



Department of Food-borne and Water-borne diseases

EPIDEMIOLOGICAL DATA FOR SALMONELLOSIS (NON TYPHOID/PARATYPHOID)

IN GREECE, 2004-2020

MANDATORY NOTIFICATION SYSTEM

Main points

- Based on the data for the period 2004-2020:
 - The notification rate of the disease was higher among children <15 years old and especially in the age group of 0-4 years old.
 - A seasonal pattern was apparent: the mean annual notification rate increased during summer, reaching a peak in August.
 - 16.8% of the cases reported one or more persons with similar symptoms among their contacts.
 - *S. Enteritidis*, *S. Typhimurium*, monophasic *S. Typhimurium*, *S. Bovismorbificans* and *S. Oranienburg* were the five most frequently reported serovars.
 - The low notification rate of Salmonellosis in Greece, in 2020, may be explained by the COVID-19 pandemic, due to a) the implementation of lockdowns and the consequent limited exposure of the population to probable risk factors, b) the reduction of visits to healthcare facilities, c) the decreased testing and d) the increased under-reporting in the surveillance systems.

Salmonella spp. is one of the etiological agents of foodborne infections, as well as the main bacterial cause of foodborne disease outbreaks, in many European countries. It is an important cause of diarrheal illness among children and the elderly [1].

Time trend

During 2004-2020, 10,707 salmonellosis cases were reported in Greece. The annual number of reported cases is presented in **Table 1**. The mean annual notification rate of salmonellosis was 5.7 cases per 100,000 population (SD: 2.55). The temporal distribution of salmonellosis notification rate is depicted in **Graph 1**. In time series analysis a statistically significant decreasing trend of the salmonellosis notification rate was observed during this period (IRR = 0.99, CI = 0.9953-0.9985, P <0.001).

Age and gender distribution

For the period 2004-2020, the disease was more frequently reported among children, especially in the 0-4 years age group (**Graph 2**). In this age group, the mean annual notification rate was 45/100,000 population, whereas it was less than 14/100,000 in the rest of the population. The notification rate among males and females was 6.1 and 8.1 cases per 100,000 population, respectively.

Seasonality

There was an apparent seasonal pattern of the disease frequency, with the mean annual notification rate for 2004-2020 increasing during summer, reaching a peak in August and gradually decreasing in autumn (**Graph 3**).

Geographical distribution

The geographical area of Northern Aegean islands had the highest mean annual notification rate (9/100,000 population) and Southern Aegean the lowest (3/100,000 population). **Figure 1** depicts the mean annual notification rate of salmonellosis by region for the period 2004-2020.

Laboratory data

The proportion of *Salmonella* serovars (out of the total number of identified serovars), for the period 2004-2020, is depicted in **Graph 4**. *Salmonella* Enteritidis, *S. Typhimurium*, monophasic *S. Typhimurium*, *S. Bovismorbificans* and *S. Oranienburg* were the most frequently identified serovars. The frequency of the reported serovars for the 17-year period is presented in **Table 2**.

It should be noted that the presented data here regard the cases reported via the mandatory notification system. For some of them the respective information from the

Reference Laboratory is available while for others it is not. Data on the total number of isolates serotyped at the Reference Laboratory can be found at: <http://www.mednet.gr/whonet/>.

Risk/Protective factors

During the period 2004-2019, 16.8% of the notified cases reported the presence of at least one person with similar symptoms among their contacts, whereas 274 (3%) reported they had travelled abroad within the incubation period.

Conclusion

The mean notification rate in the EU and EEA/EFTA countries was 20 cases per 100,000 population for the year 2019 [2]. The decreasing trend of salmonellosis notification rate, in previous years, can probably be attributed, to the actual decrease of the disease incidence, which was a common finding among EU countries [2]. This decrease could be possibly explained by the implementation of the national salmonella control programmes in the different poultry species (breeding, laying and broiler hens of *Gallus gallus*, as well as breeding and fattening turkeys), which was initiated in Greece in 2007 in compliance with the requirements of EU Regulation No 2160/2003. The aim of these programmes is to reduce the prevalence of specific *Salmonella* serotypes (targeted *Salmonella* serotypes) that have an important impact on public health. These serotypes are *S. Enteritidis* and *S. Typhimurium* (including monophasic *S. Typhimurium*) and the programmes' objectives are achieved through the implementation of intensive surveillance of the disease in the different poultry species and the application of restrictive measures during the disposal of products (meat and eggs) originating from infected flocks.

The fact that *S. Enteritidis*, *S. Typhimurium* and monophasic *S. Typhimurium* were the most frequently reported *Salmonella* serovars in humans is in accordance with the findings of other European countries [2,3]. The reported increase of monophasic *S. Typhimurium* in 2017 can be partially explained by two outbreaks caused by this serovar [4].

The seasonality pattern of the disease occurrence is also consistent with the findings from other European countries [2]. Finally, the number of salmonellosis outbreaks notified during 2004-2020 was significantly lower than that expected based on the high percentage of notified cases linked to other cases.

The decrease in Salmonellosis notification rate in 2020 may be explained by COVID-19 pandemic. Restaurants were closed for a long time due to implementation of lockdowns, therefore population's exposure to probable risk factors was limited. Moreover, people may not have visited healthcare facilities due to the fear of contracting COVID-19. Additionally, the laboratory testing for the diagnosis of the disease may have decreased and at the same time the under-reporting in the surveillance systems may have increased.

References

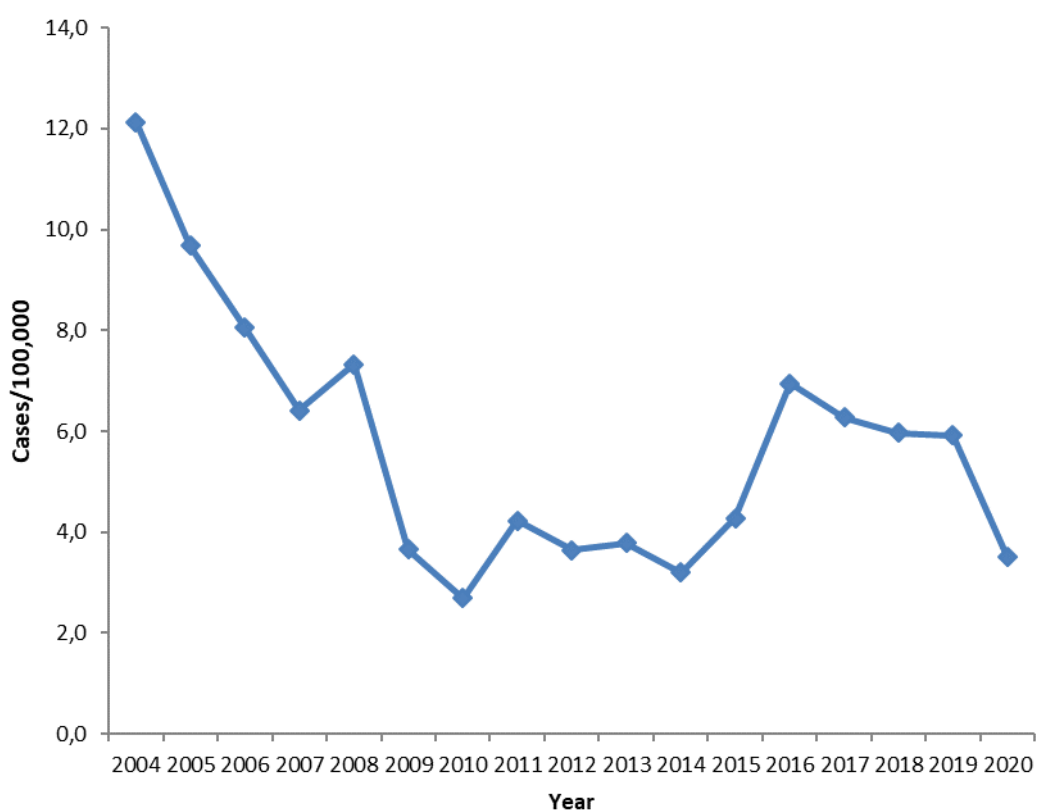
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2. European Centre for Disease Prevention and Control. Surveillance Atlas of Infectious Diseases. Salmonellosis - Data by Country and Year. Current time period: 2019. Available online: <http://atlas.ecdc.europa.eu/public/index.aspx>
3. EFSA and ECDC (European Food Safety Authority and European Centre for Disease Prevention and Control), 2021. The European Union One Health 2019 Zoonoses Report. EFSA Journal 2021;19(2):6406, 286 pp. <https://doi.org/10.2903/j.efsa.2021.6406>
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Table 1. Number of notified cases of salmonellosis per year, Mandatory Notification System, Greece, 2004-2020.

Year	Number of cases
2004	1,327
2005	1,062
2006	886
2007	708
2008	810
2009	406
2010*	299
2011	471
2012	404
2013	417
2014	349

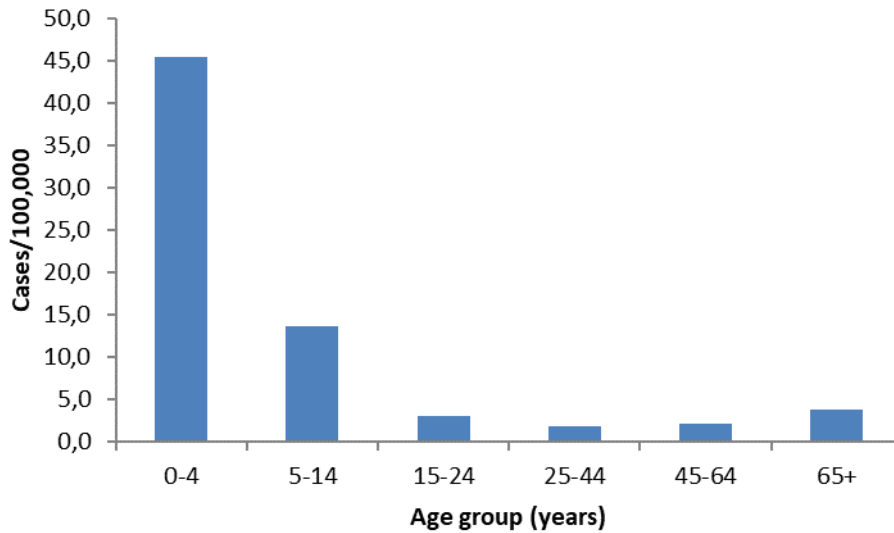
Year	Number of cases
2015	465
2016	750
2017	677
2018	652
2019	643
2020	381
Total	10,707

*The second semester of 2010 an effort for strengthening salmonellosis notification to MNS initiated.

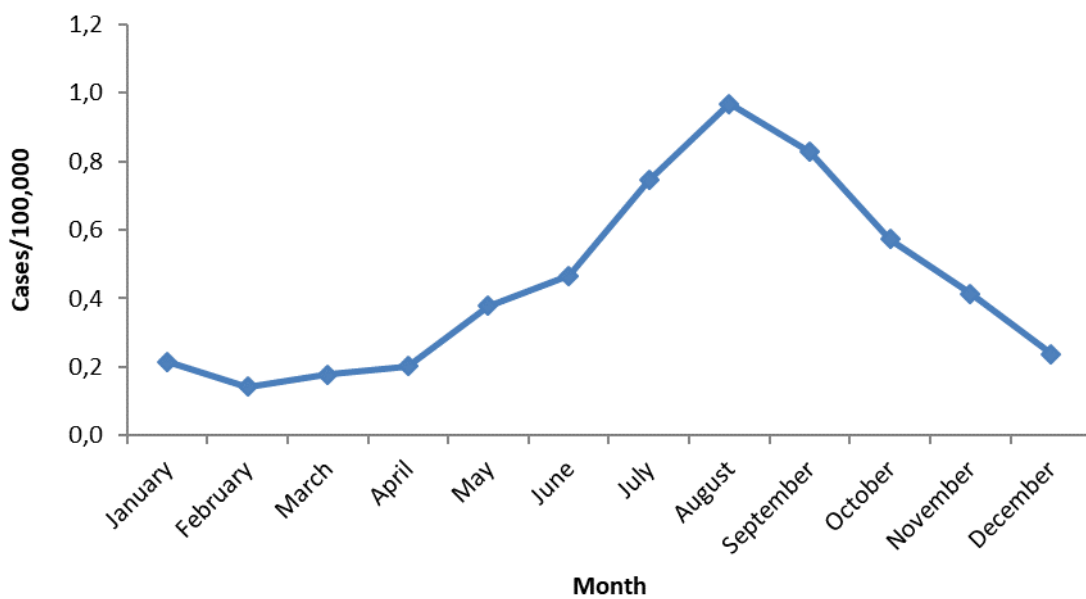


Graph 1. Time trend of salmonellosis notification rate, Mandatory Notification System, Greece, 2004-2020.

**The second semester of 2010 an effort for strengthening salmonellosis notification to MNS started.*



Graph 2. Annual notification rate (cases/100,000 population) of salmonellosis by age group, Mandatory Notification System, Greece, 2004-2020.



Graph 3. Mean annual notification rate (cases/100,000 population) of salmonellosis by month, Mandatory Notification System, Greece, 2004-2020.

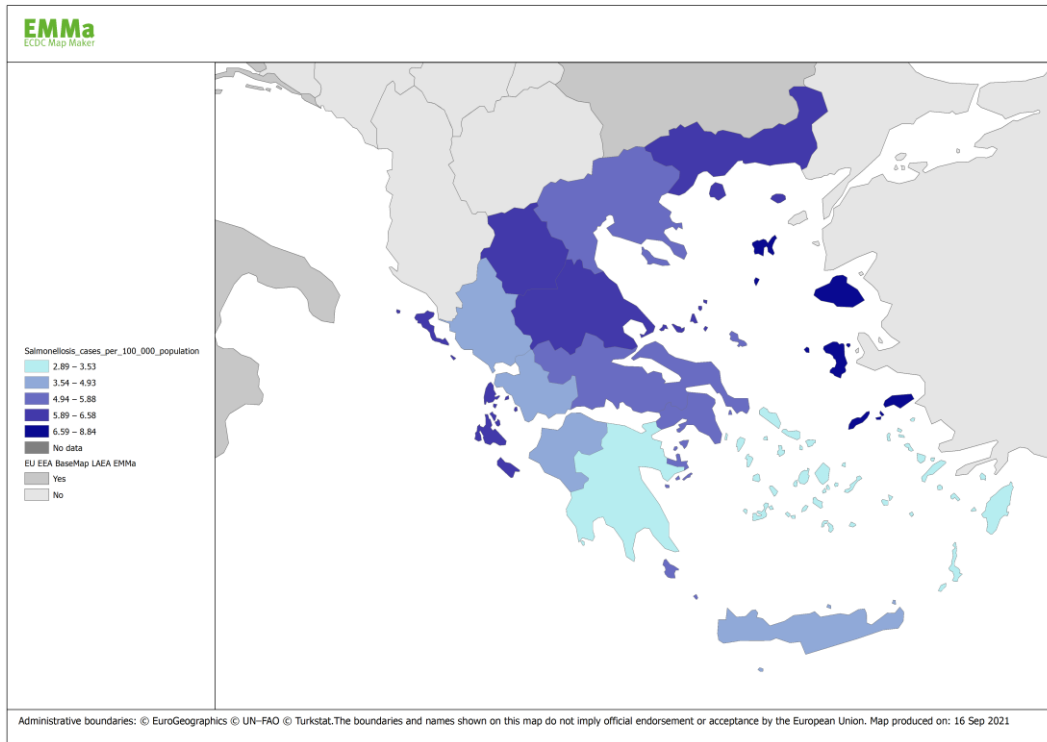
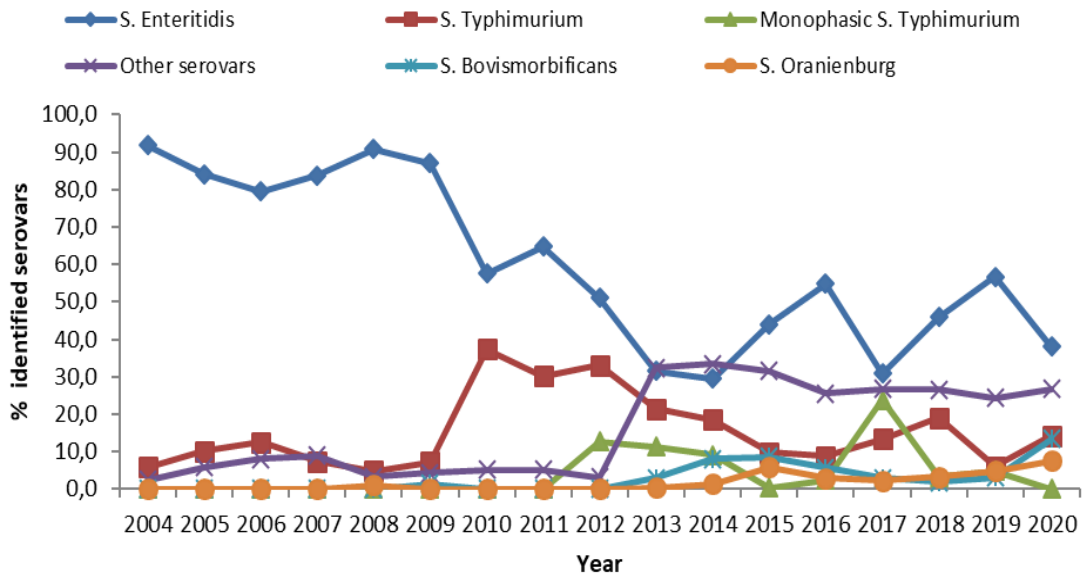


Figure 1. Mean annual notification rate (cases/100,000 population) of salmonellosis by region, Mandatory Notification System, Greece, 2004-2020.



Graph 4. Annual percentage of identified *S. Enteritidis*, *S. Typhimurium*, monophasic *S. Typhimurium*, *S. Bovismorbificans*, *S. Oranienburg* and other serovars, Mandatory Notification System & National Reference Centre for *Salmonella* and *Shigella*, Greece, 2004-2020.

Table 2. Frequency distribution of *S. Enteritidis*, *S. Typhimurium*, monophasic *S. Typhimurium*, *S. Bovismorbificans*, *S. Oranienburg* and other serovars per year, Mandatory Notification System & National Reference Centre for *Salmonella* and *Shigella*, Greece, 2004-2020.

Year	<i>S. Enteritidis</i> n (%)	<i>S. Typhimurium</i> n (%)	Monophasic <i>S. Typhimurium</i> n (%)	<i>S. Bovismorbificans</i> n (%)	<i>S. Oranienburg</i> n (%)	Other serovars n (%)	Total n (%)
2004	347 (92)	22 (6)	0 (0)	0 (0)	0 (0)	9 (2)	378 (100)
2005	305 (84)	37 (10)	0 (0)	0 (0)	0 (0)	21 (6)	363 (100)
2006	228 (80)	36 (12)	0 (0)	0 (0)	0 (0)	23 (8)	287 (100)
2007	170 (84)	15 (7)	0 (0)	0 (0)	0 (0)	18 (9)	203 (100)
2008	168 (91)	9 (5)	0 (0)	0 (0)	2 (1)	6 (3)	185 (100)
2009	60 (87)	5 (7)	0 (0)	1 (1)	0 (0)	3 (4)	69 (100)
2010	68 (58)	44 (37)	0 (0)	0 (0)	0 (0)	6 (5)	118 (100)
2011	140 (65)	65 (30)	0 (0)	0 (0)	0 (0)	11 (5)	216 (100)
2012	97 (51)	63 (33)	24 (13)	0 (0)	0 (0)	6 (3)	190 (100)
2013	75 (32)	51 (21)	27 (11)	7 (3)	1 (0)	77 (32)	238 (100)
2014	62 (30)	39 (19)	19 (9)	17 (8)	3 (1)	70 (33)	210 (100)
2015	145 (44)	32 (10)	1 (0,3)	28 (9)	19 (6)	104 (32)	329 (100)
2016	202 (55)	32 (9)	9 (2)	21 (6)	11 (3)	94 (25)	369 (100)
2017	106 (31)	46 (13)	82 (24)	10 (3)	8 (2)	92 (27)	344(100)
2018	97 (46)	40 (18)	7 (3)	4 (2)	7 (3)	56 (27)	211(100)
2019	93 (57)	10 (6)	8 (5)	5 (3)	8 (5)	40 (24)	164* (100)
2020	40 (38)	15 (14)	0 (0)	14 (13)	8 (8)	28 (27)	105 (100)

*In 2019, 481 *Salmonella* strains were not serotyped due to the lack of reagents at the National Reference Centre for *Salmonella* and *Shigella*.

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