

Parent offspring relationship for overweight and obesity

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ABSTRACT

Introduction: Childhood obesity is a matter of concern all over the world. It is evident from the literature that obesity tends to run in families. Therefore, in the present study, an attempt has been made to find the association between parental obesity and childhood obesity.

Methods: This cross-sectional study was conducted in Kot Khalsa area of Amritsar and data was collected from 102 parents (51 fathers & 51 mothers) and 105 offsprings' (68 sons & 37 daughters) belonging to middle socio-economic status and low physical activity. Height and weight measurements of parents and their offsprings' were taken by standard methodology and BMI was calculated. Prevalence of obesity among parents and offsprings' was assessed with the help of international BMI standards.

Results: The combined prevalence of overweight/obesity among parents and offsprings' was found out to be 61.77% and 20.00%, respectively which was quite higher even than the populations of the developed countries. The present results have also shown that when both parents were overweight/obese then their offsprings' had 3.14 times more relative risk for development of overweight/obesity than their normal counterparts. On the other hand, if only mother was overweight/obese then their offsprings' showed 1.19 times more relative risk for development of overweight/obesity compared to the overweight/obese fathers.

Conclusion: The results of the present study prove that offsprings' of overweight/obese parents were at an increase risk of being overweight/obese compared to their counterparts of normal weight parents. However, present findings need to be confirmed by longitudinal studies and genetic linkage studies.

Keywords: Overweight, Obesity, Body Mass Index (BMI), Parents, Children.

INTRODUCTION

Obesity is not a single disorder but a heterogeneous group of conditions with multiple causes. For the first time, Davenport (1923) reported that both familial and non-familial factors play an important role in the development of obesity. Twin, adoption and family studies (Muellar, 1983; Garn, 1985; Stunkard *et al.*, 1986; Price *et al.*,

1987; Whitaker *et al.*, 1997) have shown that obesity is strongly influenced by genetic background and an individual's chances of being obese are increased when he or she has first degree relatives who are obese., Wang *et al.* (2000), Wang and Wang (2002), Magarey *et al.*(2003), Lobstein *et al.*(2004), Bell *et al.*(2007), Mazur *et al.* (2008), Kleiser *et al.* (2009) reported from their studies that the risk of obesity is two to three times greater for an individual with family history of obesity and increases further with severe obesity. Sangha *et al.* (2006), Joseph and Rudolph (2007), Kumar *et al.*(2010), reported that the strongest predictor of childhood obesity is parental obesity and the risk of obesity is lower in children with neither parent being obese, greater when one parent is obese and greatest when both parents are obese. It is evident from the above mentioned studies that majority of these studies were conducted in developed countries. Unfortunately, there are very few reports from India regarding the association between parental obesity and childhood obesity. Therefore, in the present study, an attempt has been made to study the prevalence of overweight and obesity among parents and their offsprings' and to assess the association between parental obesity and childhood obesity.

MATERIALS AND METHODS

For the present cross-sectional study, data was collected from 102 parents and 105 offsprings' (age range: parents 30-50 years; children 10-18 years) located at Kot Khalsa area of Amritsar. All the subjects were healthy at the time of data collection. Women, who were pregnant, not included in the study. Study protocol was approved by Ethical Review Committee of Guru Nanak Dev University, Amritsar. During data collection, personal interview was held with each parent at his/her residence. Information about age, sex, occupation, socio-economic status, physical activity and life style was recorded. All the parents were predominantly engaged in business or government jobs and therefore they were considered as belonging to middle socio-economic status and low physical activity group. During interview, general awareness was also created among the subjects about obesity, its environmental determinants and health risks. Two anthropometric measurements i.e. height and weight were taken on each subject using standard methodology given by Weiner and Lourie (1981).

Analysis of Data

“Table 1: International cut off points for child and adolescents overweight and obesity by age and sex according to Body Mass Index (BMI)”

Age (in years)	Overweight (BMI ≥ 25 kg/m ²)		Obese (BMI ≥ 30 kg/m ²)	
	Boys	Girls	Boys	Girls
2.0	18.41	18.02	20.09	19.81
2.5	18.13	17.76	19.80	19.55
3.0	17.89	17.56	19.57	19.36
3.5	17.69	17.40	19.39	19.23
4.0	17.55	17.28	19.29	19.15
4.5	17.47	17.19	19.26	19.12
5.0	17.42	17.15	19.30	19.17
5.5	17.45	17.20	19.47	19.34
6.0	17.55	17.34	19.78	19.65
6.5	17.71	17.53	20.23	20.08
7.0	17.92	17.75	20.63	20.51
7.5	18.16	18.03	21.09	21.01
8.0	18.44	18.35	21.60	21.57
8.5	18.76	18.69	22.17	22.18
9.0	19.10	19.07	22.77	22.81
9.5	19.46	19.45	23.39	23.46
10.0	19.84	19.86	24.00	24.11
10.5	20.20	20.29	24.57	24.77
11.0	20.55	20.74	25.10	25.42
11.5	20.89	21.20	25.58	26.05
12.0	21.22	21.68	26.02	26.67
12.5	21.56	22.14	26.43	27.24
13.0	21.91	22.58	26.84	27.76
13.5	22.27	22.98	27.25	28.20
14.0	22.62	23.34	27.63	28.57
14.5	22.96	23.66	27.98	28.87
15.0	23.29	23.94	28.30	29.11
15.5	23.60	24.17	28.60	29.29
16.0	23.90	24.37	28.88	29.43
16.5	24.19	24.54	29.14	29.56
17.0	24.46	24.70	29.41	29.69
17.5	24.73	24.85	29.70	29.84
18.0	25.00	25.00	30.00	30.00

Adapted from Cole *et al.* (2000)

The whole data was analysed for assessment of overweight and obesity. Among parents, the prevalence of overweight and obesity was assessed according to BMI criterion given by WHO (1998). Parents were categorized on the basis of BMI as normal (BMI 18.5-24.9 kg/m²), overweight (BMI 25-29.9 kg/m²) and obese (BMI ≥ 30 kg/m²). Among offsprings', overweight and obesity was assessed using international cut off points of BMI (Table 1) devised by Cole *et al.* (2000). According to this criterion classification of overweight and obesity was as (i). if BMI analogue for age and sex is less than 25 kg/m², then the offspring is normal (ii). if BMI

analogue for age and sex is 25 kg/m^2 and more but less than 30 kg/m^2 , then offspring is overweight, and (iii). If BMI analogue for age and sex is equal to or more than 30 kg/m^2 , then the offspring is obese.

Statistical analysis

The entire data was entered into the MS-EXCEL programme. The data was analysed using Statistical Software for Windows Version 16.0 (SPSS inc. Chicago, IL). The results for continues variables were presented as mean and standard deviation and of categorical variables as absolute and percentage. Spearman's correlations were calculated to access the association between height, weight and BMI of offsprings' with parents. Statistical significance was also calculated by χ^2 -test (for discrete data) and by student's 't'-test (for continuous data). All significance tests were two-tailed and statistically significance was defined as a value of $p < 0.05$. The relative risk (RR) and odds ratio (OR) were calculated using Medcalc.

RESULTS

Mean value and standard deviation (SD) along with 't'-value with level of significance of height, weight and body mass index (BMI) in parents (fathers and mothers) and offsprings' (sons and daughters) have been summarized in Table 2. From the present study it was evident that fathers had statistically significant higher values of height than mothers, however, mothers showed statistically significant higher values of BMI than fathers. On the other hand, among offsprings', sons had statistically significant higher values of height than daughters but the difference in the mean values of weight and BMI were found to be statistically non-significant between sons and daughters.

“Table 2 : Mean and standard deviation (SD) of anthropometric variables of parents and offsprings' and 't'-value with level of significance”

Variables	Parents				't'-value	Offsprings'				't'-value
	Fathers		Mothers			Sons		Daughters		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Height (cm)	166.00	7.00	155.00	5.66	9.276**	160.00	16.35	152.00	7.61	2.614*
Weight (kg)	69.74	14.16	71.76	19.87	0.159	53.02	19.42	48.01	13.09	1.549
BMI (kg/m^2)	25.18	3.87	29.99	4.67	0.110*	19.83	4.85	20.32	4.56	0.510

*indicates value significant at $p < 0.05$

** indicates value significant at $p < 0.01$

A very high prevalence of overweight (34.31%) and obesity (27.46%) was observed in the pooled sample of parents (Table 3). In the present study, among mothers combined prevalence of overweight/obesity was significantly higher than in fathers (χ^2 7.941, df 1 and p-value 0.004). However, the prevalence of obesity in mothers was about four times more than the fathers and prevalence of overweight was about two times more in fathers than mothers.

“Table 3 : Prevalence of overweight (OW), obesity (OB) and combined overweight and obesity (OW+OB) among fathers and mothers according to BMI criteria of WHO (1998)”

Sex	Percentage Prevalence			
	Normal	OW	OB	Combined OW+OB
Fathers (51)	47.06 (24)	41.08 (21)	11.76 (6)	52.94 (27)
Mother (51)	29.41 (15)	24.45 (14)	43.14 (22)	67.59 (36)
Total (102)	38.23 (39)	34.31 (35)	27.46 (28)	61.77 (63)

Figures in parenthesis indicate number of subjects

“Table 4 : Prevalence of overweight (OW), obesity (OB) and combined overweight and obesity (OW+OB) among sons and daughters according to BMI criteria derived by Cole et al. (2000)”

Sex	Percentage Prevalence			
	Normal	OW	OB	Combined OW+OB
Sons (68)	79.42 (54)	13.23 (9)	7.35 (5)	20.58 (14)
Daughters (37)	81.08 (30)	10.81 (4)	8.11 (3)	18.92 (7)
Total (105)	80.00 (84)	12.39 (13)	7.61 (8)	20.00 (21)

Figures in parenthesis indicate number of subjects

Table 4. showed that the overall combined prevalence of overweight/obesity among sons and daughters was 20.00% (Sons: 20.58%; Daughters: 18.92%). It is interesting to observe that the difference in the percentage prevalence of overweight and obesity among sons and daughters was statistically non-significant.

As in the present sample, the number of daughters in comparison to sons was very small; therefore the total number of sons and daughters has been taken together in further analysis. In order to study the association between parental obesity and childhood obesity, parents were categorized into four groups on the basis of BMI (i). both parents having normal BMI, (ii). only father overweight/obese, (iii). only mother overweight/obese, (iv). both parents overweight/obese. It is apparent from Table 5. that when both parents were normal according to BMI, they had only 7.69%

overweight and obese offsprings’ and 92.31% normal offsprings’. On the other hand, when both parents were overweight/obese they had 33.33% overweight and obese offsprings’ and 66.67% normal offsprings’. When the impact of only maternal and paternal overweight/obesity on offsprings’ was analysed separately, it was found that if only mothers were overweight/obese then 20.00% of their offsprings’ were overweight/ obese and if only father was overweight/obese then 16.64% of their offsprings’ were overweight/obese. This indicated that prevalence of overweight/obesity in offsprings’ was associated with the overweight/obesity status of parents especially mothers.

“Table 5 : Prevalence of combined overweight and obesity (OW+OB) among offsprings’ according to parental overweight (OW) and obesity (OB) status according to body mass index (BMI)”

BMI status of Parents	Total number of Children (N=105)	BMI Status of Offsprings’	
		Normal (N=84)	Combined OW+OB (N=21)
Both Parents having Normal BMI (BMI 18.5-24.9 kg/m ²)	26	92.31 (24)	7.69 (2)
Only Father OW/OB (BMI ≥ 25kg/m ²) Mothers have normal BMI	40	80.00 (32)	20.00 (8)
Only Mothers OW/OB (BMI ≥ 25kg/m ²) Fathers have Normal BMI	12	83.33 (10)	16.64 (2)
Both Parents OW/OB (BMI ≥ 25kg/m ²)	27	66.67 (18)	33.33 (9)

Figures in parenthesis indicate number of subjects

“Table 6 : Parent-offspring correlation for some anthropometric variables”

Variables	Father-offspring Correlations	Mother-offspring Correlations
Height (cm)	0.336**	0.356**
Weight (kg)	0.083	0.517**
BMI (kg/m ²)	0.183	0.385**

**indicates correlation significant at p<0.01

The influence of parental obesity on childhood obesity was further proved by correlation coefficient analysis (Table 6). Correlation coefficient measures the degree and nature of relationship. On the basis of correlation analysis, it had been observed that offsprings’ BMI was significantly and strongly correlated with parents.

DISCUSSION

It is interesting to observe from the results of present study (Table 3 and 4) that the prevalence of overweight was found out to be higher among fathers and sons while

prevalence of obesity was higher among mothers and daughters. Exploring the international trends of overweight and obesity, it is evident from literature (WHO, 2000) that the prevalence of obesity is more among females than males while the prevalence of overweight is higher among males in comparison to females. The combined prevalence of overweight and obesity among parents and offsprings' is quite higher even than the adults and offsprings' of developed countries which were reported by WHO (2000), Lobetein *et al.*(2004).

One of the primary goals of this study was to examine the association between overweight and obesity in parents and their offsprings'. The current study shows that nutritional status of both parents has a direct effect on their offsprings' nutritional status (Table 5). The prevalence of overweight/obesity in offsprings' increases with the increasing parental BMI. The association in prevalence of overweight/obesity among offsprings' and parents had been confirmed with the help of relative risk (RR) and odds ratio (OR). The present study also showed that when both parents were overweight/obese then their offsprings' had more chances for development of overweight/obesity (RR=3.1429; 95% CI= .08732-11.3115; p=0.07, OR= 6.00; 95% CI=1.1528-31.2289; p=.0333) than their normal counterparts. The results are consistent with a study conducted by Kleiser *et al.* (2009) among 3-17 years old German children and observed that when both parents are overweight, the risk of obesity for offsprings' was increased 11 folds. Lobetein *et al.*(2004) also reported that parental obesity is the most important risk factor for obesity among children. Further more offsprings' of overweight and obese mothers showed higher risk for development of overweight/obesity (RR= 1.1905; 95% CI=0.3078-4.6038; p=.8005, OR=1.25; 95% CI=0.2273-6.8731; p=.7975) than the offsprings' of overweight/obese fathers. This shows that the impact of the maternal overweight/obesity on the childhood overweight/obesity is greater than that of the paternal overweight/obesity.

Magarey *et al.* (2003) reported that BMI is a good indicator of later obesity and further observed that tracking of BMI was strong to those subjects with both parents overweight or obese compared with that only one parent or neither parent overweight or obese. Therefore, in the present study, an attempt has also been made to report the relationship between parental BMI and offsprings' BMI on the basis of correlation analysis and observed a strong association between BMI of parents and their offsprings' but the value of correlation coefficient was observed more in case of

mothers ($r = .385$) than fathers ($r = .183$). This is consistent with other reports that too observed a significant positive correlation between maternal and offsprings' BMI as reported by Bell *et al.* (2007), Klunder *et al.* (2011), Kaur (2011) while MoSuwan *et al.* (1998) and Sangha *et al.* (2006) observed a significant correlation between paternal BMI and children's BMI. On the other hand, Maffies *et al.* (1998) and Valerio *et al.* (2006) observed that effect of parental BMI is less certain in young children.

The possible mechanism for the genetic transmission of obesity was suggested by various scientists Whitaker *et al.* (1997), Magarey *et al.* (2003), Sekine *et al.* (2002) who found that obesity in one or both of the parents probably influences the risk of obesity in their offsprings because of shared genes or environmental factors within families. The role of the home environment in the development of childhood overweight and obesity has been recognized for a long time because the home is the site where parents transmit food habits and customs to their children. According to Marins *et al.* (2004), it is important to emphasize that the mother's feeding habits tend to be adapted by the child because the mothers are usually more involved into preparation and choice of the food. Griffith and Payne (1976) reported another mechanism for the genetic transmission of obesity who found that children of obese parents are more likely to become obese than children of non-obese parents because obese individual have lower metabolic rate than the normal weight individuals and metabolic rate is strongly familial. Wardle *et al.* (2001) reported another reason for childhood obesity that children from obese/overweight families had a higher preference for fatty foods, a lower liking for vegetables, a overeating type of eating style; they had a stronger preference for sedentary activities. Perssue *et al.* (1989) also reported that energy intake and energy expenditure which are important influencing factors for obesity, tend to aggregate within families and contribute in the development of obesity in family members.

The increased familial aggregation in childhood obesity may be due to shared genes or due to lower energy expenditure. However, present findings need to be confirmed by longitudinal studies and genetic linkage studies.

CONCLUSION

A strong association between parental obesity and childhood obesity has been observed in the present study. The results of the present study prove that offsprings' of overweight/obese parents were at an increase risk of being overweight/obese

compared to their counterparts of normal weight parents. The increased familial aggregation in childhood obesity may be due to the impact of genetic and environmental factors. However, present findings need to be confirmed by longitudinal studies and genetic linkage studies.

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