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DETERMINANTS OF OVERWEIGHT AND OBESITY AMONG URBAN AND RURAL COLLEGE GIRLS

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ABSTRACT

The study was conducted to assess the determinants of obesity among urban and rural college girls. Thirty normal (BMI: 20-22.9 kgm²) and 30 obese (BMI \geq 23 kgm²) girls each from the urban and rural college were selected randomly to study the determinants of obesity among urban and rural groups. The average daily intake of energy by urban and rural normal girls was 77 and 76% of the Recommended Dietary Allowances (RDA). The corresponding values for urban and rural obese girls were 142 and 145% of the recommended level. The higher dietary intake of energy, protein, carbohydrates and fat were the most significant determinants of obesity among both urban and rural girls. Parental higher education was positively ($p \leq 0.01$) related with obesity among both urban and rural girls. A higher birth weight and family history of obese mothers ($p \leq 0.1$) and obese siblings ($p \leq 0.01$) were also found to be positively related with obesity among both urban and rural girls. Though both normal and obese subjects had sedentary lifestyle, a significantly ($p \leq 0.1$) lower Physical Activity Level (PAL) was observed among obese subjects.

Keywords: Obesity, urban, rural, college girls, nutrient intake, physical activity level.

INTRODUCTION

The prevalence of obesity is increasing worldwide at an alarming rate in both developing and developed countries. It has become serious epidemic health problem estimated to be the fifth leading cause of mortality at global level (James *et.al.*, 2004). One of the major causes of obesity is the changes in the diet in terms of quantity and quality which has become more “Westernized” (Antonio and Chiara, 2005). College students are highly exposed to unhealthy eating habits, leading to body weight gain.

Several international and regional studies indicated that factors causing obesity are multi-factorial in origin. These factors may include biological and non-biological factors such as hereditary, age, sex, education, socio-economic level, physical activity, eating habits and psychological factors (Suleiman *et.al.*, 2005). People may become obese or overweight because they increase their consumption of foods which contain high levels of sugar and fat, and/or their daily energy intake is more than their physical activities (WHO, 2004).

Although the mechanism of obesity development is not fully understood, it is confirmed that obesity occurs when energy intake exceeds energy expenditure. There are multiple etiologies for this imbalance; hence, the rising prevalence of obesity cannot be addressed by a single etiology. Genetic

factors influence the susceptibility of a given child to an obesity-conducive environment. However, environmental factors, lifestyle preferences and cultural environment seem to play major role in the rising prevalence of obesity worldwide (Phillips and Hill, 1998).

The determinants of obesity may vary in urban and rural college girls so there is need to understand rural-urban epidemiologic transition of obesity among youngsters as this has become a public health issue that characterizes the modern times and must be efficiently addressed. The study analyzed determinants of overweight and obesity among college girls.

MATERIALS AND METHODS

A group of thirty normal and thirty obese subjects were chosen randomly from two colleges each from an urban and rural location. College of Home Science, Punjab Agricultural University, Ludhiana represented for urban college while Guru Nanak National College for Women, Nakodar, represented rural college.

Body mass index (BMI) was calculated from the recorded values of height and weight (Garrow, 1981). An interview schedule cum questionnaire was developed to collect the information related to socio-economic status, parental education and occupation, hereditary and family

history of obesity, and food and nutrient intake. '24-Hour Recall Method' for three consecutive days was used to assess the food intake of the subjects. The nutrient intake was calculated using MSU Nutriguide Computer Programme (Song *et.al.*, 1992). The adequacy of nutrients was evaluated by comparing the nutrient intake with Recommended Dietary Allowances (RDA) of ICMR (ICMR, 2010). The involvement of the subjects in any kind of exercise or sports was noted down. Total time spent daily on exercise, sports and household activities was recorded. Weekly time spent on sedentary activities such as computer and television watching was also recorded.

PADM (Physical Activity Diary Method) was used to record the time spent on different activities for the days during which dietary survey was carried out. Physical Activity Ratios (PAR) given by FAO/WHO/UNU (2004) was used to calculate Physical Activity Level (PAL) of the subjects. The mean PAL was calculated as multiple of basal metabolic rate (BMR) using the following formula:

$$PAL = \frac{\sum(\text{time spent on each activity (min)} \times \text{energy cost of each activity (kcal)})}{1440 \text{ min}}$$

Basal metabolic rate (BMR) was calculated using equation given by ICMR, 2010.

$$18-30 \text{ yrs} = 14.0 \times \text{body weight (kg)} + 471$$

The total daily energy expenditure (TDEE) was calculated as:

$$TDEE = PAL \times BMR$$

The life style of the subjects was determined on the basis of physical activity level (PAL) values.

The energy balance was assessed from daily energy intake and expenditure

$$\text{Energy balance} = \text{Energy intake} - \text{Energy expenditure}$$

FAO/WHO/UNU (2004) classification was used to categorize the subjects of different age groups into three lifestyle categories namely Sedentary or light activity lifestyle (PAL: 1.40-1.69); Active or moderately active lifestyle (PAL: 1.70-1.99) and Vigorous or vigorously active lifestyle (PAL: 2.00-2.40).

Means, standard deviations and percentages were computed. Analysis of Variance was employed to study the determinants of obesity using factorial experiment in completely randomized design. Data was analyzed using "SAS 9.3" Statistical Software.

RESULTS AND DISCUSSION

PERSONAL PROFILE OF SELECTED NORMAL AND OBESE SUBJECTS

The mean age of normal and obese girls from urban groups was 20.2 and 19.9 y while it was 19.6 to 19.5 y for the rural group. The urban and rural group of both normal and obese girls matched for age. The BMI of normal girls was 21.62 kg/m² and 21.20 kg/m² in urban and rural groups, respectively, while it was 27.97 kg/m² and 27.44 kg/m² for obese girls of two groups. The BMI did not vary significantly in urban and rural group, but it was evident that BMI of normal and obese girls varied ($p \leq 0.01$) significantly. The family size also matched in urban and rural groups of both

normal and obese girls, the mean values being 5.06 and 4.90 for urban and 5.57 and 5.33 for rural normal and obese girls, respectively. The average family income of normal and obese urban girls was Rs 39661 and Rs 39643 while for rural girls; it was Rs 18,967 and Rs 20,317, respectively. Similarly, the corresponding values for per capita income were Rs 9024 and Rs 10129 and Rs 2992 and Rs 3631, respectively. The results revealed that there was a wide difference in family and per capita income of girls from urban and rural area, however, no significant difference was found in the economic status of normal and obese girls.

DETERMINANTS OF OBESITY

OCCUPATION AND EDUCATIONAL LEVEL OF PARENTS

Occupation and educational information of parents of the selected subjects have been shown in table 1. In normal subjects, 47 and 33% of the fathers had occupation of business, whereas, in obese subjects, a greater percentage i.e. 64 and 37%, respectively had business as main occupation. Higher percentage i.e. 40% of normal weight girls in rural areas belonged to the families where father's occupation was agriculture. No significant effect of father's occupation was observed in urban vs. rural and in normal vs. obese categories. Mother's occupation showed a highly ($p \leq 0.01$) significant difference in urban vs. rural category as majority of mothers in rural group were house wives. In urban group, 17% of obese girls had mothers in the occupation of service in comparison to only 3% in service in normal group. Statistical analysis revealed that both father's and mother's education was ($p \leq 0.01$) significantly different in urban vs. rural group as well as in normal vs. obese category. In case of normal girls from urban and rural group, majority i.e. 53 and 47% of fathers were intermediate and below matric, respectively. On the other hand, 53 and 30 % of fathers of obese girls were educated up to matric level in urban and rural groups, respectively. Similarly, majority i.e. 47 and 40% of mothers of both normal and obese girls from urban areas were educated up to intermediate level, while in rural area, 50 and 40% of normal girls had mothers having qualification below matric and matric, respectively. Educational level of mothers from rural areas was significantly ($p \leq 0.01$) lower as compared to urban areas.

PERSONAL AND FAMILY HISTORY

The birth weight, childhood and pre pubertal obesity and BMI of parents and siblings as reported by the subjects have been presented in Table 3. A significantly ($p \leq 0.05$) higher birth weight was observed among urban girls in both normal and obese groups. As expected, a significantly ($p \leq 0.05$) higher birth weight was reported by the obese girls in comparison to normal girls. The literature reported that birth weight tracks into adulthood. Heavier newborns become heavier adults because of steady influence of genotypes that lead to obesity (Ravelli *et.al.*, 1999 and Poulsen and Vaag, 2003).

Childhood and pre-pubertal obesity was found to be more prevalent in obese subjects, the percent prevalence being 17 and 27% in normal urban and 33 and 27% in normal rural girls. On the other hand, the childhood and pre-pubertal obesity was higher in obese girls, the percentage being 47 and 50% for urban girls and 43 and 47% for rural girls. The results clearly indicated that childhood and pre-pubertal obesity is carried forward even in adult life. Similarly, Anita and Abraham reported that overweight children were more likely to become overweight adults (Anita, 1997).

The subjects reported the height and weight of their parents and siblings and the BMI was calculated to assess obesity among parents and siblings. The results revealed that no significant difference was observed in the BMI of fathers of normal and obese girls, thus indicating, that father's body weight did not influence the obesity among children. However mother's BMI was found to be related with the weight of girls as mother's BMI was significantly ($p \leq 0.1$) higher in obese group as compared to normal group. The obese girls also had obese siblings as the statistical analysis revealed a significantly ($p \leq 0.01$) higher BMI of siblings of

the subjects in the obese group as compared to normal group. Genetic background plays a crucial role in the development of obesity (Poulsen and Vaag, 2003 and Caballero *et.al.*, 2003). A study found that all obese children had at least one obese parent and 45% of them had both parents obese (Golan *et.al.*, 1998). Overweight mothers tend to have overweight or obese children as they are more likely to establish an environment for themselves and their children that promote obesity (Styles *et.al.*, 2007).

NUTRIENT INTAKE

The daily nutrient intake of normal and obese girls has been given in table 3. The average daily intake of energy by urban and rural normal girls was 77 and 76% of the recommended dietary allowance (ICMR,2010). The corresponding values for urban and rural obese girls were 142 and 145% of the recommended level. No significant difference between energy intake of urban and rural girls was found, however a significantly ($p \leq 0.01$) higher energy intake was observed in obese girls in comparison to normal girls. Obesity is the result of over-consumption of calories.

Table 1 Occupation and educational level of parents of selected normal and obese girls

	Urban		Rural		p value	
	Normal (n=30)	Obese (n= 30)	Normal (n=30)	Obese (n= 30)	Urban/ Rural	Normal/ Obese
Occupation						
Father					0.1428 ^{NS}	0.8062 ^{NS}
Agriculture	5 (17)	4 (13)	12 (40)	9 (30)		
Business	14 (47)	19 (64)	10 (33)	11 (37)		
Service	11 (36)	7 (23)	8 (27)	10 (33)		
Mother					0.0003***	0.1385 ^{NS}
Housewife	26 (86.67)	21 (70)	30 (100)	29 (96.67)		
Business	3 (10)	4 (13.33)	0 (0)	1 (3.33)		
Service	1 (3.33)	5 (16.67)	0 (0)	0 (0)		
Education						
Father					<0.0001***	<0.0001***
Below matric	6 (20)	8 (27)	14 (47)	6 (20)		
Matric	5 (17)	1 (3)	12 (40)	8 (27)		
Intermediate	16 (53)	16 (53)	3 (10)	9 (30)		
Graduate	1 (3)	5 (17)	1 (3)	5 (17)		
Post graduate	2 (7)	0 (0)		2 (6)		
Mother					0.0003***	0.0059***
Below matric	10 (33)	8 (27)	15 (50)	5 (17)		
Matric	2 (7)	2 (7)	11 (37)	12 (40)		
Intermediate	14 (47)	12 (40)	1 (3)	7 (23)		
Graduate	3 (10)	6 (20)	3 (10)	6 (20)		
Post graduate	1 (3)	2 (6)				

Values in parenthesis are percentages

^{NS} Non significant; *Significant at 10%; **Significant at 5%; *** Significant at 1%

Table 2 Personal and family history of selected normal and obese girls

	Urban		Rural		p value	
	Normal (n=30)	Obese (n= 30)	Normal (n=30)	Obese (n= 30)	Urban/ Rural	Normal/ Obese
Birth weight, Kg						
Range	2-4	1.45-4.5	2-3.5	2-4		
Mean ± SD	2.87±0.54	3.19±0.62	2.73±0.31	2.82±0.42	0.0124**	0.0455**
Childhood obesity No. (%)						
Yes	5 (17)	14 (47)	10 (33)	13 (43)	-	-
No	25 (83)	16 (53)	20 (67)	17 (57)	-	-
Pre pubertal obesity						
Yes	18 (27)	15 (50)	8 (27)	14 (47)	-	-
No	22 (73)	15 (50)	22 (73)	16 (53)	-	-
BMI of parents and siblings						
Father						
Range	21.70-40.09	21.19-38.27	17.26-32.17	17.79-35.32	-	-
Mean ± SD	26.37±4.31	27.12±3.93	23.08±3.35	28.01±5.18	1.000 ^{NS}	0.3861 ^{NS}
Mother						
Range	18.54-38.62	20.11-45.75	18.34-32.26	15.08-34.44	-	-
Mean ± SD	27.08±3.98	27.38±5.09	26.37±4.31	27.03±4.00	0.0437**	0.0578*
Siblings						
	N=37	N=36	N=36	N=43	N=39	
Range	15.85-28.18	16.40-35.15	13.42-38.63	14.15-37.19	-	-
Mean ± SD	22.24±2.67	24.92±4.71	21.28±4.82	23.36±6.91	0.2922 ^{NS}	0.0083***

^{NS} Non significant; *Significant at 10%; **Significant at 5%; *** Significant at 1%

The results revealed that protein intake of normal girls was lesser i.e. 89 and 88% while, of obese girls, it was higher i.e. 147 and 132%, respectively of the RDA. The urban girls had significantly ($p \leq 0.1$) higher protein intake than rural girls. Similarly, obese girls also had significantly ($p \leq 0.01$) higher consumption of protein than their normal counterparts.

A significantly ($p \leq 0.01$) higher intake of carbohydrates was found among urban girls in comparison to rural girls. Obese girls consumed significantly ($p \leq 0.01$) more carbohydrates than their normal counterparts. The average carbohydrate intake of sedentary women in the age group of 25-35 years from Jaipur was found to be 228 g/d (Jain, 2003). The normal girls in the present study had

carbohydrate intake close to the reported value. The normal urban and rural girls consumed only 19 and 26% higher fat in comparison to the RDA while obese urban and rural girls consumed 132 and 177% higher fat intake. This excessive consumption of fat among Punjabi women has also been reported in literature (Kaur *et.al.*, 2013 and Dhir, 2012). The consumption of type of fat also varied among different groups. The intake of polyunsaturated fatty acids (PUFA) and cholesterol was significantly ($p \leq 0.01$) higher in urban girls while saturated fatty acids (SFA) was significantly ($p \leq 0.01$) higher in rural girls. On the other hand, obese girls from both urban and rural groups had significantly ($P \leq 0.01$) higher consumption of PUFA, SFA and cholesterol. An undesirable ratio of PUFA: SFA was observed in all groups.

Table 3 Daily intakes of nutrients by normal and obese girls

	Urban		Rural		P value	
	Normal (n=30)	Obese (n= 30)	Normal (n=30)	Obese (n= 30)	Urban/ Rural	Normal/ Obese
Energy, kcal	1472±296	2698±689	1442±286	2750±585	0.9068 ^{NS}	<0.0001***
Protein, g	49.12±11.60	81.08±23.00	48.25±10.48	72.59±16.15	0.0860*	<0.0001***
Carbohydrates, mg	220.17±39.18	388.33±105.86	186.00±37.21	345.98±94.57	0.0041***	<0.0001***
Total Fat	47.42±19.33	92.93±32.63	50.54±15.06	110.80±27.12	0.0413**	<0.0001***
PUFA, mg	5.01±2.23	8.04±5.11	3.23±1.85	6.07±4.51	0.0044***	<0.0001***
Saturated fats, mg	18.22±6.12	34.17±16.12	22.86±9.75	42.20±14.28	0.0094***	<0.0001***
Cholesterol, mg	9.34± 22.41	33.39± 43.42	2.70± 14.54	9.89± 23.05	0.0035***	0.0031***

^{NS} Non significant; *Significant at 10%; **Significant at 5%; *** Significant at 1%

PHYSICAL ACTIVITY

Physical activity pattern of normal and obese girls has been compared in table 4. The results revealed that 60 and 40% of normal urban and rural girls engaged themselves in some kind of physical exercise. On the other hand, the lesser percentage i.e. 57 and 23% of obese urban and rural girls were found to be involved in physical exercise or sports, respectively. Fifty percent of normal urban and rural girls performed exercise/sports 2-3 days a week. On the other hand, 53% of urban obese girls performed exercise/sports 4-5 days a week while 57% of rural obese girls performed exercise/sports 2-3 days. The results indicated that urban girls engagement and frequency in physical exercise/sports was higher as compared to rural girls. The duration of exercise was also higher in urban girls i.e. 24 and 54.67 min/week in both normal and obese. The statistical analysis revealed that normal girls spent significantly ($p \leq 0.05$) more time in exercise than their obese counterparts which clearly indicated that the obesity among obese girls could be due to lesser physical activity. Further, urban girls were spending significantly ($p \leq 0.05$) more time on exercise than the rural girls which could be attributed to more awareness regarding importance of physical activity among urban girls. The

increasing sedentary work is linked with great risk of obesity (Popkin et.al., 1999).

A larger percentage i.e. 90 and 100% of obese urban and rural girls respectively performed household work. On the other hand, good percentage i.e. 77 and 93% of normal urban and rural girls also performed various household activities. The results indicated that higher percentage of rural girls involved themselves in household work. No significant difference was however observed in time spent on most of the household activities between normal and obese girls. A significantly ($p \leq 0.05$ and 0.01) more than was being spent by rural girls on activities such as brooming and mopping of floor, cleaning utensils and cooking and serving food as compared to their urban counterparts.

The study revealed that time spent on computer was significantly ($p \leq 0.05$) higher in obese girls, however no difference was observed in time spend on computer by urban and rural girls. On the other hand, television viewing was significantly ($p \leq 0.05$) more in rural girls but no difference was observed between normal and obese girls. Television and computer use may cause sedentarism, which in turn may increase obesity (Marshall et.al., 2004; Nazni et.al., 2013 and Matusitz, 2012).

Table 4- Physical activity pattern of selected normal and obese girls

	Urban		Rural		Urban/ Rural	Normal/ Obese
	Normal (n=30)	Obese (n= 30)	Normal (n=30)	Obese (n= 30)		
Engagement in physical exercise or sport						
Yes	18(60%)	17(57%)	12(40%)	7(23%)	-	-
No	12(40%)	13(43%)	18(60%)	23(77%)	-	-
Frequency of physical exercise or sport/week						
2-3 days	9(50)	8(47)	6(50)	4(57)	-	-
4-5 days	4(22)	9(53)	2(17)	0(0)	-	-
6-7 days	5(28)	0(0)	4(33)	3(43)	-	-
Duration of physical exercise or sports, min/week						
Range	0-600	0-300	0-120	0-210	-	-
Mean \pm SD	124.00\pm166.87	54.67\pm69.22	35.17 \pm 47.32	23.33 \pm 49.35	-	-
Involvement in household work						
Yes	23(77%)	27(90%)	28(93%)	30(100%)	-	-
No	7(23%)	3(10%)	2(7%)	0(0%)	-	-
Time spent in household activities, min/day						
Brooming of floor	7.57 \pm 9.06	7.90 \pm 8.42	17.50 \pm 9.35	18.00 \pm 13.93	<0.0001***	0.5740 ^{NS}
Mopping of floor	5.27 \pm 7.32	4.17 \pm 6.44	20.33 \pm 12.66	18.27 \pm 16.43	<0.0001***	0.1805 ^{NS}
Making beds	4.90 \pm 6.37	3.93 \pm 4.11	8.67 \pm 4.54	8.07 \pm 7.08	0.0735 ^{NS}	0.0465**
Dusting	8.37 \pm 9.05	9.67 \pm 10.49	14.83 \pm 9.78	9.83 \pm 8.66	0.1812 ^{NS}	0.4774 ^{NS}
Cleaning utensils	7.37 \pm 9.82	6.70 \pm 9.79	16.17 \pm 10.72	11.83 \pm 11.71	0.0072**	0.2537 ^{NS}
Washing clothes (manual)	13.27 \pm 20.76	15.90 \pm 30.43	29.66 \pm 27.12	21.50 \pm 26.75	0.1125 ^{NS}	0.6255 ^{NS}
Cooking and serving food	12.24 \pm 23.13	20.90 \pm 32.92	37.67 \pm 32.90	37.20 \pm 28.19	0.0345**	0.6908 ^{NS}
Time spent on computer, hours/day						
Range	0-2	0-6	0-2	0.2-4		

Mean ± SD	0.97±0.75	1.54±1.28	0.42±0.57	1.06±1.27	0.3414 ^{NS}	0.0189***
Time spent on watching television, hours/week						
Range	0-35	0-56	2-30	0.5-70		
Mean ± SD	8.47±7.76	6.42±11.10	13.33±7.67	15.63±13.03	0.0109**	0.9698 ^{NS}

Values in parenthesis are percentages
^{NS} Non significant; *Significant at 10%; **Significant at 5%; *** Significant at 1%

ENERGY BALANCE AND PHYSICAL ACTIVITY LEVEL

The energy balance calculated from energy intake and expenditure has been shown in table 4.17. The data

revealed that energy intake of obese urban and rural girls was 42 and 45% higher than the RDA for energy, (ICMR,2010) while normal urban and rural girls had energy intake 23 and 24% lesser than the RDA. The results indicated that energy intake is a major determinant of obesity among obese groups.

Table 5- Daily energy balance and physical activity level (PAL) of selected normal and obese girls

	Urban College		Rural College		P value	
	Normal (n=30)	Obese (n= 30)	Normal (n=30)	Obese (n= 30)	Urban/Rural	Normal/Obese
Energy intake, kcal						
Range	941-2118	1184-4095	737-3202	1343-3978		
Mean ± SD	1472±296	2698±689	1442±286	2750±585	0.9068 ^{NS}	<0.0001***
Energy expenditure, kcal						
Range	1759-2234	1539-2853	1783-2304	1689-2745		
Mean ± SD	2022±128	2233±271	1934±65	2200±240	0.0701*	<0.0001***
Energy balance, kcal						
Range	225-1185.33	190-1541	100-1188	168-1456		
Mean ± SD	-550±168	464±418	-492±220	551±345	0.4971 ^{NS}	<0.0001***
Physical activity level (PAL)						
Range	1.40-1.94	1.05-2.13	1.45-1.72	1.12-2.00		
Mean±SD	1.65±0.15	1.53±0.23	1.60±0.07	1.53±0.02	0.5640 ^{NS}	<0.001***

^{NS} Non significant; *Significant at 10%; **Significant at 5%; *** Significant at 1%

and weight gain is due to increased energy intake (Anita, 1997 and Hill, 2000).

The physical activity level (PAL) showed that mean PAL values of girls from all groups had fallen in the category of sedentary workers, however obese girls had significantly ($p \leq 0.01$) lower PAL than the normal girls. No significant difference in PAL values was observed between urban and rural girls. The results clearly indicated that higher energy intake and lesser physical activity were the contributing factors for obesity. The increasing sedentary work is linked with greater risk of obesity (Popkin *et.al.*, 1999 and Byrd *et.al.*, 2010).

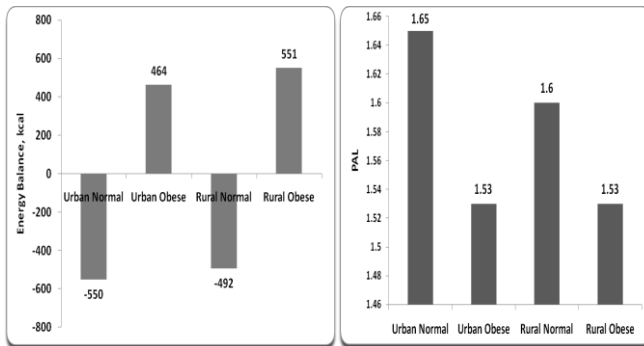


Fig 1 Energy Balance and Physical Activity Level (PAL) of urban and rural normal and obese college girls

The total daily energy expenditure of normal urban and rural girls was 2022 and 1934 kcal respectively, whereas a higher values i.e. 2233 and 2200 kcal were observed in case of obese urban attributed to their higher BMR due to large body weights. Higher total energy expenditure in the obese than the lean children despite less physical activity has been observed (Maffeis, 2000). On calculating energy balance from intake and expenditure, a negative energy balance i.e. -550 and -492 kcal was observed for normal urban and rural girls, whereas, a positive energy balance by 464 and 551 kcal was found in obese urban and rural girls (Fig.1). The increased probability of positive energy balance

CONCLUSION

Higher dietary intakes of energy, protein, carbohydrates and fat were the most significant determinants of obesity among both urban and rural girls. Parental higher education was positively related with obesity among both urban and rural girls. Higher birth weight and family history of obese mothers and obese siblings were also found to be associated factors of obesity. A significantly lower physical activity level was observed among obese subjects. Based on the results of the study, it is recommended that nutrition awareness, importance of physical activity and self discipline needs to be promoted among young girls through various educational programs, so that they can achieve optimum body composition and desirable body weights despite their

heredity and family history of obesity. There is need to educate parents as well.

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