SOCIO- DEMOGRAPHIC AND DIETARY DETERMINANTS OF OVERWEIGHT AND OBESITY IN MALE PAKISTANI ADULTS

Muhammad Abbas, MSc-Hons
Zia-ud-Din, PhD
Parvez I Paracha, PhD
Saleem Khan, PhD
Zafar Iqbal, PhD
Mudassar Iqbal, PhD
Faculty of Nutrition Sciences,
The University of Agriculture, Peshawar, Pakistan

Abstract

The aim of this study was to identify potential socio-demographic and dietary determinants of overweight and obesity in men to provide basis for effective prevention strategies. A stratified random sample of 897 men (aged >30 years and free from any chronic / congenital diseases) were selected for the study from Mardan city located in the North West of Pakistan. Height and weight of the subjects were measured using standard anthropometric methods; body mass index (BMI) was calculated. Data on dietary intake, overweight /obesity trend in the families, physical activity and socio-economic status were collected by interview. Pearson's chi square statistic and chi square trend were used to determine the differences in prevalence of overweight and obesity between different groups. Multiple logistic regressions were used to identify potential socio-demographic and dietary factors associated with overweight / obesity. Using BMI, subjects were identified as normal (<25), overweight (25-29.9) and obese (≥30). Overall, prevalence of overweight and obesity was 33% and 9% respectively. There was an increasing trend in the prevalence of overweight and obesity with increasing age (OR: 1.15, 95% CI: 1.12-1.18). Among socio-economic factors; occupation, family history of overweight/obesity, monthly income and physical activity were found to be significant predictors of overweight/obesity in study subjects. In contrast to developed countries, increased income was associated with increased levels of overweight/obesity. Among dietary factors, daily energy intake and subjects' preferences for fried meat and fatty foods were evident as significant

correlates of overweight/obesity. Strong predictors of overweight and obesity included income level, physical inactivity and poor dietary preferences in the study population.

Keywords: Overweight, socioeconomic, dietary, risk, factors

Introduction

Emerging evidence strongly suggests that overweight and obesity have reached epidemic proportions globally (WHO., 2000). Almost all countries are experiencing an obesity epidemic, although with great variation between and within countries (WHO., 2003). In the United States, for example, the prevalence of obesity rose from 15.0% to 30.9% between 1980 and 2000 (Flegal et al., 2002). Similar findings have been reported from developing countries (Hodge et., 1994; Al-Abbad and Al-Sowielem., 1998; Singh et al., 2007). The prevalence varies not only among regions and countries but also among races and ethnic groups (Jia et al., 2002). It affects all age and income groups.

Obesity is generally assessed through body mass index (BMI) (Deurenberg et al., 1998; Wang., 2004). According to this assessment individuals who fall in the range of BMI 25-29.9 are classed as over-weight and those having BMI 30 or above are classed as obese (WHO., 2001). Obesity, of any kind, is associated with non-communicable chronic diseases such as type 2 diabetes, cardiovascular and cerebrovascular diseases, digestive disorders, and cancer. Furthermore, obesity is a major independent risk factor for the development of hypertension, type II diabetes, and dyslipidemia (Cihangir et al., 2004). The risk of developing non-communicable chronic diseases had been found closely related to the BMI status (Deurenberg et al., 1998).

It is often reported that obesity is simply the result of overeating or lack of physical activity (Williamson et al., 1993; Lichtman et al., 1992; Martinez-Gonzalez et al., 1999). However, the etiology of obesity is not as simple as this, and many complex and interrelated factors are likely to contribute to the development of obesity. It has been repeatedly observed that age and income have a contributing role in the development of obesity (Cihangir et al., 2004).

Given the severity and known health hazards of obesity, gathering of a reliable data becomes essential to effectively deal with this problem. The data would facilitate in planning and implementation of appropriate nutritional intervention programs. Unfortunately, there is paucity of data in Pakistan regarding the prevalence of obesity and its causative factors particularly in areas away from the main cities. Therefore, the present study was designed with the objective to identify economic and dietary factors

associated with overweight and obesity in men in the context of a city situated in the valley of North West region of Pakistan.

Materials And Methods:

A community based cross-sectional study was conducted in Mardan city – Pakistan. Mardan city is the administrative headquarter of District Mardan, Khyber Pakhtunkhwa, where people are mostly involved in business, daily wage jobs (including both skilled and non-skilled workers); government and private services. The city includes educational institutions, hospitals, transport services and business markets that provide a wide range of job opportunities to the community.

The survey was conducted by the Department of Human Nutrition, the University of Agriculture, Peshawar between March 2005 and July 2008. Ethical approval to conduct this survey was obtained from the Directorate of Advance Studies and Research, the University of Agriculture, Peshawar. Mardan city has 15 union councils with a total population of 332700 (total male population: 169677; 29.8% of which are men ≥ 30 years i.e. 50903) based on information obtained from City District government Mardan. A two stage stratified random sampling method was used to provide stable prevalence estimates for men aged ≥ 30 year. In the first stage, the union counsels were treated as stratum of the stratified random sampling method. List of all households in each union council was obtained from local census office. In the second stage, houses were randomly selected from each union council proportional to their population size; making a total sample size of 1002. However, in the current study, only subjects with data available on all key variables (anthropometry, dietary and socioeconomic) were selected for analysis (n=897, 90%).

A responsible man; free from any congenital or chronic disorder, was enrolled from each household as the study subject. Age of the subjects was confirmed from their National Identity cards. Informed consent was obtained from each participant prior to the interview and anthropometric measurements. Weight of the subjects was taken in light clothes and without shoes using a portable electronic scale to the nearest 0.1 kg; standing height was measured to the nearest 0.1 cm using a non-stretchable measuring tape. Anthropometric measurements were recorded on a printed proforma. It also contained questions about respondent's family history of obesity which were asked thoroughly after taking physical measurements. Body mass index (BMI) (Kg/m^2) was used to define overweight and obesity **(WHO 2001).** Appropriate questionnaires were used to collect information on respondents' physical activity level, socio-economic status and dietary intake through face-to-face interview. Socioeconomic and dietary questionnaires underwent pilot testing before finalization.

Physical activity level of the participants was evaluated using short form of the International Physical Activity Questionnaire (IPAQ) (available at http://www.ipaq.ki.se, *accessed on August 2005*). This questionnaire was developed in 1998 by an international group of experts of PA assessment. It has reasonable measurement properties for monitoring physical activity status of adults at population levels. It can be used in all types of societies, from developed to developing countries (Booth et al., 2003). IPAQ is used to gather information on physical activity habits over the past week. Data on frequency (days per week) and duration (minutes per day) of vigorous activity, moderate activity, walking and sedentary activity were collected. Respondents were facilitated during interview by proving suitable examples to understand well the differences in vigorous, moderate and light/sedentary activities. Physical activity levels of the subjects were categorized in to *sedentary, moderate and vigorous* based on data collected through IPAQ.

A semi-structured questionnaire was developed and used to assess socio-demographic status (marital status, education, occupation, monthly income) of the respondents. The distribution quartiles of monthly income (Rs.) determined the income categories as lowest, low-middle, high-middle and highest incomes. Occupation status of the study subjects was grouped into three categories, *manual workers* including labor (unskilled) and skilled workers (e.g. car mechanics, masons, carpenters etc.), *government services* and *employment at private sector*.

A food preference checklist was developed to collect information on food preferences of the respondents. The checklist contained 95 common food items from different food groups (milk and milk products, meat and meat products, pulses, vegetables, fruits, cereals, nuts and seeds, beverages, sweets and confectionary products, fats and oils); each subject was asked to indicate preference for each food item. Respondents' preference for each food item was rated on a 4 point scale ('0: do not like at all' to '3: like extremely'). A variable on 'food preference score' was computed by taking the average food preference score given to different food items within a group. This variable was dichotomized at the median to generate categorical variables on *food preferences* specific to each food group *(low versus high preferences).*

Dietary intakes were quantified by using the 24-hour dietary recall method. Dietary models with different portion sizes were developed and used for assessment of portion sizes consumed in 24 hours. Dietary Energy intakes of the subjects were determined using food composition tables for Pakistan; total energy intake (kcal/day) was reported by tertiles (Tajamal., 2001).

All statistical analyses were performed using SPSS (Version 16; SPSS Inc., Chicago, IL, USA). Descriptive statistics were performed to

check data for entry errors and distribution. Pearson Chi-square statistic was used to test the association between categorical variables. Overweight/obese subjects were combined in one group and compared with normal subjects for socioeconomic status (SES) and dietary risk factors using logistic regression. Odds ratios (OR) and their corresponding 95% confidence intervals (CI) were estimated in the logistic regression analysis to evaluate association between overweight/obesity and risk factors. Univariate logistic regression was first executed to explore the unadjusted association between each factor and the risk of overweight/obesity. Multivariate logistic regression was then performed by putting all variables into the models to get OR controlled for confounders. The Wald test was reported at $p< 0.05$.

Results:

Only subjects (n=897, 90%) with data available on all key variables (weight and height, socio-demographic, physical activity and dietary characteristics) were selected for analysis.

Table 1 summarizes socio-demographic and anthropometric characteristics of the study population. Age range of the study subjects was 30 – 65 years (mean age: 41 years). The largest proportion of the subjects had no formal education (41%) and was in the lowest income group (33%). Similarly, the largest proportion was engaged in government services (38.8%). Figure 1 shows distribution of overweight and obesity by age groups. Overall, 33% and 9% of the subjects were overweight and obese respectively. Overweight was highly prevalent in the 40 – 50 years age group, followed by > 50 years age group. Obesity was however, predominantly prevalent in the >50 years group followed by 40 – 50 years age group.

Table 2 shows results on unadjusted odds ratio (OR) and 95% confidence interval (CI) for each socio-demographic and dietary factors from the univariate logistic regression. The dependent variable was overweight/obesity; its association with the socio-demographic and dietary parameters was assessed by entering each variable in the model independently. Twelve factors were examined to determine their association with the risk of overweight/obesity. Among the socio-demographic factors, age, occupation, monthly income, overweight/obesity history and physical activity showed a strong positive association ($p<0.05$) while marital status and formal education had no association with overweight/obesity ($p>0.05$). Among the dietary factors, daily energy intake and respondents' preferences for fried meat / kebab, fatty foods and sweets were strongly associated with risk of overweight/obesity ($p<0.05$) while subjects' preferences for vegetables were not ($p>0.05$).

Table 3 depicts results on adjusted OR and their corresponding 95% CI. Among the socio-demographic variables, age of the respondents, occupation, trend of overweight/obesity in closed relatives, income and physical activities were significant correlates of overweight/obesity after adjusting all of the others factors. There was an increasing trend in overweight/obesity per year of age (OR: 1.15, 95% CI: 1.12-1.18). Men in government services were more likely than manual workers to be overweight/obese (OR: 2.76, 95% CI: 1.72-4.41) as were those in business or self-employment (OR: 2.29, 95% CI: 1.34; 3.94). Family history of overweight/obesity was found to be a significant predictor (OR: 2.23, 95% CI: 1.42; 3.53); men with positive history had two times higher risk of overweight/obesity than those with no history. Similarly, strong evidence was found that overweight/obesity was highly associated with both monthly income and physical activity; men with 4th income quartile (highest income group; OR: 4.48, 95% CI: 1.68; 10.09) and light physical activity (OR: 3.89, 95% CI: 2.22; 6.82) were at higher risk of overweight/obesity in comparison to those with lowest income level and strenuous life style. Among dietary factors, daily energy intake and subjects' preferences for fried meat and fatty foods were evident as significant correlates of overweight/obesity in study subjects. Overweight/obese men were more likely to be in the 2nd and 3rd tertile of daily energy intake. The risk of overweight/obesity was significantly higher for men having more inclinations to fried meat/kebab (OR: 2.53, 95% CI: 1.23; 5.21) and fatty foods (OR: 1.61, 95% CI: 1.09; 2.38) than those with low preferences for these foods.

Figure I: Distribution of overweight and obesity by age groups

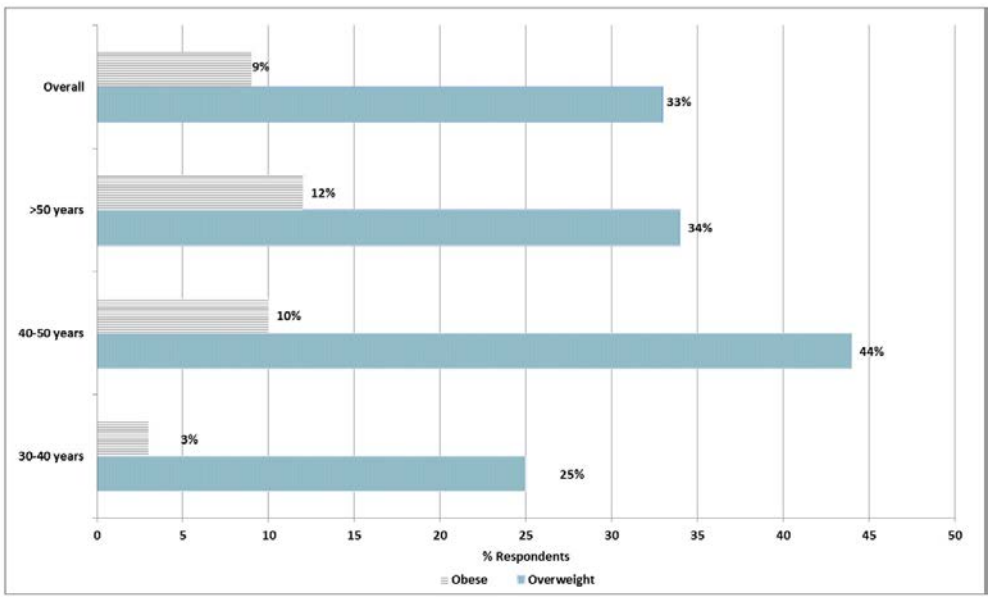

Table 1: Socio-demographic and anthropometric characteristics of the respondents

Socio-demographic characteristics		**N (%)**
Education (years)		
	No formal education	371 (41%)
	<10 years	252 (28%)
	11 - 14 years	220 (25%)
	>14 years	54 (6%)
Occupation▼		
	Manual workers	279 (31.1%)
	Government services	348 (38.8%)
	Private / self-employed	270 (30.1%)
Monthly income		
	1st quartile (lowest)	295 (33%)
	2nd quartile	243 (27%)
	3rd quartile	194 (22%)
	4th quartile (highest)	165 (18%)
Marital Status, current		
	Single	66 (7%)
	Married	831 (93%)
Family history of overweight/obesity *		
	Yes	185 (21%)
	No	712 (79%)
Anthropometric characteristics		Mean (SD)
Age (year)		41.2 (9.4) (Age range: 30 – 65 years)
Weight (kg)		68.5 (14.0)
Height (cm)		167.2 (5.3)
BMI (kg/m^2)		24.5 (4.8)

▼Manual workers include both skilled and unskilled workers; Government services include all those working in a government organization; Private/self-employed includes businessmen and individuals working in private institutions/firms. *Family history of overweight/obesity in close relatives (parents, brothers, sisters, first cousins)

Table 2: Socio-demographic and dietary risk factors associated with overweight/obesity, unadjusted analyses

Variables		**Overweight/obese N (%)***	**Crude OR (95% CI)**	**p-value**
Socio-demographic factors				
Age (y)		--	1.13 (1.11; 1.15)	0.000
Marital status, current				
	Single	24 (6.5%)	reference	
	Married	352 (93.5%)	1.25 (0.75; 2.11)	0.392
Occupation				
	Manual workers	60 (16%)	reference	
	Government services	171 (45.5%)	3.44 (2.41; 4.91)	0.000
	Private/self-employed	145 (38.5%)	4.06 (2.79; 5.90)	0.000

Education (years)				
	No formal education	158 (42%)	reference	
	<10 years	97 (26%)	0.89 (0.64; 1.23)	0.485
	11 - 14 years	98 (26%)	1.08 (0.77; 1.51)	0.658
	>14 years	23 (6%)	0.98 (0.55; 1.76)	0.901
Family history				
	No	256 (68%)	reference	
	Yes	120 (32%)	3.34 (2.38; 4.67)	0.000
Income				
	1st quartile (lowest)	71 (19%)	reference	
	2nd quartile	79 (21%)	1.49 (1.02; 2.18)	0.040
	3rd quartile	102 (27%)	3.33 (2.26; 4.91)	0.000
	4th quartile (highest)	124 (33%)	8.88 (5.74; 11.74)	0.000
Physical activity				
	Vigorous	45 (12%)	reference	
	Light	184 (49%)	5.25 (3.47; 7.95)	0.000
	Moderate	147 (39%)	1.60 (1.08; 2.76)	0.019
Dietary factors				
Daily Energy intake				
	1st tertile (lowest)	70 (18.5%)	reference	
	2nd tertile	128 (34%)	2.36 (1.65; 3.36)	0.000
	3rd tertile (highest)	178 (47.5%)	4.95 (3.46; 7.07)	0.000
Preference for fried meat/kebab				
	Low	323 (86%)	reference	
	High	53 (14%)	2.73 (1.72; 4.35)	0.000
Preference for fatty foods				
	Low	233 (62%)	reference	
	High	143 (38%)	1.57 (1.20; 2.12)	0.001
Preference for sweets				
	Low	229 (61%)	reference	
	High	147 (39%)	2.36 (1.76; 3.19)	0.001
Preference for vegetables				
	Low	271 (72%)	reference	
	High	105 (28%)	0.79 (0.58; 1.09)	0.102

*Percent of total overweight/obese subjects (n=376)

Table 3: Socio-demographic and dietary risk factors associated with overweight/obesity, adjusted analyses

Variables		**Adjusted OR (95% CI)**	**p-value**
Socio-demographic factors			
Age (y)		1.15 (1.13; 1.18)	0.000
Occupation			
	Manual workers	reference	
	Government services	2.76 (1.72; 4.41)	0.000
	Private/self-employed	2.29 (1.34; 3.94)	0.002
Family history			
	No	reference	
	Yes	2.23 (1.42; 3.53)	0.001

Income			
	1st quartile (lowest)	reference	
	2nd quartile	0.66 (0.28; 1.57)	0.351
	3rd quartile	1.79 (0.74; 4.33)	0.200
	4th quartile (highest)	4.48 (1.68; 10.09)	0.003
Physical activity			
	Vigorous	reference	
	Light	3.89 (2.22; 6.82)	0.000
	Moderate	1.77 (1.07; 2.94)	0.026
Dietary factors			
Daily Energy intake			
	1st tertile (lowest)	reference	
	2nd tertile	2.70 (1.15; 6.33)	0.024
	3rd tertile (highest)	2.53 (1.04; 6.17)	0.041
Preference for fried meat/kebab			
	Low	reference	
	High	2.53 (1.23; 5.21)	0.012
Preference for fatty foods			
	Low	reference	
	High	1.61 (1.09; 2.38)	0.017

Discussion

The present study was designed to identify potential socio-demographic and dietary factors contributing to the risk of overweight/obesity among men living in Mardan city. The city is located in the plain valley, surrounded by *Hindu Kush* mountains range, in the north western province of Pakistan, *Khyber Pakhtunkhwa.* Majority of the people in the city belong to the ethnic group, '*Pashtun'*.

Prevalence of overweight and obesity was 33% and 9% respectively among study subjects, which confirms that overweight and obesity is a public health problem in the study area. These figures are close to those reported previously from different plain areas of Pakistan (Dodani et al., 2004; Sajid et al., 2010). However, prevalence of obesity assessed in 2004 was much lower in the northern part of Pakistan in comparison to our study.[21] BMI was positively correlated with age; an increasing trend in overweight/obesity per year of age was evident in current study. Earlier studies also indicated similar trend both in Pakistan and other developing and developed countries (Dhurandhar and Kulkami., 1992; Alsaif et al., 2002; Shah et al., 2004; Rennie and Jebb., 2005; Rodríguez et al., 2009; Sajid et al., 2010).

Family history of obesity had a strong association with BMI in current study indicating that subjects having obesity in their families were more likely to be overweight/obese than those without a family history. We have shown that subjects with positive family history of obesity were 2.23 times more likely to be overweight/obesity. Our findings are in accordance

with the previous studies in Pakistan and other countries.(Magnusson and Rasmussen et al., 2002; Hajian-Tilaki and Heidari., 2007; Hou et al., 2008; Samir et al., 2011).

In our study, men in government and private services were more likely than manual workers to be overweight/obese suggesting that subjects with lower job status had lower risk of overweight/obesity. These are in contrast to some previous studies from developed countries, which have shown a strong association between low job status and high prevalence of overweight/obesity in both men and women (Kouvonen et al., 2005; Novak et al., 2006; Smith et al., 2008; Vernay et al., 2009). It has been reported that high work stress due to low status job could interrupt cortisol secretion that may have a contribution in the increased risk of overweight and obesity (Kunz-Ebrecht et al., 2004). However, in developing countries like Pakistan, labours and other heavy-duty personnel work for 8 – 10 hours; these low status jobs are more physically demanding and involve heavy manual exertions. Such occupation thus could decrease risk for overweight and obesity. Our results are however consistent with some previous findings from developing countries which have reported that subjects with low-status jobs were less likely to be overweight/obese in comparison to those with high status jobs (Uauy et al., 2001; Agrawal., 2002; Fezeu et al., 2006; Jitnarin et al., 2010).

Monthly income was evident as an important predictor of overweight/obesity in our study; subjects in the highest income quartile were 4.48 times more likely to be overweight/obese than those in the lowest quartile. These findings suggest a strong association between higher monthly income and overweight/obesity. These findings are in contrast with those reported previously which showed changeover from a positive to a negative association between income and overweight/obesity and presence of weight-control attitude and practices higher in upper social class than lower social group (Monteiro et al., 2000; Wardle and Griffith 2001; Uauy et al., 2001). In our study, this positive association between income and overweight/obesity could be partially explained by high level of unawareness regarding health consequence of poor life style and dietary intake in our community. In a relatively recent study conducted in 2004 in Pakistan, little awareness level regarding risk factors for cardiovascular diseases (CVD) was evident; overweight and obesity was prevalent in more than half of the study participants (Dodani et al., 2004). Therefore, further research focusing on awareness level regarding risk factors of overweight/obesity, weight control attitude and dietary behavior is needed in different locations of Pakistan.

Physical activity was found an important predictor of overweight/obesity in our study as have been reported previously (Ching et al.1996; Fitzgerald et al., 1997). In the adjusted analysis, a significant

association of physical inactivity with overweight/obesity was found; subjects with light physical activity or sedentary life style were more at risk of overweight/obesity than those with vigorous physical activity (table 3).

We evaluated daily energy intake and dietary preferences of the study subjects in relation to their current nutritional status. In the multivariate binary logistic regression, three dietary predictors, i.e. *total daily energy intake*, *preferences for fried meat/tikka and fatty foods*, were found associated with the risk of overweight/obesity. There was a trend of more 'daily energy intake' in the overweight/obese individuals in our study. Our findings are in fair agreements with those reported previously (Willett., 2000; Duvigneaud et al., 2007; Rodríguez et al., 2009; Jitnarin et al., 2010l). Among the dietary choices, more overweight/obese subjects showed preferences for fried meat or tikka and fatty foods. Results on dietary *preferences* for meat and fatty foods are in accordance with studies conducted recently in Japan (Goto et al., 2010) and Spain (Rodríguez et al., 2009). Subjects' preferences for sweets was though related to overweight/obesity in univariate analysis; however this association was lost in the final model suggesting that sweets consumption was not an active contributing factor to overweight/obesity in the current study. This finding supports evidence from a previous study suggesting that obese individuals prefer more fat and less sweets in their food than normal individuals (Drewnowski et al., 1995).

Pashtuns in particular have a unique dietary pattern and habit which is greatly under the influence of their culture and tradition. Wheat nan is a staple food, prepared in *tandoor* (oven) at houses. Meat is commonly consumed in different forms like fried beef/mutton or *tikka*, kebab, or meat curries. People are generally fond of eating spicy foods prepared in cooking fats and oil; other commonly consumed foods and beverages include black tea with milk and sugar or *jaggery*, lassi (yogurt drink or fermented milk), rice, fresh yogurt, pulses and seasonal fruits and vegetables. Dietary intake in the study location is highly influenced by prevailing social culture and tradition. Meat is a favorite food item in traditional cooking in this part of Pakistan. Mostly red meat (high fat cuts) is consumed in the community because of its easy availability in the market; however, access to high meat quality (manifested by low fat portion of whole meat) and quantity depends on income level of the consumer. Relationship between food accessibility and cost is a well-established fact (Quan et al., 2000; Bruening et al., 2012). Fried meat (locally called *tikka*) is one of the favorite dishes of the community in the study area. Other majorly consumed fatty foods include *kebab and Paratha.* Method of preparation of local kebab and its ingredients are different from that in advanced countries. Kebab of different types (for example, sheikh kebab and chappal kebab) are locally prepared from minced

meat, mixed with different spices and deeply fried in animal fat. *Paratha* (fried chapatti in ghee or oil) is another fatty food which is commonly consumed in the breakfast. These are high energy-dense foods and provide excess amount of energy per unit weight. Though the culture of consuming fast food is yet not fully established in Pakistan compared to developed countries, however, there is a trend to obtain excess amount of dietary energy by consuming *high-energy-dense foods.*

In our study, the pattern of overweight/obesity prevalence among various socioeconomic groups was in the opposite direction in comparison to studies in other countries; higher socioeconomic status had been reported previously as a protective factor against overweight and obesity (McLaren., 2007). Furthermore in many countries, the consumption of healthy food increases as income increases (Basiotis et al., 1998). In current study, high income group was more at risk of overweight/obesity. This could be explained by more consumption of high fatty foods due to inadequate nutritional awareness as suggested previously (Yanovski., 2003). Previous research work has shown strong evidence of a positive association between income and intake of fat and animal protein in developing countries (Popkin et al., 1993). Like other developing countries, formal education was not related to overweight/obesity in both univariate and multivariate analysis in current study (Fezeu et al., 2006). In Pakistan, education level is not necessarily associated with income level; sometime people involved in business and other high-income occupations are less educated but get more financial reward than people with high level of formal education. Higher level of education is however found to be negatively associated with overweight / obesity in developed countries (Duvigneaud et al., 2007).

Our study has certain limitations that need to be addressed in future research. Potential limitations of our study include the cross-sectional nature of our study which limits causality interpretation and reliance on self-report for dietary, physical activity and socioeconomic data. However, objectives of the study were fully explained to the participants using local language, therefore they had no reason to misreport their responses. Participants were enrolled once they fully understood the objectives of the study. Furthermore, we did not include female subjects due to social and cultural constraints; gender-wise comparison was thus not possible for the association between outcome and explanatory variables. Data on respondents' dietary behaviour and pattern such as meal distribution, frequency of meal skipping, frequency of meal outside home etc. could not be collected. These parameters may influence body weight and confounded the association between outcome and explanatory variables.

This study however contains several strengths. The sample size is pretty larger to represent the male adult population of the study area.

Anthropometric measurements were carried out by our research team; other data were collected by face-to-face interview using standardized questionnaires. A major strength of the study is that dietary intake data was not limited to fatty foods only; data on several commonly consumed dietary items were simultaneously collected. Validated food composition tables for Pakistan were used to calculate total energy intake by respondents.

Conclusion:

In conclusion, prevalence of overweight and obesity among male adults in current study was higher than those reported in 2004 from mountainous areas of Pakistan but almost similar to those reported from plain areas of Pakistan. Strong predictors of overweight and obesity included income level, physical inactivity and poor dietary preferences in the study population. Pattern of overweight/obesity prevalence among different socio-demographic groups was different in comparison to those reported from advanced countries. In current study, education level was not related to overweight/obesity while subjects in high income groups were more at risk of overweight/obesity. These findings were in contrast to those reported from developed countries. This is a dire need for launching nutritional awareness programs for adult population to overcome the problem of overweight/obesity in Pakistan.

Acknowledgement

We acknowledge financial and logistic support given by the University of Agriculture, Peshawar in the completion of the study. We are thankful to the local census office-District Mardan for their cooperation in providing us all relevant information. We thank statisticians from Department of Maths, Statistics and Computer Science, the University of Agriculture, Peshawar, for their time to time guidance with statistical analysis.

References:

Agrawal PK. Emerging obesity in Northern Indian States: A serious threat for health. Paper presented at the IUSSP Regional Conference, Bangkok, June 10-13, 2002.

Al-Abbad F.A and Al-Sowielem L.S. Prevalence of Obesity. Saudi Med J. 1998; 19(5): 608-613.

Alsaif MA, Hakim IA, and Harris RB. Prevalence and risk factors of obesity and overweight in adult Saudi population. Nutr Res. 2002; 22:1243–52

Basiotis PP, Kramer-LeBlanc CS, and Kennedy ET. Maintaining nutrition security and diet quality: the role of the Food Stamp Program and WIC. Fam Econ Nutr Rev. 1998;11:4–16

Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, and Sallis JF.International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc. 2003; 195 (9131/03): 3508-1381.

Bruening M, and Neumark-Sztainer D. Feeding a family in a recession: food insecurity among Minnesota parents. Am J Public Health. 2012; 102(3): 520-526

Cihangir E, Cengiz A, Arif H, Orhan D, Murat T, and Kubilay U. Prevalence of Obesity and Associated Risk Factors in a Turkish Population (Trabzon City, Turkey). Obes Res. 2004; 12: 1117-1127.

Deurenberg P, Yap M, and van Staveren WA. Body mass index and Percent body fat: a meta-analysis among different ethnic groups. Int J Obes. 1998; 22:1164–1171

Dhurandhar NV, and Kulkami PR. Prevalence of obesity in Bombay. Int J Obes. 1992; 16: 367-75.

Dodani S, Mistry R, Farooqi M, Khwaja A, Qureshi R, and Kazmi K. Prevalence and awareness of risk factors and behaviours of coronary heart disease in an urban population of Karachi, the largest city of Pakistan: a community survey. J Public Health (Oxf). 2004; 26:245-249

Drewnowski A, Brunzebl JD, Sande K, Iverius PH, and Greenwood MRC. Sweet tooth reconsidered: taste responsiveness in human obesity. Physio Behav. 1985; 35:617-22

Duvigneaud N, Wijndaele K, Matton L, Deriemaeker P, Philippaerts R, and Lefevre J. Socio-economic and lifestyle factors associated with overweight in Flemish adult men and women. BMC Public Health. 2007; 7:23

Fezeu L, Minkoulou E, Balkau B, Kengne AP, Awah P, and Unwin N. Association between socioeconomic status and adiposity in urban Cameroon. Int J Epidemiol. 2006; 35:105–111.

Fitzgerald SJ, Kriska AM, and Pereira MA. Associations among physical activity, television watching, and obesity in adult Pima Indians. Med Sci Sports Exerc. 1997; 27:910–15.

Flegal KM, Carroll MD, and Ogden CL. Prevalence and trends in obesity among US adults, 1999-2000. JAMA. 2002; 288: 1723-1727.

Goto M, Kiyohara K and Kawamura T. Lifestyle risk factors for overweight in Japanese male college students. Public Health Nutr. 2010; 3(10):1575-80

Hajian-Tilaki KO, and Heidari B. Prevalence of obesity, central obesity and the associated factors in urban population aged 20–70 years, in the north of Iran: a population-based study and regression approach. Obes Rev. 2007; 8:3-10

Hodge A, Dowse G, and Toelupe P. Dramatic increase in the prevalence of obesity in Western Samoa over the 13 year period 1978-1991. Int J Obes Relat Metab Disord. 1994; 18: 419-428.

Hou X, Jia W, Bao Y, Lu H, and Jiang S. Risk factors for overweight and obesity, and changes in body mass index of Chinese adults in Shanghai. BMC Public Health. 2008; 8: 389.
Ching PLYH, Willett WC, and Rimm EB. Activity level and risk of overweight in Male Health Professionals. Am J Public Health. 1996; 86:25–30.
Jia WP, Xiang KS, Chen L, Lu JX, and Wu YM. Epidemiological study on obesity and its comorbidities in urban Chinese older than 20 years of age in Shanghai, China. Obes Rev. 2002; 3, 157-165.
Jitnarin N, Kosulwat V, Rojroongwasinkul N, Boonpraderm A, Haddock CK, and Poston WSC. Risk factors for overweight and obesity among Thai adults: results of the national Thai food consumption survey. Nutrients. 2010; 2:60-74.
Kouvonen A, Kivimaki M, Cox SJ, Cox T, and Vahtera J. Relationship between work stress and body mass index among female and male employees. Psychosom Med. 2005; 67, 577-583.
Kunz-Ebrecht SR, Kirschbaum C, and Steptoe A. Work stress, socioeconomic status and neuroendocrine activation over the working day. Soc Sci Med. 2004; 58:1523-1530.
Lichtman SW, Pisarsk K, and Berman ER. Discrepancy between self-reported and actual caloric intake and exercise in obese subjects. N Engl J Med. 1992; 327: 1893-8.
Magnusson PK, and Rasmussen F. Familial resemblance of body mass index and familial risk of high and low body mass index. A study of young men in Sweden. Int J Obes Relat Metab Disord. 2002; 26:1225-31.
Martinez-Gonzalez MA, Martinez JA, Hu FB, Gibney MJ, and Kearney J. Physical inactivity, sedentary lifestyle and obesity in European Union. Inter J Obes. 1999; 23(11): 1192-1201.
McLaren L. Socioeconomic status and obesity. Epidemiol Rev. 2007; 29:29-48.
Monteiro CA, D'A Benicio MH, Conde WL, and Popkin BM. Shifting obesity trends in Brazil. Eur J Clin Nutr. 2000; 54:342-6.
Novak M, Ahlgren C, and Hammarstrom A. A life-course approach in explaining social inequity in obesity among young adult men and women. Int J Obes. 2006; 30, 191-200.
Popkin BM, Keyou G, Zhai F, Guo X, Ma H, and Zohoori N. The nutrition transition in China: A cross-sectional analysis. Eur J Clin Nutr. 1993; 47:333–346.
Quan T, Salomon J, Nitzke S, and Reicks M. Behaviors of low-income mothers related to fruit and vegetable consumption. J Am Diet Assoc. 2000;100:567–70.

Rennie KL, and Jebb SA. Prevalence of obesity in Great Britain. Obes Rev. 2005; 611-612.
Rodríguez MA, Novalbos R JP, Martínez NJM, and Escobar JL. Life-style factors associated with overweight and obesity among Spanish adults. Nutr Hosp. 2009; 242: 144-151.
Sajid M, Kazim M, Rahim N, Nasir A, Naeem Y, and Yasir H. Predictors of obesity among post graduate trainee doctors working in a tertiary care hospital of public sector in Karachi, Pakistan. J Pak Med Assoc. 2010; 60: 758.
Samir N, Mahmud S, and Khuwaja AK. Prevalence of physical inactivity and barriers to physical activity among obese attendants at a community health-care center in Karachi, Pakistan. BMC Res Notes. 2011; 4:174.
Shah SM, Nanan D, and Rahbar MH. Assessing obesity and overweight in a high mountain Pakistani population. Trop Med Int Health. 2004; 9:526–32.
Singh RB, and Pella D, Mechirova V. Prevalence of obesity, physical inactivity and undernutrition, a triple burden of diseases during transition in a developing economy. The Five City Study Group. Acta Cardiol. 2007; 62(2):119–127.
Smith PM, Frank JW, Mustard CA, and Bondy SJ. Examining the relationships between job control and health status: a path analysis approach. J Epidemiol Community Health. 2008; 62:54-61.
Tajamal H. Food composition table for Pakistan. Ministry of Planning & Development, Government of Pakistan (Revised Ed. 2001).
Uauy R, Albala C, and Kain J. Obesity trends in Latin America: transitingfrom under- to overweight. J Nutr. 2001; 131:893S-899S.
Vernay M, Malon A, Oleko A, Salanave B, Roudier C, and Szego E. Association of socioeconomic status with overall overweight and central obesity in men and women: the French Nutrition and Health Survey 2006. BMC Public Health. 2009; 9, 215-222.
Wang Y. Epidemiology of childhood obesity—methodological aspects and guidelines: what is new? Int J Obes Relat Metab Disord. 2004; 28 (Suppl-3): S21–S28.
Wardle J, and Griffith J. Socioeconomic status and weight control practices in British adults. J Epidemiol Community Health. 2001; 55:185-190.
WHO (World Health Organization). Obesity: preventing and managing the global epidemic. Report of a WHO Consultation on obesity, Geneva. WHO Technical Report Series, No. 894; 2001.
WHO (World Health Organization). Overweight and Obesity – An emerging epidemic. In: NUTRITION – for Health and Development. Sustainable Development and Healthy Environments (SDE) - World Health Organization 2000; 18-20.

WHO (World Health Organization). Recommendations for preventing excess weight gain and obesity. In: Diet, nutrition and the prevention of chronic diseases: Report of a joint WHO/FAO expert consultation, Geneva, 28 January - 1 February 2002. WHO technical report series. 2003; 916: 61-71.
Willett WC. Dietary fat plays a major role in obesity, Obes Rev. 2000; 3:59-68
Williamson D, Madans J, and Anda R. Recreational physical activity and ten year weight change in a U.S. national cohort. Inter J Obes Relat Metab Disord. 1993; 17: 279-286.
Yanovski S. Sugar and fat: cravings and aversions. J Nutr. 2003;133: 835S–837S.