NATIONAL PUBLIC HEALTH ORGANIZATION

Directorate of Epidemiological Surveillance and Interventions for Infectious Diseases

Department of Vaccine Preventable and Congenital Diseases

EPIDEMIOLOGICAL DATA FOR MEASLES IN GREECE, 2004-2024

(MANDATORY NOTIFICATION SYSTEM)

Key Points

- Between 2004 and 2024, Greece experienced three measles outbreaks during the periods 2005-2006, 2010-2011, and 2017-2018. In total, 4,189 cases were reported, with an average annual reported incidence rate of 1.92 per 100,000 population. Most of the cases involved Greek Roma (56.5%), as well as young adults from the general population who were either unvaccinated or incompletely vaccinated. The highest incidence was observed in children aged 0-4 years. There were 4 reported deaths, resulting in an average annual mortality rate of 0.02%.
- Epidemiological surveillance and timely vaccination are the most effective measures for controlling the disease.
- In this context, continuous vigilance by healthcare professionals as well as the local and national authorities is essential. Vaccination efforts should be intensified, particularly targeting specific population groups, young adolescents, and adults who did not complete their vaccination in the past.

Measles is a viral infection caused by the measles virus, an RNA virus from the paramyxovirus group of the genus Morbillivirus. The disease progresses through three stages: the prodromal stage, the exanthematous stage, and the stage of recovery [1-8].

The incubation period ranges from 7-21 days, typically 10-12 days from exposure to the prodromal stage and 14 days from exposure to rash onset [1,6].

Transmission occurs through airborne droplets and direct contact with the nasal or pharyngeal secretions of infected individuals. Less commonly, it is spread via objects recently contaminated with these secretions. The measles virus can survive on contaminated surfaces and in the surrounding environment (in droplets) for up to 2 hours after a person with measles occupied the area. Measles is highly transmissible, with a secondary attack rate of up to 90% among susceptible individuals (e.g., those who have not been immunized) [1,2,4]. To halt the transmission of the disease, a population immunity rate greater than 95% is required [9]. Transmission occurs 4 days before through 4 days after rash onset. Measles cases typically appear at the end of winter and the beginning of spring, and the disease is more severe in infants and adults, mainly due to complications [1-3,6].

Before the introduction of measles vaccine in 1963 and widespread vaccination, major epidemics occurred approximately every two to three years and caused an estimated 2.6 million deaths each year. An estimated 107500 people died from measles in 2023 – mostly children under the age of five years, despite the availability of a safe and cost-effective vaccine [10]. The World Health Organization (WHO) has targeted measles for elimination. The new WHO Global Strategic Framework 2021-2030 aims to achieve and maintain a world free of measles, rubella, and congenital rubella syndrome [11].

Time trend

From 2004 to 2024, Greece experienced three measles outbreaks: in 2005-2006, 2010-2011, and 2017-2018. During this period, 4,189 measles cases were reported to the Department of Vaccine-Preventable Diseases and Congenital Infections of the Hellenic National Public Health Organization (EODY) through the mandatory notification system.

- ✓ The first outbreak peaked in 2006 with 518 cases and an average annual incidence of 4.71 per 100,000 population (Figure 1).
- ✓ The second outbreak, more limited in scope, occurred in 2010 with 149 cases and an average annual incidence of 1.34 per 100,000 population (Figure 1).
- ✓ The third and most extensive outbreak began in 2017 with 968 cases and an average annual incidence of 8.99 per 100,000 population. It peaked in 2018 with 2,291 cases and an average annual incidence of 21.33 per 100,000 population (Figure 1).

During the years 2021, 2022, and 2023, no measles cases were reported. However, it is important to note that underreporting might have occurred due to the COVID-19 pandemic. In 2024, a minor outbreak of measles cases was observed. Over the entire period from 2004 to 2024, the mean annual notification rate was 1.85 per 100,000 population (mean number of reported cases per year: 199.5; total number of reported cases for 2004-2024: 4,189).

Age and gender distribution

Between 2004 and 2024, 4,147 cases with known age and gender were recorded. The highest incidence was in the 0-4 years age group, with a mean annual notification rate of 14.95 cases per 100,000 population, followed by the 5-14 years age group, with mean annual notification rate of 4.89 cases per 100,000 population. In other age groups, the mean annual notification rate ranged from 1.89 (in the 15-24 years age group) to 0.01 cases per 100,000 population in those over 64 years (Figure 2). The mean annual notification rate was similar between males and females (males: 1.87 per 100,000 population, females: 1.79 per 100,000 population).

Population groups

Of the total reported cases for the period 2004-2024, nationality was known for 4,084 cases (97.5%). Of these (Figure 3):

- 3,609 cases (88.4%) were of Greek nationality:
  - 1,281 (31.4%) belonged to the general population,
  - 2,309 (56.5%) were Greek Roma,
  - 19 (0.5%) were Greeks of other subpopulation groups
- 475 cases (11,6%) were of foreign nationality.

Most cases concern mainly Greek Roma, which indicates that the wide spread of the disease occurs in population pockets with low vaccination coverage.

Geographical distribution

Between 2004 and 2024, the highest mean annual notification rate of the disease was recorded in Western Greece (5.68 per 100,000 population). Significant mean annual notification rates were also noted in Eastern Macedonia and Thrace (2.82 per 100,000) and the Peloponnese (2.45 per 100,000). On the other hand, Western Macedonia and the South Aegean exhibited the lowest mean annual notification rates (0.19 and 0.36 per 100,000, respectively).

Laboratory confirmation

During the period 2004-2024, 57.5% of the cases were laboratory confirmed.

Vaccination status

Of the total reported cases from 2004 to 2024, vaccination status was known for 3,664 cases (87.5%). Most of these cases were unvaccinated (77.0%, 3,227 out of 4,189). Among the 437 cases where information on the number of vaccine doses (for measles monovalent vaccine or MMR) was available, 323 (73.9%) had received only one dose, 51 (11.7%) had received two doses, while for the remaining cases, the exact number of doses was unknown. [Figure 4]

Hospitalizations - Outcomes

Of the 4,189 measles cases reported between 2004 and 2024, 2,658 (63.5%) were hospitalized. Among these cases, 721 developed complications, with the most common being: pneumonia (279), otitis (111), hepatitis (74), elevated transaminase levels (67), and bronchiolitis (59). Notably, 6 cases of encephalitis were reported.

During the epidemic outbreak of 2017-2018, 4 deaths occurred (2 each year). The annual fatality rate for 2017 and 2018 was 0.21% and 0.09%, respectively, while the average fatality rate for the period 2004-2024 was 0.1%. All other cases recorded during this period have recovered.

Conclusions

Between 2004 and 2024, Greece had a relatively low mean annual notification rate of measles (18.5 per 1,000,000 population). Three measles outbreaks occurred from 2004 to 2024. The first outbreak, occurring in 2005-2006, was the first nationwide since 1996. It confirmed the sustained circulation of the measles virus in Greece and highlighted the role of populations with low vaccination coverage, such as Roma and migrants. The outbreak began in a Roma population in Northern Greece and spread to other parts of the population, primarily affecting young children from Roma communities, migrants, and individuals aged 15-29 and 30-39 from the general population who were unvaccinated or incompletely vaccinated [12]. The second outbreak occurred in 2010-2011. It began with cases of Bulgarian nationals working seasonally in Greece, likely linked to a large measles outbreak in Bulgaria. Most Bulgarian patients were unvaccinated children, mainly aged 1-4 years. The outbreak spread to Greek nationals, predominantly unvaccinated Roma children aged 1-4 years, and Greeks not belonging to a special population group, mostly over 20 years old and either unvaccinated or incompletely vaccinated [13]. The third outbreak occurred in 2017-2018 and mainly affected young children from Roma communities, as well as individuals aged 25-44 years from the general population who were susceptible to measles, including health professionals who were unvaccinated or incompletely vaccinated [14]. These measles outbreaks underscore the need to strengthen vaccination coverage, particularly among individuals in special population groups, and to

ensure the completion of vaccination with 2 doses of the measles vaccine for susceptible children, adolescents, and young adults from the general population.

Prevention and Control Strategies

A) Preventive Measures

Vaccination is the cornerstone of the measles prevention strategy. The available vaccines contain live attenuated measles virus, cultured in chicken embryo cells. It is recommended to be administered subcutaneously in two doses and is preferably given as a trivalent (measles-mumps-rubella) or quadrivalent (measles-mumps-rubella-varicella) vaccine. In our country, vaccines containing the Edmonston strain (M-M-R VAX PRO) and the Schwartz strain (PRIORIX and PRIORIX-TETRA) are available.

In Greece, the measles vaccine was first marketed in the early 1970s. It was included in the National Immunization Program in 1981 [15], while the trivalent measles-mumps-rubella (MMR) vaccine was included in 1989 [16]. In 1991, the second dose of the MMR vaccine was established for children aged 11-12 years, and since 1999, it started to be administered at the age of 4-6 years [17].

The current 2024 National Immunization Program (NIP) for Children and Adolescents recommends two doses of the vaccine. The second dose should ideally be given between the ages of 24–47 months, but it can be administered earlier, as long as 4 weeks have passed since the first dose. Both doses should be administered after the 12th month of life. Children and adolescents who have not received the second dose should catch up as soon as possible. Additionally, during epidemic periods, MMR vaccination can be given from the age of 6 months. In such cases, children should be revaccinated with 2 doses of MMR after the age of 12 months according to the NIP [18].

The vaccine ensures long-term immunity and has been found to be 98% effective in children vaccinated at 15 months old, while it is 95% effective in those vaccinated at 12 months old [1,4]. Approximately 2%-5% of children vaccinated with the first dose experience a failure in the primary antibody response [1,7,19]. Most children who did not develop antibodies after the first dose respond to the second dose, resulting in 99% of children vaccinated with two doses showing an antibody response indicative of immunity to measles [20]. In developing countries, where measles is a significant cause of infant mortality, the WHO recommends the Edmonston-Zagreb vaccine with an increased content of attenuated viruses for infants aged 6 months, due to its effectiveness from this age.

The administration of the live attenuated virus vaccine is contraindicated in the following cases [3]:

- In patients with immunosuppression. HIV infection is not an absolute contraindication [4,6,8].
- Susceptible women of reproductive age should be clearly instructed to avoid pregnancy for at least one month after MMR vaccination due to the theoretical risk of harm to the fetus [6].
- Individuals who have had a hypersensitivity reaction to a previous dose of the vaccine, gelatin, or neomycin. Egg allergy is not a contraindication.
- The vaccine should be administered at least 14 days before the administration of gamma globulin or blood transfusion or 3 months after [1,6].

B) Control of cases, carriers and close contacts

- Reporting the case to the appropriate health authorities
- The isolation of patients is not widely applied in the community. Children with measles are excluded from school for 4-5 days following the onset of the rash. If among the close contacts there are children

with prodromal symptoms, interaction with vulnerable individuals, particularly infants and pregnant women, should be minimized [3,4].

- Quarantine is generally not applied [3].
- Simultaneous disinfection is not practiced [3].
- Vaccination of close contacts within 72 hours of exposure to the virus provides satisfactory protection [3,5,7].
- Passive immunization with immunoglobulin (IVIG) is administered within the first 6 days of exposure to the virus for vulnerable infants under one year old, pregnant women, or immunosuppressed individuals in the close family environment of the patient who are at increased risk of complications or for whom vaccination is contraindicated. The dose is 0.25 ml/kg body weight (0.5 ml/kg for immunosuppressed individuals) with a maximum dose of 15 ml intramuscularly. The live attenuated virus vaccine should be administered to all individuals who received immunoglobulin after 5-6 months, except for those for whom vaccination is contraindicated [1,3,7].
- Contact tracing and investigation of the source of infection: Efforts should be made to identify the source of infection and other possible cases in the wider environment of the patient. Close contacts from the family, work, school, social environment, and healthcare personnel should be investigated throughout the communicability period of the disease [3].
- No specific treatment for patients is applied. In developing countries, particularly in malnourished children, the administration of vitamin A is recommended to prevent complications (such as blindness) and reduce mortality. [3,21].

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Figure 1. Time trend of measles reported cases and annual notification rate per 100,000 population in Greece, 2004-2024

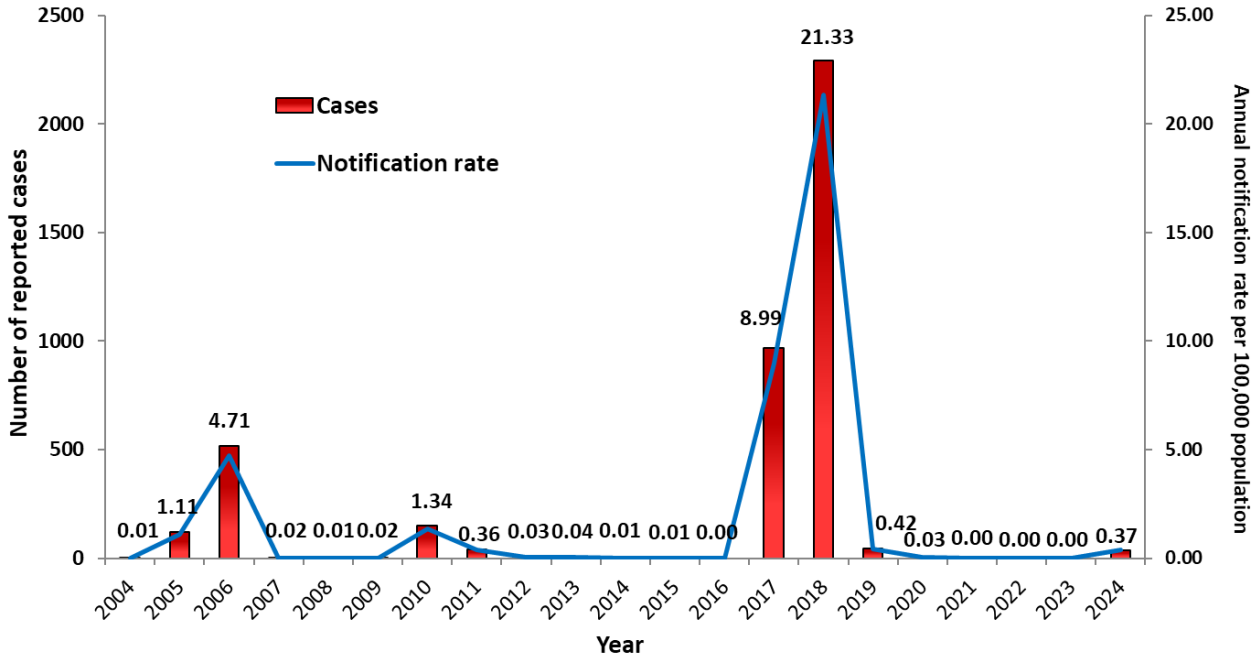


Figure 2. Age distribution of the mean annual notification rate of measles (cases/100,000 population), Greece, 2004-2024 (N=4189)

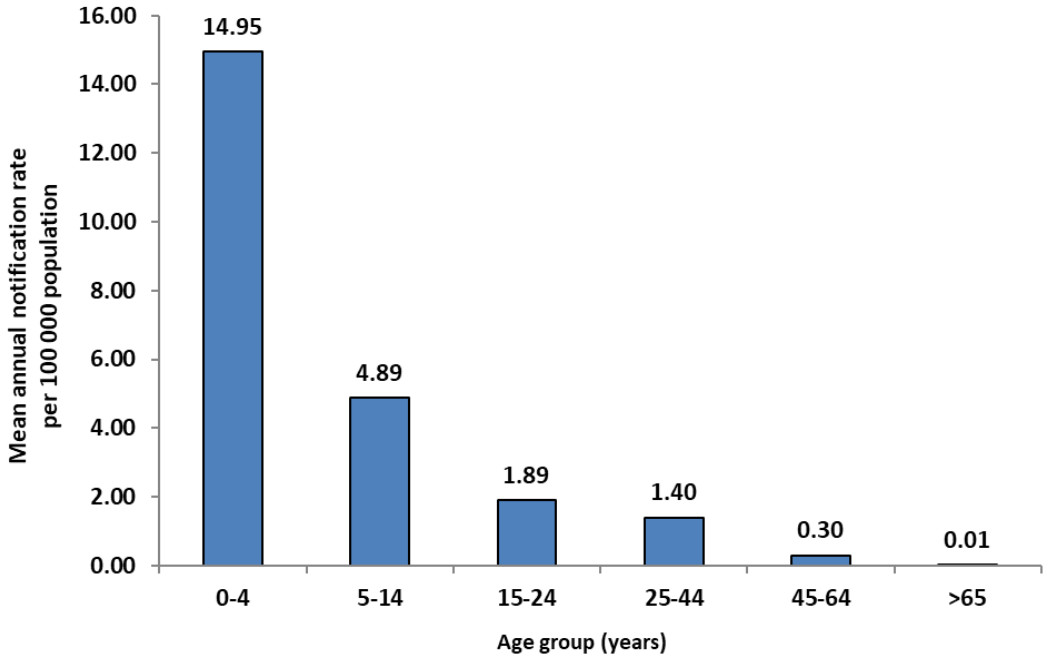


Figure 3. Distribution of measles cases by population group, Greece 2004-2024

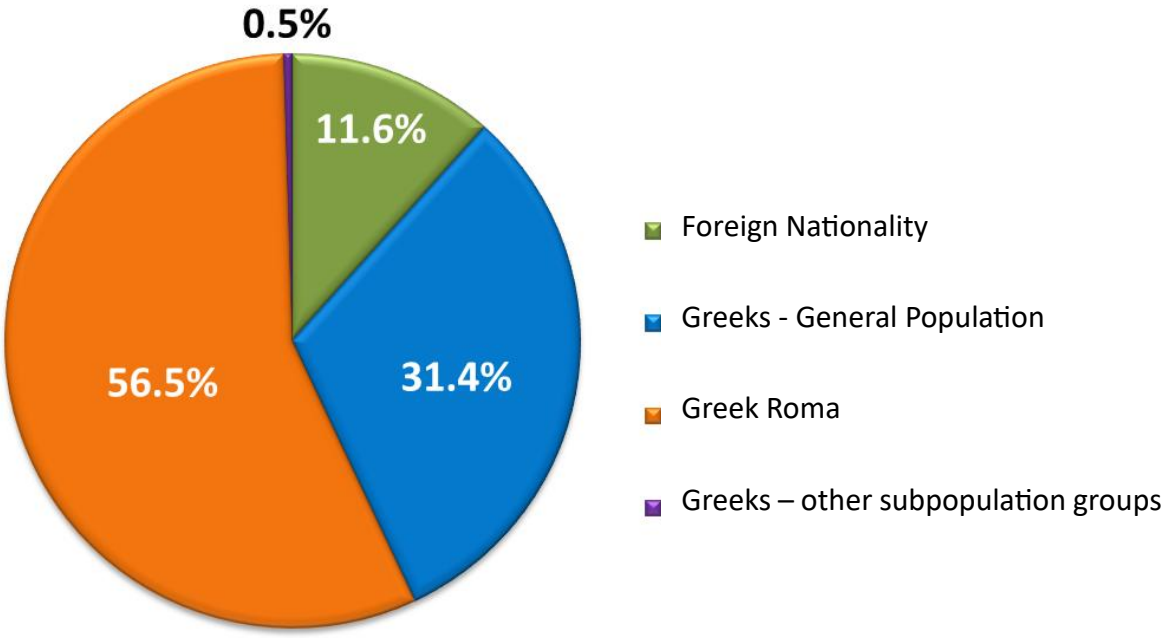
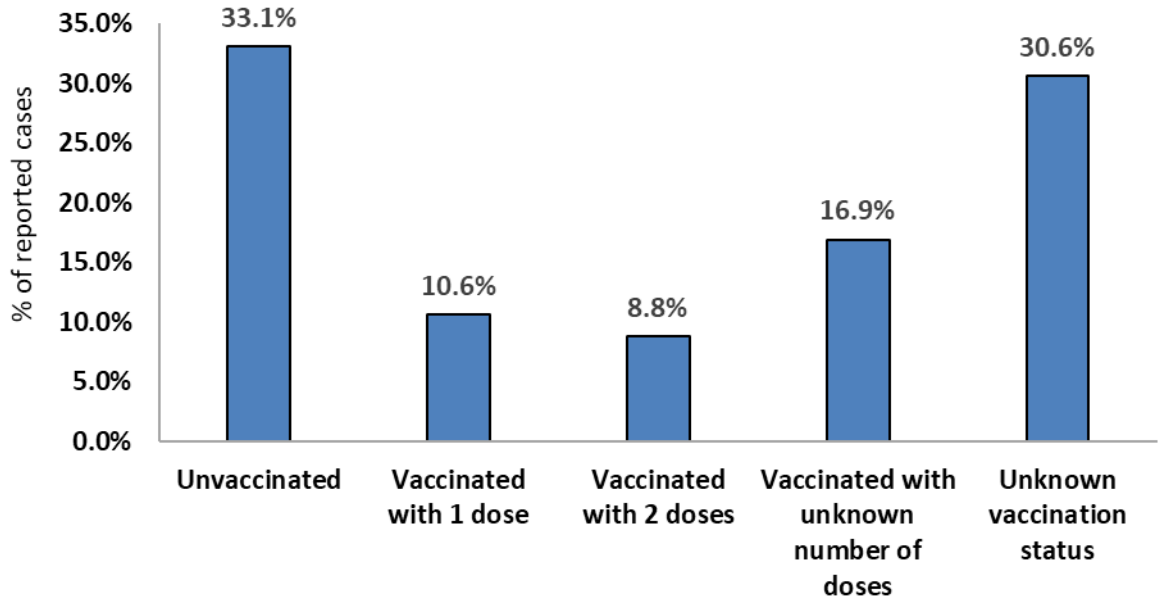


Figure 4. Frequency distribution of measles notified cases by number of vaccine doses, Greece, 2004-2024.



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