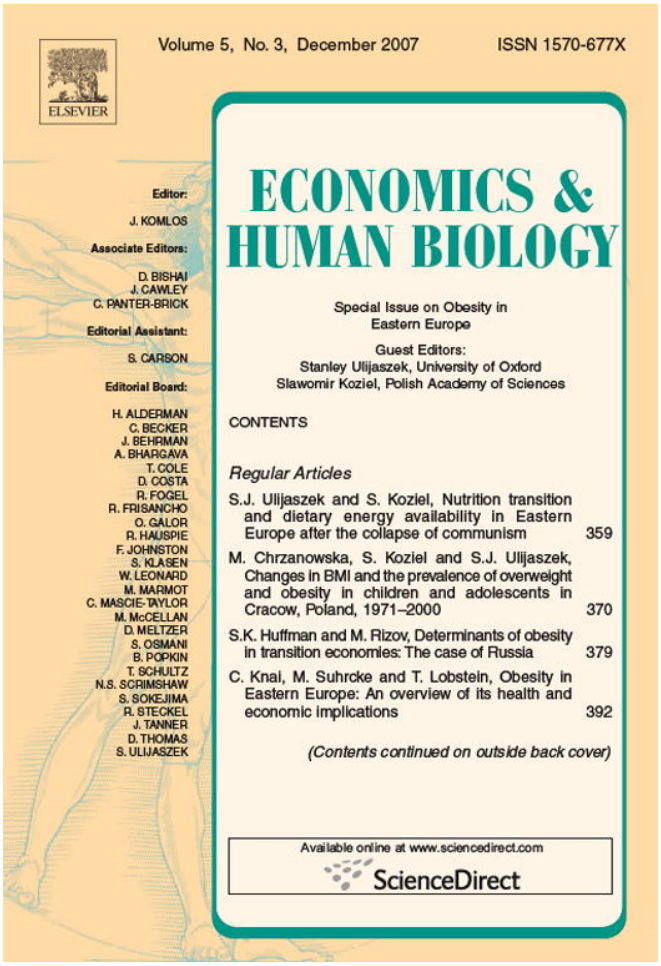

Available online at www.sciencedirect.com
ScienceDirect
ELSEVIER
Economics and Human Biology 5 (2007) 379–391
ECONOMICS AND HUMAN BIOLOGY
http://www.elsevier.com/locate/ehb

Determinants of obesity in transition economies: The case of Russia

Sonya K. Huffman [a,*], Marian Rizov [b,c]

[a] *Iowa State University, United States*
[b] *Middlesex University Business School, United Kingdom*
[c] *Wageningen University, The Netherlands*

Abstract

This paper examines human obesity, measured as weight and body mass index (BMI), and its determinants in Russia. Obesity increased dramatically during transition from a planned to a market economy, by 38%. We determine the factors contributing to rising obesity using individual level data from the Russia Longitudinal Monitoring Survey for 1994 and 2004. We find a strong positive effect of diet/caloric intake and a strong negative effect of smoking on weight and BMI. Gender, education, and income are other major determinants of obesity. Our analysis provides information on dietary patterns and other determinants of obesity in Russia which is essential for formulation and implementation of effective policies designed to reduce the problem and improve the health of the population.

JEL classification : I10

Keywords: Obesity; Health; Transition economies; Russia

1. Introduction

Transition from centrally planned to free market economies in the former socialist countries has brought big changes in all areas of the population's lives. Economic reforms were intended to increase efficiency and comprised price liberalization, privatization and enterprise restructuring. However, side effects accompanied the reforms and led to a fall in living standards for some population groups, an increase in unemployment and poverty, additional stress and uncertainty which consequently affected the population's health. As a

* Corresponding author.
E-mail address: skostova@iastate.edu (S.K. Huffman).

1570-677X/$ – see front matter © 2007 Elsevier B.V. All rights reserved.
doi:10.1016/j.ehb.2007.07.001

result, populations in transition countries have experienced dramatic changes in lifestyle and a significant decline in life expectancy. Former Soviet Union republics were the most severely affected. Studies by Brainerd and Cutler (2005), Cockerham (2000), and Shkolnikov et al. (2004) have examined the causes of the mortality crisis in Russia and other former Soviet republics and emphasize the role of increased alcohol consumption and increased stress from the transition. Stillman (2006) provides an excellent review of the literature examining health outcomes in Eastern Europe and the former Soviet Union republics during the transition period.

According to the World Health Organization (WHO, 2006), obesity has reached epidemic proportions globally and has become a major contributor to the global burden of chronic disease and disability. Overweight and obesity increase the risk of diet-related chronic diseases, including type-2 diabetes, cardiovascular disease, hypertension and stroke, and certain forms of cancer, and contribute significantly to osteoarthritis, which is a major cause of disability in adults. Notably, the emerging and transition economies, including Russia, had the highest number of diabetics in 1995 (WHO, 2006). Therefore, it is important to understand obesity and its determinants in transition countries in order to formulate an effective policy for reducing the problem and improving the health of the population.

Very few studies have examined the determinants of obesity in transition economies, in contrast to the large amount of literature in high income countries such as the USA (Chou et al., 2004; Huffman et al., 2006; Komlos and Baur, 2004; Lakdawalla and Philipson, 2002; Lakdawalla et al., 2005; Rashad, 2006; Rashad et al., 2006). But with the economic transformation and development of poor countries their populations become susceptible to obesity, also (Mendez and Popkin, 2004). Liefert (2004) examines food security in Russia and states that "... a serious food-related health problem is in fact overweight and obesity, which have increased during transition and currently affect over half of the adult population." Zohoori et al. (1998) find that during the period of 1992–1996 the prevalence of obesity, as well as the alcohol consumption has risen significantly in Russia.

Russia is one of the transition countries facing the most severe obesity and general health problems. Obesity increased during transition, rising from 20.3% of the population in 1994 to 28% in 2004—a 38% increase. Obesity rate was much higher for women at 27.8%, compared to only 9.5% for men in 1994. It has increased to 36.6% for females and 16.3% for males in 2004—a significant rise during the transition. Therefore, the objective of this paper is to examine human obesity, measured as weight and BMI, and the factors contributing to rising obesity during the transition in Russia.

2. Data and methods

A standard measure of obesity is based on the body mass index (BMI)—individual weight in kilograms divided by height in meters squared (kg/m^2). According to the WHO, an individual with a BMI over 25 kg/m^2 is defined as overweight, and with a BMI of over 30 kg/m^2 as obese. However, the BMI may overestimate body fat in athletes who have a muscular build, and may underestimate body fat in older people who have lost muscle mass (NIDDKD, 1996). Therefore, we choose both an individual's weight and BMI as measures of obesity.

To investigate the determinants of weight and BMI, major characteristics of an individual's health status, we employ data from the Russia Longitudinal Monitoring Survey (RLMS) for

1994 and 2004. The RLMS is a nationally representative household survey that annually samples the population of dwelling units.[1] The RLMS is based on multi-stage probability samples of the Russian population. The annual samples collect data for more than 4000 households and their members, who total more than 10,000 individuals each year. The collected data include a wide range of information concerning household characteristics such as demographic composition, income, and expenditures. Data on individuals includes employment, anthropometric measures, health status, nutrition, consumption, and medical problems. The BMI index for each respondent is constructed in our study from data on weight and height collected by trained personnel. The wealth of relevant variables makes the RLMS exceptionally appropriate for the purposes of this study. Table 1 presents the definitions and summary statistics for all variables used in the analysis. The summary statistics are based on the sample of 6424 individuals (age 18 and over) that remain after observations with missing values are deleted.

We establish the empirical relationship between weight (and BMI, in an alternative specification) and its determinants, including diet as measured by caloric intake and composition, and control for selective economic and socio-demographic factors. The individual's obesity relationship is specified as

$$\begin{aligned}\ln W_i = {} & \gamma_1 + \gamma_2 \ln \text{Height}_i + \gamma_3 \ln \text{Calories}_i + \gamma_4 \text{Fat}_i + \gamma_5 \text{Protein}_i + \gamma_6 \text{Smoker}_i \\ & + \gamma_7 \text{Male}_i + \gamma_8 \text{Education}_i + \gamma_9 \text{LFP}_i + \gamma_{10} \text{Age}_i + \gamma_{11} (\text{Age}_i)^2 + \gamma_{12} \ln \text{Income} \\ & + \gamma_{13} \text{Year}_i + \sum_{r=14}^{r=20} \gamma_r \text{Region} + \varepsilon_i \end{aligned} \quad (1)$$

where subscript i refers to an individual, W_i is defined as the individual's weight in kg (or alternatively BMI). Height is the individual's height measured in cm (it is excluded from the BMI specification); Calories is the total individual calories consumed per day; Fat is the share of fats in the total calorie intake[2]; Protein is the share of proteins in the total calorie intake; Smoker is a dummy variable equal to one if the individual smokes and zero otherwise; Male is a dummy variable equal to one if the individual is male and zero otherwise (i.e. female); Education is a set of dummy variables for three levels of education (basic, high, and higher); LFP is the labor force participation (employment) indicator equal to 1 if the individual works and 0 otherwise; Age is the individual's age in years (we include also squared term to control for nonlinearity of the effect); Income is the total real household income per month; Region is a set of dummy variables, one for each of eight regions of the country that capture, among other effects, the regional differences in real food prices. Year is a dummy variable equal to 1 if the year is 2004 and 0 for year 1994.[3] The set γ_1–γ_{20} are parameters of the individual's obesity function to be estimated. The random disturbance term ε_i represents the impact of all other factors and has a zero expected mean.

[1] This is not a true panel survey where sample households and individuals are followed and interviewed in each round. However, after 1999 the original design was modified and some households and individuals who moved were surveyed at their new locations. Most importantly, the analyses of the RLMS data for attrition, carried out by the Institute for Social Research at the University of Michigan, show that the exits can be characterized as random and that the sample distributions remain unchanged (Heeringa, 1997).

[2] In the model we use ln calories since the calories are total calories consumed per day and it is a continuous variable while fat and protein are in percent units.

[3] All of the variables are defined in Table 1.

Table 1
Variable definitions and summary statistics ($N = 6424$)

Variable	Mean (S.D.)	Median[a]	Definition
Weight	73.13 (14.01)	72.00	Individual weight (kg)
Height	165.08 (9.12)	164.30	Individual height (cm)
BMI	26.88 (5.01)	26.21	Individual weight divided by height squared (kg/m^2)
Calories	1857.83 (526.79)	1806.67	Total calories consumed per day
Fat	33.04 (10.19)	32.86	Percent of daily calories from fat
Protein	12.91 (3.59)	12.56	Percent of daily calories from protein
Smoker	0.28 (0.45)		Dummy variable equal to 1 if the individual smokes currently and 0 otherwise
Male	0.39 (0.49)		Dummy variable equal to 1 if the individual is a male and 0 otherwise
Education 1	0.37 (0.48)		Dummy variable equal to 1 if the individual has education level below grade 8 and 0 otherwise
Education 2	0.46 (0.50)		Dummy variable equal to 1 if the individual has completed high school and 0 otherwise
Education 3	0.17 (0.38)		Dummy variable equal to 1 if the individual has completed higher education and 0 otherwise
Age	48.73 (15.59)	47.34	Age in years
LFP	0.57 (0.50)		Dummy variable equal to 1 if the individual is employed and 0 otherwise
Income	8915.60 (7641.60)	6967.70	Total real household income per month (rubles)
Moscow-St. Petersburg	0.03 (0.18)		Dummy variable equal to 1 if the individual resides in Moscow-St. Petersburg region and 0 otherwise
North and Northwest	0.06 (0.24)		Dummy variable equal to 1 if the individual resides in North and Northwest region and 0 otherwise
Central	0.21 (0.401)		Dummy variable equal to 1 if the individual resides in Central region and 0 otherwise
Volga region	0.22 (0.42)		Dummy variable equal to 1 if the individual resides in Volga region and 0 otherwise
North Caucasus	0.15 (0.35)		Dummy variable equal to 1 if the individual resides in North Caucasus region and 0 otherwise
Ural region	0.16 (0.37)		Dummy variable equal to 1 if the individual resides in Ural region and 0 otherwise
West Siberia	0.08 (0.28)		Dummy variable equal to 1 if the individual resides in West Siberia region and 0 otherwise
East Siberia	0.08 (0.27)		Dummy variable equal to 1 if the individual resides in East Siberia region and 0 otherwise
Year	0.50 (0.50)		Dummy variable equal to 1 if year is 2004 and 0 if the year is 1994

[a] Medians are reported for the continuous variables only. Real ruble amounts, shown above, are the nominal values that have been adjusted to June 1992 rubles by the UNC Carolina Population Center.

Our empirical model is based on economic theory foundations. We consider the economic forces that affect obesity. In our analytical framework body weight (and BMI) is a result of individual's tradeoff between the supply and demand for calories. The tradeoff is continuously changing as a result of changes in the costs and benefits of physical effort and diet. First, as a result of

technological progress, there has been decline in physical expenditure of calories both at the work place and at home. This fact further implies that for working individuals the opportunity cost of exercising has increased. With transition process unfolding which saw incomes in transition countries rising, the opportunity cost of exercising has become even larger. Second, changes in the real price of food also affect importantly the supply and demand for calories. Following this line of reasoning, one can conclude that in some developed and transition countries (with rise in incomes) the tendency is towards more calorie consumption. However, households with high income can substitute calorie-rich foods with foods of higher quality which mean that obesity becomes more common among low income households. In the United States obesity is increasing across all social classes relatively equally (Maheshwari et al., 2005) while in Europe the obesity is prevalent mostly in the lower social classes (Heineck, 2006; Costa-Font and Jil, 2005).

Related process, specific to transition economies where incomes initially declined, is the substitution of cheaper food products for healthier but more expensive food. Because of the relative ease of substituting food products, in the short run, the change in the diet is potentially the leading force for the dramatic rise in obesity documented in Russia. In the long run, however, following the backward-bending labor supply curve intuition, one can hypothesize that with rising incomes leisure and thus exercising will become more valuable (and affordable). The result should be decline in the rising trend in obesity.

We include the individual's mature height in Eq. (1) as a summary indicator of an individual's genetic potential and early investment in good health. The year dummy variable controls for the overall impact of transition as well as for specific changes over time related to public health and the organization of the health care system as transition progresses. Larger caloric intake, other things equal, is expected to lead to weight gain and eventually to obesity ($\gamma_3 > 0$). Likewise, an increase of fat in the diet is expected to accelerate obesity ($\gamma_4 > 0$), and of protein—could reduce weight ($\gamma_5 \langle, \rangle 0$). Halton and Hu (2004) present a critical review of the medical literature on the effects of high protein diets on weight loss and conclude that some evidence suggest that "... higher protein diets may have beneficial effects on weight loss in the short term, although most of the studies have been small and inconclusive." However, Hu (2005) points that several studies found no significant difference in weight loss comparing higher- and lower-protein diets.

Smokers consume fewer calories than non-smokers. Specifically, cigarette smoking is associated with lower weight because smoking tends to increase metabolism and suppress appetite, thus having a negative effect on weight (and BMI) ($\gamma_6 < 0$). We expect individual weight (and BMI) to increase with age, at least up to middle age, but eventually metabolism declines and the digestive system starts to lose its efficiency (Kaufmann, 2006). The study by Pomerleau et al. (2000) show that the BMI in the Baltic countries increases with age and Abdulai (2005) finds a positive but concave relationship between age and BMI in Ghana. Therefore, we expect $\gamma_{10} > 0$ and $\gamma_{11} < 0$. For other variables the *a priori* hypotheses are more complex and outcomes less clear; therefore, we do not state prior expectations about the signs of coefficients for these variables. Of particular interest is the impact of transition on obesity which is captured by the γ_{13} coefficient. This coefficient will reflect changes in the supply and demand for calories as well as changes in the composition of population's diet during transition.

The reduced form econometric specification in Eq. (1) is estimated by ordinary least squares (OLS), both for the whole sample and by gender subgroups (male/female). Using Wald tests we also test for homogeneity of the obesity function across genders (male/female) and expect to reject the homogeneity hypothesis.

3. Results

The average individual weight was 71.9 kg in 1994 and it increased to 74.4 kg in 2004, while the average BMI was 26.2 in 1994 and it increased to 27.4 in 2004. For the same period, the average weight increased from 69.9 to 72.7 kg for females and from 74.8 to 76.7 kg for males. Fig. 1 shows the trends in overweight and obesity in Russia during 10 years of transition. Our (weighted) data reveal that the share of the population that is overweight and obese has increased in Russia during the period 1994–2004; overweight people accounted for 34.3% of the total in 1994 and for 36.1% in 2004. The increase in obesity was much more dramatic during this period, from 20.3% in 1994 to 28.0% in 2004. In 1994 the overweight rate for males was higher than that of females—35.8% versus 33.2%. Interestingly, the obesity rate is much higher for females, at 27.8%, compared to only 9.5% for males. It appears that women are much more likely to be obese in Russia—a fact in line with the trend for western countries. Importantly, the overweight and obesity rates have increased for both genders over the 10-year period, from 1994 to 2004. For women, the share of those who were overweight increased slightly, from 33.2% to 34.6%, and for men—from 35.8% to 38.1%. Obesity rates increased much more dramatically, from 27.8% to

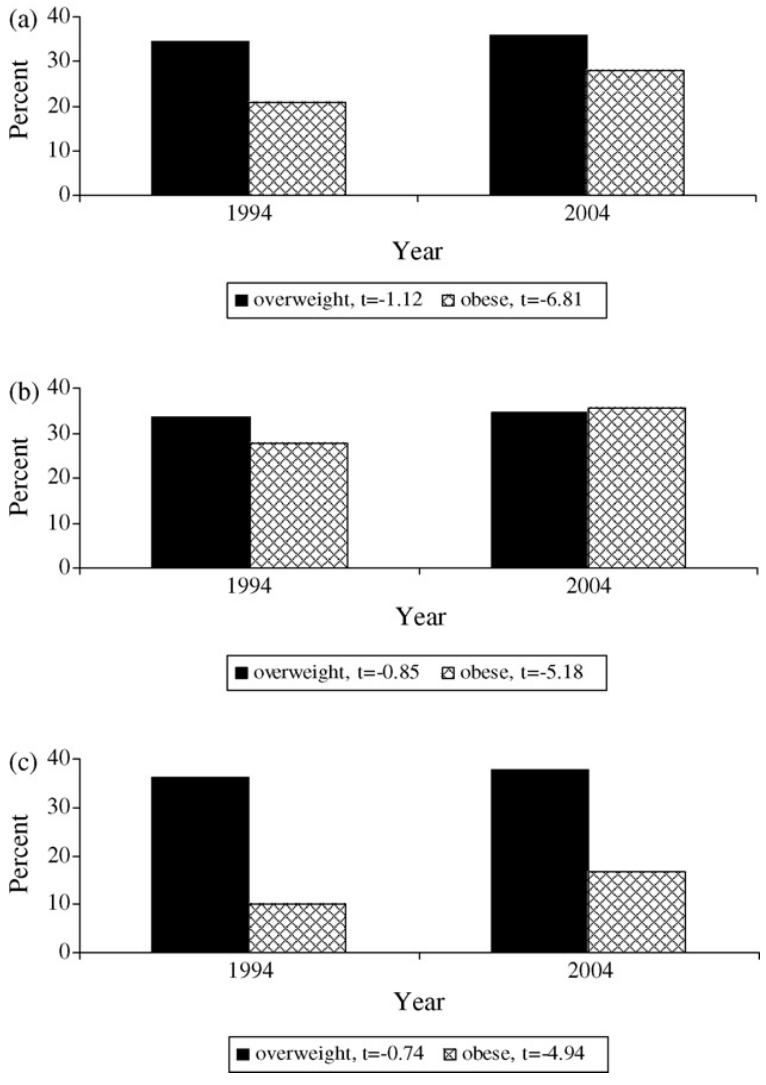

Fig. 1. Changes in overweight and obesity in Russia, 1994 and 2004 (weighted data). (a) Pooled sample; (b) females; (c) males. *Note*: *t*-Test statistics indicate the level of significance of the changes.

Table 2
OLS estimates of the obesity function (dependent variable ln Weight)

Variable	Coefficient (S.E.)		
	Pooled sample	Females	Males
ln Height	1.847 (0.071)***	1.727 (0.096)***	2.006 (0.101)***
Male	−0.038 (0.008)***	–	–
Age	0.016 (0.001)***	0.022 (0.001)***	0.009 (0.001)***
Age 2	−0.0001 (0.0000)***	−0.0002 (0.0000)***	−0.0001 (0.0000)***
Education 2	0.009 (0.006)	0.011 (0.008)	0.005 (0.008)
Education 3	−0.026 (0.008)***	−0.040 (0.011)***	0.0004 (0.011)
Smoker	−0.061 (0.007)***	−0.027 (0.014)*	−0.075 (0.008)***
LFP	0.012 (0.005)**	0.007 (0.007)	0.015 (0.008)**
ln Calories	0.017 (0.010)**	0.001 (0.013)	0.047 (0.014)***
Fat	0.001 (0.0002)***	0.001 (0.001)*	0.001 (0.0003)***
Protein	0.002 (0.001)***	0.002 (0.001)*	0.003 (0.001)***
ln Income	0.016 (0.003)***	0.019 (0.005)***	0.015 (0.005)***
Year	0.011 (0.003)***	0.013 (0.004)***	0.013 (0.004)***
North and Northwest	0.026 (0.019)	0.036 (0.025)	0.009 (0.024)
Central	0.024 (0.016)	0.027 (0.022)	0.019 (0.021)
Volga region	0.010 (0.016)	0.016 (0.022)	0.006 (0.021)
North Caucases	0.035 (0.017)**	0.033 (0.023)	0.042 (0.022)**
Ural region	0.013 (0.017)	0.020 (0.022)	0.009 (0.021)
West Siberia	0.019 (0.018)	0.030 (0.025)	0.006 (0.024)
East Siberia	0.032 (0.018)*	0.045 (0.025)*	0.018 (0.024)
Constant	−5.923 (0.366)***	−5.363 (0.495)***	−6.823 (0.529)***
R^2	0.26	0.23	0.31
Number of observations	6424	3892	2532

Robust standard errors are in parentheses.
* Statistically significant at the 10% level or less.
** Statistically significant at the 5% level or less.
*** Statistically significant at the 1% level or less.

36.6% for women and from 9.5% to 16.3% for men. We have included the *t*-test statistics in the figure to assess the significance of changes in overweight and obesity rates between 1994 and 2004. The *t*-tests indicate that the increase of obesity is statistically significant. Therefore, it is important to identify the factors that are behind the dramatic increase in obesity among Russians during their economic transition.

We estimate the individual obesity function as specified in Eq. (1) by OLS using a balanced panel of individuals from 1994 and 2004 and report the robust standard errors corrected for individual clustering. Table 2 presents the OLS estimates of the individual obesity function where the dependent variable is the natural logarithm of an individual's weight. It is fitted on data pooled over men and women and separately by gender. We test for equality across gender and reject the homogeneity hypothesis.[4] We find strong econometric evidence for the factors affecting the obesity functions of both females and males. The results show a strong positive effect of diet/caloric intake and a strong negative effect of smoking on weight and BMI. Furthermore, other major determinants of obesity are gender, education, and income.

[4] We applied Wald tests for coefficient differences between the male and female subsamples. The results are available from the authors upon request.

Table 3
OLS estimates of the obesity function (dependent variable ln BMI)

Variable	Coefficient (S.E.)		
	Pooled sample	Females	Males
Male	−0.049 (0.006)***	–	–
Age	0.016 (0.001)***	0.022 (0.001)***	0.009 (0.001)***
Age 2	−0.0001 (0.0000)***	−0.0001 (0.0000)***	−0.0001 (0.0000)***
Education 2	0.009 (0.006)	0.010 (0.008)	0.004 (0.008)
Education 3	−0.029 (0.008)***	−0.044 (0.011)***	−0.001 (0.011)
Smoker	−0.062 (0.007)***	−0.027 (0.014)*	−0.075 (0.008)***
LFP	0.012 (0.005)**	0.007 (0.007)	0.015 (0.008)**
ln Calories	0.017 (0.010)**	0.001 (0.013)	0.047 (0.014)***
Fat	0.001 (0.0002)***	0.0004 (0.0003)*	0.001 (0.0003)***
Protein	0.002 (0.001)***	0.002 (0.001)*	0.003 (0.001)***
ln Income	0.016 (0.003)***	0.018 (0.005)***	0.016 (0.005)***
Year	0.010 (0.003)***	0.011 (0.004)***	0.013 (0.004)***
North and Northwest	0.029 (0.019)	0.042 (0.025)*	0.008 (0.024)
Central	0.024 (0.016)	0.028 (0.022)	0.019 (0.020)
Volga region	0.011 (0.016)	0.018 (0.022)	0.006 (0.021)
North Caucases	0.036 (0.017)**	0.033 (0.023)	0.042 (0.021)**
Ural region	0.014 (0.017)	0.021 (0.022)	0.009 (0.021)
West Siberia	0.021 (0.018)	0.032 (0.025)	0.006 (0.024)
East Siberia	0.035 (0.018)*	0.049 (0.025)*	0.018 (0.024)
Constant	2.510 (0.081)***	2.463 (0.109)***	2.418 (0.116)***
R^2	0.19	0.19	0.15
Number of observations	6424	3892	2532

Robust standard errors are in parentheses.
* Statistically significant at the 10% level or less.
** Statistically significant at the 5% level or less.
*** Statistically significant at the 1% level or less.

Table 3 presents the OLS estimates of the obesity function where the dependent variable is the natural logarithm of BMI. It is again fitted to data pooled over men and women, and separately by gender. The results from the estimated BMI equation are similar to those from the weight equation. We tested for equality across genders and rejected the hypothesis at the 1% level. Furthermore, we fitted the obesity models separately for the 1994 and 2004 subsamples and also for each year by gender.[5] The effects of the determinants of obesity are similar, with the only difference being the impact of income, which is larger in magnitude in 2004. This is an important result pointing to the fact that economic forces have begun to play an increasingly important role in individual choices with the unfolding transition to a market economy.

An important determinant for health is diet (food consumption), which has been changing during the transition in Russia. Fig. 2 presents the changes in consumption (for weighted data) of fruits and vegetables, meat and fish, dairy products, potatoes, bread, fats, sugar, and eggs over 10 years of transition. Consumption of these products is measured as the household real (with reference to June 1992) monthly expenditures. There is a trend of declining consumption of many traditionally important products. The consumption of all main food groups, with the exception of potatoes, has significantly decreased. The most dramatic change is in the consumption of

[5] The results are available from the authors upon request.

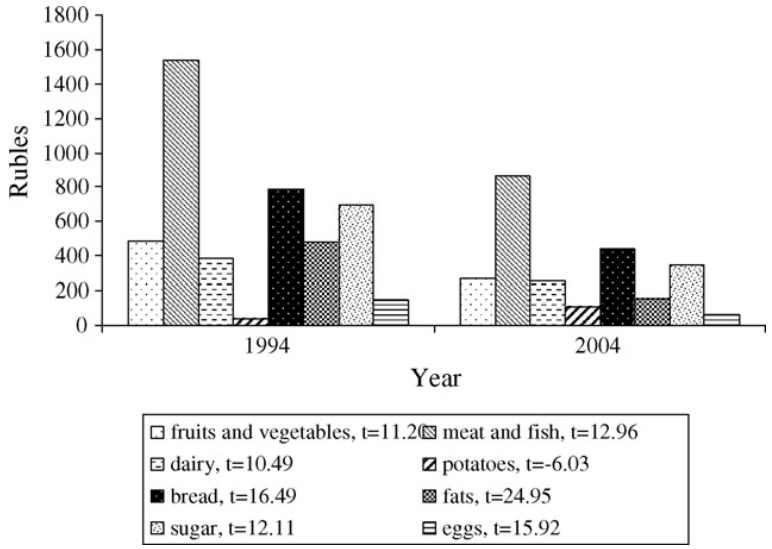

Fig. 2. Changes in consumption of fruits and vegetables, meat and fish, dairy, potatoes, bread, fats, sugar, and eggs in Russia, 1994 and 2004 (weighted data). *Note*: Constant rubles with base of June 1992 are used. *t*-Test statistics indicate the level of significance of the changes.

potatoes which increased by 160%. The *t*-test statistics reported in the figure indicate that all of the changes in consumption between 1994 and 2004 are statistically significant.

Fig. 3 shows the changes in consumption of alcohol and cigarette smoking in Russia during the period 1994–2004. The number of people who consume alcohol has decreased from 60% to 48% during the 10-year period, while there was a slight increase in smoking, from 28% to 29%. The *t*-test statistics indicate that only the changes in alcohol consumption are statistically significant.

4. Discussion

The overweight and obesity have increased in Russia during the period 1994–2004. An increase in food fat content, holding protein content and caloric consumption constant, makes both women and men gain more weight. Age has a positive and significant effect on weight, but the age effect is diminishing. Weight also increases with an individual's height. Total calories consumed positively and significantly affect only male's weight, while the protein intake leads to an increase in the weight of both men and women. A 10% increase in caloric intake increases individual's weight by 0.47% for males. Smoking has a strong and statistically significant

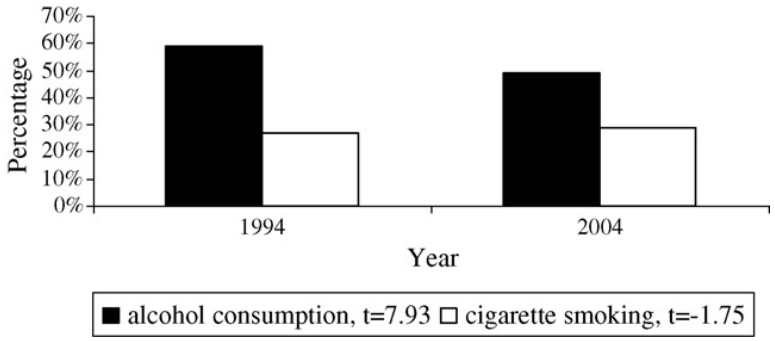

Fig. 3. Changes in alcohol consumption and cigarette smoking in Russia, 1994 and 2004 (weighted data). *Note*: *t*-Test statistics indicate the level of significance of the changes.

negative effect on individual's weight—a decrease of 7.5% for men and of 2.7% for women, respectively. A higher level of education decreases a woman's weight by 4% compared to the basic education category, but there is no significant effect of education on male's weight. The status of participating in the labor force (being employed) has a significantly positive effect (a 1.5% increase) on men's weight. However, there is no such effect for women. One can possibly argue that being employed increases significantly the opportunity costs of off-the-job physical exercise needed to maintain lower (optimal) weight for men.

The estimated coefficients for the year dummy are positive and statistically significant, indicating that people are heavier in 2004 than 1994. Individual weight has increased by 1.1%, other things equal, during transition. This finding suggests that during transition the standard mechanism driven by technological progress is possibly also at work, as it is observed for other developed and developing countries. Our results are broadly in line with findings by Rashad et al. (2006) and Smith et al. (2005). An increase in household income increases weight for both males and females. This finding is consistent with other study by Jahns et al. (2003). The income effect observed could capture the more sedentary nature of higher income jobs and the increased opportunity cost of exercising. Most of the coefficients on the regional dummies are not statistically significant. Only the weight of males living in the North Caucasus and females living in the East Siberia regions is significantly higher relative to the weight of individuals residing in the Moscow-St. Petersburg regions.

A male's age and the fat content of food consumed by men both have statistically significant and positive effects on BMI. The peak of female's BMI is at 63 years of age; while the peak for the male's BMI is at 61 years of age. A female's BMI increases with female dietary fat and protein consumption while more education decreases the BMI of women. Being employed, total calories intake, fat and protein consumption all increase the BMI of males but being a smoker significantly decreases male's BMI. Importantly, the BMI for both genders is higher in 2004 than in 1994. Female's BMI is higher by 1.1%, and male's BMI is 1.3% higher.

An important reason for an individual being overweight or obese in Russia is that the traditional diet is high in sugar and livestock products (meat and dairy) that contain fat, protein and cholesterol, but it is low in consumption of healthier foods, such as vegetables and fruits, and extremely low in citrus fruit intake (Ginter, 1995). This is probably due to the difficulty of growing fruits and vegetables in the Russian climate, as well as to the state authorities' dietary recommendations during the Soviet era that heavily favored meat and dairy products. The original Recommended Daily Intake in the Soviet Union specified that high protein intakes were necessary for maintaining good health. But high animal protein diets are likely to be high in saturated fat also.

What happened to the consumption of foods such as meat and fish, fruits and vegetables, dairy, alcohol, etc., during the transition in Russia? The expectation is that Russian households have responded to the income and price shocks by shifting the composition of their diets toward cheaper foods as the households in other transition economies did (Hossain and Jensen, 2000; Huffman and Johnson, 2004). The most dramatic change is in the consumption of potatoes which increased significantly. The consumption of the other food groups has declined by at least a half. This evidence confirms that the Russian households have indeed responded to price and income shocks as a result of the economic reforms by shifting consumption towards cheaper types of food.

The average adult consumes about 1860 calories per day. Importantly, the total calorie consumption has not changed over the 10-year period of transition. Protein intake contributes around 13% of the calories for the average Russian, with a very small increase during the transition period. Caloric intake from fat was 33.6% for adult men and women in 1994, with a

little decline in 2004, to 32.5%, possibly due to a small overall improvement in nutritional status. The recommendation of the World Health Organization for the fat intake is to be lower than 30% of the diet.

In summary, although the total calories consumed did not change over the 10-year period obesity has increased. Possible reason for this is the change in consumption patterns such as further shifting away form healthy and balanced diet comprising fruits and vegetables toward fatty and sugary products and excessive consumption of potatoes. Another reason is possibly related to unhealthy lifestyle such as increased alcohol consumption, among certain groups of the population. There is also evidence that technological progress affecting the supply and demand for calories through the increased opportunity cost of exercising has been inducing changes in lifestyle as well.

5. Conclusions

During 10 years of transition, obesity in Russia increased from 20% to 28% of the population in 2004. This paper examines the factors that may be responsible for this increase in obesity. An effective targeted public health strategy requires more detailed information on the determinants and the distribution of obesity within population. Data from the RLMS from 1994 and 2004 show that diet/caloric intake, smoking and education are important determinants of obesity in Russia. Our study finds a strong positive effect of caloric intake and a strong negative effect of smoking on weight and BMI. Our findings are similar to those for developed market economies (Chou et al., 2004; Rashad, 2006; Rashad et al., 2006).

In the empirical analysis, we use a balanced panel from 1994 and 2004 for individuals. This allows us to trace the effects of various factors on obesity over time. The individual obesity function is the focus of this analysis. We find that demographic and anthropometric characteristics such as height, gender, and age positively and significantly influence the degree of overweight and obesity. Age has a positive but diminishing effect on weight and higher education is related to lower individual weight. Interestingly, our findings are similar to findings for the US population by Lakdawalla and Philipson (2002). Furthermore, economic and dietary factors such as caloric intake and its composition in fat and protein also contribute positively and significantly to high individual's weight, and thus, to obesity, but smoking deters overweight. Income is positively associated with higher weight and BMI for both females and males—an effect currently observed in developed countries. In 1970s, in the United States, the obesity rate of the population was heavily concentrated in low income households, but over the past three decades obesity has spread throughout the middle and high income population groups (Komlos and Baur, 2004; Maheshwari et al., 2005). Being employed increases individual's weight also but only for males.

Information on dietary patterns and other determinants of obesity is essential for the formulation, implementation and monitoring of effective policies designed to improve overall nutritional well-being and reduce obesity and mortality of the population. Understanding the determinants of obesity in Russia is important in order to define what strategies are most likely to be effective in preventing and reducing obesity. An important finding of the paper is that the effects of all factors on individual weight (and BMI) remain largely unchanged over the ten-year period covered by the analysis, with a tendency of strengthening the effects by the end of the period, in 2004.

Our preliminary analysis provides also evidence that individuals who are obese are more likely to be absent from work, other things equal, which suggests important economic

implications of obesity. This paper only focuses on the main determinants of obesity in Russia. Future research should evaluate the impact of overweight and obesity on the economic and social performance of individuals in transition economies.

Acknowledgements

We thank Wally Huffman, the Human Resource Workshop participants at the Department of Economics, Iowa State University, the editors and anonymous referees for helpful comments.

References

Abdulai, A., 2005, The Increasing Significance of Overweight Problems in Developing Countries: Empirical Evidence for Urban Accra in Ghana. Unpublished working paper. University of Kiel, Germany.

Brainerd, E., Cutler, D., 2005. Autopsy on an empire: understanding mortality in Russia and the former Soviet Union. J. Econ. Perspect. 19, 107–130.

Chou, S., Grossman, M., Saffer, H., 2004. An economic analysis of adult obesity: results from the behavioral risk factor surveillance system. J. Health Econ. 23, 565–587.

Cockerham, W., 2000. Health lifestyles in Russia. Social Sci. Med. 51, 1313–1324.

Costa-Font, J., Jil, J., 2005. Obesity and the incidence of chronic diseases in Spain: a seemingly unrelated probit approach. Econ. Human Biol. 3, 188–214.

Ginter, E., 1995. Cardiovascular risk factors in the former communist countries. Eur. J. Epidemiol. 11, 199–205.

Halton, T., Hu, F., 2004. The effects of high protein diets on thermogenesis, satiety and weight loss: a critical review. J. Am. Coll. Nutr. 23, 373–385.

Heeringa, S., 1997, Russia Longitudinal Monitoring Survey (RLMS) Sample Attrition, Replenishment, and Weighting in Rounds V–VII. Available at: http://www.cpc.unc.edu/projects/rlms/project/samprep.pdf.

Heineck, G., 2006. Height and weight in Germany, evidence from the German socio-economic panel, 2002. Econ. Hum. Biol. 4, 359–382.

Hossain, F., Jensen, H., 2000. Lithuania's food demand during economic transition. Agric. Econ. 23, 31–40.

Hu, F., 2005. Protein, body weight, and cardiovascular health. Am. J. Clin. Nutr. 82, 242S–247S.

Huffman, S., Johnson, S., 2004. Impacts of economic reform in Poland: incidence and welfare changes within a consistent framework. Rev. Econ. Stat. 86, 626–636.

Huffman, W., Huffman, S., Tegene, A., Rickertsen, K., 2006, The economics of obesity-related mortality among high income countries. Unpublished working paper. Iowa State University, Ames.

Jahns, L., Baturin, A., Popkin, B., 2003. Obesity, diet, and poverty: trends in the Russian transition to market economy. Eur. J. Clin. Nutr. 57, 1295–1302.

Kaufmann, M., 2006, Physiol. Aging. Retrieved February 23, 2007, from http://www.efmoody.com/longterm/agingexternal.html.

Komlos, J., Baur, M., 2004. From the tallest to (one of) the fattest: the enigmatic fate of the American population in the 20th century. Econ. Hum. Biol. 2, 57–74.

Lakdawalla, D., Philipson, T., 2002. The growth of obesity and technological change: a theoretical and empirical examination. Unpublished working paper. National Bureau of Economic Research, Cambridge.

Lakdawalla, D., Philipson, T., Bhattacharya, J., 2005. Welfare-enhancing technological change and the growth of obesity. Am. Econ. Rev. 95, 253–257.

Liefert, W., 2004. Food Security in Russia: Economic Growth and Rising Incomes are Reducing Insecurity. Food Security Assessment, USDA, Washington, DC.

Maheshwari, N., Robinson, J., Kohatsu, N., Zimmerman, B., 2005. Obesity prevalence increasing 3 times faster in high than low income groups: National Health and Nutrition Examination Surveys 1971–2002. Circulation 111, 190.

Mendez, M., Popkin, B., 2004. Globalization, urbanization and nutritional change in the developing world. J. Agric. Dev. Econ. 1, 220–241.

National Institute of Diabetes and Digestive and Kidney Diseases (NIDDKD), 1996. Statistics Related to Overweight and Obesity. US Government Printing Office, Washington, DC. , In: http://www.medhelp.org/NIHlib/GF-367.html.

Pomerleau, J., Pudule, I., Grinberga, D., Kadziauskiene, K., Abaravicius, A., Bartkeviciute, R., Vaask, S., Robertson, A., McKee, M., 2000. Patterns of body weight in the Baltic Republics. Publ. Health Nutr. 3, 3–10.

Rashad, I., 2006. Structural estimation of caloric intake, exercise, smoking, and obesity. Quart. Rev. Econ. Finan. 46, 268–283.

Rashad, I., Grossman, M., Chou, S., 2006. The super size of America: an economic estimation of body mass index and obesity in adults. Eastern Econ. J. 32, 133–148.

Shkolnikov, V., Andreev, E., Leon, D., McKee, M., Mesle, F., Vallin, J., 2004. Mortality reversal in Russia: the story so far. Hygiea Internationalis 4, 29–80.

Smith, P., Bogin, B., Bishai, D., 2005. Are time preferences and body mass index associated? Evidence from the national longitudinal survey of youth. Econ. Hum. Biol. 3, 259–270.

Stillman, S., 2006. Health and nutrition in Eastern Europe and the former Soviet Union during the decade of transition: a review of literature. Econ. Hum. Biol. 4, 104–146.

World Health Organization, 2006. http://www.who.int/dietphysicalactivity/publications/facts/obesity/en/.

Zohoori, N., Mroz, T., Popkin, B., Glinskaya, E., Lokshin, M., Mancini, D., Kozyreva, P., Kosolapov, M., Swafford, M., 1998. Monitoring the economic transition in the Russian Federation and its implications for the demographic crisis—the Russian Longitudinal Monitoring Survey. World Dev. 26, 1977–1993.