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Effects of Obesity on the Markers of Cardiovascular Disease in Tashkent City, Uzbekistan Evidence from a Population-Based Health Examination Survey

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ABSTRACT

Objective: This study examines the epidemiology of obesity and markers of cardiovascular disease (CVD) in adult men and women in Tashkent City, Uzbekistan. The study also examines the association between obesity and the markers of CVD.

Method**:** The analysis uses data from the 2002 Uzbekistan Health Examination Survey, which included a representative sample of 778 men age 15–59 years and 843 women age 15–49 years residing in Tashkent City. The survey measured height, weight, and markers of CVD, such as high blood cholesterol and triglyceride levels, diabetes, and high blood pressure. The survey also asked questions on physical activity, dietary habits, tobacco smoking, alcohol use, and other characteristics. The analysis was conducted using binomial and multinomial logistic regression methods, separately for men and women.

Results**:** Consumption of animal source protein among women and tobacco smoking in the past among men were positively associated with obesity, but there were no consistent associations with other dietary indicators, physical activity level, or alcohol use. Obese men were more than 10 times as likely to have CVD as those with a normal BMI, whereas obese women were two and half times as likely to have CVD (aOR=10.34 for men and 2.48 for women), after controlling for physical activity level, dietary habits, tobacco smoking, and other factors.

Conclusions**:** The study found a strong positive association between obesity and markers of CVD in adult men and women in Tashkent City, Uzbekistan. The relationship between obesity and markers of CVD was much stronger among men than among women. Policies and programs related to obesity and associated CVD outcomes need to be gender sensitive.

KEY WORDS

Overweight, Obesity, BMI, Hypertension, Total Cholesterol, High-Density Lipoprotein, HDL, Triglycerides, Diabetes, Cardiovascular Disease, Tashkent City, Uzbekistan

HUMAN SUBJECT INFORMED CONSENT

Results presented in this paper are based on an analysis of existing survey data with all identifier information removed. Informed consent was obtained from all respondents in the survey before asking questions and separately before obtaining measurements of height and weight, and blood pressure, and before collecting blood samples for the lipids profile and diabetes.

INTRODUCTION

Obesity is increasing at an alarming rate throughout the world and has become a global health problem. The World Health Organization (WHO) has declared overweight as one of the top 10 health risks in the world and one of the top five in developed nations (WHO, 2002). According to a recent estimate, the total numbers of overweight and obese adults in 2005 were 937 million and 396 million respectively, accounting for a third of the adult population in the world (Kelly et al., 2008). Adjusting for secular trends, by 2030, the absolute numbers of overweight and obese are projected to increase to 2.16 billion and 1.12 billion, respectively.

Problems of overweight and obesity are caused by chronic imbalance between energy intake and actual energy needs of the body. Declining physical activity and increasing consumption of foods rich in saturated fat and sugar are primary reasons for the growing obesity epidemic worldwide (WHO, 2003). Once considered a problem related to affluence, obesity is now fast growing in many developing countries (Monteiro et al., 2004; WHO, 2003) and the burden of obesity is shifting toward groups with lower socioeconomic status (Monteiro et al., 2004). Developing countries also account for an increasing share of CVD cases. These problems are particularly severe in Eastern Europe and Central Asia, where obesity and associated CVDs are already a major cause of ill health and death (Young et al., 2005; Popkin et al., 1997).

Obesity is an important determinant of a range of cardiovascular diseases (Krauss et al., 1998). CVD risk factors, such as elevated blood pressure, elevated total cholesterol and low-density lipoprotein cholesterol (LDL-C), and low levels of high-density lipoprotein cholesterol (HDL-C) tend to increase with overweight and obesity (Bazzano et al., 2003; Krauss et al., 1998).

Overweight and obesity are most closely related to non-insulin dependent diabetes mellitus (NIDDM) or Type 2 diabetes (Ishikawa-Takata et al., 2002; Ko et al., 1999; McKeigue et al., 1991). Overweight and obesity have also been closely associated with ischemic heart disease (Silventoinen et al., 2009; WHO, 2002; Lerman-Garber et al., 1999), hypertension (Colín-Ramírez et al., 2009; Mishra et al., 2006; Kotsis et al., 2005; Sanchez-Castillo et al., 2005; Nanchahal et al., 2005; Adair, 2004; Hu et al., 2004; Liu et al., 2004; Niskanen et al., 2004; Lee et al., 2004; Venkatramana and Reddy, 2002) and dyslipidaemia (Barzi et al., 2009; Ishikawa-Takata et al., 2002; Misra et al., 2001; Ko et al., 1999).

WHO estimates that approximately 58% of diabetes mellitius, 21% of ischemic heart disease, and 8–42% of certain cancers can be attributed to BMI above 21 kg/m^2 (WHO, 2002). Risk estimates from population studies suggest that 75% of hypertension can be directly attributed to obesity. The risk of CVD varies by gender. Changes in HDL-C levels are usually more pronounced in women than in men (Li et al., 2006; Margolis et al., 1996). However, the association between obesity and LDL-C is more complex and its concentrations increase with BMI in men, but such an increase is not as pronounced in women. Furthermore, central obesity in women is associated with elevated LDL-C concentrations (Onat et al., 2007).

According to the burden of disease estimates from WHO, overweight and hypertension are among the top three leading causes of disease burden among women and among the top five leading causes of disease burden among men in the Central Asian Republics of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan (WHO, 2006a). In each of these countries, about one in three adults are already overweight or obese and cardiovascular diseases accounts for about two-thirds of all deaths (WHO, 2006b). Yet, there is limited understanding of the scope and the underlying behavioral risk factors of these problems in such settings.

There are only a few studies on the epidemiology and risk factors of obesity and its association with markers of CVD risk in Central Asian countries. An earlier large population-based study in Kazakhastan noted a strong association between obesity, hypertension, and coronary heart disease (Kadyrova and Salkhanov, 1990). A recent national population-based study in Uzbekistan observed a strong positive association between obesity and hypertension in adults (Mishra et al., 2006). Studies in Sirdaria province and the Fergana Valley in Uzbekistan have also recorded high prevalence of central obesity and its strong association with glucose intolerance in adults (King et al., 2002; King et al., 1998). Another study has warned of an inevitable epidemic of hypertension in Central Asia, Kyrgyzstan in particular (Young et al., 2005).

A limiting factor has been a lack of reliable data on CVD markers from representative samples of the population. However, a recent health examination survey in Uzbekistan measured levels of obesity and a number of markers of CVD risk for adult men and women in Tashkent City. The survey also collected information on health risk behaviors, including level of physical activity, dietary habits, tobacco smoking, and alcohol use, as well as socio-demographic characteristics. These data provide an opportunity to study the epidemiology of obesity and markers of CVD in adult men and women, and examine the associations between obesity and markers of CVD.

DATA AND METHODS

Data

The analysis is based on data for 778 men age 15–59 years and 843 women[1] age 15–49 years from Tashkent City included in the 2002 Uzbekistan Health Examination Survey (UHES) (AIC, MOH, et al., 2004). The survey collected information on a variety of lifestyle and health indicators such as physical activity, diet, smoking, alcohol use, and other risk factors for CVDs. The survey also collected data on a number of key biomarkers, such as measurements of height, weight, and blood pressure, cholesterol and triglyceride levels, and diabetes for all respondents in Tashkent City.

Measurements of obesity and markers of CVD risk

All survey respondents were weighed using a solar-powered scale with an accuracy of ±100 gm. Their height was measured using an adjustable wooden measuring board, specifically designed to provide accurate measurements (to the nearest of 0.1 cm) in developing-country field situations. The body mass index (BMI) is calculated by dividing weight (in kilograms) by the square of height (in meters) [kg/m^2]. The BMI is used to define underweight (BMI < 18.5), normal weight (18.5 ≥ BMI < 25.0), overweight (25.0 ≥ BMI < 30.0) and obese (BMI ≥ 30.0).

Markers of CVD were measured by female and male interviewers who were nurses and doctors. Prior to the survey fieldwork, these interviewers were given refresher training in measurement procedures in non-clinical settings. Blood pressure measurements were made using sphygmomanometers (Mercury safe, TRIMLINEm Mercurial Desk Sphygmomanometer) and

[1] Women who were pregnant at the time of the survey or had a live birth or a still birth in the previous 2 months are excluded.

stethoscopes according to the protocols of Westat Inc. (1993). Two measurements of systolic and diastolic blood pressure (measured in millimeters of mercury, mmHg) were taken at an interval of at least 10 minute between the measurements. The second measurement was used to classify adults as hypertensive if their systolic blood pressure was ≥ 130 mmHg, if their diastolic blood pressure was ≥ 85 mmHg, or if they were taking antihypertensive drugs (BP medicine).

For fasting blood samples, eligible respondents were informed that it was necessary to fast 10 to 12 hours before a blood specimen would be drawn, and they were asked to consent to participate in the study. A follow-up visit was then scheduled, usually for the next morning, during which a trained health technician obtained the blood sample. Fasting blood samples could be obtained from 82% of eligible women and 81% of eligible men. Two samples of venous blood were obtained from each respondent in color-coded Vacu-tainer tubes, one of which contained an anticoagulant. The samples were labeled (to allow linking back to the women's and men's questionnaires), placed in an ice-cooled bag, and taken to a vehicle, where the tube without anticoagulant was centrifuged. Both samples remained in the vehicle in an ice-cooled chest until the end of the workday. At the end of each work day, the samples were transported to the Institute of Dermatology and Venereal Diseases in Tashkent City for biochemical analysis to measure cholesterol levels and diabetes. Total cholesterol and triglyceride levels were measured in serum, and HDL cholesterol was measured in plasma.[2]

[2] Measurements were made using the Roche Diagnostics Reflotron and Roche reagents in milligrams per deciliter (mg/dl).

Markers of CVD: The following CVD markers were included in the analysis:

- Hypertension (systolic ≥ 130 mmHg, diastolic ≥ 85 mmHg, or taking BP medication)
- Total cholesterol (TC) level (180+ mg/dl)
- HDL < 40 mg/dl for men and HDL < 50 mg/dl for women
- TC/HDL ratio (6+)
- Triglycerides (150+ mg/dl)
- Diabetes mellitus (measured as glycosylated hemoglobin (HbA1c) as a percentage of total hemoglobin) (6% or higher)

Definition of CVD risk: A person with three or more of the above conditions (except TC/HDL ratio) was considered at risk of CVD.

Risk factors and confounders

The risk factors of obesity and CVD risk included in the study are: physical activity level (expressed as MET-minutes per week, where METs are multiples of the resting metabolic rate), eight indicators of diet (frequency of eating animal proteins, carbohydrates, fresh fruits and vegetables, dried fruits and vegetables, canned or pickled fruits and vegetables, fried foods, adding salt to cooked food, and adding fat to cooked food), tobacco smoking, and alcohol consumption in the last 12 months. The background characteristics of the respondents that are included as potential confounders are: age, marital union, education, work status (employment status in the last 12 months), difficulty in making ends meet (economic status), ethnicity, and religion. For definitions of these variables, see Table 1.

Analysis

Data are analyzed using both descriptive statistics and multivariate logistic regression methods (both binary and multinomial). All analysis is done separately for adult men (age 15–59) and women (age 15–49). Women who were pregnant at the time of the survey and women who had a live birth or a stillbirth during the two months preceding the survey were excluded from the analysis. The logistic regression models were estimated using the STATA statistical software package (Stata Corporation, 2005). In the survey, certain categories of respondents were over sampled and nonresponse rates varied from one geographical area to another. In all analyses in this study, weights are used to restore the representativeness of the sample (AIC, Ministry of Health et al., 2004). Results are presented in the form of odds ratios (OR) and relative risk ratios (RRR).

RESULTS

Table 1 presents the percentage distributions of men (15–59) and women (15–49) by selected risk factors and background characteristics in Tashkent City. Men were more likely than women to be physically active, smoke tobacco, or consume alcohol. However, women consume carbohydrates, fresh fruits and vegetables, and fried foods more frequently than men. Women also consumed animal proteins more frequently than men. However, women were less likely than men to consume dried and canned or pickled fruits and vegetables and to add salt or fat to cooked food. Women were considerably less likely to be employed than men. About three-fifths of men and women were married at the time of UHES. Seventeen percent of women were widowed, divorced, or separated, compared with less than 5% of men. More than two-thirds of the respondents were Uzbek, and more than three-quarters were Muslim.

Table 1. Sample distribution (%) of men age 15-59 and women age 15-49 by selected risk factors and background characteristics, Tashkent City, 2002

Characteristic	Men (15-59)	Women (15-49)
Risk Factors		
Physical activity level[1]		
Low	45.1	60.8
Medium	35.4	35.8
High	19.5	3.5
Diet		
Animal protein[2] (days/week)		
<2	15.3	5.1
2-3	61.3	69.1
4+	23.4	25.8
Carbohydrates[3]		
Not every day	54.8	7.7
Every day	45.2	92.3
Fresh fruits and vegetables[4] (days/week)		
<3	21.2	0.2
3-4	39.5	7.7
5+	39.3	92.0
Dried fruits and vegetables[5] (days/week)		
<1	47.6	71.1
1-2	38.7	26.1
3+	13.8	2.9
Canned or pickled fruits and vegetables[6]		
Does not eat	33.9	79.0
Eats, <2 days/week	33.2	17.4
Eats, 2+ days/week	32.9	3.6
Fried foods[7] (days/week)		
<3	30.5	6.8
3-5	50.5	22.0
6+	19.0	71.2
Adds salt to cooked food		
No	66.6	96.7
Yes	33.4	3.3
Adds fat to cooked food		
No	83.8	96.1
Yes	16.2	3.9
Tobacco smoking[8]		
Never	53.0	96.7
Past only	6.4	0.5
Current	40.6	2.9
Alcohol consumption in last 12 months[9]		
No	37.3	54.1
Yes-not a problem drinker	49.1	45.5
Yes-problem drinker	13.6	0.4

(Cont'd)

Table 1 – Cont'd

Characteristic	Men (15-59)	Women (15-49)
Background characteristics		
Age		
15-19	20.3	17.0
20-24	14.3	14.3
25-29	13.8	14.3
30-34	12.1	13.3
35-39	9.1	14.3
40-44	12.7	13.8
45-49	7.8	13.1
50-54	6.7	NA
55-59	3.2	NA
Marital union		
Never married	35.2	23.9
In union	60.2	59.6
Separated/divorced/ widowed	4.6	16.5
Education		
Primary/middle	10.3	8.1
Secondary	39.7	35.7
Secondary special	18.1	28.4
Higher	31.9	27.8
Work status[10]		
Not employed	31.0	49.7
White collar	49.9	43.6
Manual/agriculture	19.2	6.7
Making ends meet[11]		
Great difficulty	27.5	28.8
Some difficulty	30.2	31.2
Little or no difficulty	42.3	40.1
Ethnicity		
Uzbek	73.4	68.0
Other[12]	26.6	32.0
Religion		
Muslim	81.4	77.4
Other[13]	18.6	22.6
Number[14]	**778**	843

NA: not applicable

[1]Physical activity level is expressed as MET-minutes per week. METs are multiples of the resting metabolic rate. Using the International Physical Activity Questionnaire (IPAQ) guidelines (IPAQ, 2004), a physical activity score is calculated for each person based on the information on total number of minutes per week spent walking (x3.3 METs), doing moderate physical activity (x4.0 METs), and vigorous physical activity (x8.0 METs). Persons with a physical activity score <6,000 MET-minutes are defined as having a low level of physical activity; 6,000-13,999 as having a medium level of physical activity; and 14,000+ as having a high level of physical activity.

[2]Animal protein intake is measured as the average number of days in the last week eating any of the following four categories of foods: 1. cheese, yoghurt, kefir, ice cream, milk, or other milk products; 2. eggs; 3. red meats; 4. fish and poultry.

[3]Carbohydrate intake is measured as the average number of days in the last week eating any of the following three categories of foods: 1. roots and tubers such as white potatoes, turnips, radishes, or beet root; 2. bread, rice, pasta, cereal, cookies, biscuits or similar products made with wheat or white flour; 3. sugary foods, confectionery, pastry, cakes, chocolates, or sweets.

[4]Fresh fruit and vegetable intake is measured as the average number of days in the last week eating any of the following three categories of foods: 1. dark green leafy vegetables or condiments such as parsley, dill, spinach, rahon, cilantro, basil, mint, lettuce or cabbage; 2. other fresh vegetables including vegetables in stews, soups, and salads; 3. fresh fruits.

[5]Dried fruit and vegetable intake is measured as the average number of days in the last week eating any of the following three categories of foods: 1. beans, peas, or legumes; 2. nuts or seeds; 3. dried fruits.

[6]Canned or pickled fruit and vegetable intake is measured as the average number of days in the last week eating any of the following three categories of foods: 1. foods prepared with tomato paste; 2. pickled or canned vegetables; 3. canned fruits.

[7]Number of days fried foods were eaten in the last week.

[8]Tobacco smoking in past only includes persons who smoked fairly regularly in the past but do not currently smoke.

[9]Based on the Rapid Alcohol Problems Screen (RAPS) guidelines (Cherpitel, 1997), a person who consumed alcohol in the past 12 months is defined as a problem drinker or alcohol dependent if he/she answered "yes" to any of the following questions: 1. Do you sometimes take a drink in the morning when you first get up? 2. During the past year, has a friend or family member ever told you about things you said or did while you were drinking that you could not remember? 3. During the past year, have you failed to do what was normally expected of you because of drinking? 4. During the past year, have you lost friends because of your drinking?

[10]White collar includes professional, technical, managerial, clerical, or sales and services; manual/agriculture includes skilled manual, unskilled manual, or agriculture.

[11]Making ends meet denotes economic hardship for the household in which the person lives. The little or no difficulty category includes households mentioning a little difficulty, fairly easily, easily, or very easily in response to the question on ability to make ends meet.

[12]Other ethnic groups include Russian, Karakalpak, Tajik, and others.

[13]Other religions include Christian, no religion, and others.

[14]Actual number of cases for individual variables varies slightly depending on the number of missing cases. Women who were pregnant or had a live birth or a stillbirth in the previous 2 months are excluded from all analyses.

Prevalence of overweight/obesity and CVD risk

In Tashkent City, 36% of men age 15–59 and 34% of women age 15–49 were overweight or obese. The proportion obese was greater among women (10%) than among men (6%) (Table 2). Twenty-one percent of men and 14% of women in Tashkent City were at increased risk of CVD. Prevalence of overweight, obesity, and risk of CVD did not vary much by physical activity level in both men and women, but tobacco smoking (more so for smoking in the past) and alcohol consumption in men were associated with higher levels of obesity and risk of CVD. Among the diet indicators, frequently eating animal source proteins and fried food were positively associated with obesity in women. Adding salt or fat to cooked food and frequently eating fried foods were positively associated with CVD risk in most cases. The association of other diet variables with obesity and risk of CVD were generally small and inconsistent.

As expected, there was a strong positive association between age and the prevalence of obesity and risk of CVD in both men and women. The proportion of men that were overweight or obese increased from 10% at age 15–19 to more than 50% after age 35. The proportion of women that were overweight or obese increased from 7% at age 15–19 to more than 50% after age 40. Similarly, the risk of CVD among men increased from 13% at age 15–19 to about 30% at age 35–59; and among women from 3% at age 15–19 to 33% at age 45–49. Education level was positively associated with the prevalence of obesity and risk of CVD in both men and women. Men in union were more likely to be overweight or obese and had a higher risk of CVD, but the risk of CVD was greater among widowed, divorced, and separated women than among women who were never married or in union. Prevalence levels of overweight and obesity were higher among wealthier men who could make ends meet with little or no difficulty, but not among wealthier women. However, the risk of CVD was higher among both wealthier men and women.

Table 2. Prevalence (%) of overweight and obesity and risk of cardiovascular disease (CVD) by selected risk factors and background characteristics, by sex, Tashkent City 2002

	Men (15-59)			Women (15-49)		
Characteristic	Over-weight	Obese	At risk of CVD[a]	Over-weight	Obese	At risk of CVD[a]
Risk Factors						
Physical activity level						
Low	35.6	8.1	23.2	22.2	10.9	14.8
Medium	24.6	3.5	18.5	28.8	7.3	11.7
High	25.6	6.6	21.7	21.4	17.9	10.0
Diet						
Animal protein						
<2	22.2	7.4	19.8	30.2	7.0	5.9
2-3	31.5	6.2	22.9	24.9	9.6	13.9
4+	29.5	5.2	17.8	22.7	11.1	14.0
Carbohydrates						
Not every day	31.8	7.7	20.7	25.4	6.4	19.2
Every day	27.3	4.2	21.8	24.5	10.2	13.1
Fresh fruits and vegetables (days/week)						
<3	28.9	6.4	18.3	NI	NI	NI
3-4	32.1	4.9	18.6	25.8	11.3	15.2
5+	27.8	7.2	25.3	24.4	9.8	13.4
Dried fruits and vegetables (days/week)						
<1	30.5	8.9	21.9	26.7	9.0	14.3
1-2	30.1	2.9	20.4	19.7	12.0	11.5
3+	26.2	5.8	20.8	17.4	13.0	10.5
Canned or pickled fruits and vegetables						
Does not eat	30.7	8.3	23.4	24.8	9.8	13.7
Eats, <2 days/week	30.9	7.8	19.8	23.2	10.1	13.8
Eats, 2+ days/week	27.7	2.4	20.4	28.6	10.7	8.3
Fried foods (days/week)						
<3	30.7	5.1	19.0	20.0	1.8	5.6
3-5	31.0	5.8	21.8	21.6	8.5	15.6
6+	24.8	8.8	23.3	26.0	11.1	13.5
Adds salt to cooked food						
No	30.6	6.0	20.1	24.8	9.9	13.5
Yes	28.0	6.4	23.2	19.2	7.7	15.0
Adds fat to cooked food						
No	29.9	6.7	20.2	25.1	9.9	13.1
Yes	28.9	3.3	25.7	12.1	9.1	23.1
Tobacco smoking						
Never	25.5	4.7	19.3	NI	NI	NI
Past only	45.8	10.4	30.3	NI	NI	NI
Current	32.5	7.2	22.5	NI	NI	NI
Alcohol consumption in last 12 months						
No	20.8	4.9	17.6	28.2	10.3	15.7
Yes-not a problem drinker	35.9	6.5	22.7	20.3[b]	9.3[b]	10.8[b]
Yes-problem drinker	31.7	7.9	25.3	-	-	-

(Cont'd)

Table 2 – Cont'd

Characteristic	Men (15-59) Over-weight	Men (15-59) Obese	Men (15-59) At risk of CVD[a]	Women (15-49) Over-weight	Women (15-49) Obese	Women (15-49) At risk of CVD[a]
Background characteristics						
Age						
15-19	8.2	2.0	12.6	5.8	0.7	2.8
20-24	15.7	3.9	16.7	13.2	3.5	7.8
25-29	25.5	4.1	15.9	21.6	5.2	7.3
30-34	31.8	4.7	17.2	27.6	9.5	7.4
35-39	51.5	7.6	31.4	27.4	15.9	21.2
40-44	47.8	7.6	30.5	44.6	12.7	16.1
45-49	46.4	7.1	29.8	38.1	24.8	33.3
50-54	40.0	18.0	30.2	NA	NA	NA
55-59	41.7	16.7	30.0	NA	NA	NA
Marital union						
Never married	9.4	2.0	13.8	7.8	2.1	6.0
In union	42.4	8.8	25.8	29.8	13.2	14.3
Separated/divorced/ widowed	21.9	3.1	20.7	30.3	9.1	20.2
Education						
Primary/middle	21.1	4.0	11.7	18.5	7.7	13.2
Secondary	25.1	6.7	21.2	23.2	7.8	12.4
Secondary special	29.3	5.3	22.1	22.1	12.6	10.3
Higher	38.6	6.6	23.5	30.6	10.4	18.2
Work status						
Not employed	16.2	4.4	17.6	20.8	9.2	13.0
White collar	40.2	6.2	23.4	28.2	10.4	13.9
Manual/agriculture	25.2	8.6	21.9	29.4	11.8	14.6
Making ends meet						
Great difficulty	26.4	5.1	20.5	23.7	10.5	12.4
Some difficulty	29.3	5.4	17.6	25.8	9.5	12.3
Little or no difficulty	32.2	7.3	24.3	24.2	9.6	15.2
Ethnicity						
Uzbek	32.5	6.3	19.8	26.6	10.6	11.8
Other	22.3	5.6	24.6	20.3	8.2	17.2
Religion						
Muslim	31.8	6.7	20.4	26.1	11.1	13.3
Other	21.0	3.6	24.4	19.3	5.5	14.3
Total	29.7	6.1	21.2	24.6	9.9	13.5
Number	720		614	804		681

Note: For variable definitions, see Table 1.
NA: not applicable; NI: Not included due to small number.
[a]A person with three or more of the following conditions was considered at risk of CVD: hypertension (systolic ≥ 130 mmHg, diastolic ≥ 85 mmHg, or taking BP medication), total cholesterol ≥180 mg/dl, HDL <40 mg/dl for men and <50 mg/dl for women, triglycerides 150+ mg/dl, and HbA1c ≥ 6%.
[b]Category includes all alcohol consumers in the last 12 months

Effects of physical activity, diet, and other factors on risk of overweight and obesity

Table 3 shows that with other factors controlled, medium to high physical activity level was significantly negatively associated with overweight or obesity in men, but not in women. Independent of physical activity level and other factors, men eating animal protein for 4 or more days per week, on average, were almost twice as likely to be overweight as those eating animal protein less than 2 days per week (aRRR=1.96) , but this effect was small and statistically not significant for women (aRRR=1.36). Women who consumed fried food more than 6 days a week were more than six times as likely to be obese as those who consumed fried food less than 3 days per week (aRRR=6.64), but this effect was much smaller and statistically not significant for men (aRRR=1.63). The results for most other diet variables were inconsistent. For example, contrary to the expectation, adding fat to cooked food was significantly negatively associated with overweight or obesity in women.

Table 3. Adjusted effects of selected risk factors on the risk of overweight and obesity, by sex, Tashkent City, 2002

	Men (15-59)			Women (15-49)		
	Over-weight	Obese	Over-weight/ Obese	Over-weight	Obese	Over-weight/ Obese
Characteristic	aRRR	aRRR	aOR	aRRR	aRRR	aOR
Risk Factors						
Physical activity level						
Low‡	1.00	1.00	1.00	1.00	1.00	1.00
Medium	0.58 *	0.23 **	0.51 **	0.92	0.45 *	0.78
High	0.61	0.37 †	0.57 †	1.09	2.04	1.38
Diet						
Animal protein (days/week)						
<2‡	1.00	1.00	1.00	1.00	1.00	1.00
2-3	1.67	1.35	1.57	1.08	1.29	1.12
4+	1.96 †	1.37	1.80 †	1.36	1.86	1.43
Carbohydrates						
Not every day‡	1.00	1.00	1.00	1.00	1.00	1.00
Every day	0.88	0.43 *	0.80	0.68	0.70	0.67
Fresh fruits and vegetables (days/week)						
<3‡	1.00	1.00	1.00	1.00	1.00	1.00
3-4	1.05	0.79	1.01	0.84[a]	0.75[a]	0.82[a]
5+	0.85	1.41	0.92	-	-	-
Dried fruits and vegetables (days/week)						
<1‡	1.00	1.00	1.00	1.00	1.00	1.00
1-2	0.77	0.22 **	0.65 †	0.76	1.37	0.91
3+	0.78	0.99	0.78	0.75	2.21	1.00
Canned or pickled fruits and vegetables						
Does not eat‡	1.00	1.00	1.00	1.00	1.00	1.00
Eats, <2 days/week	0.98	1.03	0.99	0.98	0.73	0.91
Eats, 2+ days/week	0.75	0.25 *	0.66	2.22	1.35	1.93
Fried foods (days/week)						
<3‡	1.00	1.00	1.00	1.00	1.00	1.00
3-5	0.99	1.11	1.01	1.07	4.04	1.32
6+	0.85	1.63	0.96	1.19	6.64 †	1.61
Adds salt to cooked food						
No‡	1.00	1.00	1.00	1.00	1.00	1.00
Yes	0.96	1.39	1.02	0.80	0.66	0.77
Adds fat to cooked food						
No‡	1.00	1.00	1.00	1.00	1.00	1.00
Yes	0.85	0.46	0.78	0.29 *	0.47	0.35 *
Tobacco smoking						
Never‡	1.00	1.00	1.00	NI	NI	NI
Past only	1.30	1.58	1.33	NI	NI	NI
Current	0.84	0.80	0.82	NI	NI	NI

(Cont'd)

Table 3 – Cont'd

Characteristic	Men (15-59) Over-weight aRRR	Men (15-59) Obese aRRR	Men (15-59) Over-weight/ Obese aOR	Women (15-49) Over-weight aRRR	Women (15-49) Obese aRRR	Women (15-49) Over-weight/ Obese aOR
Alcohol consumption in last 12 months						
No‡	1.00	1.00	1.00	1.00	1.00	1.00
Yes-not a problem drinker	1.10	0.99	1.09	0.63[b] *	0.75[b]	0.67[b] *
Yes-problem drinker	0.80	0.85	0.83	-	-	-
Background characteristics						
Age						
15-19‡	1.00	1.00	1.00	1.00	1.00	1.00
20-24	1.26	1.10	1.22	1.64	5.60	2.07
25-29	1.07	0.32	0.87	2.49	8.66 †	3.16 *
30-34	1.31	0.37	1.03	4.01 *	21.20 *	5.57 **
35-39	3.51 †	0.95	2.76 †	4.41 *	40.47 **	7.28 ***
40-44	3.01 †	0.89	2.43	11.56 ***	58.48 ***	16.00 ***
45-49	2.80	0.88	2.23	10.25 ***	136.80 ***	18.70 ***
50-54	2.94	2.54 †	2.88 †	NA	NA	NA
55-59	3.78 †	3.22	3.66 †	NA	NA	NA
Marital union						
Never married‡	1.00	1.00	1.00	1.00	1.00	1.00
In union	3.66 **	6.14 †	4.09 ***	1.90	1.24	1.74
Separated/divorced/ widowed	1.48	1.18	1.58	1.68	0.65	1.36
Education						
Primary/middle‡	1.00	1.00	1.00	1.00	1.00	1.00
Secondary	1.22	1.90	1.34	1.47	1.52	1.48
Secondary special	1.38	1.32	1.39	1.36	2.13	1.55
Higher	1.71	2.41	1.81 †	1.92	1.80	1.89
Work status						
Not employed‡	1.00	1.00	1.00	1.00	1.00	1.00
White collar	1.15	1.08	1.15	1.04	0.73	0.94
Manual/agriculture	0.85	1.96	0.97	1.39	1.31	1.35
Making ends meet						
Great difficulty‡	1.00	1.00	1.00	1.00	1.00	1.00
Some difficulty	0.84	0.73	0.84	1.07	1.07	1.05
Little or no difficulty	1.11	1.38	1.16	0.83	0.85	0.83
Ethnicity						
Uzbek‡	1.00	1.00	1.00	1.00	1.00	1.00
Other	0.75	1.76	0.89	0.91	1.47	1.04
Religion						
Muslim‡	1.00	1.00	1.00	1.00	1.00	1.00
Other	0.70	0.31	0.59	0.53 †	0.27 *	0.44 *
Number	682		682	755		755

Note: For variable definitions, see Table 1.

NA: not applicable; NI: Not included due to small number.

‡Reference category; aRRR: adjusted relative risk ratio; aOR: adjusted odds ratio

$^{\dagger}p<.1$, $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$
[a]Category includes 3 or more days per week
[b]Category includes all alcohol consumers in the last 12 months

The adjusted effects of smoking and alcohol consumption were small and not significant. Among the background factors, age was strongly positively associated with overweight and obesity, particularly among women. Men currently in a marital union were much more likely to be overweight or obese than never married men (OR=4.09). Currently in-union women were also more likely to be overweight or obese than never married women (OR=1.74), but this effect was statistically not significant. With other factors controlled, Muslim men and women were more likely to be overweight or obese, but these effects were statistically not significant for men. Adjusted effects of education, work status, and economic status were generally small.

Effects of overweight and obesity on the markers of CVD

Table 4 shows the unadjusted and adjusted effects of overweight and obesity on the risk of hypertension, diabetes, and high total cholesterol (TC), low high density lipoprotein (HDL), high TC/HDL ratio, and high triglyceride level (TG), separately for adult men and women in Tashkent City. The effects of other risk and confounding factors included in the adjusted models are not shown.

Table 4. Unadjusted and adjusted effects of overweight and obesity on the risk of hypertension, diabetes, high total cholesterol, low HDL, high TC/HDL ratio, and high triglyceride levels, by sex, Tashkent City, 2002

	Unadjusted		Adjusted	
	Overweight	Obese	Overweight	Obese
CVD marker	OR	OR	aOR	aOR
Hypertension (BP≥130/85 mmHg or taking BP medication)				
Men (15-59)	1.37	3.43 ***	1.00	2.38 *
Women (15-49)	2.55 *	7.50 ***	2.77 *	5.92 ***
Diabetes (HbA1c/Hb≥6%)				
Men (15-59)	1.38	9.32 ***	1.47	12.29 ***
Women (15-49)	1.07	3.59 **	0.67	2.57 †
Total cholesterol (≥180 mg/dl)				
Men (15-59)	1.60 *	3.41 ***	1.47	3.64 **
Women (15-49)	1.81 **	3.11 ***	1.17	1.59
HDL (mg/dl)				
Men (15-59) (<40 mg/dl)	1.01	5.17 **	0.91	5.53 **
Women (15-49)Female (<50 mg/dl)	0.98	1.55	1.31	2.64 *
TC/HDL (≥6.0)				
Men (15-59)	1.54	11.08 ***	1.23	10.75 ***
Women (15-49)	1.98 †	2.55 *	1.31	1.27
TG (≥150 mg/dl)				
Men (15-59)	1.98 ***	7.65 ***	2.18 ***	8.07 ***
Women (15-49)	1.67 *	3.60 ***	1.34	2.89 ***

Note: For variable definitions, see text.
$^{\dagger}p<.1$, $^{*}p<.05$, $^{**}p<.01$, $^{***}p<.001$
OR: odds ratio; aOR: adjusted odds ratio

Table 4 shows that obesity is strongly positively associated with each of the six markers of CVD. There are also several statistically significant associations of overweight with markers of CVD. For example, obese men were 3.4 times and obese women were 7.5 times more likely to be hypertensive than men and women with a normal BMI. Even after controlling for physical activity, diet, and other factors, obese men and women were much more likely to be hypertensive than men and women with a normal BMI (aOR=2.38, $p<0.05$; and aOR=5.92, $p<.001$). With other factors controlled, obese men were 12.3 times more likely to be diabetic, 3.6 times more likely to have high TC, 5.5 times more likely to have low HDL, 10.8 times more likely to have a high TC/HDL ratio, and 8.1 times more likely to have a high triglyceride level.[3] Correspondingly, obese women were 2.6 times more likely to be diabetic, 1.6 times more likely to have high TC, 2.6 times more likely to have low HDL, 1.3 times more likely to have a high TC/HDL ratio, and 2.9 times more likely to have a high triglyceride level. The adjusted effects of obesity on high TC and a high TC/HDL ratio for women were statistically not significant. Obese women have a greater risk of hypertension than obese men, but on all other CVD markers obese men are at a much greater risk than obese women.

Table 5 shows the unadjusted and adjusted effects of overweight and obesity on the combined indicator of CVD risk in alternative models separately for men and women. In the unadjusted models (Model 1), overweight men and women were about twice as likely to be at the risk of CVD as men and women with a normal BMI (OR=1.83 for overweight men and OR=2.01 for overweight women), whereas obese men were more than 11 times and obese women more than 4 times as likely to be at the risk of CVD as men and women with a normal BMI (OR=11.28 for obese men[4] and OR=4.50 for obese women).

[3] When the analysis was restricted to men age 15-49, obese men were 3.1 times more likely to be hypertensive, 7.9 times more likely to be diabetic, 2.6 times more likely to have high TC, 9.1 times more likely to have low HDL, 16.2 times more likely to have a high TC/HDL ratio, and 6.2 times more likely to have a high triglyceride level.
[4] OR=8.07 for obese men age 15-49.

Table 5. Unadjusted and adjusted effects of overweight and obesity and other selected risk factors on the risk of cardiovascular disease (CVD), by sex, Tashkent City, 2002

	Men (15-59)			Women (15-49)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Characteristic	OR	aOR	aOR	OR	aOR	aOR
Risk Factors						
BMI (kg/m^2)						
18.5-24.9‡	1.00	1.00	1.00	1.00	1.00	1.00
25.0-29.9	1.83 **	1.84 *	1.62 †	2.01 *	2.07 **	1.32
30.0+	11.28 ***	10.96 ***	10.34 ***	4.50 **	4.67 ***	2.48 *
Physical activity level						
Low‡		1.00	1.00		1.00	1.00
Medium		0.95	1.09		0.77[b]	0.60[b]
High		0.84	0.81		-	-
Diet						
Animal protein (days/week)						
<2‡		1.00	1.00		1.00	1.00
2-3		1.03	1.03		3.21	2.80
4+		0.68	0.65		3.27	3.27
Carbohydrates						
Not every day‡		1.00	1.00		1.00	1.00
Every day		1.14	1.18		0.45 †	0.27 **
Fresh fruits and vegetables (days/week)						
<3‡		1.00	1.00		1.00	1.00
3-4		0.99	0.95		1.11[c]	1.15[c]
5+		1.48	1.45		-	-
Dried fruits and vegetables (days/week)						
<1‡		1.00	1.00		1.00	1.00
1-2		0.83	0.76		0.70	0.71
3+		0.92	0.89		0.86	1.69
Canned or pickled fruits and vegetables						
Does not eat‡		1.00	1.00		1.00	1.00
Eats, <2 days/week		0.86	0.94		0.98	0.74
Eats, 2+ days/week		1.01	1.04		0.56	0.39
Fried foods (days/week)						
<3‡		1.00	1.00		1.00	1.00
3-5		1.06	1.28		2.39	1.68
6+		1.10	1.43		1.75	2.14
Adds salt to cooked food						
No‡		1.00	1.00		1.00	1.00
Yes		1.24	1.35		1.31	2.23
Adds fat to cooked food						
No‡		1.00	1.00		1.00	1.00
Yes		1.48	1.26		2.27	1.86

(Cont'd)

Table 5 – Cont'd

	Men (15-59)			Women (15-49)			
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	
Characteristic	OR	aOR	aOR	OR	aOR	aOR	
Tobacco smoking							
Never‡		1.00	1.00		NI	NI	
Past only		1.41	1.33		NI	NI	
Current		1.00	0.89		NI	NI	
Alcohol consumption in last 12 months							
No‡		1.00	1.00		1.00	1.00	
Yes-not a problem drinker		1.23	1.11		0.70[d]	0.53[d]	*
Yes-problem drinker		1.50	1.14		-	-	
Background characteristics							
Age							
15-19‡			1.00			1.00	
20-24			1.26			4.22	†
25-29			0.99			4.58	†
30-34			1.15			4.54	
35-39			2.49			15.11	**
40-44			3.02			9.07	*
45-49			2.52			22.94	***
50-54			1.65			NA	
55-59			1.54			NA	
Marital union							
Never married‡			1.00			1.00	
In union			0.98			0.66	
Separated/divorced/ widowed			1.02			0.91	
Education							
Primary/middle‡			1.00			1.00	
Secondary			1.37			0.94	
Secondary special			1.68			0.60	
Higher			1.47			1.21	
Work status							
Not employed‡			1.00			1.00	
White collar			0.84			0.77	
Manual/agriculture			0.84			0.93	
Making ends meet							
Great difficulty‡			1.00			1.00	
Some difficulty			0.75			0.98	
Little or no difficulty			1.12			1.41	
Ethnicity							
Uzbek‡			1.00			1.00	
Other			0.88			3.33	**
Religion							
Muslim‡			1.00			1.00	
Other			2.03			0.52	
Number	562	561	561	638	637	637	

Note: For variable definitions, see Table 1. For the definition of the risk of CVD, see Table 2.
NA: not applicable; NI: Not included due to small number.

‡Reference category; OR: odds ratio; aOR: adjusted odds ratio
†$p<.1$, * $p<.05$, ** $p<.01$, *** $p<.001$
[a]A person with three or more of the following conditions was considered at risk of CVD: hypertension >=130/85 or taking BP medication, total cholesterol >=180, HDL <40 mg/dl for men and <50 mg/dl for women, triglycerides 150+ mg/dl, and HbA1c >= 6%.
[b]Category combines medium and high levels of physical activity
[c]Category combines 3 or more days/week
[d]Category includes all alcohol consumers in the last 12 months

Controlling for physical activity level, diet, and other factors weakens these associations some, but obese men remained more than 10 times and obese women 2.5 times more likely to be at the risk of CVD than men and women with a normal BMI (aOR=10.34 for obese men[5] and aOR=2.48 for obese women) (Model 3, Table 5). The adjusted effects of overweight were reduced for both men and women (aOR=1.62 for overweight men and aOR=1.32 for overweight women), and remained significant only for men.

None of the physical activity, diet, or other factors included in Model 3 has any significant effect on the risk of CVD in men; whereas only age, ethnicity, carbohydrate intake, and alcohol use are significantly associated with the risk of CVD in women. However, contrary to the expectation, women consuming carbohydrates every day were significantly less likely to be at the risk of CVD than women consuming carbohydrates less frequently (aOR=0.27).

[5] aOR=7.53 for obese men age 15-49.

DISCUSSION

We find that in Tashkent City men are less likely to be obese than women, but men are at a much greater risk of CVD than women. Our analysis shows that with physical activity level, diet, tobacco smoking, alcohol use, and a number of other potentially confounding factors statistically controlled, obese men are almost 10 times and obese women are almost two and half times more likely to be at the risk of CVD than men and women with a normal BMI. For individual CVD markers, independent of other factors, obese men are more likely than obese women to have diabetes, high total cholesterol, low high density lipoproteins, and high triglyceride levels, but obese women are more likely than obese men to have hypertension. Our analysis also finds that eating animal source protein and tobacco smoking in the past are positively associated with obesity, but there are no consistent associations with other diet indicators or alcohol use. The study found no significant association between physical activity level and obesity or CVD risk.

The findings about a strong positive association between obesity and various markers of CVD risk are consistent with previous research in Central Asia (Mishra et al., 2006; Jafar, 2006; Kadyrova and Salkhanov, 1990) and elsewhere (Nanchahal et al., 2005; Kotsis et al., 2005; Sanchez-Castillo et al., 2005; Venkatramana and Reddy, 2002). Strong gender differential observed in the prevalence of CVD markers and in the association between obesity and CVD risk could be due to differences in biological factors, fat distribution, and certain risk factors not measured adequately in this study.

A lack of association of obesity or risk of CVD with physical activity level and generally weak, inconsistent associations with diet, smoking, and alcohol use may be due to cross-sectional nature of our data. It is possible that some men and women altered their physical activity patterns, changed their eating habits, or quit smoking after becoming obese or after being diagnosed with hypertension, diabetes, high cholesterol, or some CVD condition. Inconsistent and weak associations of obesity or risk of CVD with physical activity, dietary habits, and other risk behaviors may also be partly due to imperfect measurements of these behaviors in the survey.

Our study was not able to consider other measures of obesity, particularly abdominal obesity, which may be more relevant for linking obesity with CVD. In Asian populations, abdominal or central obesity is more common than obesity defined by BMI, and health risks associated with overweight and obesity have been shown to occur at lower levels of BMI than in North America or Europe (WHO, IASO, IOTF, 2000). Moreover, the UHES did not collect direct information on total energy intake. Instead, it was assessed indirectly from a number of diet history and food frequency questions, which have been evaluated previously and found to be sufficiently valid for etiologic studies (Kabagambe et al., 2001; Subar et al., 2001). Finally, our study could not control directly for the extent of use of medical services in connection with obesity or risk of CVD, although the set of control variables used in the study includes several measures of socioeconomic status, which are typically correlated with access to and use of medical services.

In conclusion, this study provides important new information on the prevalence of obesity and markers of CVD in different socio-demographic population groups in Tashkent City. The study found a strong positive association between obesity and markers of CVD risk in adult men and women. The relationship between obesity and markers of CVD risk is stronger for men than for women. Moreover, several other relationships are observed only for men but not for women. The findings emphasize the need for prospective cohort studies with better measurements of physical activity, dietary habits, and other risk factors to better understand the epidemiology of obesity and CVD risk. The strong gender differential observed in the markers of CVD highlights the need for the policies and programs related to obesity and CVD to be gender sensitive. Additional research is needed to explore the sex differential in the relationship between obesity and risk of CVD.

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