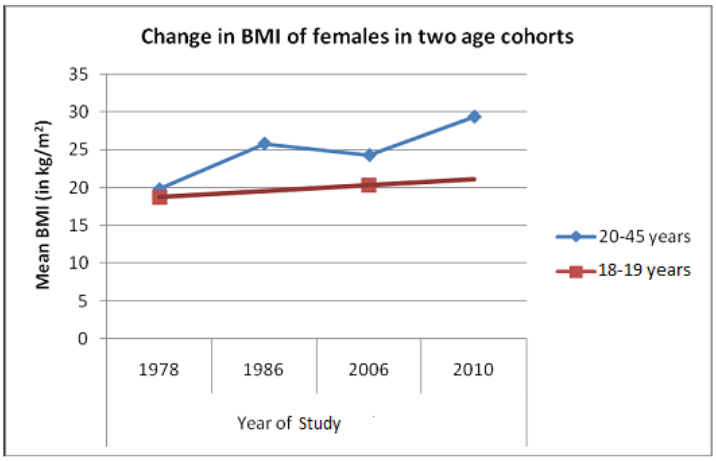

Fig. 1c: Change in BMI of females over the years in two age cohorts (18-19 years and 20-45 years).

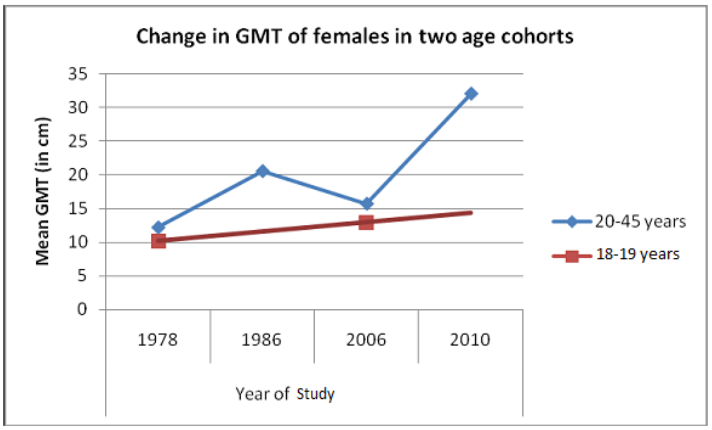

Fig. 1d: Change in GMT of females over the years in two age cohorts (18-19 years and 20-45 years).

Discussion

Over the last century the world has undergone a remarkable transformation in size, body proportions, growth rates and maturational timing. Populations in general have become taller at every age from infancy onward, far heavier and with a larger leg-to-

trunk ratio. From 1978 to 2010, BMI increased significantly among the North Indian females and, indeed, at an alarming magnitude in both age groups in the latest population. This trend was similar for almost all obesity markers. These upward trends in obesity markers find their association with increased fat-free mass and fat mass, affecting both general and regional adiposity indices though the measures of central obesity increased steadily and significantly. The lower BMI among subjects in 2006 could be attributed in part to the gain in height relative to weight while during 1986 and 2010 the increase in mean weight subsequently with the decline in height resulted into increased BMI. Increase in GMT concomitant to increase in BMI over time indicated increase in body fatness.

In 1970's, women were involved in their chores single handedly without the help of many mechanical equipments and diet was not solely governed by higher energy density food. The nutritional transition in 1980's continued into next decade and diet patterns now involve a greater role for fat and added sugars in foods, greater saturated fat intake (mostly from animal sources), reduced intakes of complex carbohydrates and dietary fiber, and reduced fruit and vegetable intake (Drewnowski et al., 1997). These dietary changes are compounded by lifestyle changes that reflect reduced physical activity at work and during leisure time (Ferro-Luzzi et al., 1996). Nuclearization of family life, practice of neolocal residence, employment of housemaids and dependence on technology for household chores like cleaning, washing etc have gradually affected the women physiology/ morphology over a period of time. These series of changes are indicators of elevated socio-economic status; hence they are also true characteristics of women being involved in the study year 2010. These women belonged to a trading community which mostly has sedentary lifestyle. Their food habits also involved lots of oily eatables (Gupta et al., 2012). The analysis revealed remarkable geographical influence on increasing trend in general adiposity. The females with diverse ethnic background but matched for geographical region (Delhi) showed a progressive trend in obesity markers. Increases in energy intake, portion sizes, sweetened beverage intake, eating out and decline in sufficient vigorous physical activity, have contributed to the escalating trends in mean WC and WHtR in the present study. In addition, growing evidence has indicated towards a potentially causal relationship between stress and abdominal obesity (Li et al., 2006). Stress is yet another indispensible correlate of mechanization and urbanization, which Delhi truly represents. An increase in BMI in the present population also warrants a fundamental change in dietary habits. The drop across these trend curve lines over time can be attributed to differences in socioeconomic status (SES), racial/ethnic disparities, rural-urban differences or variations in geographic regions. Subjects in year 1976, 1986, and 2006 were all matched for ethnicity, but the socio-economic measures of subjects studied in the year 2006 were lower than year 1986. Women involved in the study in year 1986, were working women most of them being teachers. This can also be accredited to rural-urban effect as compared to urban areas; rural areas are characterized by lower socioeconomic status (SES), poorer health care, lower standards of living, and fewer opportunities of employment. In 2006, area under study was Shahjanpur city; agriculture based District of Uttar Pradesh. The study constituted of affluent Khatri who had food rich in fat and sugar. But, the city still had not come in terms with full-fledged urbanization. They did not have access to fast food and still maintained certain traditional means for daily chores and in mode of transportation, unlike the Khatri women of Delhi. Currie et al. (2009) points towards a significant effect of proximity to fast food restaurants on the risk of obesity. Ewing et al. (2003) have also mentioned the impact of major sources of physical activity like occupation, household and transportation on obesity.

Limitation

No standard score was used in the earliest studies to stratify the population according to socio-economic status. So statistically we could not compare the socio-economic status for all populations. Though, a qualitative comparison of gadgets etc in the households has been used as basis for socio-economic status.

Conclusion

Dynamics in lifestyle, physical activity, diet and epigenetic mechanisms have woven a subtle web with connotations like prolonged positive energy imbalance, decrease in total energy expenditure due to decline in spontaneous but not voluntary physical activity (Eisenmann, 2006), psycho-social stress all have lead to significant upward trends of obesity. Identifying women who are at greater risk for weight gain for numerous socio-economical and occupational rationales may help target and design interventions to prevent weight retention and obesity in women, the procreators which may also be associated with health complications of their children.

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Conflict of interest

The authors declare that they have no competing interests.

Bibliography

McTigue KM, Garrett JM, Popkin BM. (2002) The natural history of the development of obesity in a cohort of young U.S. adults between 1981 and 1998. Ann Intern Med 136:857– 864.

He J, Klag MJ, Whelton PK, Chen JY, Qian MC, He GQ. (1994) Body mass and blood pressure in a lean population in Southwestern China. Am J Epidemiol 139:380–389.

Ko GTC, Chan JCN, Cockram CS, Woo J. (1999) Prediction of hypertension, diabetes, dyslipidaemia or albuminuria using simple anthropometric indexes in Hong Kong Chinese. Int J Obes 23:1136–1142.

Amos AF, McCarty DJ, Zimmet P. (1997) The rising global burden of diabetes and its complications: estimates and projections to the year 2010. Diabet Med 14(5):S1–85.

Kapoor S, Bhasin P, Dhall M, Bhardwaj S. (2010) Reproductive characteristics and socio-demographic factors as predictors of general and regional obesity among adult women. Ind J Phys Anthrop & Hum Genet 29(1-2):201.

Kapoor S, Singh IP, Bharadwaj H. (1980) Body fat and fat-free mass assessed by densitometric and anthropometric techniques in adult Indian women. Z Morph Anthrop 71 (3):274-84.

Sinha R, Kapoor S. (2006) Parent-child correlation for various indices of adiposity in an endogamous Indian population. Coll Antropol 30(2):291–296.

Tandon K, Kapoor S, Kapoor AK. (2011) Covariates and Prevalence of Obesity among Adult North Indian Population. Coll Antropol 35(2):305–311.

Gupta S, Kapoor S. (2011) Gender differences in familial aggregation of adiposity traits in Aggarwal Baniya families. Euras J Anthropol 2(2):85-95.

Joosse SA. (2011) Two-sample t-test calculator. Available from http://in-silico.net/statistics/ttest

Drewnowski A, Popkin BM. (1997) The nutrition transition: new trends in the global diet. Nutr Rev 55:31-43.

Ferro-Luzzi A, Martino L. (1996) Obesity and physical activity. Ciba F Symp 201:207-221.

Gupta S, Kapoor S. (2012) Optimal cut-off values of anthropometric markers to predict hypertension in North Indian population. J Commun Health 37(2):441-447.

Li C, Ford ES, Mokdad AH, Cook S. (2006) Recent trends in waist circumference and waist-height ratio among US children and adolescents. Pediatrics 118(5). doi10.1542/peds.2006-1062.

Currie J, DellaVigna S, Moretti E, Pathania V. (2009) The effect of fast food restaurants on obesity. NBER working paper series. Working Paper 14721. http://www.nber.org/papers/w14721

Ewing R, Schmid T, Killingsworth R, Zlot A, Raudenbush S. (2003) Relationship between urban sprawl and physical activity, obesity, and morbidity. Am J Health Promot 18(1):47-57.

Eisenmann JC. (2006) Insight into the causes of the recent secular trend in paediatric obesity: Common sense does not always prevail for complex, multi-factorial phenotypes. Prev Med 42(5):329-35.