

Price Changes Alone Are Not Adequate to Produce Long-Term Dietary Change^{1,2}

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Abstract

Taxation has been proposed as a means to reduce consumption of unhealthy food items. However, it is unknown if taxation without regulations or other activities known to shift eating behaviors lead to long-term dietary change. This unexplored issue is examined using data from the Russia Longitudinal Monitoring Survey. Data were from adults aged 25–55 y who participated in the nationally representative Russian Longitudinal Monitoring Survey. Twenty-four-hour dietary recalls, detailed food expenditure data, and community-level food prices collected over 1994–2005 were used for these analyses. Longitudinal random effects models were used to test the relation of time on the structure of diet while controlling for total household expenditures. The proportion of total energy consumed from fat was higher in all other years combined compared with 1998 ($P < 0.001$). The proportion of dietary fat from high-fat meat and high-fat dairy items were lowest in 1998 and increased over subsequent years despite increasing costs. Percent fat from fats and oils continued to decline with rising costs. Price changes led to substantial shifts in the structure of food consumption. However, except for the most expensive items, consumption of items returned to levels consumed in the former Soviet Union following price stabilization. *J. Nutr.* 140: 1887–1891, 2010.

Introduction

Increasing the cost of “junk” food items through taxation of these items has been proposed as a way to improve overall health. Two main arguments have been posited surrounding the relation between the cost of food and food consumption. First, governmental subsidies caused distortion of the prices of grains, animal source foods, fats, and sugars compared with legumes, fruits, and vegetables (1–3), making legumes, fruits, and vegetables relatively more expensive to consume. Second, healthy food items usually cost more compared with less healthful items and result in lower consumption of healthy food items (4,5). The effects of taxation in the absence of accompanying education and public health policies and whether taxation of food items will affect consumption of these items remain unknown. It is plausible that taxation of junk food items would produce an initial decrease in consumption of these items; however, without public education, any increase in household income would be accompanied by a return to consumption of these items as the population becomes accustomed to the new higher prices.

Countries that were once part of the Soviet Union or satellites of the former Soviet Union provide a model to study the short- and long-term effects of price change on diet. The former Soviet Union provided high subsidies for a set of high-fat meat and

high-fat dairy items (particularly beef, pork, and dairy) such that consumers paid the equivalent of a few United States pennies for a kilogram of beef, of butter, or of milk (6,7). Five-year plans promoted consumption of meat and dairy items to exceed consumption in the United States (6,8). Not only was the population accustomed to these dietary habits, but the Soviet Union medical and nutritional establishments created dietary standards that called for very high (58–108 g/d) levels of protein intake (6,7). To the best of the authors' knowledge, neither the Soviet Union government nor the medical or public health community provided education about the negative effects of high saturated fat and animal product intake on health. The education and promotion provided by the Soviet government to eat meat had ended by the 1980s, but the practices were ingrained in the population. Furthermore, no counter education was provided.

Following the fall of the Soviet Union in 1991, a major economic restructuring occurred in Russia and other countries that were once part of the former Soviet Union. The economic turmoil of the 1990s produced economic price shocks. The resultant price changes were likely to lead to initial dietary change in Russia, but the nature of these changes have not been thoroughly examined. Traditionally, Russia had a very high obesity prevalence, among the world's highest cardiovascular mortality rate, and low nutrition literacy (7,9,10); these factors make Russia a useful model for providing insight into the broader question: Will increasing the price of certain food items decrease consumption of these items if price changes are not accompanied by educational programs and shifts in public norms? We hypothesize that in the absence of any shifts in norms

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and education related to food choice, the Russian population will shift back to previous dietary consumption patterns once incomes increase, i.e. income increases will be linked with a return to familiar and favored dietary practices. The aim of the current study was to determine the short- and long-term effects of price change on diet.

Methods

Participants

Participants were from The Russian Longitudinal Monitoring survey (RLMS). The RLMS has previously been described in detail (11–13). Briefly, from 1992 to 2007, surveys were conducted each year at the individual, household, and community levels. Each year the same housing units were surveyed. If the original occupant had moved, the current resident was interviewed and the resident who moved was also followed, so both a nationally representative sample and a panel sample were developed. Over 4000 households were surveyed in each round. Individuals were given identification numbers that were linked from year to year. For the purposes of the current study, individuals who participated in the RLMS between 1994 and 2005 were included. This yielded 19,946 participants. Outside evaluations found these data to be representative of the population residing in Russia (12,14). Individuals who were between 25 and 55 y who participated in at least 1 survey round were included in the study.

This study was approved by the University of North Carolina at Chapel Hill Institutional Review Board. All participants consented to be interviewed.

Measures and interviews

Dietary interviews. Data were collected on diet from 1994 to 2005 and have previously been described (15). Each year, 24-h recalls were conducted for as many members of the household as possible. In 1996 two 24-h food recalls were conducted and for the purpose of this study only the first day was used to be consistent with the data collected in all other rounds. Ratios of within- to between-person variance were of high quality in these surveys (12). Nutritional information from the 24-h recalls was obtained by using the Russia Nutrient Data Base, which was developed by Russian Institute of Nutrition nutritionists using information from the USDA and West German food composition tables. The Russia Nutrient Data Base was continually updated as new products became available on the Russian market (6,16).

Total energy consumption and macronutrient composition were available for overall diet and individual food groups. The following individual food groupings were analyzed: percent dietary fat, percent dietary fat from high-fat meat sources (i.e. beef and sausage), percent dietary fat from fats and oils, and percent dietary fat from high-fat dairy sources (i.e. full-fat milk and cream).

Economic data. Community price data were collected from each community at the time of each survey each year. These data contained information about the cost of food items such as high-fat meats, fats and oils, and high-fat dairy items, as previously described (12,14). Briefly, a systematic community survey was carried out at each round. A subsample of food sources were selected for price data collection. Initially, prices from both free market and state stores were collected, but state stores disappeared by 2004 and only free markets (combination of open air markets, farmers markets, and small and large food stores) were selected. The same were selected for major sets of commodities due to the existence of separate stores for bread and other baked items, meats, and dairy. In some communities, these were separate stores and in other communities these were combined in 1 store. Detailed data were also collected on total household expenditures for each household surveyed and were the best proxy for permanent income and poverty status. Total household expenditures were used in all models as a continuous measure. For the purposes of this study, total household expenditures were deflated to 1992 values and cost of food items were inflated to 2008 values. In addition, data were adjusted for the revaluation of the ruble in 1998 as follows: real values prior to 1998 were divided by 1000.

Time. Dichotomous indicator variables were created by grouping 1994, 1995, and 1996 as 1 indicator variable. The year following the economic crisis, 1998, was grouped as its own indicator variable and used as the referent group. The years following the economic crisis, 2000, 2001, 2002, and 2003, were grouped as a single indicator variable and 2004 and 2005 were each used as indicator variables. Data were not collected in 1997 and 1999 and were therefore not included in the analyses. Indicator variables were created based on adjacent years with similar dietary and economic patterns. In addition, all years other than 1998 were grouped as 1 indicator variable and 1998 as a separated indicator variable for analyses involving Student's *t* tests. Individual years were not compared with 1998.

Statistical analyses

All statistical analyses were performed using STATA 11.0 (17). Student's *t* tests were used to determine whether 1998 differed from all other years. Longitudinal data analyses were conducted using the random effects model using generalized least squares. Random effects were estimated within and between individuals. Four models were used: 1) percent fat = age, male, total household expenditures, dichotomous indicator variables; 2) percent fat from high-fat meats = age, male, total household expenditures, dichotomous indicator variables; 3) percent fat from fats and oils = age, male, total household expenditures, dichotomous indicator variables; and 4) percent fat from high-fat dairy items = age, male, total household expenditures, dichotomous indicator variables. Significant interaction effects did not exist between the age or male variable and percent fat, percent fat from fats and oils, and percent fat from high-fat dairy items. All significance tests were 2-tailed and $P < 0.05$ was considered significant.

Results

Prices increased from 1994 to 2005, rising sharply ~1998. Following a stark decrease in total household expenditures in 1998, spending increased until 2002, when another price shock accompanied by recovery occurred (Fig. 1). Mean prices for high-fat meats, fats and oils, and high-fat dairy items increased over time (Fig. 2), with large increases between 1996 and 2000 (prices inflated to 2008 levels). Although the rate of change was similar for fats and oils and the other items studied (data not shown), the cost of fats and oils remained higher than the other times and consumption differences remained.

Dietary consumption followed a similar but inverse pattern with decreased percent of energy from fat coming from high-fat meats, fats and oils, and high-fat dairy items when prices rose sharply (Table 1). Percent energy intake from dietary fat, percent fat intake from high-fat meat, and percent fat intake from high-fat dairy items were higher in all years other than 1998 compared with 1998 ($P < 0.001$).

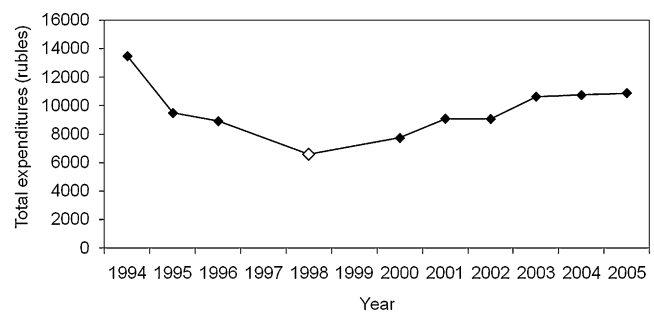


FIGURE 1 Total household expenditures on food by Russian adults from 1994 to 2005. All prices were deflated to the 1992 value. Values are means, $n = 3800$ – 4400 , weighted to be nationally representative.

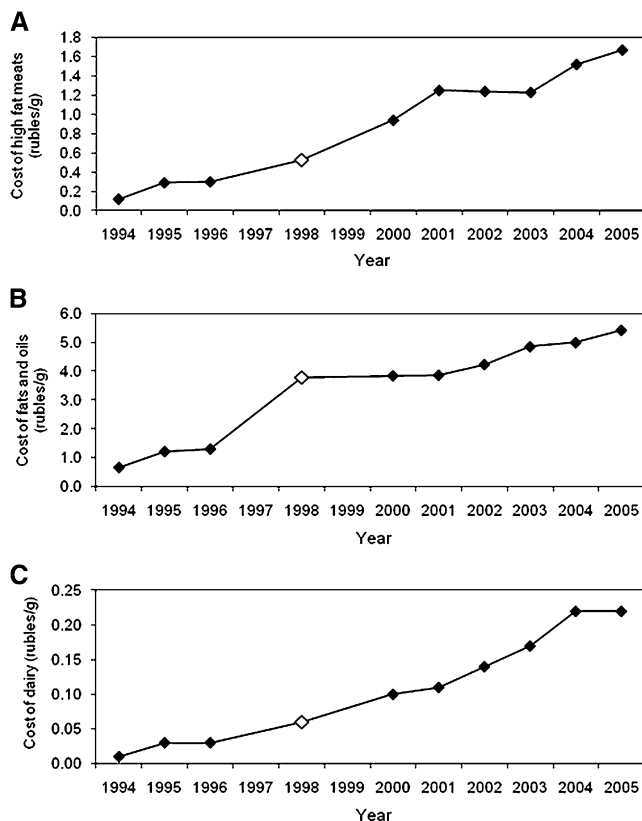


FIGURE 2 Prices of high-fat meats (A), fats and oils (B), and high-fat dairy items (C) in Russia from 1994 to 2005. Values are means, $n = 298\text{--}340$ communities.

Results from each of the models adjusted for age, male, and total household expenditures (the best proxy for permanent income) are presented (Table 2). Overall, fat consumption was lower in 1998 ($P < 0.001$) compared with the other years. Percent fat from high-fat meats was higher between 1994 and 1996 compared with 1998 ($P < 0.001$), remained low between 2000 and 2003, then increased and was higher in 2004 ($P < 0.001$) and 2005 ($P < 0.001$) compared with 1998. Percent dietary fat from fats and oils was higher in 1994–1996 compared with 1998 ($P < 0.001$), but compared with 1998, percent fat from fats and oils was lower in the years that followed ($P < 0.001$). Percent fat from fats and oils was ~40% lower in 2005

compared with 1994. Compared with 1998, percent fat from high-fat dairy item consumption was higher in subsequent years ($P < 0.001$).

Discussion

The Russian Federation provides an example of economic changes occurring in the absence of any concurrent education or other regulatory change. Over the long term, steep price increases did not result in long-term dietary shifts; in fact, participants might have reverted to the prior education received during the Soviet regime and reverted to prior consumption patterns. Fat consumption significantly decreased following the economic crisis but quickly rebounded as incomes increased. Consumption of high-fat meat and high-fat dairy items also quickly returned to the consumption levels noted in the era when high-fat meat and high-fat dairy items were highly subsidized and consumption was encouraged. Data from this study support the notion that, over time, as income increase and individuals adjust to higher cost of food items, consumption reverts to patterns prior to price increases.

The initial impetus for studying the effect of price changes on food consumption, such as the consumption of sugar-sweetened beverages and junk food, arose from 2 different bodies of work. The first studied the effects of increasing tobacco cost on smoking behavior (18–21). The second explored the role of price policy in guiding consumption (22,23). Several factors seemed important in decreasing tobacco use in the United States population. Taxation helped reduce the use of tobacco, but the largest decrease in tobacco use came immediately following tax increases (24), similar to decreased consumption noted following sharp price increases in Russia. However, tobacco control programs were also useful in decreasing tobacco use (25). States with higher taxes and more tobacco control policies experienced a greater decline in tobacco-related deaths from cardiovascular disease than states with lower taxation and fewer tobacco control policies (26), indicating both price and education might be important in behavior alteration.

Similarly, many economists have studied United States and European farm policy and the ways subsidies for oil seed, livestock and livestock feed, and sugar, among others, shifted consumption patterns (2,27–29). In general, the consensus is that subsidies have distorted consumption globally away from legumes and produce and toward oils, sugars, and animal foods (30).

TABLE 1 Percent fat intake and percent fat from high-fat meats, fats and oils, and high-fat dairy items by year¹

Year	<i>n</i>	Fat, %	Fat from high-fat meats, %	Fat from fats and oils, %	Fat from high-fat dairy items, %
1994	4539	34.3 ± 10.6	27.3 ± 23.4	15.9 ± 19.3	9.5 ± 14.7
1995	4153	32.8 ± 10.2	22.5 ± 22.7	15.0 ± 18.6	11.3 ± 15.9
1996	3409	32.0 ± 10.2	21.8 ± 22.8	13.9 ± 18.2	11.7 ± 16.7
1998	4234	30.9 ± 10.8*	20.8 ± 22.9*	12.0 ± 17.9	9.7 ± 15.1*
2000	4502	31.6 ± 10.2	19.3 ± 21.5	11.9 ± 16.9	10.4 ± 15.7
2001	5054	32.4 ± 10.1	20.1 ± 21.4	11.4 ± 16.3	10.8 ± 15.8
2002	5218	33.4 ± 10.1	22.0 ± 22.3	11.4 ± 16.5	10.9 ± 15.9
2003	5356	33.8 ± 10.1	23.5 ± 22.8	10.0 ± 15.2	10.7 ± 15.3
2004	5419	33.7 ± 9.9	23.6 ± 22.9	10.4 ± 15.3	10.9 ± 15.3
2005	5030	34.6 ± 10.6	23.6 ± 10.6	9.9 ± 14.8	11.3 ± 15.7

¹ Values are means ± SD. *Lower than all other years combined, $P < 0.001$ (Student's *t* test).

TABLE 2 Longitudinal random effects models predicting intake¹

	β	SE	P-value
Percent energy from fat (<i>n</i> = 46,316 observations)			
Male	-0.11	0.11	<0.32
Age	-0.001	0.001	<0.05
Total household expenditures (rubles)	<0.001	<0.001	<0.001
1994–1996	2.04	0.17	<0.001
2000–2003	1.76	0.16	<0.001
2004	2.57	0.20	<0.001
2005	3.43	0.20	<0.001
Percent total fat from high-fat meats (<i>n</i> = 46,304 observations)			
Male	-2.29	0.23	<0.001
Age	-0.003	0.001	<0.03
Total household expenditures (rubles)	<0.001	<0.001	<0.001
1994–1996	2.64	0.39	<0.001
2000–2003	0.16	0.36	<0.67
2004	2.33	0.45	<0.001
2005	1.98	0.45	<0.001
Percent total fat from fats and oils (<i>n</i> = 46,304 observations)			
Male	-0.40	0.17	<0.02
Age	0.002	0.0008	<0.01
Total household expenditures (rubles)	<0.001	<0.001	<0.02
1994–1996	3.06	0.29	<0.001
2000–2003	-0.73	0.28	<0.01
2004	-1.42	0.34	<0.001
2005	-1.97	0.34	<0.001
Percent total fat from high-fat dairy items (<i>n</i> = 46,304 observations)			
Male	1.03	0.16	<0.001
Age	0.003	0.001	<0.01
Total household expenditures (rubles)	<0.001	<0.001	<0.10
1994–1996	1.06	0.26	<0.001
2000–2003	1.10	0.25	<0.001
2004	1.26	0.30	<0.001
2005	1.65	0.31	<0.001

¹ 1998 was the referent year.

It has been proposed that increasing the price of these less healthful food items and sugar-sweetened beverages would result in behavioral changes that would enhance health by encouraging consumption of healthier food items (31). In the current study, increasing prices and decreasing overall total household expenditures resulted in initial decreased consumption of the items studied, consistent with previous research (22,23,32–36). For example, changes in the prices of fruits and vegetables along with the price of fast food influenced consumption in such a way that increased fast food prices were associated with consumption of healthier diets (22). Another study showed mothers purchased fewer junk food items when the items were more expensive (23). Other studies showed that decreased price of fruits, vegetables, and low-fat items resulted in higher consumption of these items (32–36). Although all of the studies were able to evaluate the initial effect of price change without accompanied educational programming, none of these studies addressed the long-term effects of price change.

As further evidence regarding the power of education in producing behavioral change, the Soviet government educated the population to consume meat and dairy, setting nutritional guidelines that called for high levels of animal protein (6). Following the fall of the Soviet Union, no additional education was provided and the message encouraging high meat and dairy

consumption was never withdrawn, clarified, or accompanied by education concerning the dangers of high-fat diets. This, along with familiar and comfortable dietary patterns, might help to explain the return to consumption of high-fat meat and high-fat dairy items as soon as economic conditions allowed. Therefore, it is plausible that the education provided by the Soviet Union more than a decade earlier might help explain the return to consumption of high-fat meat and high-fat dairy items. Applying the similar strategy, but encouraging consumption of healthy food items, might also result in long-term change.

In earlier discussions of the nutrition transition, one major proposition was that the shift of relative prices without concomitant education or other sources of norm changes would not result in long-term health benefits; however, this remained an untested proposition (37,38). The current study extended previous knowledge by tracking long-term effects of price change unaccompanied by new educational programming. Results indicated that consumption of percent fat, high-fat meats, and high-fat dairy items decreased with economic price shocks; however, over time consumption returned to pre-price shock levels despite the higher cost.

Percent dietary fats resulting from fats and oils showed a different pattern. Costs of fats and oils increased over the time period studied and were the most expensive food item studied. Consumption decreased and began to level off but did not show the return that high-fat meats and high-fat dairy items showed. These results suggest that unless price increases are extreme and continual and the item remains substantially more expensive than other items, consumption will revert back to the initial dietary consumption pattern over time. Further, in the Soviet Union, consumption of high-fat meat and high-fat dairy items but not pure fats and oils was encouraged. This, coupled with the high cost, likely made purchasing fats and oils prohibitive. In 2005, consumption of high-fat dairy items had risen higher than pre-price shock levels and consumption of high-fat meat was moving in this direction. This might indicate and illustrate not only a return to previous dietary preferences but also indicates that only consistent, extremely high prices prevent a shift back to dietary preferences. Given that percent fat intake from high-fat meat and high-fat dairy items has not greatly overshot pre-price shock levels, this indicates that it is not solely price driving the return to the consumption of some items relative to other items.

Limitations

There are several limitations to this study. First, data were not collected in 1997, the year in which economic price shocks were the most severe and 1999, which may or may not have indicated the beginning of economic rebound. Second, the ruble experienced a redenomination in 1998 that may have contributed to the consumption changes noted in this year. It is also possible that the composition of the sample differed from year to year. In the later rounds, the impact of the former Soviet Union policies may have been less, especially among younger individuals. Third, it must be noted that a key difference between the Russian economic transition and the proposed taxation of junk food items is that during the Russian economic transition, price rose initially very rapidly accompanied by decreases in incomes. We understand that we do not fully capture all these dynamics with the data at hand. Furthermore, in many countries proposing taxation, there would be no related income decreases. Hence, we must be cautious in how much of the Russian experience can be applied to other countries. Fourth, it is unknown if accompanying education programs would produce long-term behavior change.

In conclusion, the data from Russia suggest that rapid price changes not accompanied by other societal shifts in norms or education may result in only short-term effects. These results suggest that after the initial discomfort with increased prices diminishes, consumption might slowly return to normal, especially if incomes increase, as found in Russia. This Russian experience suggests that price changes alone will not yield long-term changes in dietary consumption patterns.

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