NATIONAL PUBLIC
HEALTH ORGANIZATION

# Department of Food-borne and Water-borne diseases

## EPIDEMIOLOGICAL DATA FOR SALMONELLOSIS (NON TYPHOID/PARATYPHOID)

## IN GREECE, 2004-2021

## MANDATORY NOTIFICATION SYSTEM

### Main points

- Based on the data for the period 2004-2021:

- 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.

- 17% 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, during the period 2020-2021, may be explained by the COVID-19 pandemic, due to a) the implementation of lockdowns and other mitigation measures 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 Mandatory Notification System.

*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 2004-2021, 11,025 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 6 cases per 100,000 population (SD: 3). 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 = 0.9950-0.9980, P <0.001).

## Age and gender distribution

For the period 2004-2021, 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 and 5.3 cases per 100,000 population, respectively.

## Seasonality

There was an apparent seasonal pattern of the disease frequency, with the mean annual notification rate for 2004-2021 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 2004-2021.

## Laboratory data

The proportion of *Salmonella* serovars (out of the total number of identified serovars), for the period 2004-2021, 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 18-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 National Salmonella Shigella Reference Centre (SSRC) is available while for others it is not. Data on the total number of isolates serotyped at the SSRC can be found at: http://www.mednet.gr/whonet/.

## Risk/Protective factors

During the period 2004-2021, 17% of the notified cases reported the presence of at least one person with similar symptoms among their contacts, whereas 278 (3%) reported they had travelled abroad within the incubation period.

## Conclusion

The mean notification rate in the EU and EEA/EFTA countries was 14 cases per 100,000 population for the year 2020 [2]. The decreasing trend of salmonellosis notification rate, in the period preceding the COVID-19 pandemic, 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 and the fact that the highest notification rate was reported in the 0-4 years age group was also consistent with the findings from other European countries [2].

The decrease in salmonellosis notification rate in the period 2020-2021 may be explained by COVID-19 pandemic and is compatible with other European countries' data [3]. Lockdowns and measures related to closure of restaurants and other social events or mass gatherings may have reduced population exposure to risk factors associated with the occurrence of the disease. In addition, other non-pharmaceutical mitigation measures may have resulted in this decrease.

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 of salmonellosis in the Mandatory Notification System increased [5].

## References


1. Heymann D, MD. Control of Communicable Diseases Manual. 20th Edition, 2015, American Public Health Association.

2. European Centre for Disease Prevention and Control. Surveillance Atlas of Infectious Diseases. Salmonellosis - Data by Country and Year. Current time period: 2020. Available online: http://atlas.ecdc.europa.eu/public/index.aspx

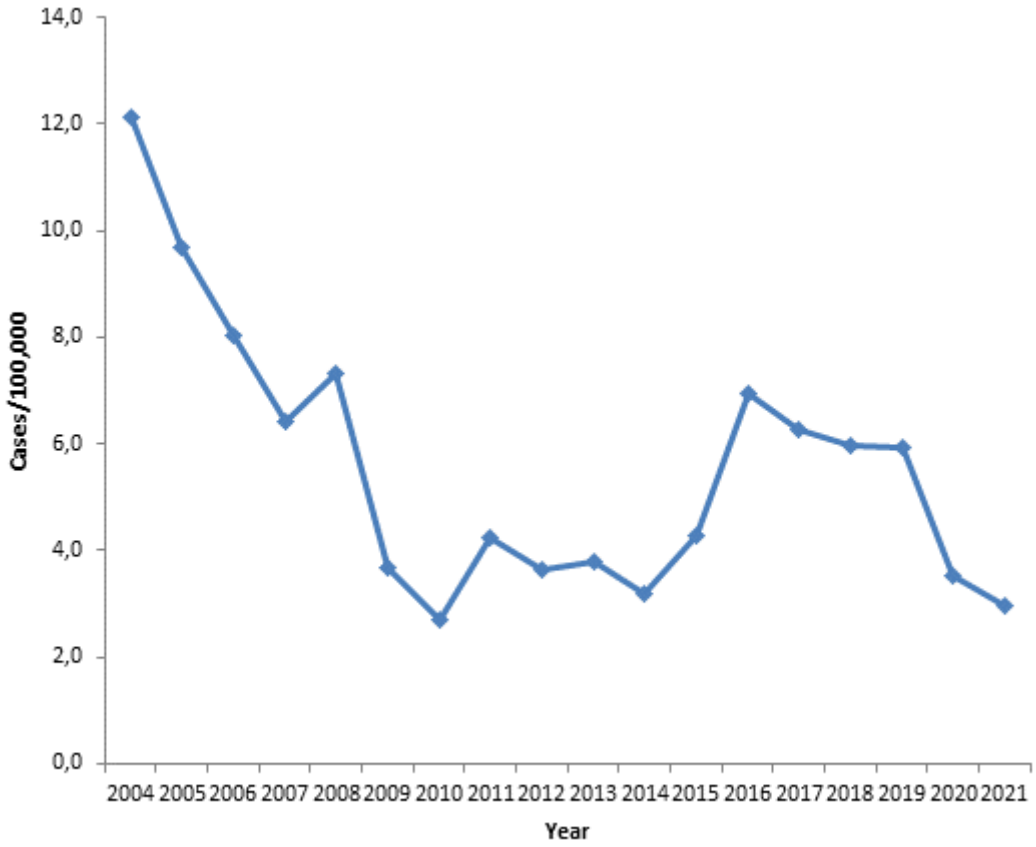
3. EFSA and ECDC (European Food Safety Authority and European Centre for Disease Prevention and Control), 2021. The European Union One Health 2020 Zoonoses Report. EFSA Journal 2021;19(12):6971, 324 pp. https://doi.org/10.2903/j.efsa.2021.6971

4. Mandilara G, Sideroglou T, Chrysostomou A, Rentifis I, Papadopoulos T, Polemis M, Tzani M, Tryfinopoulou K, Mellou K. The Rising Burden of Salmonellosis Caused by Monophasic *Salmonella* Typhimurium (1,4,[5],12:i:-) in Greece and New Food Vehicles. Antibiotics (Basel). 2021 Feb 13;10(2):185. doi: 10.3390/antibiotics10020185.

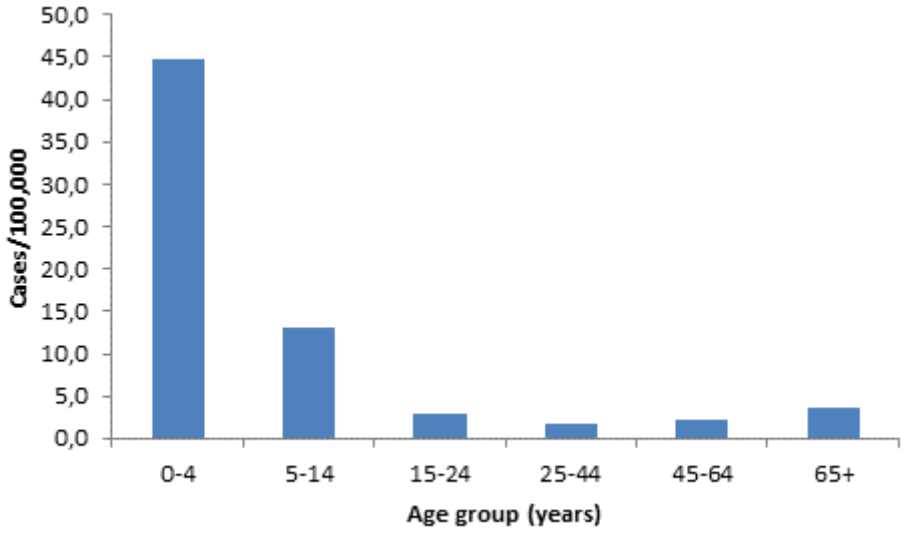
5. National Public Health Organization. Evaluation of underreporting in the Mandatory Notification System of laboratory confirmed salmonellosis, shigellosis, listeriosis, Hepatitis A Virus infection, typhoid/paratyphoid fever cases by Public General Hospitals in Greece. Available from: http://bitly.ws/v9dp

**Table 1.** Number of notified cases of salmonellosis per year, Mandatory Notification System, Greece, 2004-2021.

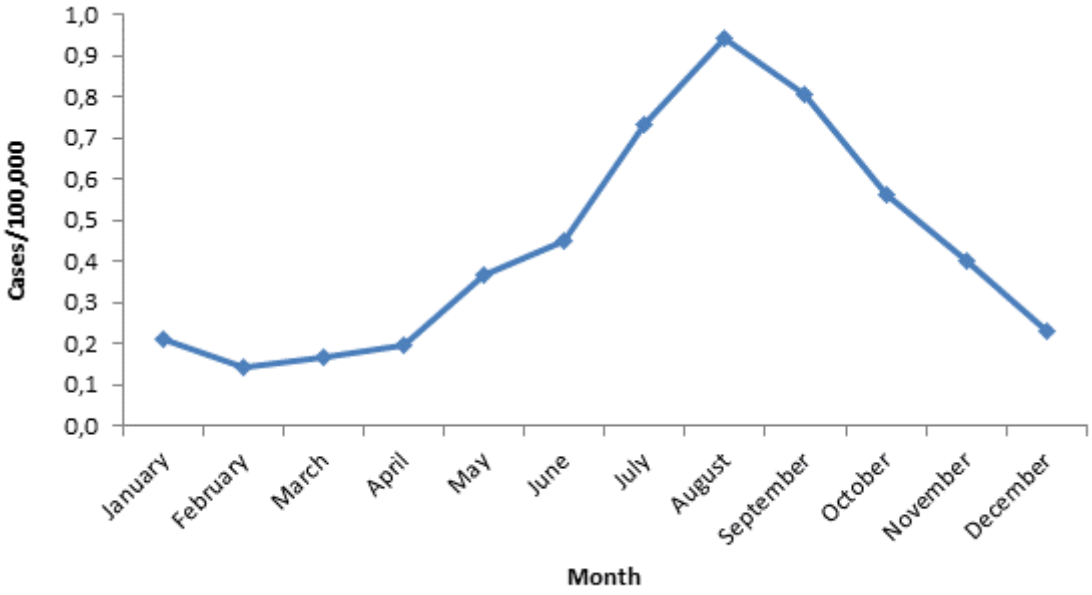
| Year | Number of cases |
|---|---|
| 2004 | 1,327 |
| 2005 | 1,062 |
| 2006 | 886 |
| 2007 | 708 |
| 2008 | 810 |
| 2009 | 406 |
| 2010 | 299 |
| 2011 | 471 |
| 2012 | 404 |
| 2013 | 417 |
| 2014 | 349 |
| 2015 | 465 |
| 2016 | 750 |
| 2017 | 677 |
| 2018 | 652 |
| 2019 | 643 |
| 2020 | 381 |
| 2021 | 318 |
| Total | 11,025 |




**Graph 1.** Time trend of salmonellosis notification rate, Mandatory Notification System, Greece, 2004-2021.




**Graph 2.** Annual notification rate (cases/100,000 population) of salmonellosis by age group, Mandatory Notification System, Greece, 2004-2021.




**Graph 3.** Mean annual notification rate (cases/100,000 population) of salmonellosis by month, Mandatory Notification System, Greece, 2004-2021.

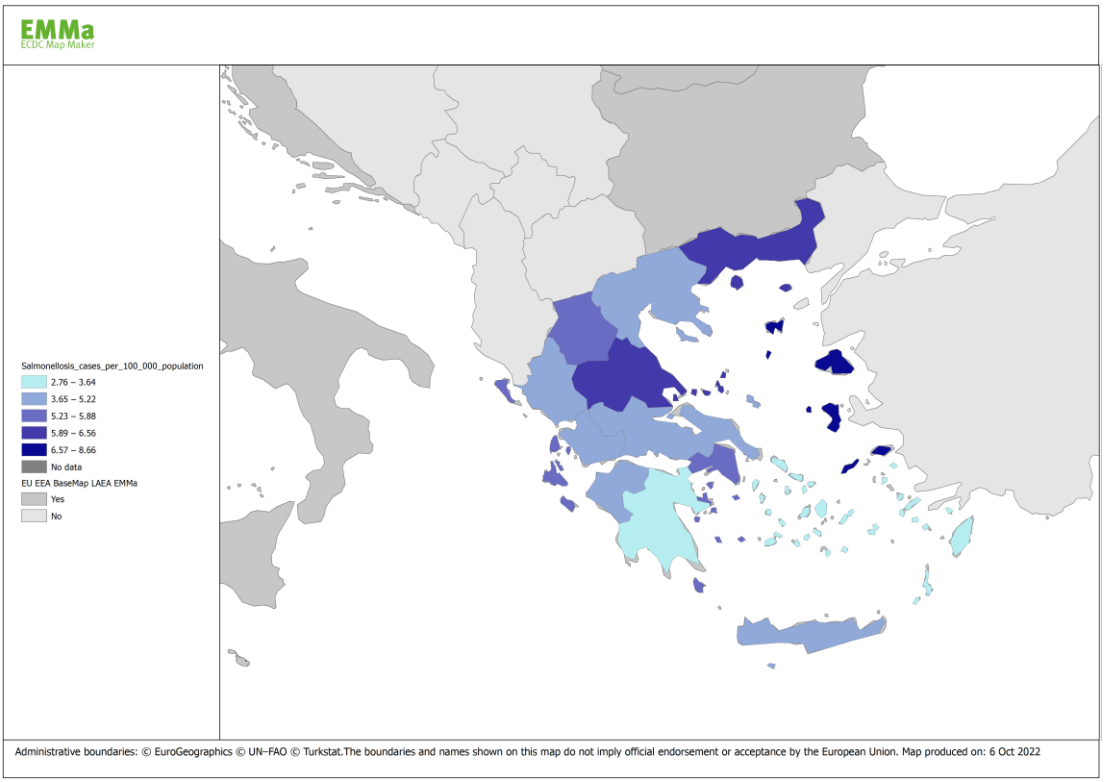
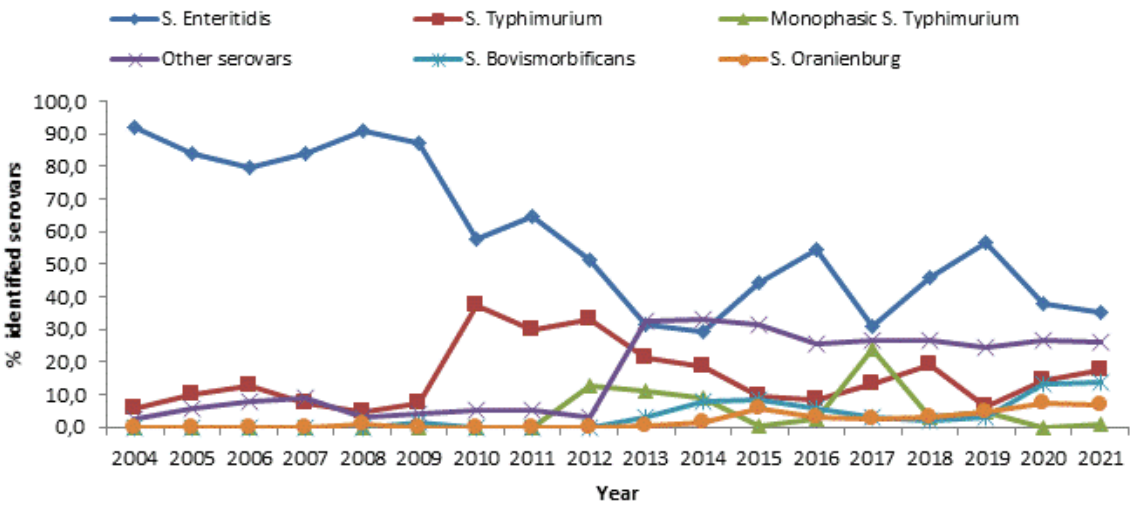



**Figure 1**. Mean annual notification rate (cases/100,000 population) of salmonellosis by region, Mandatory Notification System, Greece, 2004-2021.




**Graph 4.** Annual percentage of identified *S*. Enteritidis, *S*. Typhimurium, monophasic *S*. Typhimurium, *S*. Bovismorbificans, *S*. Oranienburg and other serovars, Mandatory Notification System & National Salmonella Shigella Reference Centre, Greece, 2004-2021.

**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 Salmonella Shigella Reference Centre, Greece, 2004-2021.

| Year | *S*. Enteritidis n (%) | *S*. Typhimurium n (%) | Monophasic *S*. Typhimurium n (%) | *S*. Bovismorbificans n (%) | S. Oranienburg 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) |

| Year | *S*. Enteritidis n (%) | *S*. Typhimurium n (%) | Monophasic *S*. Typhimurium n (%) | *S*. Bovismorbificans n (%) | S. Oranienburg n (%) | Other serovars n (%) | Total n (%) |
|---|---|---|---|---|---|---|---|
| **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) |
| **2021** | 46 (35) | 23 (18) | 1 (1) | 18 (14) | 9 (7) | 34 (26) | 131 (100) |

*Last updated: October 2022*