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Changing patterns of fruit and vegetable intake in countries of the former Soviet Union

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Abstract

Objective: To assess how the frequency of low fruit and vegetable consumption has changed in countries of the former Soviet Union (FSU) between 2001 and 2010 and to identify factors associated with low consumption.

Design: Cross-sectional surveys. A standard questionnaire was administered at both time points to examine fruit and vegetable consumption frequency. Logistic regression analysis was used to examine the relationship between demographic, socio-economic and health behavioural variables and low fruit and vegetable consumption in 2010.

Setting: Nationally representative population samples from Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia and Ukraine.

Subjects: Adults aged 18 years and older.

Results: Between 2001 and 2010 notable changes occurred in fruit and vegetable consumption in many countries resulting in a slight overall deterioration in diet. By 2010 in six countries about 40 % of the population was eating fruit once weekly or less often, while for vegetables the corresponding figure was in excess of 20 % in every country except Azerbaijan. A worse socio-economic situation, negative health behaviours (smoking and alcohol consumption) and rural residence were all associated with low levels of fruit and vegetable consumption.

Conclusions: International dietary guidelines emphasise the importance of fruit and vegetable consumption. The scale of inadequate consumption of these food groups among much of the population in many FSU countries and its link to socio-economic disadvantage are deeply worrying. This highlights the urgent need for a greater focus to be placed on population nutrition policies to avoid nutrition-related diseases in the FSU countries.

Keywords
Diet
Former Soviet Union
Fruit
Vegetables
Consumption

Globally, one of the main determinants of life expectancy is economic development, as demonstrated by the now well-known Preston curve[1]. However, some countries perform somewhat better than expected and others worse. Among the latter are many of the countries of the former Soviet Union (FSU)[2]. There are many reasons for this, but the leading explanations have been identified as alcohol, smoking, diet and health-care provision failures[3–5]. However, the situation is changing and, throughout this region, life expectancy has been improving during the 2000s[6]. The reasons remain inadequately understood although it is likely that there has been some improvement in all of the major risk factors. Our previous research has examined changes in smoking[7] and access to health care[8,9], and ongoing research is examining changes in alcohol consumption. There have been a number of relatively recent studies that have looked at some aspects of nutrition although mainly secondary to other issues[10–15], but there has been little research specifically on changing diet in this region in the past decade outside Russia[16–18]. This gap is important as the experience of countries in Central Europe following the opening of markets in the 1990s suggests that changing diets are likely to have a significant impact on health[19,20].

Earlier research in this region has characterised the traditional diet as high in fat and particularly low in fruit and vegetables, although differences in traditional diets in the South Caucasus and Central Asia were not explored[3]. Thus, research in the three Baltic states in the late 1990s reported median intakes of under 200 g/d[21],

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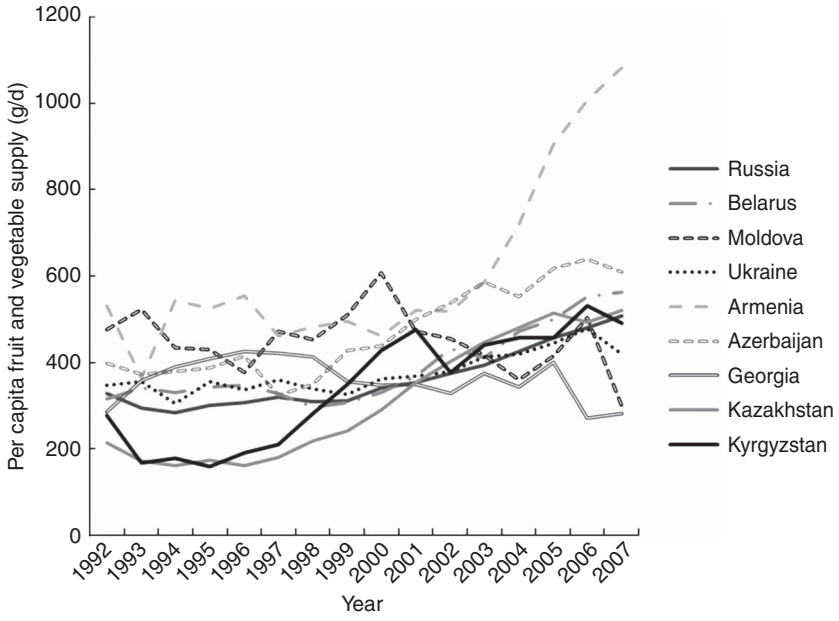

Fig. 1 Trends in the per capita supply of fruit and vegetables (g/d) from 1992 to 2007 in countries of the former Soviet Union (data source: FAO[24])

compared with the WHO recommendation of at least 400 g/d[22] or five servings of fruit and vegetables[23]. Many aspects of life in this region are, however, changing and food balance data from the FAO show substantial changes in the supply of fruit and vegetables since the late 1990s (Fig. 1)[24]. However, there are known discrepancies between these data and actual consumption levels[25]. Hence, it is necessary to complement them with data from surveys. In the present paper we seek partially to address this gap by reporting on the findings from surveys in nine FSU countries. This is now a priority: determining what people eat is an essential element of formulating evidence-based nutritional policies.

Methods

The data used in the present study are taken from two nationally representative cross-sectional household surveys conducted among adults in Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia and Ukraine in 2001 and again in 2010, when Azerbaijan was also included. Details of the earlier Living Conditions, Lifestyles and Health (LLH) survey conducted in October and November 2001 have been presented elsewhere[10,26]. In both the LLH and the more recent Health in Times of Transition (HITT) surveys, multistage random sampling with stratification by region and rural/urban settlement type was used. Within each primary sampling unit (about 50–200 (LLH), 100–200 (HITT) per country), households were selected by standardised random route procedures or selected by random sampling from a household list (in the case of Armenia in the earlier survey). Within each of the selected households one person (aged 18 years and over) was chosen (based on the nearest birthday). If there was no one at home after three visits (on different days and at different times), the next household on the route was selected.

The HITT survey was conducted between March and May 2010 (except in Kyrgyzstan, where political violence delayed the data collection until early 2011). Face-to-face interviews were conducted by trained fieldworkers in the respondents' homes. Response rates varied from 71 % to 88 % in the LHH survey and from 47·3 % (Kazakhstan) to 83·0 % (Moldova) in the HITT survey. In the LHH study, approximately 2000 interviews were completed in each country with the exception of Russia (4000) and Ukraine (2400). For HITT there were 1800 respondents in each country, except in Russia (3000) and Ukraine (2000). As with the earlier study larger samples were collected in these countries to reflect their larger and more regionally diverse populations. In Georgia there was also a greater number of respondents (2200) as a result of a booster survey of 400 additional interviews that was undertaken in November 2010 to ensure a more representative sample. All participants gave informed consent prior to their inclusion in the study.

The HITT questionnaire included many of the same questions that had been used in the LLH survey to enable comparability. The draft questionnaire was forward- and back-translated into each of the languages in which it was administered, and then piloted before being finalised. Except in Russia and Belarus (where all interviews were conducted in Russian), respondents were given the choice of answering in Russian or a national language. Many of the questions used in both surveys are common

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survey questions. Other questions were designed specifically for use in these surveys based on our knowledge of the populations' behaviour/lifestyles in this region[26] (e.g. the question relating to garden plots). In the current study the primary outcomes of interest concern the consumption of fruit and vegetables, information about which was obtained in response to two questions: 'How often in the past week have you eaten … fresh fruit/vegetables (except for potatoes)?' In the LLH study interviewees were presented with the response options 'daily', '2 or 3 times per week', 'occasionally (1 time per week)' and 'extremely seldom'. In HITT the options were 'daily/almost daily', 'several times per week', 'once a week' and 'less than once a week'.

As details of the LLH study population have been presented elsewhere[26], here we will focus on characteristics of the HITT sample, which are presented in Table 1. Table 2 presents details of fruit and vegetable consumption in the countries in 2001 and 2010. Table 3 presents results from a logistic regression analysis that was performed to examine which factors were associated with consuming fruit and vegetables in 2010. In the regression analysis we examined factors associated with eating fruit and vegetables once weekly or less often where those individuals with inadequate diets were coded '1' (while respondents giving other answers were coded '0').

The independent variables examined in the analysis included demographic factors: sex; age (18–39/40–59/60+ years); educational attainment (completed higher education/less than completed higher education); household size (i.e. number of members – a continuous variable); and residential location (urban/rural). Socio-economic situation was assessed using variables relating to: economic well-being, measured through an item on self-rated household economic situation (categorised as 'good'/'very good'/'average'/'bad'/'very bad'); information about the extent to which the respondent's household was required to limit its basic food intake in the past 12 months ('never'/'sometimes'/'constantly'); and possessing a garden plot (yes/no). Health beliefs were assessed using information on attitudes towards having a healthy diet (dichotomised as 'important' and 'quite important'/'rather unimportant' and 'unimportant'); smoking behaviour, i.e. smoking/non-smoking and the number of cigarettes smoked each day among smokers (1–10/11+); and the frequency of alcohol consumption ('never'/'once per week or less'/'2–3 times per week or more'). We also examined the relationship between self-reported health (categorised as 'good' and 'very good'/'average'/'bad' and 'very bad') and diet.

Statistical analysis

The associations between these variables and fruit and vegetable consumption were examined by conducting logistic regression analyses using the statistical software package STATA version 12·1. Two models were examined. In Model 1 we examined the association between each independent variable and the outcome variable (inadequate diet). In Model 2 we examined the association between each independent variable and having an inadequate diet using a fully adjusted analysis where each variable is controlled for the effects of all the other variables in the model and for the possible country effects. The analysis was adjusted for clustering to account for the survey's clustered design. The results are presented in the form of odds ratios with 95 % confidence intervals. The level of statistical significance was set at $P < 0{\cdot}05$.

Results

In the 2010 HITT survey there were more female than male respondents (56·5 % *v.* 43·5 %) in all of the study countries (Table 1). Georgia had a particularly high ratio of females to males (64:36), although this has been found in all recent surveys and is believed to reflect large-scale labour migration in the post-Soviet period[27,28]. In most countries just under two-thirds of the population lived in urban locations. The proportion of respondents who had completed their higher education ranged from about 18 % in Armenia, Azerbaijan, Kyrgyzstan and Moldova to 36·2 % in Georgia. There was a large variation in the range of respondents who felt their households were in a bad/very bad economic situation with the figure varying from 7·0 % in Kazakhstan to 44·1 % in Georgia. Large differences were also observed in the percentage of respondents who constantly had to limit their food intake and regarding the possession of a garden plot, with figures for the former ranging from 3·2 % (Kazakhstan) to 17·5 % (Georgia) and for the latter from 26·1 % (Armenia) to 69·8 % (Moldova). In every country over 90 % of interviewees thought that having a healthy diet was important although there was a sizeable number of heavy smokers (15·8 %) and frequent drinkers (9·5 %) across the countries. In total, 18·5 % of the respondents reported their health as being bad/very bad with the figures ranging from 9·6 % (Kazakhstan) to 36·9 % (Georgia).

The prevalence of fruit and vegetable consumption varied greatly among the FSU countries between 2001 and 2010 (Table 2). In terms of daily/almost daily consumption of fruit a three-way pattern was clearly visible: in three countries (Armenia, Belarus and Ukraine) the prevalence remained essentially unchanged, in three countries (Georgia, Kyrgyzstan and Moldova) it decreased sharply while in Kazakhstan and Russia it increased significantly. This meant that by 2010 about 20 % of the population (or more) in six countries were eating fruit less than once weekly, with large increases in Georgia (8·9 % to 28·5 %), Kyrgyzstan (8·5 % to 26·3 %) and Moldova (8·5 % to 28·2 %; Table 2). In contrast, the decline in those eating fruit less than once weekly between 2001 and 2010 was marked in Kazakhstan (28·4 % to 19·7 %) and especially in Russia (30·2 % to 9·0 %; Table 2). The country with the highest

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Table 1 Sample characteristics of HITT 2010 study (*n* 18 000), by country†

	Armenia		Azerbaijan		Belarus		Georgia		Kazakhstan		Kyrgyzstan		Moldova		Russia		Ukraine		All countries	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Total sample	1800	100·0	1800	100·0	1800	100·0	2200	100·0	1800	100·0	1800	100·0	1800	100·0	3000	100·0	2000	100·0	18 000	100·0
Gender																				
Women	977	54·3	954	53·0	1015	56·4	1400	63·6	946	52·6	930	51·7	1003	55·7	1789	59·6	1157	57·9	10 171	56·5
Men	823	45·7	846	47·0	785	43·6	800	36·4	854	47·4	870	48·3	797	44·3	1211	40·4	843	42·2	7829	43·5
Age (years)																				
18–39	919	51·1	961	53·4	850	47·2	856	38·9	963	53·5	1033	57·4	794	44·1	1251	41·7	828	41·4	8455	47·0
40–59	625	34·7	663	36·8	547	31·9	817	37·1	571	31·7	568	31·6	651	36·2	1047	34·9	619	31·0	6135	34·1
60+	256	14·2	176	9·8	376	20·9	527	24·0	266	14·8	199	11·1	355	19·7	702	23·4	553	27·7	3410	18·9
Education level																				
Complete higher education	325	18·1	323	18·0	396	22·0	796	36·2	428	23·8	320	17·8	332	18·5	662	22·2	484	24·4	4066	22·6
Less than complete higher education	1474	81·9	1468	82·0	1404	78·0	1403	63·8	1372	76·2	1480	82·2	1463	81·5	2326	77·8	1500	75·6	13 890	77·4
Household size																				
Mean and SD	4·5	1·5	4·3	1·6	2·9	1·3	3·8	1·8	4·0	1·8	4·7	2·2	3·1	1·5	2·9	1·4	3·0	1·4	3·6	1·8
Location																				
Urban	1393	77·4	1016	56·4	1323	73·5	1051	47·8	1000	55·6	820	45·6	687	38·2	2179	72·6	1396	69·8	10 865	60·4
Rural	407	22·6	784	43·6	477	26·5	1149	52·2	800	44·4	980	54·4	1113	61·8	821	27·4	604	30·2	7135	39·6
Economic situation																				
Good/very good	499	27·8	458	25·8	409	22·8	117	5·4	572	31·9	622	34·6	461	25·9	519	18·0	328	16·5	3985	22·4
Average	970	54·0	926	52·2	1158	64·5	1105	50·6	1097	61·1	994	55·3	873	49·0	1885	65·3	1188	59·9	10 196	57·3
Bad/very bad	328	18·3	391	22·0	228	12·7	964	44·1	126	7·0	181	10·1	447	25·1	484	16·8	467	23·6	3616	20·3
Limit food																				
Never	971	54·0	889	49·9	1356	75·5	783	35·7	1411	78·7	951	53·0	1182	66·0	2184	73·4	1163	58·4	10 890	60·8
Sometimes	662	36·8	640	36·0	376	20·9	1025	46·8	325	18·1	584	32·6	538	30·0	655	22·0	613	30·8	5418	30·3
Constantly	165	9·2	251	14·1	65	3·6	383	17·5	57	3·2	259	14·4	72	4·0	137	4·6	215	10·8	1604	9·0
Garden plot																				
No	1307	73·9	1128	65·2	674	37·7	871	41·5	663	36·9	592	32·9	532	30·2	1213	41·5	748	39·0	7728	44·0
Yes	462	26·1	603	34·8	1113	62·3	1128	58·5	1132	63·1	1208	67·1	1232	69·8	1707	58·5	1172	61·0	9857	56·1
Healthy diet																				
(Quite) important	1681	93·5	1752	97·7	1713	96·0	2148	98·7	1679	93·9	1759	97·9	1754	97·6	2732	93·5	1908	96·5	17 126	96·0
(Rather) unimportant	116	6·5	41	2·3	72	4·0	29	1·3	109	6·1	38	2·1	43	2·4	190	6·5	69	3·5	707	4·0
Cigarettes																				
0	1296	72·2	1408	78·7	1330	74·2	1692	77·0	1275	71·0	1387	77·3	1442	80·6	2063	69·3	1452	73·5	13 345	74·5
1–10/d	103	5·7	57	3·2	262	14·6	139	6·3	238	13·3	202	11·3	165	9·2	356	12·0	207	10·5	1729	9·7
11+/d	397	22·1	325	18·2	200	11·2	366	16·7	283	15·8	206	11·5	182	10·2	556	18·7	317	16·0	2832	15·8
Alcohol																				
Never	386	24·8	1440	80·4	241	13·4	653	29·7	599	33·3	899	49·9	289	16·2	661	22·1	449	22·7	5617	31·8
1 time/week or less	1058	68·0	285	15·9	1387	77·3	1379	62·8	1080	60·1	849	47·2	1030	57·5	2049	68·6	1275	64·5	10 392	58·8
2–3 times/week or more	111	7·1	66	3·7	167	9·3	164	7·5	118	6·6	52	2·9	471	26·3	277	9·3	254	12·8	1680	9·5
Self-reported health																				
Very good/good	975	54·2	1059	58·9	622	34·6	538	24·5	795	44·2	955	53·1	666	37·3	1027	34·5	653	32·8	7290	40·6
Average	613	34·1	441	24·5	911	50·6	848	38·6	832	46·2	637	35·4	697	39·0	1469	49·4	896	45·1	7344	40·9
Very bad/bad	211	11·7	298	16·6	267	14·8	810	36·9	173	9·6	208	11·6	424	23·7	480	16·1	440	22·1	3311	18·5

HITT, Health in Times of Transition.
†Data are presented in the form of numbers and percentages unless stated otherwise.

Table 2 Prevalence of fruit and vegetable consumption in 2001 and 2010, by country†

	n	*n*	Daily/almost daily (%)				Several times per week (%)				Once weekly (%)				Less than once weekly (%)			
	2001	2010	2001	95 % CI	2010	95 % CI	2001	95 % CI	2010	95 % CI	2001	95 % CI	2010	95 % CI	2001	95 % CI	2010	95 % CI
Fruit																		
Armenia	2000	1790	35·0	32·9, 37·1	35·3	33·0, 37·5	31·7	29·6, 33·7	33·2	31·0, 35·4	21·0	19·2, 22·8	21·5	19·6, 23·3	12·4	10·9, 13·8	10·1	8·7, 11·5
Azerbaijan	–	1786	–	–	43·3	41·0, 45·6	–	–	35·3	33·1, 37·5	–	–	16·7	15·0, 18·5	–	–	4·6	3·6, 5·6
Belarus	1995	1788	21·7	19·8, 23·5	22·4	20·4, 24·3	33·9	31·9, 36·0	36·9	34·7, 39·2	26·8	24·8, 28·7	20·5	18·6, 22·3	17·6	16·0, 19·3	20·3	18·4, 22·1
Georgia	2007	2176	37·9	35·7, 40·0	19·3	17·7, 21·0	37·4	35·3, 39·5	33·3	31·3, 35·3	15·8	14·2, 17·4	18·8	17·2, 20·5	8·9	7·7, 10·2	28·5	26·6, 30·4
Kazakhstan	1999	1786	17·2	15·5, 18·8	31·7	29·6, 33·9	24·6	22·7, 26·5	28·5	26·4, 30·6	29·9	27·9, 31·9	20·0	18·2, 21·9	28·4	26·4, 30·3	19·7	17·9, 21·6
Kyrgyzstan	1997	1800	38·6	36·4, 40·7	21·1	19·2, 23·0	34·2	32·1, 36·2	30·8	28·7, 33·0	18·8	17·1, 20·5	21·8	19·9, 23·7	8·5	7·3, 9·7	26·3	24·2, 28·3
Moldova	1996	1775	33·5	31·4, 35·5	23·7	21·7, 25·6	38·3	36·1, 40·4	27·9	25·9, 30·0	19·8	18·0, 21·5	20·2	18·4, 22·1	8·5	7·2, 9·7	28·2	26·1, 30·3
Russia	3994	2967	14·9	13·8, 16·0	31·2	29·5, 32·9	24·6	23·3, 25·9	37·5	35·8, 39·3	30·3	28·9, 31·8	22·3	20·8, 23·8	30·2	28·7, 31·6	9·0	8·0, 10·0
Ukraine	2379	1979	25·9	24·1, 27·7	26·6	24·7, 28·6	29·3	27·4, 31·1	34·3	32·2, 36·4	26·5	24·7, 28·3	20·8	19·0, 22·6	18·4	16·8, 19·9	18·3	16·6, 20·0
Vegetables																		
Armenia	2000	1793	28·6	26·6, 30·6	41·7	39·4, 43·9	40·6	38·4, 42·7	36·5	34·3, 38·8	20·6	18·8, 22·4	16·8	15·1, 18·6	10·3	8·9, 11·6	5·0	4·0, 6·0
Azerbaijan	–	1770	–	–	47·9	45·6, 50·2	–	–	32·8	30·6, 35·0	–	–	12·8	11·3, 14·4	–	–	6·4	5·3, 7·6
Belarus	1998	1786	37·0	34·9, 39·2	25·1	23·1, 27·2	41·0	38·9, 43·2	43·5	41·2, 45·8	17·2	15·6, 18·9	18·8	17·0, 20·6	4·7	3·8, 5·6	12·5	11·0, 14·1
Georgia	2008	2192	39·1	37·0, 41·3	27·8	25·9, 29·7	36·2	34·1, 38·3	40·9	38·9, 43·0	17·2	15·6, 18·9	17·5	15·9, 19·1	7·4	6·3, 8·6	13·8	12·4, 15·3
Kazakhstan	1998	1797	37·0	34·9, 39·2	42·5	40·2, 44·8	39·3	37·2, 41·5	31·3	29·1, 33·4	17·7	16·0, 19·3	15·4	13·7, 17·0	6·0	4·9, 7·0	10·9	9·4, 12·3
Kyrgyzstan	2000	1800	45·1	42·9, 47·3	34·2	32·0, 36·4	32·8	30·7, 34·9	33·1	30·9, 35·2	15·4	13·8, 16·9	17·0	15·3, 18·7	6·8	5·7, 7·8	15·7	14·0, 17·4
Moldova	1999	1775	36·3	34·2, 38·4	24·6	22·6, 26·6	44·1	41·9, 46·3	32·1	29·9, 34·2	14·9	13·3, 16·4	19·4	17·5, 21·2	4·8	3·9, 5·7	24·0	22·0, 26·0
Russia	3999	2967	44·6	43·0, 46·1	35·5	33·8, 37·2	34·0	32·5, 35·5	43·3	41·6, 45·1	15·7	14·5, 16·8	15·9	14·6, 17·2	5·8	5·1, 6·5	5·3	4·5, 6·1
Ukraine	2384	1987	42·1	40·1, 44·1	44·3	42·2, 46·5	34·0	32·1, 35·9	34·6	32·5, 36·7	17·3	15·8, 18·8	12·5	11·0, 13·9	6·6	5·6, 7·6	8·6	7·3, 9·8

Total samples: in 2001, fruit (*n* 18 367), vegetables (*n* 18 386); in 2010, fruit (*n* 17 847), vegetables (*n* 17 867).
†Data are presented in the form of numbers, and percentages with 95 % confidence intervals.

level of fruit consumption in 2010 was Azerbaijan, where 43·3 % of the population was consuming fruit on a daily/almost daily basis.

In contrast to fruit consumption, most countries (five) recorded a decrease in daily/almost daily vegetable consumption (of about 10–12 %) between 2001 and 2010. The exceptions were Ukraine, Kazakhstan and especially Armenia, where this figure rose from 28·6 % in 2001 to 41·7 % in 2010. By this later date, 24·0 % of the population was eating vegetables less than once weekly in Moldova while this figure was between 5·0 % and 15·7 % in the other countries. As with fruit consumption, the country with the highest level of daily/almost daily vegetable consumption in 2010 was Azerbaijan (47·9 %). In terms of the overall pattern in daily/almost daily fruit and vegetable consumption across the period, only one country – Kazakhstan – experienced a notable increase in consumption of both types of food, while three countries (Georgia, Kyrgyzstan and Moldova) all experienced a sharp decline in both fruit and vegetable consumption.

In the regression analysis (Table 3) a number of variables were significantly associated with both inadequate fruit and vegetable consumption. Men were more likely to eat fruit once weekly or less often compared with women (OR = 1·10; 95 % CI 1·02, 1·20), as were respondents aged 40–59 years (OR = 1·23; 95 % CI 1·14, 1·33) and 60+ years (OR = 1·37; 95 % CI 1·23, 1·54) compared with those aged 18–39 years. Those individuals who had a lower level of education were also more likely to eat fruit (OR = 1·20; 95 % CI 1·15, 1·26) and vegetables (OR = 1·15; 95 % CI 1·10, 1·21) once weekly or less often. Compared with the economically advantaged, those who reported that their economic situation was average or poor were significantly more likely to have lower levels of fruit (OR = 1·37; 95 % CI 1·23, 1·53 and OR = 2·23; 95 % CI 1·93, 2·59, respectively) and vegetable consumption (OR = 1·21; 95 % CI 1·08, 1·36 and OR = 1·68; 95 % CI 1·43, 1·97, respectively). As expected, there was a linear relationship between food limitation and inadequate diet with the odds for low fruit consumption increasing by 1·7 times (OR = 1·69; 95 % CI 1·52, 1·87) among those who sometimes limited their food intake and more than doubling (OR = 2·07; 95 % CI 1·76, 2·43) among those who constantly limited food intake compared with those who never did; while an almost identical odds gradient was noted among these groups for inadequate vegetable consumption (OR = 1·62; 95 % CI 1·45, 1·81 and OR = 2·03; 95 % CI 1·70, 2·42, respectively). Living in a rural location also significantly increased the risk for both low fruit (OR = 1·59; 95 % CI 1·37, 1·84) and vegetable (OR = 1·37; 95 % CI 1·16, 1·62) consumption. In terms of the ‘health environment’, smoking heavily (eleven or more cigarettes daily) increased the likelihood of having an inadequate fruit (OR = 1·20; 95 % CI 1·08, 1·34) and vegetable intake (OR = 1·16; 95 % CI 1·03, 1·31), while not believing that diet was important increased the risk for inadequate fruit and vegetable consumption by

Table 3 Factors associated with the consumption of fruit and vegetables once weekly or less often in nine former Soviet countries in 2010

	Fruit once weekly or less often						Vegetables once weekly or less often					
			Model 1†		Model 2‡ (*n* 16 592)				Model 1†		Model 2‡ (*n* 16 607)	
	n	%	OR	95 % CI	OR	95 % CI	*n*	%	OR	95 % CI	OR	95 % CI
Gender												
Women	3761	37·3	1·00	Ref.	1·00	Ref.	2687	26·6	1·00	Ref.	1·00	Ref.
Men	3080	39·7	1·10	1·04, 1·18**	1·10	1·02, 1·20*	2167	27·9	1·07	1·00, 1·15	1·09	1·00, 1·18
Age (years)												
18–39	2740	32·6	1·00	Ref.	1·00	Ref.	2067	24·6	1·00	Ref.	1·00	Ref.
40–59	2481	40·8	1·42	1·33, 1·53***	1·23	1·14, 1·33***	1720	28·2	1·20	1·11, 1·30***	1·05	0·96, 1·15
60+	1620	48·3	1·93	1·76, 2·12***	1·37	1·23, 1·54***	1067	31·6	1·41	1·28, 1·56***	1·04	0·91, 1·17
Education												
High	1150	28·4	1·00	Ref.	1·00	Ref.	834	20·7	1·00	Ref.	1·00	Ref.
Low	5681	41·3	1·33	1·27, 1·39***	1·20	1·15, 1·26***	4012	29·1	1·25	1·20, 1·31***	1·15	1·10, 1·21***
Household size	6832	38·4	0·96	0·94, 0·98***	0·99	0·97, 1·02	4847	27·2	0·96	0·94, 0·99**	0·98	0·95, 1·00
Location												
Urban	3531	32·8	1·00	Ref.	1·00	Ref.	2541	23·6	1·00	Ref.	1·00	Ref.
Rural	3310	46·8	1·81	1·59, 2·05***	1·59	1·37, 1·84***	2313	32·7	1·57	1·36, 1·82***	1·37	1·16, 1·62***
Economic situation												
Good	1077	27·1	1·00	Ref.	1·00	Ref.	841	21·2	1·00	Ref.	1·00	Ref.
Average	3716	36·7	1·56	1·40, 1·74***	1·37	1·23, 1·53***	2590	25·6	1·28	1·15, 1·43***	1·21	1·08, 1·36**
Poor	1992	55·9	3·41	2·97, 3·91***	2·23	1·93, 2·59***	1383	38·6	2·34	2·04, 2·69***	1·68	1·43, 1·97***
Limit food												
Never	3392	31·3	1·00	Ref.	1·00	Ref.	2404	22·2	1·00	Ref.	1·00	Ref.
Sometimes	2549	47·6	1·99	1·81, 2·19***	1·69	1·52, 1·87***	1804	33·5	1·76	1·59, 1·95***	1·62	1·45, 1·81***
Constantly	881	55·6	2·74	2·37, 3·17***	2·07	1·76, 2·43***	636	40·0	2·33	1·99, 2·72***	2·03	1·70, 2·42***
Garden plot												
Yes	4204	43·0	1·00	Ref.	1·00	Ref.	2910	29·7	1·00	Ref.	1·00	Ref.
No	2515	32·8	0·65	0·58, 0·72***	0·97	0·87, 1·09	1850	24·1	0·75	0·67, 0·85***	1·01	0·89, 1·14
Healthy diet												
Important	6473	38·1	1·00	Ref.	1·00	Ref.	4581	26·9	1·00	Ref.	1·00	Ref.
Unimportant	296	42·3	1·19	1·00, 1·42	1·23	1·02, 1·48*	231	32·9	1·33	1·10, 1·60**	1·42	1·17, 1·74**
Cigarettes												
0	4973	37·6	1·00	Ref.	1·00	Ref.	3571	26·9	1·00	Ref.	1·00	Ref.
1–10/d	650	37·8	1·01	0·91, 1·12	1·03	0·92, 1·15	435	25·3	0·92	0·81, 1·04	0·91	0·80, 1·04
11+/d	1179	42·0	1·20	1·10, 1·31***	1·20	1·08, 1·34**	822	29·4	1·13	1·03, 1·25*	1·16	1·03, 1·31*
Alcohol												
Never	2070	37·1	1·00	Ref.	1·00	Ref.	1527	27·3	1·00	Ref.	1·00	Ref.
1 time/week or less	3936	38·2	1·04	0·95, 1·15	1·04	0·95, 1·14	2780	27·0	0·98	0·88, 1·09	0·99	0·90, 1·09
2–3 times/week or more	756	45·5	1·41	1·23, 1·63***	1·20	1·02, 1·41*	511	30·7	1·18	1·00, 1·38*	0·96	0·80, 1·14
Self-reported health												
Good	2284	31·5	1·00	Ref.	1·00	Ref.	1732	23·9	1·00	Ref.	1·00	Ref.
Average	2847	39·1	1·39	1·28, 1·51***	1·06	0·97, 1·16	1914	26·3	1·14	1·04, 1·24**	0·97	0·89, 1·07
Bad	1684	51·7	2·32	2·08, 2·60***	1·21	1·07, 1·38**	1191	36·3	1·82	1·62, 2·03***	1·17	1·02, 1·34*

Ref., referent category.
*$P<0·05$; **$P<0·01$; ***$P<0·001$.
†Model 1: Bivariate analysis.
‡Model 2: Multivariate analysis adjusted for country and for all other variables in the model.

1·23 (95 % CI 1·02, 1·48) and 1·42 (95 % CI 1·17, 1·74) times, respectively. Respondents who assessed their own health as bad were also significantly more likely to eat fruit (OR = 1·21; 95 % CI 1·07, 1·38) and vegetables (OR = 1·17; 95 % CI 1·02, 1·34) once weekly or less often compared with those individuals whose health was good. No consumption effect was observed for household size or for possessing a garden plot. Finally, those individuals who drank alcohol more frequently had a 1·2 times increased risk of eating fruit once weekly or less often compared with non-drinkers (OR = 1·20; 95 % CI 1·02, 1·41).

Discussion

Between 2001 and 2010 there were notable changes in the consumption of fruit and vegetables in many countries of the FSU. Overall, the situation seems to have become slightly worse as only one country – Kazakhstan – recorded an increase in the daily/almost daily consumption of fruit and vegetables while three others (Georgia, Kyrgyzstan and Moldova) experienced sharp declines in both. The scale of the problem can be gauged by the fact that in 2010 in two-thirds of the countries about 40 % or more of the population was eating fruit once weekly or less often while in every country except Azerbaijan at least 20 % of the population was eating vegetables once weekly or less often, with this figure being significantly higher in Moldova. Regression analyses highlighted that a number of factors were associated with both low fruit and vegetable consumption. Specifically, living in a rural location, being economically disadvantaged and engaging in negative health behaviours were all associated with having an inadequate diet.

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Before discussing the main findings of our study, there are several limitations which must be considered. First, and most obviously, neither survey was designed specifically to capture a comprehensive picture of dietary behaviour and the results can only provide an indication of the scale and nature of the situation, especially as the respective survey questions were not validated dietary measures. It would have required substantially greater resources than were available to administer food frequency or dietary recall surveys. Moreover, except in Armenia, food composition databases used in this region date from the Soviet period and, as we have previously shown in Estonia, are now obsolete[29]. Nevertheless, in the absence of any other published analyses of survey data we believe that the present results have some value in a region that has been the subject of remarkably little public health research. Second, as with most surveys those individuals who are socially marginalised and who may be most at risk of poor diet (e.g. homeless people) will have been missed, which may underestimate the prevalence of inadequate dietary intake. Third, although the country samples were nationally representative their size was nevertheless comparatively small when compared with the total population, which means that we may have missed important dietary variations across country (sub)populations. Moreover, as a result of the relatively small size of the country samples and a need to maximise statistical power in the regression analysis we were unable to perform male–female and country-specific analyses when examining the factors associated with inadequate fruit and vegetable consumption. Had this been possible, it might have further increased our understanding of the issue of consumption within these countries. Fourth, recall bias may also have been a possible problem. The answers came from respondents' self-reports which may have lacked accuracy when compared with the more usual dietary data collection methods. Fifth, the question on consumption had slightly differently worded response categories in the two survey years which may have biased the comparative analyses of changes in the prevalence of fruit and vegetable consumption across the two time points. Sixth, as diet is influenced by seasonality, using information from one specific time point may have resulted in a biased picture of dietary intake for the whole year. Moreover, as the LLH and HITT data were collected at different points in the year this may have affected our across-time comparisons. Finally, it should also be noted that we were not able to examine other factors such as the role of agricultural subsidies and international trade agreements, which may have affected consumption in differing ways in the individual countries in this region.

The present findings are both surprising and alarming. Surprising, because food balance data suggest that several countries have experienced increases in supply. There is also some, albeit very limited, data from one part of Russia suggesting an increase between 1992 and 2007[30]. However, it is possible that more up-to-date data might show that the recent decline in food supply in some countries, shown in Fig. 1, has accelerated, possibly related to the global financial crisis, although Kazakhstan, with its oil revenues, may have seen a smaller relative decline than many of the other countries since 2008. Alarming because, as noted above, the situation was bad relative to much of the rest of the world to begin with.

The present study has highlighted the close link between socio-economic disadvantage and poor diet in the countries in this region as those in a poor economic situation were at significantly greater risk of eating fruit and vegetables less often. While not a surprising finding, it is nevertheless deeply worrying given the sharp growth in poverty that occurred in many of these countries in the early post-Soviet period[31] and continuing high levels of poverty[32]. Indeed, poverty, beyond what is captured in our variables, might also partly explain the relationship we observed between rural location and inadequate diet, as some evidence suggests that there may have been a 'ruralization' of poverty in some of these countries[33] and that rates of rural poverty are higher than those in urban areas in several of our study countries[34–36]. The association between area of residence and diet is complex and almost certainly influenced by other contextual factors. For example, it has been shown that rural Americans living in poverty had lower-quality diets which was associated with food insecurity[37], although diet among rural inhabitants of the Baltic states was better than their urban counterparts, in large part because they could grow their own food[38]. However, in the countries included here, there are identifiable problems that may be impacting on rural diet. Financial difficulties facing rural enterprises have seen the non-payment, late payment and even 'payment in kind' of wages in some countries[34] which might also have impacted on the ability to consume fruit and vegetables on a regular basis.

In terms of individual risk factors, those who regarded a healthy diet as being unimportant were more likely to have an inadequate diet. This finding accords with that from a recent study in Ireland which has shown that those with poorer fruit and vegetable consumption levels also have more negative attitudes towards healthy eating[39]. Our study revealed, however, that not only negative health attitudes but also worse health behaviours were associated with an inadequate diet – as both heavier smokers and those who consumed alcohol more frequently had lower levels of fruit and vegetable consumption. This finding is consistent with earlier research which has highlighted how negative health behaviours (smoking, drinking, poor diet and physical inactivity) 'cluster' in some individuals[40]. Alternatively, it is possible that economic factors may underlie the relationship between these health risk behaviours, with smokers and drinkers (particularly more frequent drinkers) spending

money on alcohol and cigarettes rather than fresh fruit and vegetables. Some evidence also indicates that while the price of food increased throughout the transition period, alcohol seems to have become comparatively cheaper[41]. These opposing trends might not only have fuelled the exceptionally large increase in alcohol consumption in some countries like Russia in the post-Soviet period[42] but also resulted in an inadequate diet for some people.

The finding that men and those with a lower education have less adequate diets mirrors previous results from the region[14,43] and provides further support for the notion that men[44] and those with a lower level of education[18,45] may have been particularly disadvantaged in terms of health outcomes in the transition period. Similarly, the association we observed between having poor health and an inadequate diet was not unexpected given the role of diet in physical well-being – although determining the direction of the association was not possible in our cross-sectional study. It is possible, for example, that physical incapacity could limit income and/or access to food outlets and thus result in a more inadequate diet. One unexpected finding, however, was the lack of association between owning a garden plot and diet. This seems to contradict the idea advanced previously of the importance of garden plots for food provision in this region[46–49]. However, other research has highlighted the complexity of the relationship between garden plots, where they are situated and what they produce[15,50] and the difference between subsistence food provision and the provision of a sustainably good diet[51]. Lack of nutritional knowledge and seasonality probably influence the relationship[15]. It has also been suggested in this context that people's dietary behaviour is heavily influenced by deeply embedded practices that are taken for granted[52]. This may mean that a greater availability of fruit and vegetables might not necessarily translate into a better diet. This suggests the need for more research on this phenomenon in the countries in this region to determine exactly how garden plots are being used and the role they are playing in terms of population diet in the FSU countries.

The present paper provides the first comparable information on the way several aspects of diet have changed in the countries of the FSU in the period between 2001 and 2010. It has shown that overall the situation in these FSU countries was worse in 2010 than it was in 2001. This is a matter of considerable concern. Although life expectancy has been improving, at least on the basis of these data it seems unlikely that diet is playing a major role in this improvement. Indeed, it may be storing up further problems for the future, given the evidence of high levels of overweight and obesity in some of our study countries[53]. However, it is only the first step in developing agendas for research and policy that will reverse the observed trends and thus contribute to more rapidly closing the health gap with other countries at similar levels of development. Future research should therefore build upon the present study by collecting more detailed information on diet from larger population samples within the individual countries. In particular, the FFQ should be validated in the countries in this region and additional information collected using food diaries over different periods of the year so as to capture the effects of seasonality. While the present paper has provided an important overview of fruit and vegetable intake in the countries in this region, there is now an urgent need for more detailed, in-depth, country-specific portraits in order to better understand diet and its effect on population health in the FSU.

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