

# The role of mother's education in the nutritional status of children in Serbia

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## Abstract

**Objective:** The present study aimed to identify the role of mother's education in the nutritional status of children aged 2–5 years in Serbia.

**Design:** Nationally representative population-based study. Age- and gender-specific BMI percentiles of children were analysed. In accordance with the WHO growth reference, children with BMI less than the 5th percentile were considered undernourished. Logistic regression was used to calculate the association between mother's education and other socio-economic determinants as possible confounders.

**Setting:** UNICEF's fourth Multiple Indicator Cluster Survey, conducted in both Roma and non-Roma settlements in Serbia.

**Subjects:** Children (*n* 2603) aged 2–5 years (mean age 3.05 years).

**Results:** Less than 5% of children aged 2–5 years were undernourished. There were significantly more undernourished children among the Roma population, in the capital of Serbia and among those whose mothers were less educated. There were statistically significant differences according to mother's education in all socio-economic characteristics (ethnicity, area, region of living and wealth index). Mother's level of education proved to be the most important factor for child's nutritional status; place of living (region) was also associated.

**Conclusions:** Mother's education is the most significant predictor of children's undernutrition. It confirms that investment in females' education will bring benefits and progress not only for women and their children, but also for society as a whole.

**Keywords**  
Mother's education  
Undernutrition  
Children

Child undernutrition is a significant global health problem and one of the leading risk factors for child mortality and morbidity worldwide<sup>(1)</sup>. It accounts for 45% of all deaths in children under the age of 5 years<sup>(2)</sup>. Since adequate nutrition is essential during childhood to ensure healthy growth, undernutrition during early childhood may substantially increase vulnerability to infection and disease and the risk of premature death<sup>(3)</sup>. Undernutrition in children leads to permanent effects diminishing health capital later in life. It produces serious health, social and economic consequences in the course of life, as well as across generations<sup>(3–7)</sup>.

The child undernutrition prevalence rate remains a significant public health problem in many developing countries, including Serbia. Based on data from 2005 and 2010, undernutrition has increased in Serbia and become more alarming. Multiple Indicator Cluster Surveys (MICS) have been conducted periodically in Serbia (2010 and 2005).

These surveys showed that the prevalence of child undernutrition (under the age of 5 years) in 2010 was higher than that in 2005 in non-Roma and Roma children (11% *v.* 13% for non-Roma children, 31% *v.* 28% for Roma children)<sup>(8,9)</sup>.

To date, different studies have shown that various indicators of socio-economic status are associated with children's nutritional status, such as educational level of parents, parental income and family assets<sup>(10–14)</sup>. Poverty, which is very typical for low- and middle-income countries, is one of the main risk factors for child undernutrition. Low level of household wealth is also a background characteristic contributing to the prevalence of undernourished children<sup>(13,15–18)</sup>. While low household income has a negative effect on children's nutritional status, education acts as a protective factor following the pattern that children whose mothers have higher or high education are more likely to be well-nourished<sup>(12–14)</sup>.

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Some studies have confirmed that mother's education is one of the main determinants of undernutrition<sup>(12–14)</sup>. Also, it has been shown that children whose mother was more educated were more likely to consume the optimal amounts of protein, Ca and vitamins necessary for their proper physical and psychological growth<sup>(19)</sup>. Apart from the socio-economic impact on child undernutrition, some recent studies have confirmed a negative influence of health factors such as diarrhoea or symptoms of respiratory disease on children's nutritional status<sup>(20–22)</sup>.

So far, little is known about the contribution of maternal education to the occurrence of child undernutrition in Serbia, as well as the interrelatedness of other socio-demographic factors and new health symptoms. Therefore, the present study aimed to identify whether and how mother's education is associated with the nutritional status of children aged 2–5 years in Serbia.

## Method

### *Population and sampling*

The present study was performed as a secondary data analysis of the fourth Multiple Indicator Cluster Survey (MICS4) that was conducted in Serbia in 2010, carried out by the Statistical Office of the Republic of Serbia with support from UNICEF<sup>(9)</sup>.

The MICS4 was conveyed in two separate population samples: (i) a national sample representative of the population of Serbia; and (ii) a national Roma sample representative of the population living in Roma settlements in Serbia. In the present study we were interested in the population of children aged 2–5 years. MICS4 was conducted at the national level for urban and rural areas, and for four regions composing Serbia: Belgrade, Vojvodina, Sumadija and Western Serbia, and Southern and Eastern Serbia. For both populations, the following sampling method was used to ensure representativeness and random selection of households. The urban and rural domains within twenty-five areas were identified as the main sampling strata, and the sample was selected in two stages. Within each stratum, a specified number of census enumeration areas was selected systematically with probability proportional to size. After a household listing was carried out within the selected enumeration areas, the listed households were divided into households with and without children under the age of 5 years, and then a separate systematic sample of households was selected for each group.

According to this recruitment method 6885 non-Roma households were randomly selected, and 6803 were found to be occupied during the survey and approached by interviewers. In 6392 non-Roma households the interview was completed (household response rate was 94%). In the interviewed households 3398 non-Roma children under 5 years of age were identified, and 3374 of them

completed the questionnaire (response rate within interviewed households was 99%).

According to this recruitment method 1815 Roma households were randomly selected, and 1782 were found and successfully approached by interviewers. In 1711 Roma households the interview was completed (household response rate was 96%). In the interviewed households 1618 Roma children under 5 years of age were identified, and 1604 of them completed the questionnaire (response rate within interviewed households was 99%).

In the present study we selected children who fulfilled the following criteria: (i) they were 2–5 years old; and (ii) their height and weight were measured. The number of children who met these criteria and who therefore were included in the study was 2603 (1734 non-Roma and 869 Roma children).

### *Survey instrument*

Information on sociodemographic characteristics of children was obtained from the household questionnaire (Household Questionnaire), while the information on new health symptoms that a child might have were obtained using the questionnaire for children under the age of 5 years (Questionnaire for Children Under Five). Both questionnaires were administered to mothers (or primary caregivers), filled in during a face-to-face interview conducted by trained interviewers and completed for each child up to the age of 5 years living in that household. Both questionnaires were based on the standard questionnaires that are used in MICS rounds<sup>(9)</sup>. After the questionnaires had been completed, anthropometric measurements (weight and height) were done by trained interviewers, using anthropometric equipment recommended by UNICEF. Children's weight was measured with a Seca 874 U Scale. Height was measured with a measuring board placed on a stable surface against a wall, table, tree or staircase. Children were without footwear and should have removed all but minimal clothes (such as their underwear) to obtain an accurate weight.

### *Variables*

We were interested in three groups of variables in the present study: (i) sociodemographic characteristics of the household and mother/caregiver; (ii) the recent presence of certain health symptoms in children; and (iii) anthropometric measures that were used to calculate BMI.

Sociodemographic characteristics employed in the current analysis include: ethnicity (non-Roma/Roma); gender (male/female); type of settlement (urban/rural); region (Belgrade, Vojvodina, Sumadija and Western Serbia, and Southern and Eastern Serbia); mother's education (no school at all, primary school, secondary school and university degree); and wealth. Wealth of the household was measured by the Demographic and Health Survey Wealth Index (hereafter, 'wealth index'), which in its calculation includes variables related to examinees'

assets (i.e. household facilities)<sup>(23)</sup>. The statistical procedure of principal components analysis was used to assign the factor scores to each variable. The resulting asset scores were standardized in relation to a standard normal distribution with a mean of 0 and an SD of 1. These standardized scores were summed up by household and individuals were ranked according to the total score of the household. According to the wealth index, respondents were classified into five socio-economic groups or quintiles: poorest, poorer, middle, richer and richest, with the same number of individuals in each. Information related to the recent presence of certain health symptoms included symptoms of diarrhoea and cough. Mothers/caregivers of children were supposed to answer whether their child had had diarrhoea or a cough within the last 2 weeks preceding the interview.

The outcome of interest was age- and gender-specific BMI of children aged 2–5 years, whose percentiles were constructed according to the WHO Child Growth Standards, released in April 2006<sup>(24)</sup>. We used percentiles for assessing/indicating the relative position of the child's BMI value among children of the same gender and age. An unfavourable nutritional status for children aged 2–5 years was determined using the cut-off for under-nutrition: less than the 5th percentile<sup>(25)</sup>.

### Statistical analysis

Data were analysed by the  $\chi^2$  test and logistic regression analyses. Chi-square analyses were used to test differences in the frequency of answers to each variable between these two samples and also to test the differences in the level of mother's education and their sociodemographic characteristics. To assess the degree of correlation between variables, the Spearman correlation coefficient was calculated.

Univariate logistic regression analysis examined the association between children's undernutrition, socio-economic characteristics and recent health status. Multicollinearity among independent variables was tested by the test of tolerance and variance inflation factor values. All variables whose *P* values in univariate logistic regression analysis were less than 0.05 were included in the multivariate logistic regression analysis. Three separate multivariate models were generated. The results of regression analyses were presented as odds ratios with 95% confidence intervals, and considered significant if the *P* value was less than 0.05.

The analyses were done using the statistical software package IBM SPSS Statistics Version 20.

### Results

Out of 2603 children aged 2–5 years (mean age 3.05 years), less than 5% (116 or 4.45%) were undernourished according to the WHO Child Growth Standard.

Data on undernourished children were stratified for a broad range of socio-economic characteristic and new symptoms of diarrhoea or a cough in the last 2 weeks (Table 1). We found statistically significant differences in the number of undernourished children in the two ethnic groups (non-Roma and Roma population), regarding the region they lived in and mother's level of education (Table 1). More than one-third of all children (37.3%) had a cough within the 2 weeks preceding the interview. There were fewer undernourished children in the group who had a cough within the 2 weeks before the interview in comparison to those who did not have this symptom (3.5% *v.* 5.0%).

The majority of mothers of children in our sample held a secondary education (41.8%); less than every third women in the sample had just primary education (31.8%) and no education at all was confirmed by 7.6% of women (Table 1). When stratifying by the level of mother's education, for all sociodemographic characteristics we found that there were statistically significant differences in the tested categories (Table 2). While 86.4% of non-Roma mothers obtained a secondary or higher/high degree, only 8.8% of Roma mothers had a secondary or higher/high level of education. On the other hand, 91.1% Roma mothers finished only primary school or had no education at all. When looking at the regional distribution of mother's (un)education (both samples together), we found that the largest percentage of mothers who had no education at all (13.0%) lived in Southern and Eastern Serbia. This result is significantly higher than in other regions (Vojvodina, Belgrade, and Sumadija and Western Serbia) where the percentage of uneducated mothers was 8.4%, 4.8% and 2.0%, respectively. Also, results showed that the highest percentage of mothers with higher/high level of education was found in Belgrade (24.5%), in comparison to other regions where this percentage was significantly lower (Sumadija and Western Serbia, 21.9%; Vojvodina, 19.3%; Southern and Eastern Serbia, 11.6%; Table 2).

Before conducting the univariate and multivariate logistic regression analyses, preliminary analyses which tested the assumptions of normality, linearity, multicollinearity and homogeneity of variance were done and demonstrated that they were not disturbed. The correlation coefficient between ethnicity and mother's education (0.712) showed that high correlation exists, but the value of this correlation was not high enough to conduct analyses for the Roma and non-Roma samples separately. Univariate logistic regression analysis was performed to determine the associations of socio-economic characteristics and recent health status with undernutrition (Table 3). The results indicated that Roma children were more often undernourished than non-Roma children (OR = 1.79; 95% CI 1.23, 2.60). In comparison to Belgrade, children who lived in all other regions had lower chance to be undernourished (Vojvodina: OR = 0.48; 95% CI 0.30, 0.76; Sumadija and Western Serbia: OR = 0.22; 95% CI 0.11, 0.42; Southern and Eastern Serbia: OR = 0.40;

**Table 1** Socio-economic characteristics and recent health status, according to nutritional status, among children aged 2–5 years from Roma and non-Roma settlements; UNICEF fourth Multiple Indicator Cluster Survey, Serbia, 2010

	Undernourished (n 116)		Others (n 2487)		Total (n 2603)		P value*
	n	%	n	%	n	%	
<b>Socio-economic characteristic</b>							
Ethnicity							0.003
Non-Roma	62	3.6	1672	96.4	1734	66.6	
Roma	54	6.2	815	93.8	869	33.4	
Gender							0.765
Male	58	4.3	1290	95.7	1348	51.8	
Female	58	4.6	1197	95.4	1255	48.2	
Area							0.144
Urban	78	5.0	1492	95.0	1570	60.3	
Rural	38	3.7	995	96.3	1033	39.7	
Region							<0.001
Belgrade	45	8.6	481	91.4	526	20.2	
Vojvodina	33	4.3	741	95.7	774	29.7	
Sumadija and Western Serbia	11	2.0	541	98.0	552	21.2	
Southern and Eastern Serbia	27	3.6	724	96.4	751	28.9	
Mother's education							0.046
None	9	4.5	190	95.5	199	7.6	
Primary	49	5.9	780	94.1	829	31.8	
Secondary	45	4.1	1044	95.9	1089	41.8	
Higher/high	13	2.7	473	97.3	486	18.7	
Wealth index quintile							0.068
Poorest	28	24.1	519	20.9	547	21.0	
Second	11	9.5	488	19.6	499	19.2	
Middle	23	19.8	458	18.4	481	18.5	
Fourth	22	19.0	494	19.9	516	19.8	
Richest	32	27.6	528	21.2	560	21.5	
<b>Recent health symptoms</b>							
Child had diarrhoea in last 2 weeks							0.801
Yes	9	3.9	221	96.1	230	8.8	
No	107	4.5	2266	95.5	2373	91.2	
Child had cough in last 2 weeks							0.085
Yes	34	3.5	937	96.5	971	37.3	
No	82	5.0	1550	95.0	1632	62.7	

\*According to the  $\chi^2$  test.

95% CI 0.24, 0.65). Children whose mothers had finished only primary school had more than two times greater risk to be undernourished in comparison to children whose mothers had finished higher or high school (OR=2.29; 95% CI 1.23, 4.26). The presence of certain health symptoms (diarrhoea or a cough) showed no association with undernutrition (Table 3).

To control for the possible impact of confounding variables in the observed associations with undernutrition, three multivariate-adjusted logistic regression analyses were undertaken (Table 4). In the first multivariate logistic regression model, which included ethnicity, wealth index and region, the role of ethnicity remained almost equally (OR=1.79) and significantly ( $P=0.005$ ) associated with undernutrition as in the univariate logistic regression analysis, as did the wealth index and region, although slightly attenuated. However, after adding mother's education in the second model, the significance of the association of undernutrition with ethnicity completely disappeared ( $P=0.162$ ), but secondary education (relative to higher education) became a predictor of children's undernutrition (OR=1.92; 95% CI 1.00, 3.67). The third multivariate logistic regression model was performed after

removing ethnicity, and showed stronger relationships between the primary and secondary level of mother's education and undernutrition (respectively: OR=2.98; 95% CI 1.50, 5.94 and OR=2.02; 95% CI 1.06, 3.86).

In two out of three models, the wealth index did not change its relationship significantly. This result confirmed that only children belonging to the second poorest socio-economic group were less likely to be undernourished in comparison to those who belonged to richest socio-economic category (model 1: OR=0.46; CI 95% 0.22, 0.94; model 2: OR=0.39; CI 95% 0.19, 0.82). Belgrade was the region with a significantly higher proportion of undernourished children, and this association remained significant and almost unchanged even after controlling for all other independent variables in all multivariate models.

**Discussion**

In the present study we investigated the associations between children's undernutrition and a wide range of socio-economic determinants, based on a nationwide

**Table 2** Socio-economic characteristics, according to level of mother's education, among children aged 2–5 years from Roma and non-Roma settlements; UNICEF fourth Multiple Indicator Cluster Survey, Serbia, 2010

Socio-economic characteristic	None (n 199)		Primary (n 829)		Secondary (n 1089)		Higher (n 486)		Total (n 2603)		P value*
	n	%	n	%	n	%	n	%	n	%	
<b>Ethnicity</b>											
Non-Roma	10	0.6	226	13.0	1015	58.5	483	27.9	1734	66.6	<0.001
Roma	189	21.7	603	69.4	74	8.5	3	0.3	869	33.4	<0.001
<b>Area</b>											
Urban	118	7.5	480	30.6	579	36.9	393	25.0	1570	60.3	<0.001
Rural	81	7.8	349	33.8	510	49.4	93	9.0	1033	39.7	<0.001
<b>Region</b>											
Belgrade	25	4.8	170	32.3	202	38.4	129	24.5	526	20.2	<0.001
Vojvodina	65	8.4	232	30.0	328	42.4	149	19.3	774	29.7	<0.001
Sumadija and Western Serbia	11	2.0	100	18.1	320	58.0	121	21.9	552	21.2	<0.001
Southern and Eastern Serbia	98	13.0	327	43.5	239	31.8	87	11.6	751	28.9	<0.001
<b>Wealth index quintile</b>											
Poorest	113	20.7	303	55.4	127	23.2	4	0.7	547	21.0	<0.001
Second	39	7.8	183	36.7	243	48.7	34	6.8	499	19.2	<0.001
Middle	29	6.0	136	28.3	247	31.4	69	14.3	481	18.5	<0.001
Fourth	10	1.9	127	24.6	237	45.9	142	27.5	516	19.8	<0.001
Richest	8	1.4	80	14.3	235	42.0	237	42.3	560	21.5	<0.001

\*According to the  $\chi^2$  test.

**Table 3** Univariate logistic regression analysis: associations of socio-economic characteristics and recent health status with undernutrition of children aged 2–5 years from Roma and non-Roma settlements; UNICEF fourth Multiple Indicator Cluster Survey, Serbia, 2010

Socio-economic characteristic	Univariate logistic regression		
	P value	OR	95 % CI
<b>Socio-economic characteristic</b>			
<b>Ethnicity</b>			
Non-Roma		1.00 (Reference)	
Roma	0.002	1.79	1.23, 2.60
<b>Area</b>			
Urban		1.00 (Reference)	
Rural	0.120	0.73	0.49, 1.08
<b>Gender</b>			
Male		1.00 (Reference)	
Female	0.694	1.08	0.74, 1.56
<b>Wealth index quintile</b>			
Poorest	0.662	0.89	0.53, 1.50
Second	0.005	0.37	0.18, 0.75
Middle	0.503	0.83	0.48, 1.44
Fourth	0.278	0.74	0.42, 1.28
Richest		1.00 (Reference)	
<b>Mother's education</b>			
None	0.218	1.72	0.72, 4.10
Primary	0.009	2.29	1.23, 4.26
Secondary	0.159	1.57	0.84, 2.94
High/higher		1.00 (Reference)	
<b>Region</b>			
Belgrade		1.00 (Reference)	
Vojvodina	0.002	0.48	0.30, 0.76
Sumadija and Western Serbia	<0.001	0.22	0.11, 0.42
Southern and Eastern Serbia	<0.001	0.40	0.24, 0.65
<b>Recent health symptoms</b>			
<b>Child had diarrhoea in last 2 weeks</b>			
Yes		1.00 (Reference)	
No	0.675	0.86	0.43, 1.73
<b>Child had cough in last 2 weeks</b>			
Yes		1.00 (Reference)	
No	0.070	0.69	0.46, 1.03

representative and random sample of children aged 2–5 years and their families, by applying the well-known MICS methodology developed by UNICEF<sup>(9)</sup>. Results of our study indicated that a lower level of mother's education increased the chance for children's undernutrition. Besides education, ethnicity (being Roma) was associated with higher odds for children's undernutrition, but it seemed that this association was mediated by maternal education and vice versa. It was shown that Roma children had almost double the chance to be undernourished compared with non-Roma children (model 1). This association was mediated by the degree of mother's education. The association between undernutrition and ethnicity disappeared after controlling for mother's education (model 2), and only secondary education was a predictor of child undernutrition (OR=1.92; 95 % CI 1.00, 3.67). When removing ethnicity from the analysis (model 3), a significant change was noted in the strength of the association between the level of mother's education and undernutrition (mother's primary education *v.* high education: OR = 2.98; 95 % CI 1.50, 5.94; mother's secondary education *v.* high education: OR = 2.02; 95 % CI 1.06, 3.86). Having in mind the strong correlation between

**Table 4** Univariate and multivariate logistic regression analyses: associations of socio-economic characteristics with undernutrition among children aged 2–5 years from Roma and non-Roma settlements; UNICEF fourth Multiple Indicator Cluster Survey, Serbia, 2010

	Univariate logistic regression			Multivariate logistic regression		
	<i>P</i> value	OR	CI 95 %	<i>P</i> value	OR	CI 95 %
<b>Model 1</b>						
Ethnicity						
Non-Roma		1.00 (Reference)			1.00 (Reference)	
Roma	0.002	1.79	1.23, 2.60	0.005	1.79	1.19, 2.70
Wealth index quintile						
Poorest	0.662	0.89	0.53, 1.50	0.761	0.92	0.52, 1.61
Second	0.005	0.37	0.18, 0.75	0.033	0.46	0.22, 0.94
Middle	0.503	0.83	0.48, 1.44	0.970	0.99	0.56, 1.75
Fourth	0.278	0.74	0.42, 1.28	0.600	0.86	0.49, 1.52
Richest		1.00 (Reference)			1.00 (Reference)	
Region						
Belgrade		1.00 (Reference)			1.00 (Reference)	
Vojvodina	0.002	0.48	0.30, 0.76	0.010	0.53	0.32, 0.86
Sumadija and Western Serbia	<0.001	0.22	0.11, 0.42	<0.001	0.28	0.14, 0.55
Southern and Eastern Serbia	<0.001	0.40	0.24, 0.65	<0.001	0.39	0.23, 0.65
<b>Model 2</b>						
Ethnicity						
Non-Roma		1.00 (Reference)			1.00 (Reference)	
Roma	0.002	1.79	1.23, 2.60	0.162	1.54	0.84, 2.82
Wealth index quintile						
Poorest	0.662	0.89	0.53, 1.50	0.456	0.79	0.42, 1.48
Second	0.005	0.37	0.18, 0.75	0.013	0.39	0.19, 0.82
Middle	0.503	0.83	0.48, 1.44	0.622	0.86	0.48, 1.55
Fourth	0.278	0.74	0.42, 1.28	0.400	0.78	0.44, 1.39
Richest		1.00 (Reference)			1.00 (Reference)	
Region						
Belgrade		1.00 (Reference)			1.00 (Reference)	
Vojvodina	0.002	0.48	0.30, 0.76	0.012	0.54	0.33, 0.87
Sumadija and Western Serbia	<0.001	0.22	0.11, 0.42	<0.001	0.27	0.14, 0.55
Southern and Eastern Serbia	<0.001	0.40	0.24, 0.65	<0.001	0.39	0.23, 0.66
Mother's education						
None	0.218	1.72	0.72, 4.10	0.456	1.55	0.49, 4.88
Primary	0.009	2.29	1.23, 4.26	0.100	2.07	0.87, 4.92
Secondary	0.159	1.57	0.84, 2.94	0.050	1.92	1.00, 3.67
High/higher		1.00 (Reference)			1.00 (Reference)	
<b>Model 3</b>						
Wealth index quintile						
Poorest	0.662	0.89	0.53, 1.50	0.081	0.52	0.25, 1.08
Second	0.005	0.37	0.18, 0.75	0.630	1.16	0.64, 2.11
Middle	0.503	0.83	0.48, 1.44	0.877	1.05	0.56, 1.97
Fourth	0.278	0.74	0.42, 1.28	0.292	1.40	0.75, 2.59
Richest		1.00 (Reference)			1.00 (Reference)	
Region						
Belgrade		1.00 (Reference)			1.00 (Reference)	
Vojvodina	0.002	0.48	0.30, 0.76	0.007	0.51	0.32, 0.84
Sumadija and Western Serbia	<0.001	0.22	0.11, 0.42	<0.001	0.26	0.13, 0.52
Southern and Eastern Serbia	<0.001	0.40	0.24, 0.65	<0.001	0.40	0.24, 0.67
Mother's education						
None	0.218	1.72	0.72, 4.10	0.067	2.44	0.94, 6.34
Primary	0.009	2.29	1.23, 4.26	0.002	2.98	1.50, 5.94
Secondary	0.159	1.57	0.84, 2.94	0.033	2.02	1.06, 3.86
High/higher		1.00 (Reference)			1.00 (Reference)	

education and ethnicity and the fact that ethnicity completely lost its significance after controlling for education and other socio-economic variables in the model, we realized that the role of education is crucial. This observation is understandable because, in general, the Roma population, especially Roma women, is less educated than the non-Roma population<sup>(26)</sup>. It is important to emphasize that the Roma population is the largest disadvantaged population group in Serbia<sup>(27–30)</sup> and the second largest

ethnic group, accounting for 2.05% (147 604) of the total population in Serbia<sup>(31)</sup>. According to the data from a pilot census conducted among the Roma population, their educational status is very low: just 30.4% of the Roma population completed primary school (adults older than 15 years), while the proportion of those with high or higher education is 7.41%<sup>(26)</sup>. In our sample, almost 70% of Roma women completed primary school, which might be a consequence of the younger age of women in our sample as compared

with those covered by the pilot census. This observation indicates that new generations of Roma women are attending school more frequently than their ancestors.

Another possible explanation for the association and interplay between mother's education, ethnicity and undernutrition of children is the fact that Roma women and men are initiating intimate partner relationships in their early age, which are often ending in pregnancy. According to the pilot census conducted in Roma households, more than one-third of Roma women (38%) have their first child before the age of 18 years, and 10% of them even before the age of 16 years<sup>(26)</sup>. Generally speaking, undereducated mothers (those who completed just primary school) are usually not able to understand birth control options<sup>(32,33)</sup>, so they get pregnant and deliver the baby very early as teenagers, before completing secondary school. Most often they do not get back to school due to the obligations related to motherhood. It is a pity that the data set we worked on did not provide information on mother's age, so we cannot firmly support these assumptions. Still, our assumptions are based on the fact that teenage pregnancies are associated with low birth weight, which leads to undernutrition further in childhood<sup>(34–38)</sup>.

Surprisingly, we found that there was no strong relationship between wealth index and children's undernutrition, except the finding that poor children (second quintile) had fewer chances to be undernourished in comparison to the richest (fifth quintile). A possible explanation might be that food and nutrition are a priority for low-income families: 'basic needs first', according to Maslow's hierarchy of human needs<sup>(39)</sup>. It could also be due to natural selection which is present from early childhood, so that children in low-income families who are less capable of living or undernourished simply do not survive<sup>(40,41)</sup>.

Children living in all regions other than Belgrade had less chance to be undernourished, independently of other variables. Unfavourable environmental factors such as air pollution, noise and high density of population in Belgrade might be responsible for adverse effects on the nutritional status of children. Except environment, a possible explanation could be a great migration (from rural areas to Belgrade) which is mostly caused by unemployment due to the lack of qualifications and low level of education. In Belgrade, people have very low income and disproportionately high rents, so they can barely feed the family. With the need to earn more, they are forced to have more than one job or to spend many hours at work, and almost to neglect children and their developmental needs. During their parents' working hours, most children spend time at day-care centres. The Statistical Office of the Republic of Serbia has reported that Belgrade is the region with the highest percentage of day-care centre attendance and also the highest percentage of children who spend more than 9 h/d there, in comparison to other Serbian regions<sup>(42)</sup>. Although day-care centre attendance could serve as a protective factor

against malnutrition<sup>(43,44)</sup>, a study conducted among Dutch toddlers (1–3 years old), both at childcare and at home, showed that children consumed more or less equal amounts of energy at home and childcare<sup>(45)</sup>. In Belgrade, we have quite the opposite situation. The duration of children's stay in day-care centres can be very variable. Children can stay at day-care centres for between 6 and 12 h/d. During that time they are supposed to receive a certain number of meals, according to the official nutritional recommendations for their age. While we can only speculate about children's compliance to the food intake in day-care centres, the above-mentioned patterns of parental long working hours and less time spent at home are usually associated with a lack of time to prepare meals. Therefore, parents most often rely only on the nutrition children receive at day-care centres, while they provide not more than some snacks at home. These results have been confirmed in one study conducted in North America, where attending day-care centres did not show any favourable effects on child nutritional status<sup>(46)</sup>.

The present study has certain limitations. The cross-sectional study design used provides just a 'snapshot' of the prevalence rate of undernourished children in Serbia and the socio-economic characteristics associated with it. Future longitudinal studies can solve this disadvantage. Also, the data were self-reported, so there is a possibility that some answers were not credible.

On the other hand, using a well-acknowledged method (MICS4) and data based on a nationally representative sample ensure the relevance of the obtained results and their use for future planning and generalization. Despite the limitations, the present study is among the first in Serbia which examines the role of mother's education in child undernutrition in Serbia. Therefore, it can serve as a benchmark for further studies that will analyse factors associated with children's nutritional status.

The study results indicate that one of the main determinants of undernutrition among children in Serbia is rooted in mothers' education. This result has been confirmed in other countries too<sup>(12–14,19,34–38)</sup>. This finding is independent of ethnicity, area of living and the wealth index, with the exception of Belgrade, the capital of Serbia, where child undernutrition is more frequent than in the other Serbian regions, and surprisingly it is least in the second poorest layer of the wealth index. It implies that decision makers and public health authorities need to initiate actions to enhance women's educational promotion and to address social determinants to achieve optimal health outcomes as highlighted by the Commission on the Social Determinants of Health<sup>(47)</sup>.

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