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EPIDEMIOLOŠKE KARAKTERISTIKE SALMONELOZA U POPULACIJI BEOGRADA ZA PERIOD 1994-2013. GODINE

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SAŽETAK

Uvod/Cilj: Procenjuje se da prijavljeni slučajevi salmoneloze širom sveta predstavljaju samo 1-10% realne učestalosti ove bolesti. Cilj istraživanja je bio da se analiziraju epidemiološke karakteristike salmoneloza u populaciji Beograda za period od 1994. do 2013. godine.
Metode: Podaci o broju obolelih od salmoneloza po polu, uzrastu i opštinama, za navedeni period su preuzeti iz Gradskog zavoda za javno zdravlje Beograd i računate su opšte, uzrasno-specifične i standardizovane stope incidencije. Za procenu trenda incidencije korišćena je *joinpoint* regresiona analiza.
Rezultati: U posmatranom dvadesetogodišnjem periodu registrovana su 12.452 obolela od salmoneloza, a ženski pol je bio više zastupljen (53,5%) u odnosu na muški (46,5%). Kod oba pola najviše prosečne uzrasno-specifične stope incidencije za posmatrani period su bile u uzrasnoj grupi 0-4 godine, a najniže kod osoba starih 70 i više godina. Prema rezultatima joinpoint regresione analize kod muškaraca postoji značajan pad incidencije od uzrasne grupe 15-19 godina pa na dalje, a kod žena od uzrasne grupe 10-14 godina. U periodu od 1994. do 2013. godine, prosečna standardizovana stopa incidencije za salmoneloze (na 100.000) u populaciji Beograda bila je 61,6 (61,7 za muškarce i 61,4 za žene). Najčešći serotipovi salmonela izolovanih iz humanog materijala bili su *S. enteritidis* (81,6%), *S. typhimurium* (7,7%) i *S. infantis* (2,6%).
Zaključak: Trend opadanja salmoneloza, zapažen u našoj studiji, govori o boljoj kontroli uzgoja na farmama, proizvodnje i prometa mesa i primeni higijensko-sanitarnih mera u ovim procesima i sve zastupljenijoj primeni HACCP standarda za zdravstvenu bezbednost hrane u Beogradu.

Ključne reči: salmoneloze, incidencija, trend, joinpoint regresija, serotipovi salmonela

Uvod

Salmonella je vodeći uzročnik akutnog bakterijskog gastroenteritisa širom sveta. Procenjuje se da oko 55% slučajeva ima veze sa trovanjem hranom, 14% sa putovanjem, 13% sa životnom sredinom, 9% sa direktnim ljudskim kontaktom i 9% sa direktnim kontaktom sa životinjom (1,2).

Procenjuje se da u Sjedinjenim Američkim Državama ima oko milion slučajeva salmoneloza godišnje, što dovodi do otprilike 19.000 hospitalizacija i 370 smrtnih ishoda (3). U Evropskoj uniji, 6,2 miliona ljudi oboli svake godine (4), u Africi taj broj iznosi 2,5 miliona sa 4.100 smrtnih ishoda (5). Smatra se da je stvaran broj slučajeva salmoneloza veći, s obzirom da se mnogi slučajevi sa blagom atipičnom formom bolesti ne registruju. Procenjuje se da prijavljeni slučajevi čine 1-10% stvarne učestalosti ove bolesti (6). Iako velike epidemije salmoneloze obično privlače pažnju medija, 60-80% svih slučajeva salmoneloza se klasifikuju kao pojedinačni slučajevi (7).

Rezultati praćenja laboratorijski potvrđenih infekcija 2010. godine, koje su činile 15% stanovništva Sjedinjenih Američkih Država, pokazali su da su ove infekcije najčešće prijavljivane, sa incidencijom od 17,6 na 100.000 stanovnika. Incidencija je bila najveća kod dece mlađe od 5 godina (69,5 na

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EPIDEMIOLOGICAL CHARACTERISTICS OF SALMONELLOSIS IN THE POPULATION OF BELGRADE FOR THE PERIOD 1994-2013

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SUMMARY

Background/Aim: The registered salmonella cases are estimated to constitute 1-10% of the real frequency of this disease. The aim of the research was to analyze epidemiological salmonella characteristics in Belgrade population for the period 1994-2013.
Methods: The data on the number of salmonella cases regarding gender, age and municipalities for the given period were taken from the City Institute of Public Health in Belgrade and used to calculate crude, age-specific and standardized incidence rates were used. For estimating the incidence trend joinpoint regression analysis was used.
Results: In the given 20-year period there were 12,452 salmonellosis cases, and female infected persons were more present (53.5%) than males (46.5%). In both sexes, the highest average age-specific rates were found in age group 0-4, and the lowest for people age 70 and older. According to joinpoint regression analysis there is a significant incidence decline in men from the age group 15-19 and further on, while in women that decline starts with the age group 10-14. The average standardized salmonellosis incidence rate (per 100,000) was 61.6 (61.7 for men and 61.4 for women). The most frequent *Salmonella* serotypes isolated from human material were *S. enteritidis* (81.6%), *S. typhimurium* (7.7%) and *S. infantis* (2.6%).
Conclusion: The decline in salmonellosis noticed in our study suggests better farming control, better control of meat production and turnover and application of hygienic and sanitary measures in these processes as well as the greater presence of the HACCP standard for the health safety of food in Belgrade.

Keywords: salmonellosis, incidence, trend, joinpoint regression, *salmonella* serotypes

Introduction

Salmonella is the leading cause of acute bacterial gastroenteritis across the world. It is estimated that about 55% of the cases has to do with food poisoning, 14% with travelling, 13% with environmental sources, 9% with direct human contact and 9% with direct contact with an animal (1,2).

It is estimated that in the USA there are about one million *Salmonella* cases per year, leading to around 19,000 hospitalizations and 370 fatalities (3). Within the European Union, there are 6.2 million of people every year (4), in Africa the number is 2.5 million with 4,100 fatalities (5). The real number of salmonella cases is considered to be larger, as many mild cases are not registered. The registered cases are estimated to constitute 1-10% of the real frequency of this disease (6). Very large salmonella epidemics tend to draw media attention, 60-80% of cases are considered to be isolated (7).

The results of the laboratory confirmed infections monitoring in 2010 comprising 15% of the US population, showed that these infections were the most frequently reported ones, with the incidence of 17.6 per 100,000 persons. The incidence was the largest in children under 5 (69.5 per 100,000 children), and only 5% of the reported cases were associated with epidemic outbreaks. The incidence was significantly higher in 2010 (10%) than in the period 2006-2008. The same

100.000 dece), a samo 5% prijavljenih slučajeva je bilo povezano za epidemijom. Incidencija je bila značajno viša 2010. godine (10%) nego u periodu 2006-2008. Iste godine, serotipovi *Salmonella enteritidis* (22%), *Salmonella Newport* (14%) i *Salmonella typhimurium* (13%) izolovani su kao najčešći (8). U periodu 1998-2008. godine u Sjedinjenim Američkim Državama registrovana je 1.491 epidemija salmoneloze.

Najčešći uzročnici ovih epidemija bila su 4 serotipa salmonela: *Salmonella enteritidis*, *Salmonella typhimurium*, *Salmonella Newport* i *Salmonella Heidelberg* (9). U periodu od 2008. do 2012. godine, u okviru Evropske unije, registrovan je značajan pad incidencije salmoneloza (32%) (10).

U skladu sa navedenim trendovima, cilj ovog istraživanja je bio da se analiziraju epidemiološke karakteristike salmoneloza u populaciji Beograda za period od 1994. do 2013. godine.

Metode

U istraživanju je korišćena deskriptivna epidemiološka studija. Podaci o broju obolelih od salmoneoza po polu, uzrastu i opštinama za navedeni vremenski period preuzeti su iz Gradskog zavoda za javno zdravlje Beograd. Individualno prijavljivanje zarazne bolesti korišćeno je kao izvor podataka o broju obolelih od salmoneloza. Svi oboleli su bili laboratorijski potvrđeni slučajevi. Podaci o serotipu salmoneloza iz humanog materijala na teritoriji Beograda preuzeti su iz Nacionalne referentne laboratorije za salmonelu (Institut za javno zdravlje Srbije „Dr Milan Jovanović Batut“). Podaci o serotipovima salmonela iz namirnica i iz biološkog materijala kliconoša dobijeni su iz mikrobiološke laboratorije Gradskog zavoda za javno zdravlje. Podaci o smrtnim ishodima od salmoneloza za period od 1994. do 2013. godine preuzeti su iz Gradskog zavoda za javno zdravlje.

Tabela 1. Uzrasno-specifične stope incidencije (na 100.000) za salmonelozu, muškarci, Beograd, 1994-2013.

	Uzrasne grupe									
Godina	**0-4**	**5-9**	**10-14**	**15-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**≥70**
1994.	292,1	118,4	66,5	67,8	35,5	19,2	19,2	21,9	25,4	10,0
1995.	247,4	132,3	73,9	73,6	43,6	27,5	22,1	23,8	11,5	4,3
1996.	247,4	108,6	73,9	36,8	37,5	18,4	13,5	10,5	19,1	2,9
1997.	216,8	45,4	35,1	23,2	23,3	17,5	18,3	12,4	12,7	2,9
1998.	268,6	73,0	25,9	42,6	35,5	25,9	29,8	13,3	17,8	11,4
1999.	216,8	79,0	40,7	32,9	39,5	25,9	27,9	5,7	16,5	5,7
2000.	296,9	167,8	42,5	42,6	37,5	27,5	32,7	17,1	25,4	15,7
2001.	209,7	55,3	12,9	27,1	28,4	8,4	17,3	22,8	17,8	5,7
2002.	307,7	101,6	53,4	38,6	29,8	10,0	16,4	20,0	5,8	9,1
2003.	584,1	304,9	62,7	46,4	59,6	36,1	51,8	35,0	22,1	12,1
2004.	496,6	149,9	62,7	44,4	31,6	25,1	12,1	24,0	5,8	16,6
2005.	319,1	142,3	39,5	9,7	19,9	16,1	12,1	10,0	10,5	15,1
2006.	216,5	55,9	30,2	17,4	26,2	16,1	10,4	12,0	9,3	1,5
2007.	247,9	96,6	25,5	25,1	23,5	19,1	4,3	24,0	17,4	0
2008.	205,1	48,3	11,6	13,5	11,7	3,0	7,8	11,0	4,6	1,5
2009.	267,8	129,6	25,5	15,5	22,6	13,1	6,0	11,0	4,6	7,6
2010.	242,2	73,7	7,0	9,7	8,1	9,0	3,5	5,0	5,8	1,5
2011.	254,0	130,6	5,3	64,6	30,9	16,7	14,3	9,6	6,9	3,7
2012.	223,2	77,9	16,0	20,8	20,9	18,3	5,7	7,0	11,5	9,9
2013.	194,7	120,6	31,9	18,4	16,4	7,2	3,8	6,1	3,5	3,7
Prosek za 1994-2013.	268,3	112,8	40,1	36,8	27,4	17,4	16,6	15,0	11,9	6,9

year, serotypes *S. enteritidis* (22%), *S. Newport* (14%) and *S. typhimurium* (13%) were isolated as the most frequent ones (8). In the period 1998-2008 in the USA 1491 salmonella epidemics were registered.

The most frequent causes of these epidemics were 4 serotypes of salmonella: *S. enteritidis*, *S. typhimurium*, *S. Newport* and *S. Heidelberg* (9). In the period 2008 -2012, within the EU, a significant decline in *Salmonella* incidence (32%) was registered (10).

According to the mentioned trends, the aim of the research was to analyze epidemiological *salmonella* characteristics in Belgrade population for the period 1994-2013.

Methods

The research used descriptive epidemiological study. The data on the number of salmonella cases regarding gender, age and municipalities for the given period were taken from the City Institute of Public Health in Belgrade. Individual registrations of the contagious disease were used as a data source on the number of the cases of salmonellosis. All the infected were laboratory confirmed cases. The data on salmonella serotypes from human material on the territory of Belgrade were taken from the National reference salmonella laboratory (the Institute of Public Health of Serbia „Dr Milan Jovanović Batut“). The data on salmonella from food and bio material of the carriers were provided by microbiological laboratory of the City Institute of Public Health. The data on salmonellosis fatalities in the period 1994-2013 were taken from the City Institute of Public Health.

In the analysis, crude, age-specific and standardized incidence rates were used. As the nominator for counting incidence rates, the census data for 1991 (for the period 1994-2001), 2002 (for the period 2002-2010) and 2011 (for the period 2011-2013) were used. Standardized incidence rates were calculated using the method

Table 1. Age-specific incidence rates (per 100,000) for salmonellosis, men, Belgrade, 1994-2013

	Age groups									
Year	**0-4**	**5-9**	**10-14**	**15-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**≥70**
1994	292.1	118.4	66.5	67.8	35.5	19.2	19.2	21.9	25.4	10.0
1995	247.4	132.3	73.9	73.6	43.6	27.5	22.1	23.8	11.5	4.3
1996	247.4	108.6	73.9	36.8	37.5	18.4	13.5	10.5	19.1	2.9
1997	216.8	45.4	35.1	23.2	23.3	17.5	18.3	12.4	12.7	2.9
1998	268.6	73.0	25.9	42.6	35.5	25.9	29.8	13.3	17.8	11.4
1999	216.8	79.0	40.7	32.9	39.5	25.9	27.9	5.7	16.5	5.7
2000	296.9	167.8	42.5	42.6	37.5	27.5	32.7	17.1	25.4	15.7
2001	209.7	55.3	12.9	27.1	28.4	8.4	17.3	22.8	17.8	5.7
2002	307.7	101.6	53.4	38.6	29.8	10.0	16.4	20.0	5.8	9.1
2003	584.1	304.9	62.7	46.4	59.6	36.1	51.8	35.0	22.1	12.1
2004	496.6	149.9	62.7	44.4	31.6	25.1	12.1	24.0	5.8	16.6
2005	319.1	142.3	39.5	9.7	19.9	16.1	12.1	10.0	10.5	15.1
2006	216.5	55.9	30.2	17.4	26.2	16.1	10.4	12.0	9.3	1.5
2007	247.9	96.6	25.5	25.1	23.5	19.1	4.3	24.0	17.4	0
2008	205.1	48.3	11.6	13.5	11.7	3.0	7.8	11.0	4.6	1.5
2009	267.8	129.6	25.5	15.5	22.6	13.1	6.0	11.0	4.6	7.6
2010	242.2	73.7	7.0	9.7	8.1	9.0	3.5	5.0	5.8	1.5
2011	254.0	130.6	5.3	64.6	30.9	16.7	14.3	9.6	6.9	3.7
2012	223.2	77.9	16.0	20.8	20.9	18.3	5.7	7.0	11.5	9.9
2013	194.7	120.6	31.9	18.4	16.4	7.2	3.8	6.1	3.5	3.7
Average for 1994-2013	268.3	112.8	40.1	36.8	27.4	17.4	16.6	15.0	11.9	6.9

Tabela 2. Uzrasno-specifične stope incidencije (na 100.000) za salmonelozu, žene, Beograd, 1994-2013.

	Uzrasne grupe									
Godina	**0-4**	**5-9**	**10-14**	**15-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**≥70**
1994.	281,6	96,5	68,8	63,8	43,0	36,7	37,5	19,8	25,1	12,0
1995.	239,6	94,4	60,9	51,8	88,9	54,3	62,8	26,2	26,2	9,6
1996.	234,6	98,6	76,6	53,8	48,8	34,4	30,5	19,8	13,6	12,0
1997.	180,3	41,9	31,4	33,9	28,3	34,4	35,8	18,9	18,8	4,8
1998.	219,8	81,8	31,4	39,9	35,2	27,6	37,5	24,4	29,3	14,4
1999.	187,7	41,9	29,5	35,9	51,8	42,1	54,9	26,2	25,1	18,0
2000.	298,9	136,3	49,1	71,8	68,4	54,3	77,6	35,2	20,9	8,4
2001.	209,9	71,3	19,7	31,9	35,2	25,3	38,4	28,9	20,9	15,6
2002.	351,1	67,1	22,1	36,3	42,1	28,8	26,7	28,4	13,8	9,3
2003.	564,2	284,6	36,8	54,4	64,9	69,6	70,1	56,8	28,6	18,7
2004.	435,1	142,3	73,5	46,3	38,6	30,6	32,0	39,6	11,8	10,4
2005.	300,1	80,6	34,3	38,3	28,9	15,8	25,2	20,7	10,8	14,5
2006.	156,1	51,0	12,3	2,0	10,5	23,2	25,2	26,7	6,9	5,2
2007.	273,1	77,9	17,2	24,2	23,7	23,2	11,4	22,4	27,6	0
2008.	207,1	34,9	9,8	14,1	14,9	23,2	13,7	15,5	6,9	3,1
2009.	243,1	96,7	22,1	14,1	22,8	12,1	10,7	15,5	9,9	4,1
2010.	240,1	77,9	22,1	8,1	12,3	12,1	8,4	15,5	5,9	4,1
2011.	235,3	74,3	5,6	43,7	31,8	24,3	27,3	15,7	11,0	13,5
2012.	177,7	74,3	14,1	14,6	22,1	19,0	22,9	16,4	7,4	7,6
2013.	145,2	124,8	25,3	4,9	14,5	9,9	15,0	14,2	3,7	3,4
Prosek za 1994-2013.	250,5	93,0	35,4	36,2	35,5	30,0	33,4	23,3	15,7	9,1

U analizi su korišćene opšte, uzrasno-specifične i standardizovane stope incidencije. Za imenilac prilikom računanja stopa incidencije korišćeni su podaci iz popisa stanovništva za 1991. godinu (za period 1994-2001.), za 2002. (za period 2002-2010.) i za 2011. (za period 2011-2013.). Standardizovane stope incidencije su računate uz pomoć metoda direktne standardizacije, gde je populacija sveta po Segiju korišćena kao standardna populacija (11). Za procenu trenda incidencije korišćena je joinpoint regresiona analiza (*Joinpoint Regression Program, Version 4.0.4. May 2013; Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute*), prema metodi Kima i saradnika (12). Uz pomoć ove analize, procenjena je prosečna procentualna godišnja promena trenda i identifikovani su periodi u vremenu kada su se značajne promene desile. Za svaku procentualnu godišnju promenu, izračunati su 95% intervali poverenja, i pomoću njih je utvrđeno da li je promena u svakom segmentu značajno različita od nule (nula označava da nije bilo promena u trendu).

Rezultati

U Beogradu u periodu od 1994. do 2013. godine, prosečni udeo obolelih od salmoneloza bio je 18,7% od svih obolelih od gastrointestinalnih zaraznih bolesti. U datom dvadesetogodišnjem periodu registrovana su 12.452 obolela od salmoneloza, a ženski pol je bio više zastupljen (53,5%) u odnosu na muški (46,5%).

Uzrasno-specifične stope incidencije (na 100.000) za salmonelozu u Beogradu, za period 1994-2013. godine prikazane su u tabeli 1 za muškarce i tabeli 2 za žene. Kod oba pola, najviše prosečne uzrasno-specifične stope incidencije bile su u uzrasnoj grupi 0-4 godine, a najniže kod osoba starih 70 i više godina.

Prema rezultatima *joinpoint* regresione analize, kod muškaraca postoji značajan pad incidencije kod uzrasne grupe 15-19 godina pa na dalje, a

Table 2. Age-specific incidence rates (per 100,000) for salmonellosis, women, Belgrade, 1994-2013

	Age groups									
Year	**0-4**	**5-9**	**10-14**	**15-19**	**20-29**	**30-39**	**40-49**	**50-59**	**60-69**	**≥70**
1994	281.6	96.5	68.8	63.8	43.0	36.7	37.5	19.8	25.1	12.0
1995	239.6	94.4	60.9	51.8	88.9	54.3	62.8	26.2	26.2	9.6
1996	234.6	98.6	76.6	53.8	48.8	34.4	30.5	19.8	13.6	12.0
1997	180.3	41.9	31.4	33.9	28.3	34.4	35.8	18.9	18.8	4.8
1998	219.8	81.8	31.4	39.9	35.2	27.6	37.5	24.4	29.3	14.4
1999	187.7	41.9	29.5	35.9	51.8	42.1	54.9	26.2	25.1	18.0
2000	298.9	136.3	49.1	71.8	68.4	54.3	77.6	35.2	20.9	8.4
2001	209.9	71.3	19.7	31.9	35.2	25.3	38.4	28.9	20.9	15.6
2002	351.1	67.1	22.1	36.3	42.1	28.8	26.7	28.4	13.8	9.3
2003	564.2	284.6	36.8	54.4	64.9	69.6	70.1	56.8	28.6	18.7
2004	435.1	142.3	73.5	46.3	38.6	30.6	32.0	39.6	11.8	10.4
2005	300.1	80.6	34.3	38.3	28.9	15.8	25.2	20.7	10.8	14.5
2006	156.1	51.0	12.3	2.0	10.5	23.2	25.2	26.7	6.9	5.2
2007	273.1	77.9	17.2	24.2	23.7	23.2	11.4	22.4	27.6	0
2008	207.1	34.9	9.8	14.1	14.9	23.2	13.7	15.5	6.9	3.1
2009	243.1	96.7	22.1	14.1	22.8	12.1	10.7	15.5	9.9	4.1
2010	240.1	77.9	22.1	8.1	12.3	12.1	8.4	15.5	5.9	4.1
2011	235.3	74.3	5.6	43.7	31.8	24.3	27.3	15.7	11.0	13.5
2012	177.7	74.3	14.1	14.6	22.1	19.0	22.9	16.4	7.4	7.6
2013	145.2	124.8	25.3	4.9	14.5	9.9	15.0	14.2	3.7	3.4
Average for 1994-2013	250.5	93.0	35.4	36.2	35.5	30.0	33.4	23.3	15.7	9.1

of direct standardization, where the population of the world by Segi was used as the standard population (11). For estimating the incidence trend joinpoint regression analysis was used (Joinpoint Regression Program, Version 4.0.4. May 2013; Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute), according to the method by Kim et al. (12). Using this analysis, the average annual percentage trend change was estimated and the time intervals of important changes were identified. For every percentage of annual change, the 95% trust intervals were calculated, and using them it was established whether the change in every segment is significantly different from zero (zero means no change in trend).

Results

In Belgrade in the period 1994-2013 the average part that salmonellosis cases formed in all intestinal contagious disease cases was 18.7%. In the given 20-year period there were 12,452 salmonellosis cases, and female infected persons were more present (53.5%) than male (46.5%).

Age-specific incidence rates (per 100,000) for salmonellosis in Belgrade, for the period 1994-2013 are given in Table 1 for men and in Table 2 for women. In both sexes, the highest average age-specific rates were found in age group 0-4, and the lowest for people age 70 and older.

According to joinpoint regression analysis there is a significant incidence decline in men from the age group 15-19 and further on, while in women that decline starts with the age group 10-14 (Table 3). In men, a significant incidence decline was registered in the age group 10-14, but only in the period 1994-2001 and 2004-2011, and in women in the age group 0-4 only in the period 2003-2013.

In the period 1994-2013 the average standardized salmonellosis incidence rate in Belgrade (per 100,000) was 61.6 (61.7 for men and 61.4 for women) (Table 4).

In the period 1994-2013 there has been a decline in standardized salmonellosis incidence rates in total

Tabela 3. Trendovi uzrasno-specifičnih stopa incidencije za salmonelozu prema *joinpoint* regresionoj analizi, muškarci i žene, Beograd, 1994-2013.

Muškarci					Žene				
Uzrasne grupe	**Period**	**APC**	**Niži od 95% IP**	**Viši od 95% IP**	**Uzrasne grupe**	**Period**	**APC**	**Niži od 95% IP**	**Viši od 95% IP**
0-4	1994-2000.	-3,6	-9,2	-9,2	**0-4**	1994-2003.	6,1	-0,9	13,5
	2000-2003.	33,5	-6,5	-6,5		2003-2013.	-6,9*	-12,1	-1,3
	2003-2006.	-22,1	-45,4	-45,4	**5-9**	1994-2013.	-0,1	-4,0	4,0
	2006-2013.	-1,5	-6,1	-6,1	**10-14**	1994-2013.	-7,9*	-11,6	-4,0
5-9	1994-2013.	-0,1	-0,1	-4,0	**15-19**	1994-2013.	-9,6*	-14,8	-4,0
10-14	1994-2001.	-15,0*	-15,0*	-27,7	**20-29**	1994-2013.	-6,7*	-9,9	-3,4
	2001-2004.	41,7	41,7	-57,6	**30-39**	1994-2013.	-6,2*	-8,9	-3,4
	2004-2011.	-29,3*	-29,3*	-42,3	**40-49**	1994-2013.	-7,1*	-10,6	-3,5
	2011-2013.	135.5	135.5	-29,6	**50-59**	1994-2003.	7,1*	1,9	12,5
15-19	1994-2013.	-5,7*	-5,7*	-9,6		2003-2013.	-10,2*	-13,9	-6,4
20-29	1994-2013.	-4,8*	-4,8*	-7,6	**60-69**	1994-2013.	-7,6*	-10,7	-4,4
30-39	1994-2013.	-4,5*	-4,5*	-8,5	**≥70**	1994-2013.	-6,8	-14,7	1,9
40-49	1994-2013.	-8,8*	-8,8*	-12,7					
50-59	1994-2013.	-4,2*	-4,2*	-8,1					
60-69	1994-2013.	-6,9*	-6,9*	-10,4					
≥70	1994-2013.	-4,8	-4,8	-13,6					

APC - *Annual percent change*; 95% IP - 95% interval poverenja

kod žena taj pad počinje od uzrasne grupe 10-14 godina (tabela 3). Kod muškaraca, značajan pad incidencije registrovan je u uzrasnoj grupi 10-14 godina, ali samo u periodu 1994-2001. i 2004-2011. godine, dok je kod žena taj pad registrovan u uzrasnoj grupi 0-4 samo u periodu 2003-2013. godine.

U periodu od 1994. do 2013. godine, prosečna standardizovana stopa incidencije salmoneloza u Beogradu (na 100.000) bila je 61,6 (61,7 za muškarce i 61,4 za žene) (tabela 4).

U periodu od 1994. do 2013. godine došlo je do pada standardizovanih stopa incidencije salmoneloza u opštoj populaciji i prema polu, ali je značajan pad registrovan samo kod žena (slika 1).

U periodu od 1994. do 2013. godine u Beogradu, pet najčešćih serotipova salmonela izolovanih iz humanog materijala bili su *S. enteritidis* (81,6%), *S. typhimurium* (7,7%), *S. infantis* (2,6%), *S. hadar* (1,8%) i *S. agona* (0,6%). Ovih pet serotipova salmonela činili su 94,3% svih salmoneloza izolovanih iz humanog materijala.

U periodu od 1994. do 2013. godine u laboratoriji za sanitarnu mikrobiologiju Gradskog zavoda za javno zdravlje, u okviru redovnog nadzora, mikrobiološka analiza je uključila 151.129 prehrambenih namirnica na teritoriji Beograda, a salmonella je izolovana u 295 (0,2%).

Najćešće izolovan serotip bila je *S. enteritidis* sa 146 izolata (49,8%), *S. infantis* sa 34 izolata (11,6%) bila je na drugom mestu, zatim slede *S. typhimurium* sa 28 izolata (9,6%), *S.hadar* sa 11 izolata (3,8%) i *S. agona* sa 8 izolata (2,7%).

Salmonella (laboratorija za sanitarnu mikrobiologiju Gradskog zavoda za javno zdravlje) je najčešće bila prisutna u pilećem mesu (49,2%), zatim u tortama i kolačima (8,8%), svinjskom mesu (5,1%), sladoledu (3,1%), ruskoj salati i svinjetini (2,7%).

Prosečna opšta stopa mortaliteta za salmonelozu u Beogradu za period od 1994. godine do 2013. godine bila je 0,06 na 100.000 stanovnika.

Diskusija

Prema našim rezultatima, slučajevi salmoneloza činili su 18,7% svih slučajeva intestinalnih zaraznih bolesti u Beogradu u periodu od 1994. do 2013. godine, dok su u Kantonu Sarajevo ovi slučajevi imali mnogo manji udeo, 11,2% u periodu od 2005. do 2009. godine (13), a u Durham regiji u Kanadi ovi slučajevi imali su veći udeo, jednu čet-

Table 3. Trends of age-specific incidence rates for salmonellosis according to the joinpoint regression analysis, men and women, Belgrade, 1994-2013

Muškarci					Žene				
Age	Period	APC	Lower 95% IP	Higher 95% IP	Age	Period	APC	Lower 95% IP	Higher 95% IP
0-4	1994-2000	-3.6	-9.2	-9.2	**0-4**	1994-2003	6.1	-0.9	13.5
	2000-2003	33.5	-6.5	-6.5		2003-2013	-6.9*	-12.1	-1.3
	2003-2006	-22.1	-45.4	-45.4	**5-9**	1994-2013	-0.1	-4.0	4.0
	2006-2013	-1.5	-6.1	-6.1	**10-14**	1994-2013	-7.9*	-11.6	-4.0
5-9	1994-2013	-0.1	-0.1	-4.0	**15-19**	1994-2013	-9.6*	-14.8	-4.0
10-14	1994-2001	-15.0*	-15.0*	-27.7	**20-29**	1994-2013	-6.7*	-9.9	-3.4
	2001-2004	41.7	41.7	-57.6	**30-39**	1994-2013	-6.2*	-8.9	-3.4
	2004-2011	-29.3*	-29.3*	-42.3	**40-49**	1994-2013	-7.1*	-10.6	-3.5
	2011-2013	135.5	135.5	-29.6	**50-59**	1994-2003	7.1*	1.9	12.5
15-19	1994-2013	-5.7*	-5.7*	-9.6		2003-2013	-10.2*	-13.9	-6.4
20-29	1994-2013	-4.8*	-4.8*	-7.6	**60-69**	1994-2013	-7.6*	-10.7	-4.4
30-39	1994-2013	-4.5*	-4.5*	-8.5	**≥70**	1994-2013	-6.8	-14.7	1.9
40-49	1994-2013	-8.8*	-8.8*	-12.7					
50-59	1994-2013	-4.2*	-4.2*	-8.1					
60-69	1994-2013	-6.9*	-6.9*	-10.4					
≥70	1994-2013	-4.8	-4.8	-13.6					

APC - Annual percent change; 95% CI - 95% confidence interval

population and regarding genders, but a significant decline was registered only in women (Figure 1).

In the period 1994-2013 in Belgrade five most frequent salmonella serotypes isolated from human material were *S. enteritidis* (81.6%), *S. typhimurium* (7.7%), *S. infantis* (2.6%), *S. hadar* (1.8%) and *S. agona* (0.6%). These five *Salmonella* serotypes formed 94.28% of all *Salmonella* isolates from human material.

In the period 1994-2013 in the laboratory for sanitary microbiology of the City Institute of Public Health, within the regular monitoring, microbiological analysis included 151,129 groceries on the territory of Belgrade, and in 295 *Salmonella* was isolated (0.2%).

The most frequently isolated serotype was *S. enteritidis* with 146 izolates (49.8%), *S. infantis* with 34 isolates (11.6%) was on the second place, then *S. typhimurium* with 28 isolates (9.6%), *S. hadar* with 11 isolates (3.8%) and *S. agona* with 8 isolates (2.7%).

Salmonella (laboratory for sanitary microbiology of the City Institute of Public Health in Belgrade) was most frequently present in chicken meat (49.2%), then in cakes and cookies (8.8%), pork (5.1%), ice cream (3.1%), Russian salad and pork (2.7%).

The average crude mortality rate for salmonellosis in Belgrade for the period 1994-2013 was 0.06 per 100,0000 people.

Discussion

According to our results, salmonella cases formed 18.7 % of all cases of intestinal contagious diseases in Belgrade in the period 1994-2013, while in Sarajevo Canton these cases formed much smaller part, 11.2%, in the period 2005-2009 (13), and in Durham region in Canada these cases formed a larger part, a quarter (25.1%) of all intestinal contagious diseases in the monitored period (14).

In the Belgrade region, in the period 1994-2013 a decline in salmonellosis was noticed (15-19). Similar trend was observed within the EU (20), as well as in London where a salmonellosis decline of 50% was observed in the period 2007-2011 (21). The salmonellosis decline within the EU in the last five years can be ascribed to the implementation of salmonella control programs in poultry industry starting with 2007 (20).

In the monitored 20-year-period in Belgrade, the highest age-specific incidence rate was registered in the age group 0-4 (259.6 per 100,000),

Tabela 4. Standardizovane stope salmoneloze, kod muškaraca i žena, Beograd, 1994-2013.

	Standardizovana*/100.000		
Godina	**Oba pola**	**Muškarci**	**Žene**
1994.	72,3	72,8	72,6
1995.	76,9	73,3	79,4
1996.	65,4	62,9	67,2
1997.	45,1	44,2	45,5
1998.	58,1	59,0	56,7
1999.	55,0	54,7	54,7
2000.	83,8	77,2	89,4
2001.	48,8	43,4	56,2
2002.	66,7	65,0	67,5
2003.	135,8	135,5	135,6
2004.	93,7	95,4	91,6
2005.	62,8	65,0	60,5
2006.	39,0	44,1	33,7
2007.	53,5	53,5	53,4
2008.	36,0	34,9	36,9
2009.	52,6	56,3	48,7
2010.	42,0	40,5	43,3
2011.	58,1	62,3	53,8
2012.	44,3	47,0	41,7
2013.	43,0	46,3	39,4
1994-2013.	61,6	61,7	61,4

Prema svetskoj populaciji po Segiju

vrtinu (25,1%) svih intestinalnih bolesti u posmatranom periodu (14).

Na području Beograda, u periodu od 1994. do 2013. godine primećen je pad salmoneloza (15-19). Sličan trend je primećen i u zemljama Evropske unije (20), kao i u Londonu gde je pad salmoneloza od 50% primećen u periodu od 2007. do 2011. godine (21). Pad salmoneloza u okviru Evropske unije tokom prethodnih pet godina može se pripisati primeni programa kontrole salmoneloza u živinarskoj industriji koji je započet 2007. godine (20).

U posmatranom dvadesetogodišnjem periodu u Beogradu, najviša uzrasno-specifična stopa incidencije registrovana je u uzrasnoj grupi 0-4 godine (259,6 na 100.000), i ova stopa je takođe bila najviša u ovoj najmlađoj grupi u Evropskoj uniji (94,8 na 100.000), a 2011. godine ova stopa bila je tri puta viša u odnosu na stariju decu i pet puta viša u poređenju sa drugim uzrasnim grupama (20). Najviša stopa incidencije salmoneloza registrovana je u uzrasnoj grupi mlađih od jedne godine (880 na 100.000) u Novom Zagrebu u periodu od 1990. do 2009. godine (22). Rezultati drugih studija su takođe pokazali da je najviša učestalost salmoneloza registrovana u najmlađoj grupi osoba, ispod 4 godine starosti, tako je u Londonu u periodu od 2007. do 2011. godine ova najmlađa grupa činila 27,6% svih registrovanih slučajeva salmoneloza, što je malo manje u odnosu na našu studiju (32,4%) (21). U jednoj studiji koja je sprovedena u Kantonu Sarajevo u periodu od 2005. do 2009. godine uzrasna grupa od 0 do 6 godina bila je na drugom mestu po učestalosti obolevanja od salmoneloza (31,1%), odmah iza grupe 25-49 godina (43,6%) (21). Prema našim podacima prosečna uzrasno-specifična stopa za uzrasnu grupu od 0-4 godine za muški pol iznosila je 268,25 na 100.000 stanovnika, a za ženski pol 250,52 na 100.000 stanovnika, što su oko deset puta više uzrasno-specifične stope u istoj uzrasnoj grupi nego što su zabeležene u 2012. godini u Irskoj i iznose 26,4 na 100.000 stanovnika za muški pol i 23,5 na

Table 4. Standardized salmonellosis rates, in men and women, Belgrade, 1994-2013

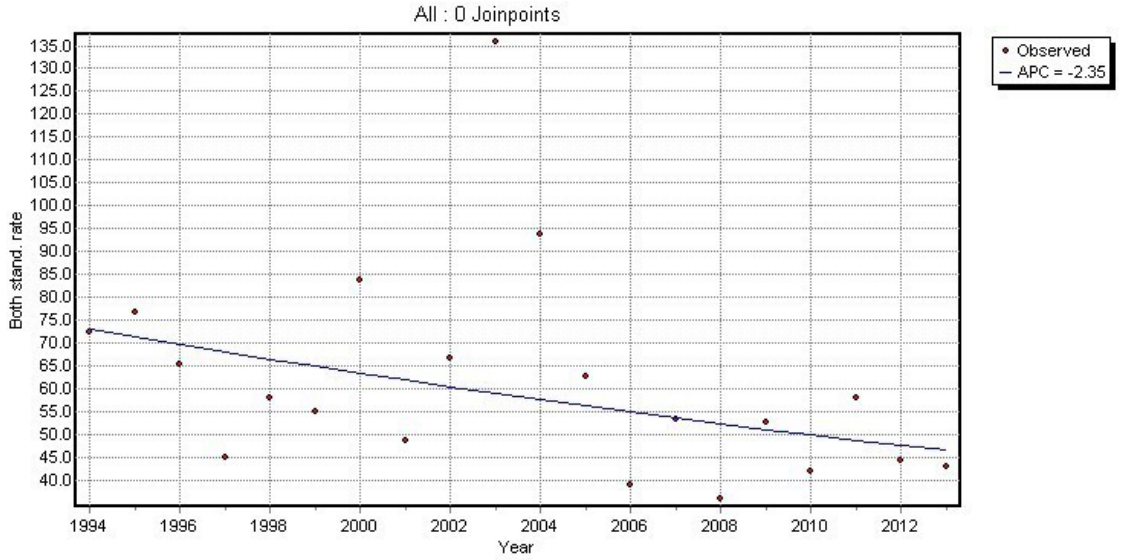
Standardized*/100,000			
Year	**Both sexes**	**Men**	**Women**
1994	72.3	72.8	72.6
1995	76.9	73.3	79.4
1996	65.4	62.9	67.2
1997	45.1	44.2	45.5
1998	58.1	59.0	56.7
1999	55.0	54.7	54.7
2000	83.8	77.2	89.4
2001	48.8	43.4	56.2
2002	66.7	65.0	67.5
2003	135.8	135.5	135.6
2004	93.7	95.4	91.6
2005	62.8	65.0	60.5
2006	39.0	44.1	33.7
2007	53.5	53.5	53.4
2008	36.0	34.9	36.9
2009	52.6	56.3	48.7
2010	42.0	40.5	43.3
2011	58.1	62.3	53.8
2012	44.3	47.0	41.7
2013	43.0	46.3	39.4
1994-2013	61.6	61.7	61.4

According to the population of the world by Segi

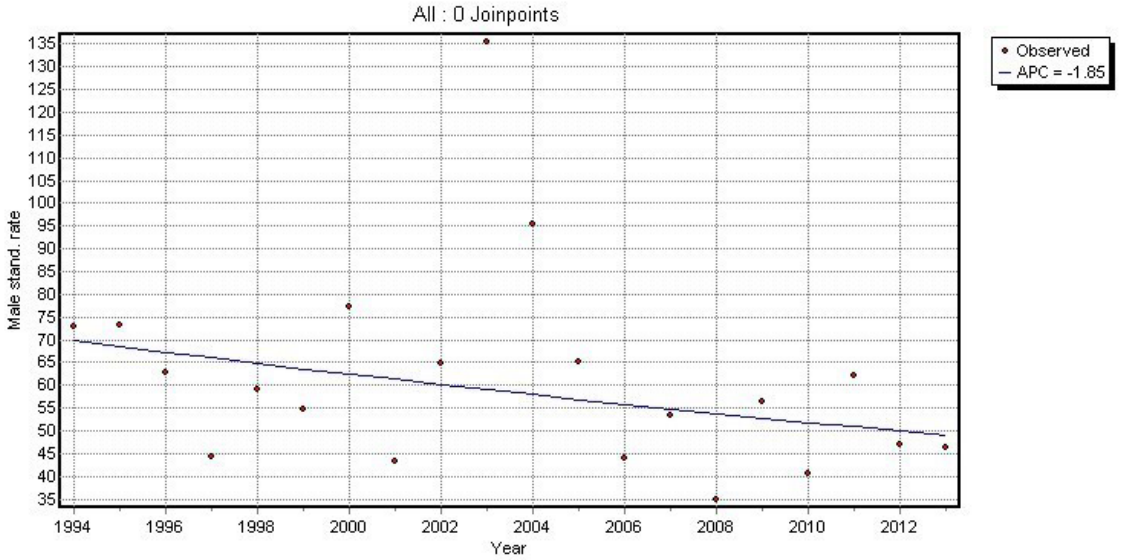
and this rate was also the highest in this youngest group in the EU (94.8 per 100,000 people) and in 2011 it was three times higher than in older children and five times compared to other age groups (20). The highest salmonellosis incidence rate was registered in the age group of under-one-year old (880 per 100,000) in Novi Zagreb in the period 1990-2009 (22). Other studies' results also showed that the highest frequency of salmonellosis is registered in the youngest group of persons, under the age of 4, so in London in the period 2007-2011 this youngest age group made 27.6% of all registered salmonellosis cases, which is slightly smaller presence compared to our study (32.4%) (21). In a study conducted in Sarajevo Canton in the period 2005-2009 age group of 0-6 was second in frequency of contracting salmonellosis (31.1%), right behind the group 25-49 (43.6%) (13). According to our data, the average age-specific rates for the age group of 0-4 for male children were 268.2 per 100,000 people, and for female 250.5 per 100,000 people, which are ten times higher age-specific rates in the same age group than in Ireland in 2012, with 26.4 per 100,000 people for male and 23.5 per 100,000 people for female children (23). The reasons for the highest salmonellosis incidence rate in the youngest group are that the infective dose in children is small, it is possible that symptomatic infections are more frequent, samples of biological material for laboratory analysis are taken more often, clinical presentation can be more serious, so the hospitalizations are more frequent, which makes the infection registration better.

In our study average age-specific salmonellosis incidence rates in the period 1994-2013 are higher for male persons in the age group under 14, and for women in age group older than 20. Women tend to contract the disease more frequently than men. In our study the ratio of infected women and men was 1.15:1, which is slightly smaller than that registered in Novi Zagreb in the period 1990-2009

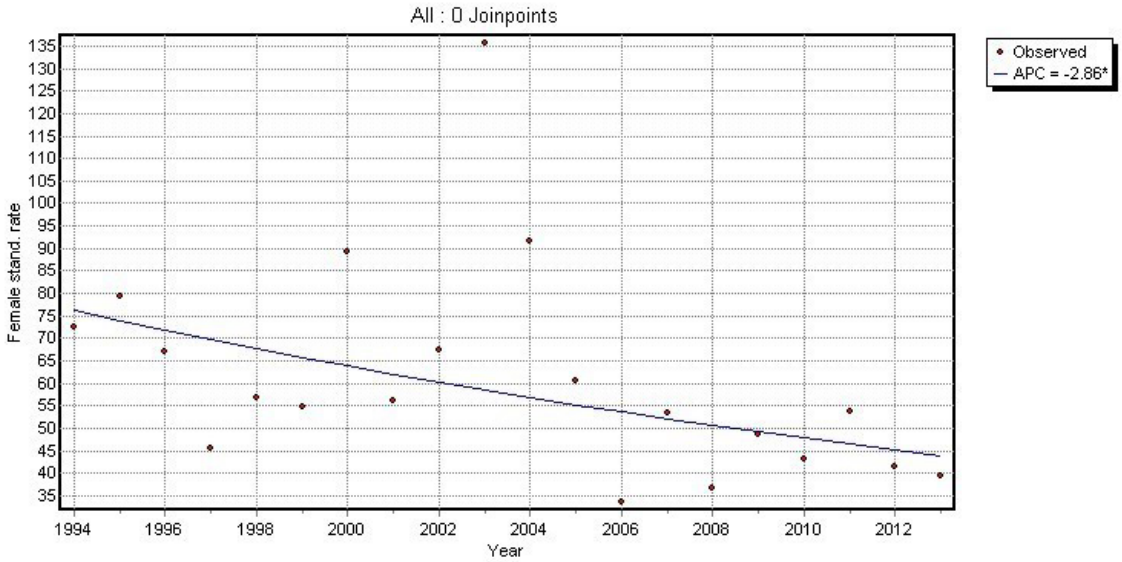
a)



b)

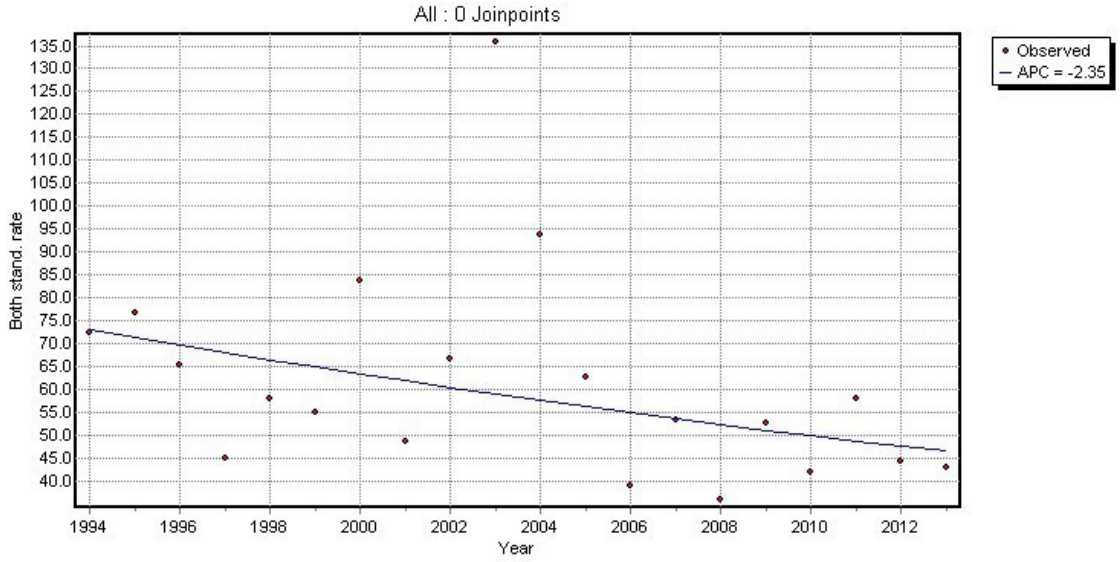


c)

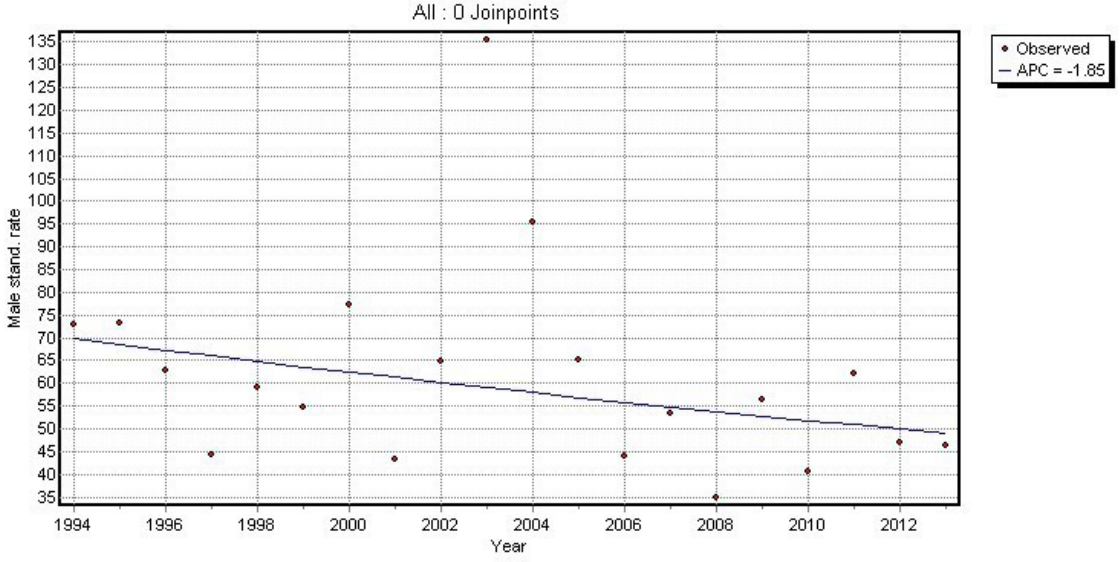


Slika 1. Praćeni i procenjeni terndovi standardizovanih stopa incidencije salmoneloze za a) oba pola, b)muškarci i c) žene, Beograd, 1994-2013.

a)



b)



c)

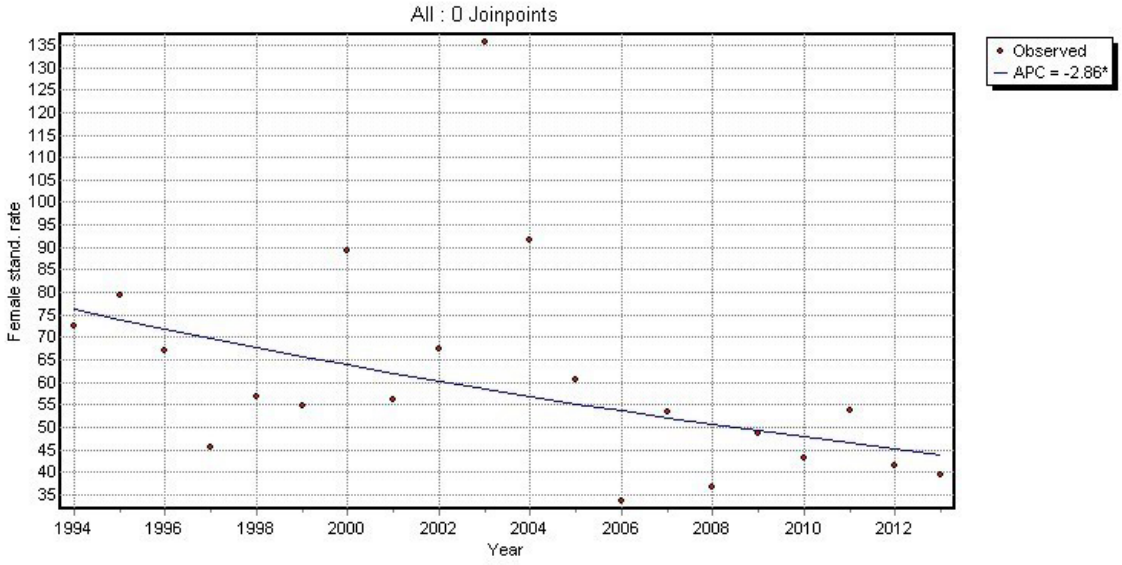


Figure 1. Observed and estimated trends of the standardized salmonellosis incidence rates for both gender, men and women, Belgrade, 1994-2013

100.000 stanovnika za ženski pol (23). Razlozi za najvišu stopu incidencije salmoneloza u najmlađoj uzrasnoj grupi su što je infektivna doza kod dece mala, moguće je da su češće simptomatske infekcije, uzorci biološkog materijala za laboratorijsku analizu se češće uzimaju, klinička slika može biti teža, tako da su učestalije hospitalizacije, a samim tim i bolja prijava infekcija.

U našoj studiji, prosečne uzrasno-specifične stope incidencije salmoneloza u periodu od 1994. do 2013. godine bile su više kod muškaraca u uzrasnoj grupi ispod 14 godina, a kod žena u uzrasnoj grupi starijih od 20 godina. Žene češće obolevaju od muškaraca. U našoj studiji odnos obolelih od salmoneloza žena i muškaraca je bio 1,15:1, što je nešto manji odnos od onog zabeleženog u Novom Zagrebu u periodu 1990-2009. godine (1,2:1) (22) i Hong Kongu u periodu od 2003. do juna 2011. godine (1,24:1) (24). U drugim studijama je takođe bilo više žena među obolelima od salmoneloza. Odnos obolelih žena i muškaraca u Sjedinjenim Američkim Državama 2011. godine bio je 1,09:1 (24). Razlog za nešto veći broj obolelih među osobama ženskog pola može biti što žene češće učestvuju u pripremi hrane, češće dolaze u kontakt sa sirovim mesom ili jajima, koji mogu biti kontaminirani salmonelama. U jednoj studiji koja je sprovedena u Londonu u periodu od 2007. do 2011. godine, nije bilo značajne razlike između polova po pitanju obolevanja (21), a u Irskoj 2012. godine odnos inficiranih žena i muškaraca bio je 0,90:1,11 (23).

Prema našim podacima najzastupljeniji serotipovi salmonela izolovani iz humanog materijala bili su *S. enteritidis* i *S. typhimurium*. Ovi serotipovi su takođe bili najčešći u humanom materijalu u periodu od 2001. do 2007. godine širom sveta, osim u Okeaniji i Severnoj Americi. U Severnoj Americi i Okeaniji (Australija i Novi Zeland), najčešći serotip u datom periodu bio je *S. typhimurium*, a *S. enteritidis* je bio drugi najčešći serotip. U nekim regionima, učestalost ova dva serotipa je mnogo niža. Rezultati studije koja je sprovedena 2008. godine u gradu Damaru, u Jemenu, pokazali su da je kod pregledanih pacijenata jedne bolnice učestalost *S. enteritidis* bila 24,4%, a *S. typhimurium* 13,3% (25). U datom periodu (2001-2007), procentualno učešće *S. enteritidis* i S*. typhimurium* širom sveta u odnosu na 15 najčešćih serotipova iznosili su 43,5% i 17,1% (26), a u zemljama članicama Evropske unije učešće ova dva serotipa u 2012. godini iznosi 41,3% i 22,1% (10), što se razlikuje od učestalosti ova dva serotipa salmonele u našoj studiji gde *S. enteritidis* iznosi 81,6%, a *S. typhimurium* 7,7%. Rezultati studije sprovedene u Novom Zagrebu u periodu od 1990. do 2009. godine pokazuju približno istu zastupljenost dva najčešća serotipa salmonele kao i u našoj studiji i iznose – *S. enteritidis* – 84% i *S. typhimurium* - 7% (22). Ostali serotipovi salmonela se češće registruju na određenim kontinentima i regionima: *S. Newport* (3,5%) je najčešći serotip u Latinskoj i Severnoj Americi, kao i u Evropi. *S. infantis* (1,8%) je dominantan serotip koji se registruje u svim regionima. *S. Virchow* (1,5%) se najviše registruje u Aziji, Evropi i Okeaniji. *S. Hadar* (1,5%) je naročito prisutan u Evropi, dok je *S. agona* (0,8%) veoma čest u Latinskoj i Severnoj Americi i Evropi (26). Prema našim rezultatima, nakon *S. enteritidis* i *S. typhimurium*, najčešći serotipovi salmonela, slično situaciji u svetu, su *S. infantis* (2,6%), *S. hadar* (1,8%), *S. agona* (0,6%). Postoje velike razlike u najčešće izolovanim serotipovima između regiona, ali su te razlike manje između zemalja u okviru istog regiona (26).

U studiji sprovedenoj u gradu Sana u Jemenu od 2009. do 2010. godine, najveći procenat salmonela u hrani registrovan je u crvenom mesu (14,7%), piletini (12,1%), kuvanim jelima (9,5%), mleku i mlečnim proizvodima (5%), sokovima (4,8%), povrću (4,4%), sandvičima (3%) i tortama (2,6%) (27). U studiji koja je sprovedena u Novom Zagrebu u periodu 1990-2009. godine, učešće namirnica u kojima je dokazano prisustvo salmonela iznosi 32% za jaja, 10% za torte i piletinu, 5% za mleveno meso, 2% za sladoled, 1,5% za sir i 1% za francusku salatu i svinjetinu (22). Rezultati pomenute dve studije se znatno razlikuju od rezultata dobijenih u našoj studiji gde je procentualno najzastupljenija namirnica u kojoj je potvrđeno prisustvo salmonele bila piletina, koja čini skoro polovinu svih namirnica sa izolatima salmonela (49,15%), a zatim slede torte i kolači.

Mortalitet od salmoneloza je nizak. Prosečna sirova stopa mortaliteta u našoj studiji je iznosila 0,06 na 100.000 stanovnika. Godišnja stopa mortaliteta u Nemačkoj, u periodu 2004-2008. godine je iznosila 0,055 na 100.000 stanovnika (28). Stopa mortaliteta u Sjedinjenim Američkim Državama, u periodu 1996-2005. godine, bila je 0,07 na 100.000 (29). U drugoj studiji, koja je obuhvatila stanovništvo Sjedinjenih Američkih Država u periodu 1990-2006, godišnja stopa mortaliteta bila je 0,03 na 100.000 stanovnika (30).

(1.2:1) (22) and in Hong Kong in the period 2003-June 2011 (1.24:1) (24). In other studies women were also more present among salmonellosis cases. The ratio of infected women and men in the USA in 2011 was 1.09:1 (24). The reason for the greater number of women among the infected could be the fact that women are more involved in food preparation, they are more likely to handle raw meat and eggs, which can be contaminated with salmonella. In a study conducted in London in the period 2007-2011 there was no significant difference regarding contracting salmonella between the genders (21), and in Ireland in 2012 the ratio of infected women and men was 0.90:1.11 (23).

As our data suggest, *S. enteritidis* and *S. typhimurium* were the most present in human material. These were also the most present serotypes in human material in the period 2001-2007 worldwide, except for Oceania and North America. In North America and Oceania (Australia and New Zealand) the most present serotype in the given period was *S. typhimurium*, and *S. enteritidis* was the second most frequent. In some regions, the frequency of these two serotypes is much lower. The results of a study conducted in 2008 in the city Thamar, Yemen, showed that in examined patients of one hospital the frequency of *S. enteritidis* was 24.4%, and *S. typhimurium* 13.3% (25). In the given period (2001-2007) the percentages of *S. enteritidis* and *S. typhimurium* worldwide among the 15 most common serotypes were 43.5% and 17.1% (26), and within the EU the percentages for these two serotypes in 2012 were 41.3% and 22.1% (10), which is different than in our study, where the percentage for *S. enteritidis* was 8.6%, and for S. typhimurium 7.7%. The results of a study conducted in Novi Zagreb in the period 1990-2009 showed similar percentages for the two most frequent salmonella serotypes as in our study - *S. enteritidis* – 84% and *S. typhimurium* – 7% (22). Other serotypes are more likely to be registered in other continents and regions: *S. Newport* (3.5%) is mostly present in Latin and North America, as well as in Europe. S. infantis (1.8%) is a dominant serotype registered in all regions. *S. Virchow* (1.5%) is mostly registered in Asia, Europe and Oceania. *S. hadar* (1.5%) is especially present in Europe, while *S. agona* (0.8%) is very frequent in Latin and North America and Europe (26). According to our results, after *S. enteritidis* and *S. typhimurium* the most frequent salmonella serotypes are, similar to the situation in world, *S. infantis* (2.6%), *S. hadar* (1.8%) and *S. agona* (0.6%). There are major differences in the most frequently isolated serotypes between regions, but these differences are less prominent between the countries of the same region (26).

In a study conducted in the city of Sana'a in Yemen in the period 2009-2010.the largest percentage of *salmonella* in food was registered in red meat (14.7%), chicken (12.1%), cooked dishes (9.5%), milk and dairy products (5.0%), juice (4.8%), vegetables (4.4%), sandwiches (3.0%) and cakes (2.6%) (27). In the study conducted in Novi Zagreb in the period 1990-2009 the percentage of food with registered *salmonella* was 32% for eggs, 10% for cakes and chicken, 5% for minced meat, 2% for ice cream, 1.5% for cheese and 1% for French salad and pork (22). The results of the two mentioned studies are significantly different than those of our study, where the most frequent food with *salmonella* was chicken, which formed a half of all food with *salmonella* isolates (49.2%), followed by cakes and cookies.

Salmonellosis mortality is low. The average raw mortality rate in our study was 0.06 per 100,000 people. The annual mortality rate in Germany, in the period 2004-2008 was 0.055 per 100,000 people (28). The mortality rate in the USA, in the period 1996-2005 was 0.07 per 100,000 people (29). In another study including the population of the USA in the period 1990-2006, the annual mortality rate was 0.03 per 100,000 people (30).

The decline in salmonellosis noticed in our study, on one hand suggests better farming control, better control of meat production and turnover and application of hygienic and sanitary measures in these processes as well as the greater presence of the HACCP standard for health safety of food in Belgrade. This makes it less likely for the contaminated food to reach the consumers. On the other hand, it is important, but not sufficient for the Belgrade population to be informed about the risks of using groceries without thermal treatment (eggs), as well as about the importance of hygienic and epidemiological habits and conditions among them. The reason for this decline might be the greater number of infected with an atypical form of the disease, which makes such patients unrecognized and unregistered.

Trend opadanja salmoneloza, zapažen u našoj studiji, sa jedne strane govori o boljoj kontroli uzgoja na farmama, proizvodnje i prometa mesa i primeni higijensko-sanitarnih mera u ovim procesima, kao i sve zastupljenijoj primeni HACCP standarda za zdravstvenu bezbednost hrane u Beogradu. Stoga je manja verovatnoća da će kontaminirana hrana dospeti do potrošača. S druge strane, značajna je, ali ne i dovoljna, prosvećenost stanovništva o rizicima korišćenja termnički neobrađenih namirnica (jaja), kao i o važnosti higijensko-epidemioloških navika i uslova među stanovništvom Beograda. Razlog za uočeni trend opadanja obolevanja od salmoneloza može biti i veći broj obolelih sa atipičnom formom bolesti, što dovodi do toga da ovi pacijenti ostaju neprepoznati, a samim tim i neprijavljeni.

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Competing interests

The authors declare no competing interests.

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