NATIONAL PUBLIC
HEALTH ORGANIZATION

# Department of Food-borne and Water-borne diseases

## EPIDEMIOLOGICAL DATA FOR SALMONELLOSIS (NON-TYPHOID/PARATYPHOID) IN GREECE, 2004-2023

## MANDATORY NOTIFICATION SYSTEM

### Main points

- Based on the data for the period 2004-2023:

- 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.

- 15.1% 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.

- In 2023, the notification rate of salmonellosis increased by 47% compared to 2022.

*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 2004-2023, 12,601 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 5.8 cases per 100,000 population (SD: 2,5). In 2023, the notification

rate of salmonellosis increased by 47% compared to 2022. 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 = 0.9973-0.9999, P <0.001).

### Age and gender distribution

For the period 2004-2023, 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 46.2/100,000 population, whereas it was less than 14/100,000 in the rest of the population. The notification rate among males and females was 6.2 and 5.4 cases per 100,000 population, respectively.

### Seasonality

There was an apparent seasonal pattern of the disease frequency, with the mean annual notification rate for 2004-2023 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 (8.7/100,000 population) and Southern Aegean the lowest (3.0/100,000 population). **Figure 1** depicts the mean annual notification rate of salmonellosis by region for the period 2004-2023.

### Laboratory data

The proportion of *Salmonella* serovars (out of the total number of identified serovars), for the period 2004-2023, is depicted in **Graph 4**. *Salmonella* Enteritidis, *S*. Typhimurium, monophasic *S*. Typhimurium, *S*. Bovismorbificans and *S*. Oranienburg were the most frequently identified serovars. In 2023, the proportion of *S*. Enteritidis increased by 52.5% compared to 2022. The frequency of the reported serovars for the period of interest 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 and on antimicrobial resistance can be found at: http://www.mednet.gr/whonet/.

### Risk/Protective factors

During the period 2004-2023, 15.1% of the notified cases reported the presence of at least one person with similar symptoms among their contacts, whereas 361 (2.9%) reported they had travelled abroad within the incubation period.

### Conclusion

The mean notification rate reported by the EU and EEA/EFTA countries (excluding UK) was 15.5 cases per 100,000 population for the year 2022 [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 the implemented public health measures and is compatible with other European countries' data [3].

NPHO is in close collaboration with the other competent bodies for the monitoring of the increase of salmonellosis notification rate and the proportion of *S*. Enteritidis that was noticed in 2023 for the implementation of public health measures.

## References


1. Heymann DL. Control of Communicable Diseases Manual. 21st Edition, 2022. Washington DC: 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: 2022. Available online: http://atlas.ecdc.europa.eu/public/index.aspx

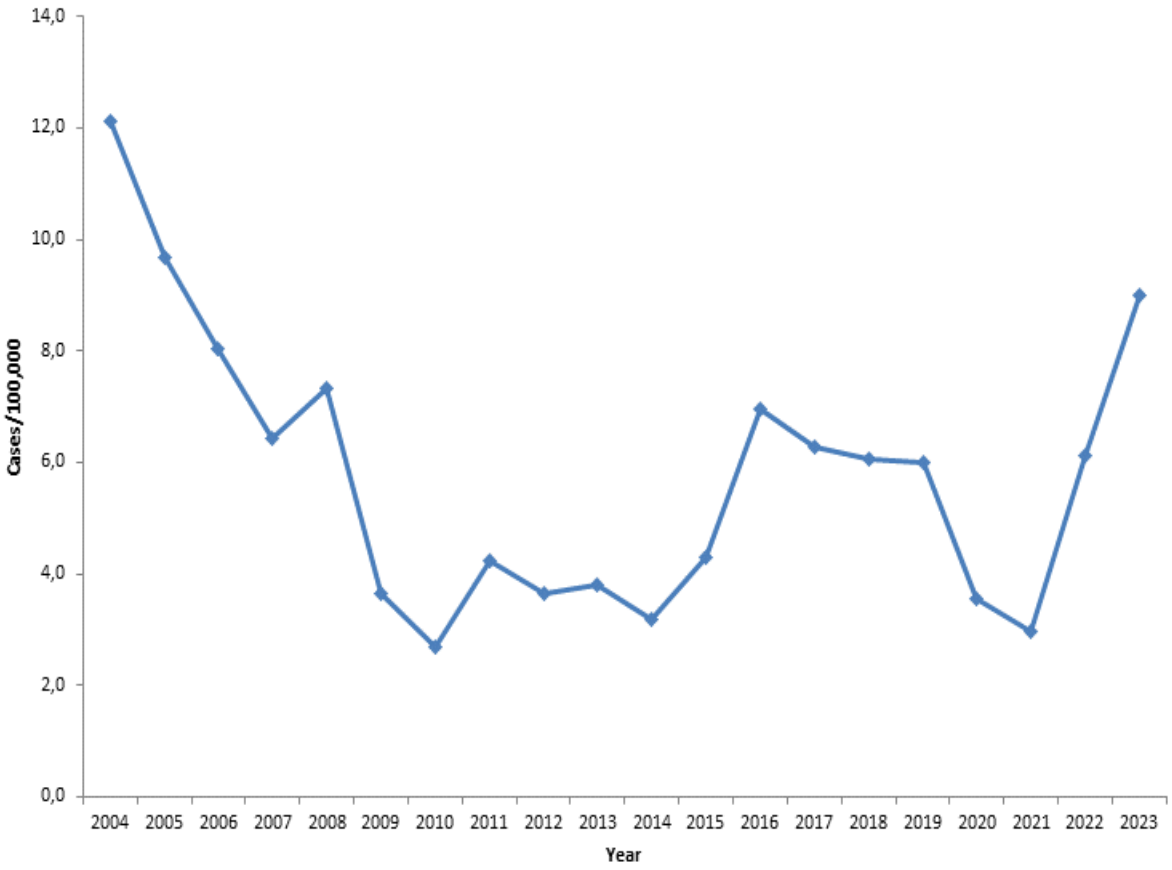
3. EFSA and ECDC (European Food Safety Authority and European Centre for Disease Prevention and Control), 2023. European Union One Health 2023 Zoonoses Report. EFSA Journal 21(12). https://doi.org/10.2903/j.efsa.2023.8442

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.

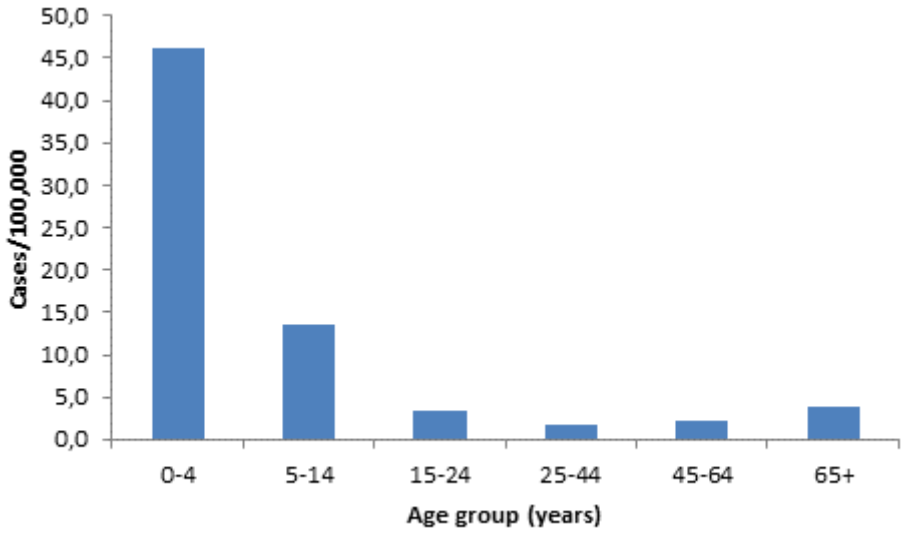

**Table 1.** Number of notified cases of salmonellosis per year, Mandatory Notification System, Greece, 2004-2023.

| 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 |

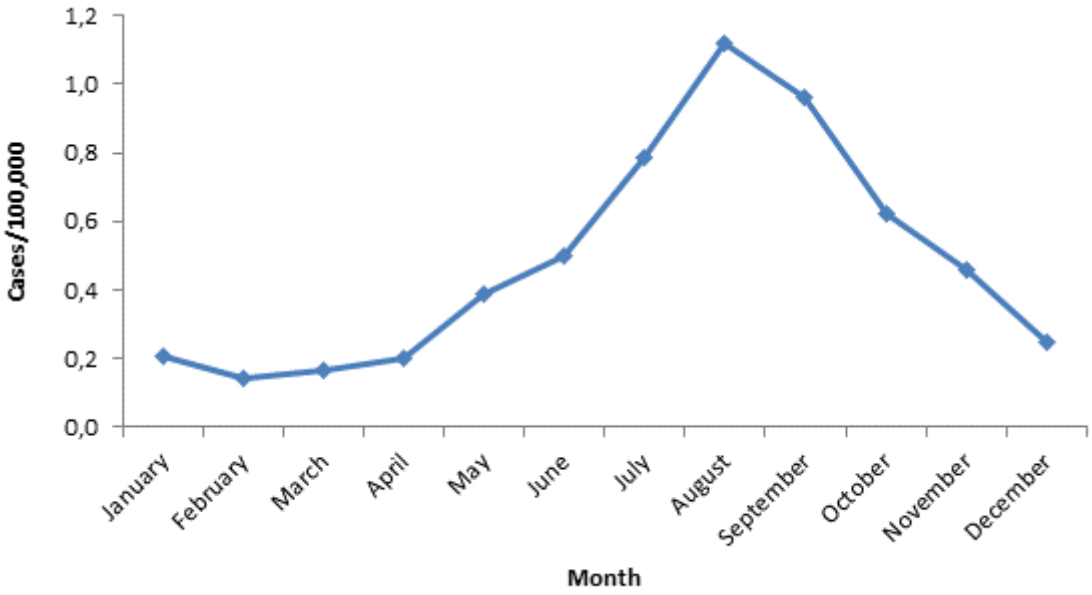
| Year | Number of cases |
|---|---|
| 2016 | 750 |
| 2017 | 677 |
| 2018 | 652 |
| 2019 | 643 |
| 2020 | 381 |
| 2021 | 318 |
| 2022 | 640 |
| 2023 | 936 |
| Total | 12,601 |




**Graph 1.** Time trend of salmonellosis notification rate, Mandatory Notification System, Greece, 2004-2023.




**Graph 2.** Annual notification rate (cases/100,000 population) of salmonellosis by age group, Mandatory Notification System, Greece, 2004-2023.




**Graph 3.** Mean annual notification rate (cases/100,000 population) of salmonellosis by month, Mandatory Notification System, Greece, 2004-2023.

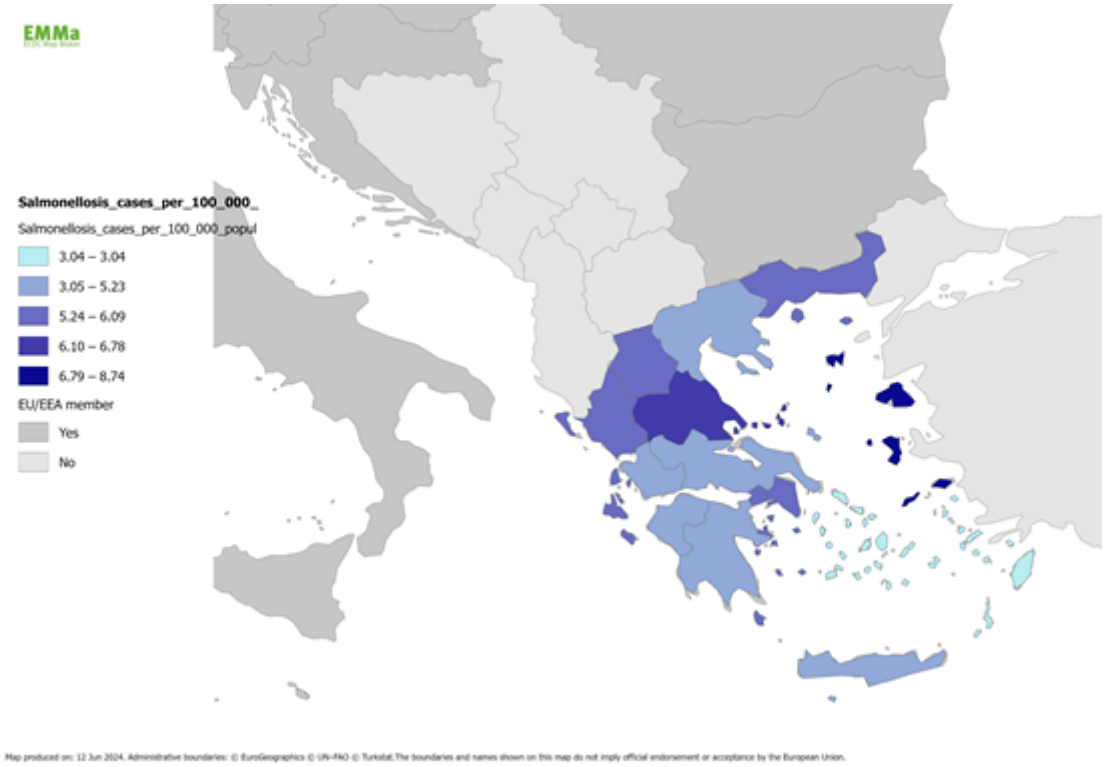
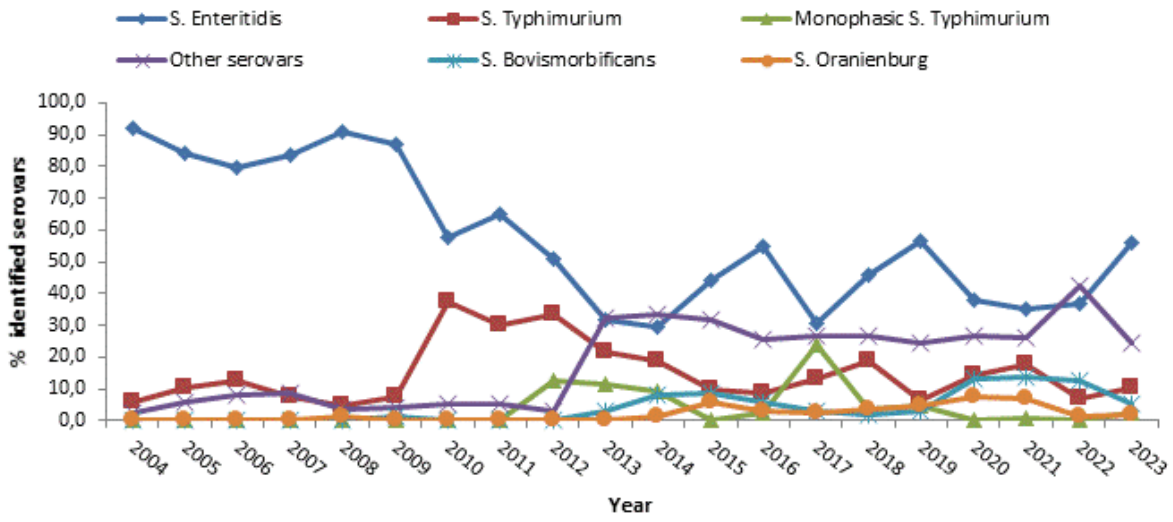



**Figure 1**. Mean annual notification rate (cases/100,000 population) of salmonellosis by region, Mandatory Notification System, Greece, 2004-2023.




**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, 2004-2023.

**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, 2004-2023.

| 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) |
| **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) |
| **2022** | 55(37) | 10(7) | 0(0) | 19(13) | 2(1) | 64(42) | 150(100) |
| **2023** | 194 (56) | 35(10) | 8(2) | 19(6) | 7(2) | 84(24) | 347 (100) |

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*Tags: non-typhoid/paratyphoid salmonellosis; notification rate; epidemiological data*