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Trends in pediatric vaccination coverage in Italy from 2000 to 2023

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Abstract
Vaccination represents one of the most effective public health interventions. However, a decrease in pediatric vaccination coverage has been observed in Italy, with an increase in vaccine-preventable infectious diseases. To counter this phenomenon, the Italian government approved a compulsory vaccination law in 2017, increasing the number of mandatory vaccinations from four to 10. This study analyzes the trends of vaccination coverages in Italy from 2000 to 2023, with a focus on the impact of the law. Vaccination coverage data were obtained from the Italian Ministry of Health, sorted by antigen. A linear regression and joinpoint regression analysis was performed for each antigen to identify a significant or non-significant change (increase or decrease) in the trend. Vaccination coverages declined steadily until 2015, but with the introduction of the law 119/2017, there was an increase for all antigens, ranging from 1.05% for tetanus to 5.30% for rubella. During the years of the COVID-19 pandemic, a decline in coverage was observed for all antigens, with values ranging from −0.24% for varicella to −2.39% for rubella. Implementing vaccine mandates seem to be useful for increasing vaccination coverages. Likewise, this study showed the negative impact of the COVID-19 pandemic on primary healthcare services, such as vaccination, contributing to a decline in coverage. Health systems should measure vaccination coverages and monitor changes and variations to be resilient toward external stressors and be proactive in tackling crises.

Introduction

Vaccination is recognized as one of the most effective public health interventions, reducing morbidity and mortality rates associated to infectious diseases [1]. Indeed, it is estimated that vaccines prevent 3.5–5 million deaths each year [1], saving 154 million lives worldwide over the last 50 years [2]. In addition to the direct impact on health, by reducing the economic burden of infectious diseases, vaccination campaigns have proven to be a cost-effective intervention [3]. Maintaining optimal values of vaccination coverage, therefore, is a priority for countries to ensure the health of the population, reduce health care-related costs, and prevent the spread of outbreaks caused by vaccine-preventable diseases (VPDs) [4].

Despite the proven efficacy, over the past years there has been a growing skepticism and hesitancy about vaccination, which has led in many countries, including European ones, to an alarming decline in coverages and the resurgence of VPDs, such as measles [5]. Vaccine hesitancy, defined as delayed acceptance or refusal of vaccination despite the availability of vaccines and vaccination services, is a complex and multifactorial phenomenon [6]. Indeed, social, educational, cultural, economic, political, scientific, and health factors contribute to the growth of this phenomenon, which is also fueled by the spread of fake news [7]. In addition to individuals' behaviors, other organizational, logistic, and management factors, as well as healthcare emergencies, may also lead to a reduction in vaccination coverage [8, 9].

In this context, to face the decline in coverage, many countries have adopted mandatory vaccinations, albeit with different modalities [10]. In Italy, e.g. mandatory vaccinations were extended from four (diphtheria, tetanus, hepatitis B, poliomyelitis) to 10 (diphtheria, tetanus, pertussis, poliomyelitis, *Haemophilus influenzae* type B, hepatitis B, measles, mumps, rubella, and varicella) by Law 199/2017 [11], to counter the decrease of coverage and the spread of outbreaks of measles. According to the Law, compliance with vaccination requirements is necessary for admission to kindergarten (for children 0–6 years old), while from elementary school onward unvaccinated children may be admitted to school but incur administrative fines. Compulsory and recommended vaccinations are free of charge, according to the National Vaccine Prevention Plan.

In this context, the aim of this study is to describe Italian coverage trends from 2000 to 2023 of the 10 compulsory vaccinations and of further two highly recommended pediatric vaccinations, with the primary aim to investigate changes over time related to Law 119/2017.

Methods

Data collection

Data on vaccination coverage were extracted from the Italian Ministry of Health website as of May 2025 [12]. The analysis considered the period from 2000 (first year available) to 2023 (last year available). Data are reported as a percentage of 24-month-old children being vaccinated for the following antigens: poliomyelitis, diphtheria, tetanus, pertussis, hepatitis B, *H. influenzae* type b, measles, mumps, rubella, varicella, meningococcus C, and pneumococcus.

In some cases, the same antigen may refer to different types of vaccination. For example, from 2000 to 2009, vaccination coverages referring to the single antigen for diphtheria and tetanus are reported both as trivalent diphtheria–tetanus–pertussis (DTP-3) vaccination and as the sum of trivalent DTP-3 and bivalent diphtheria–tetanus (DT) vaccination. In this case, therefore, to ensure more complete data, we considered the values referring to the sum of DTP-3 and DT. In contrast, the coverage values for pertussis refer exclusively to DTP-3 vaccination [12]. Data for individual antigens are available from 2010.

Similarly, from 2000 to 2008, vaccination coverages for measles, mumps, and rubella refer to trivalent MMR vaccination. In 2009, on the other hand, data for measles, mumps, rubella, and varicella coverage all refer to the M–MMR–MMRV indicator, which represents the sum of single measles vaccination (M), trivalent measles–mumps–rubella vaccination (MMR) and quadrivalent measles–mumps–rubella–varicella vaccination (MMRV). Thus, the single antigen coverages correspond to the combination of the three different types of vaccination used, even in cases where the antigen is present in only one of them (i.e. varicella). From 2010 to 2012, data are presented both as M–MMR–MMRV vaccination and as MMR–MMRV vaccination. In this case, we assumed that data for measles antigen refer to the M–MMR–MMRV indicator, while those for mumps, rubella, and varicella refer to the MMR–MMRV indicator. Data for single antigens became available from 2013.

Statistical analysis

Joinpoint regression model was used to evaluate changes in vaccination coverages. Joinpoint is used in many different scientific domains, including vaccination [13, 14] to analyse trend changes over time. This model allows to identify a point ("joinpoint") at which parameter changes occur in the time series. In this study, a trend analysis was conducted for each antigen. The year was considered as the independent variable, and the vaccination coverage for each antigen as the dependent variable, expressed as a percentage.

Preliminary assessments were performed to evaluate stationarity, homoscedasticity and heteroscedasticity, normality, and autocorrelation of the data. We evaluated the stationarity of the time series derived from vaccination coverage data through the Augmented Dickey–Fuller (ADF) test. The test assessed local stationarity within segments of the time series using lag variables ranging from 1 to 5 years, or up to a maximum of $n - 2$ years of observation. The ADF test indicated that *H. influenzae* B and meningococcus C coverages were stationary, while all other vaccines showed non-stationary trends.

Subsequently, a linear regression model was conducted for each variable, to estimate the overall trend for each antigen, identifying the coefficient of regression (CR), and the resulting residuals were examined to assess key assumptions, specifically homoscedasticity/heteroscedasticity (Breusch–Pagan test), normality (Shapiro–Wilk test), and autocorrelation (Durbin–Watson test). The dependent variable was the vaccination coverage, while the years represented the independent variable. Results were considered significant when $P < .05$.

Residuals for all vaccines were found to be non-normally distributed, as confirmed by the Shapiro–Wilk test (P values $< .05$ for all vaccines). Heteroscedasticity was present in the residuals of coverages for *H. influenzae* B, mumps, pertussis, and meningococcus C, as evidenced by the significant results from the Breusch–Pagan test. In contrast, the remaining vaccines exhibited homoscedastic residuals. Finally, the Durbin–Watson test for autocorrelation revealed that coverages diphtheria, *H. influenzae* B, measles, and meningococcus C had significant autocorrelation in their residuals, whereas no autocorrelation was observed in the residuals of the other vaccines. Statistical analyses were performed using Stata software, version 14 (StataCorp LP, College Station, TX).

Once non-stationarity had been assessed and the core assumptions of linear regression had been verified, we performed the joinpoint regression analysis using the Joinpoint Trend Analysis Software 5.2.0 (Desktop Version), as provided by the Surveillance Research Program of the US National Cancer Institute [15]. More precisely, to strengthen the robustness of the analyses and reduce the risk of misinterpreting the results, we applied a logarithmic transformation to the data to attenuate non-stationarity, and we employed nonparametric permutation-based models to mitigate the effects of any lack of normality and/or homoscedasticity on the integrity of the findings. Finally, any autocorrelation detected in the residuals by the Wooldridge test has been accommodated within the NCI's Joinpoint software by specifying a first-order autoregressive error model.

The joinpoint model estimates the Annual Percentage Change (APC), reflecting an increase or decrease in vaccination coverage over time. For each vaccination, the presence of any one joinpoint (the software predicts a minimum of zero to a maximum of five joinpoints) expresses the presence of changes in the APC trend. APC is considered significant when $P < .05$.

Results

Poliomyelitis

Coverage was ≥95% from 2000 to 2013, then in 2018 and 2019, and in 2022. The lowest values, instead, were observed in 2016 (93.33%), 2015 (93.43%), and 2021 (94%) (Table 1). Overall, linear regression modeling showed a statistically significant decline in vaccination coverage (CR = −0.114, 95% CI [−0.157, −0.070], $P < .001$) (Table 2, Supplementary Fig. S1). The joinpoint analysis highlighted two changes in the trend (Fig. 1, Supplementary Table S1). The first interval was characterized by a constant trend from 2000 to 2012, with coverage maintained between 95.9% and 96.6% without significant changes (APC = −0.0060). Subsequently, from 2012 to 2015, a significant decrease is observed (APC = −0.8586). The last trend, from 2015 to 2023, is characterized by a significant increase (APC = +0.1427).

Diphtheria

Coverage resulted ≥95% from 2000 to 2013, then in 2018, and in 2022. As for poliomyelitis, the lowest values were observed in 2016 (93.35%), 2015 (93.56%), and 2020 (93.92%) (Table 1). An overall significant decline in coverage was observed from 2000 to 2023 (CR = −0.100, 95% CI [−0.150, −0.050], $P < .001$) (Table 2, Supplementary Fig. S1). The analysis highlighted two joinpoints (Fig. 1, Supplementary Table S1). Specifically, a non-significant increase between 2000 and 2012 was observed (APC = +0.0341), followed by a significant decrease (APC = −0.9754) between 2012 and 2015, and then a significant rise until 2023 (APC = +0.1916).

Tetanus

Tetanus coverage showed a similar trend to that of diphtheria, albeit with some differences in terms of joinpoints. Coverage resulted ≥95% from 2000 to 2013, then in 2018, and in 2022, while the lowest values were observed in 2016 (93.56%), 2015 (93.72%), and 2021 (94.0%). An overall significant decline in vaccination coverage was observed during the entire period (CR = −0.105, 95% CI [−0.151, −0.060], $P < .001$) (Table 2, Supplementary Fig. S1). Three joinpoint identified four trends (Fig. 1, Supplementary Table S1). A significant increase from 2000 to 2002 (APC = +0.7282) was followed by two non-significant trends (from 2002 to 2012, with an APC = −0.0345, and from 2012 to 2015, with an APC = −0.7977). Finally, a non-significant increase was observed in the last trend (APC = +0.1099).

Pertussis

The highest coverage was reported in 2007 (96.5%), while the lowest in 2010 (87.3%). Overall, linear regression showed a non-significant increase during the study period (CR = 0.065, 95% CI [−0.049, 0.179], $P = .251$) (Table 2, Supplementary Fig. S1). Joinpoint analysis showed a significant increase from 2000 to 2003 (APC = +2.6643), followed by a significant decrease from 2003 to 2023 (APC = −0.0811) (Fig. 1, Supplementary Table S2).

Table 1. Vaccination coverage in Italy by antigen from 2000 to 2023

Year[a]	Poliomyelitis	Diphtheria	Tetanus	Pertussis	Hepatitis B	*Haemophilus influenzae* B	Measles	Mumps	Rubella	Varicella	Meningococcus C	Pneumococcus
2000	96.6	95.3	95.3	87.3	94.1	54.7	74.1	74.1	74.1	–	–	–
2001	95.8	95.9	95.9	93.3	94.5	76.9	76.9	76.9	76.9	–	–	–
2002	95.9	96.8	96.8	92.9	95.4	83.4	80.8	80.8	80.8	–	–	–
2003	96.6	96.6	96.6	95.8	95.4	90.4	83.9	83.9	83.9	–	–	–
2004	96.8	96.6	96.6	94	96.3	93.8	85.7	85.7	85.7	–	–	–
2005	96.5	96.2	96.2	94.7	95.7	94.7	87.3	87.3	87.3	–	–	–
2006	96.5	96.6	96.6	96.2	96.3	95.5	88.3	88.3	88.3	–	–	–
2007	96.7	96.7	96.7	96.5	96.5	96	89.6	89.6	89.6	–	–	–
2008	96.3	96.7	96.7	96.1	96.1	95.7	90.1	90.1	90.1	–	–	–
2009	96.1	96.2	96.2	96	95.8	95.6	89.9	89.9	89.9	89.9[a]	–	–
2010	96.3	96.4	96.4	96.2	95.8	94.6	90.6	90.5	90.5	90.5[a]	–	–
2011	96.1	96.3	96.3	95.8	96	95.6	90.1	89.9	89.9	89.9[a]	–	–
2012	96.1	96.2	96.2	96.00	96.00	94.8	90.00	89.2	89.2	89.2[a]	–	–
2013	95.74	95.75	95.81	95.68	95.65	94.91	90.35	90.3	90.3	33.19	77.05	86.94
2014	94.71	94.71	94.82	94.64	94.61	94.31	86.74	86.67	86.69	36.64	73.94	87.46
2015	93.43	93.35	93.56	93.33	93.2	93.03	85.29	85.23	85.22	30.73	76.62	88.73
2016	93.33	93.56	93.72	93.55	92.68	93.05	87.26	87.2	87.19	46.06	80.67	88.35
2017	94.6	94.63	94.7	94.62	94.39	94.29	91.84	91.79	91.81	45.62	82.64	90.9
2018	95.09	95.08	95.1	95.07	94.91	94.26	93.22	93.17	93.21	74.23	84.93	91.89
2019	95.01	94.99	95	94.99	94.93	94.89	94.49	94.44	94.47	90.5	79.44	92
2020	94.02	93.92	94.04	94.03	94.01	94.00	92.7	92.47	92.21	90.28	70.96	90.58
2021	94.00	94.00	94.00	94.00	93.98	93.94	93.85	93.8	93.85	92.08	73.37	91.25
2022	95.15	95.14	95.14	95.14	95.05	95.08	94.4	94.37	94.39	93.35	85.6	91.73
2023	94.76	95.55	94.76	94.76	94.76	94.83	94.64	94.61	94.64	93.76	83.76	91.57

a: From 2009 to 2012 data for varicella vaccination refer to the combined vaccination M–MMR–MMRV. Data about the single antigen were available from 2013. For meningococcus C and pneumococcus data are available starting from 2013.

Table 2. Linear regression coefficients from 2000 to 2023 for each antigen

Antigen	CR	LCI	UCI	*P*-value
Poliomyelitis	−0.114	−0.157	−0.070	.000
Diphtheria	−0.100	−0.150	−0.050	.000
Tetanus	−0.105	−0.151	−0.060	.000
Pertussis	0.065	−0.049	0.179	.251
Hepatitis B	−0.059	−0.117	−0.002	.043
Haemophilus influenzae B	0.657	0.179	1.136	.009
Measles	0.615	0.422	0.807	.000
Mumps	0.610	0.418	0.803	.000
Rubella	0.610	0.417	0.802	.000
Varicella	7.684	5.511	9.857	.000
Meningococcus C	0.435	−0.651	1.521	.389
Pneumococcus	0.485	0.260	0.710	.001

CR, coefficient of regression; LCI, lower confidence interval; UCI, upper confidence interval.

Hepatitis B

The highest value of coverage was observed in 2007 (96.5%), while the lowest in 2015 (92.68%). The linear regression showed an overall significant decrease from 2000 to 2023 (CR = −0.059, 95% CI [−0.117, −0.002], $P = .043$) (Table 2, Supplementary Fig. S1). The analysis highlighted three joinpoints (Fig. 1, Supplementary Table S1). After an initial significant increase in coverage (APC = +0.5284) between 2000 and 2004, a stable trend was observed until 2012 (APC = −0.0064), with values always ≥95%. From 2012 to 2015, a non-significant decline was reported (APC = −0.8830), followed by a non-significant increase until 2023 (APC = +0.1858).

Haemophilus influenzae type B

Coverages ranged from a low of 54.7% in 2000 to a high of 96.0% in 2007, with an overall significant increase shown by linear regression (CR = 0.657, 95% CI [0.179, 1.136], $P = .009$) (Table 2, Supplementary Fig. S1). One joinpoint was observed, identifying two trends (Fig. 1, Supplementary Table S1). From 2000 to 2002 it was reported a significant increase (APC = +28.2894), followed by a non-significant increase (APC = 0.1242).

Measles, mumps, and rubella

The trends related to measles, mumps, and rubella were nearly overlapping (Table 1), with slight differences in coverage linked to the construction of indicators for these antigens, as reported in the Methods section. Of note, for any of the antigens, the target of 95% was not reached during the entire period of study.

Overall, linear regression showed a significant increase for all the indicators: measles: CR = 0.615, 95% CI [0.422, 0.807], $P < .001$; mumps: CR = 0.610, 95% CI [0.418, 0.803], $P < .001$; rubella: CR = 0.610, 95% CI [0.417, 0.802], $P < .001$ (Table 2, Supplementary Fig. S2).

Coverages were significantly increasing for all three antigens up to 2010 (2012 for measles), where a joinpoint was observed in all the trends (Fig. 2, Supplementary Table S2). A first significant increase (APC = +3.9309 for mumps and rubella, +4.0976 for measles) until 2004 was reported, followed by a more contained significant increase (APC = +0.5932 for measles until 2012 and APC = 0.8737 for mumps and rubella until 2010). Subsequently, all the trends significantly decreased until 2015 (APC = −2.2593 for measles; APC = −1.2130 for mumps; APC = −1.2118 for rubella), followed by a significant increase until 2018 (APC = +3.1614 for measles; APC = +2.8172 for mumps; APC = +2.8071 for rubella). Finally, the trends showed a non-significant increase in coverages in the period 2018–2023 (APC = +0.1630 for measles; APC = +0.2111 for mumps; APC = +0.2152 for rubella).

Varicella

Varicella coverage was evaluated from 2013, as reported in the Methods section. Linear regression shows an overall significant increasing trend (CR = 7.684, 95% CI [5.511, 9.857], $P < .001$) over the period (Table 2, Supplementary Fig. S2D). Similarly, joinpoint regression showed no change in the trend (Fig. 2, Supplementary Table S1).

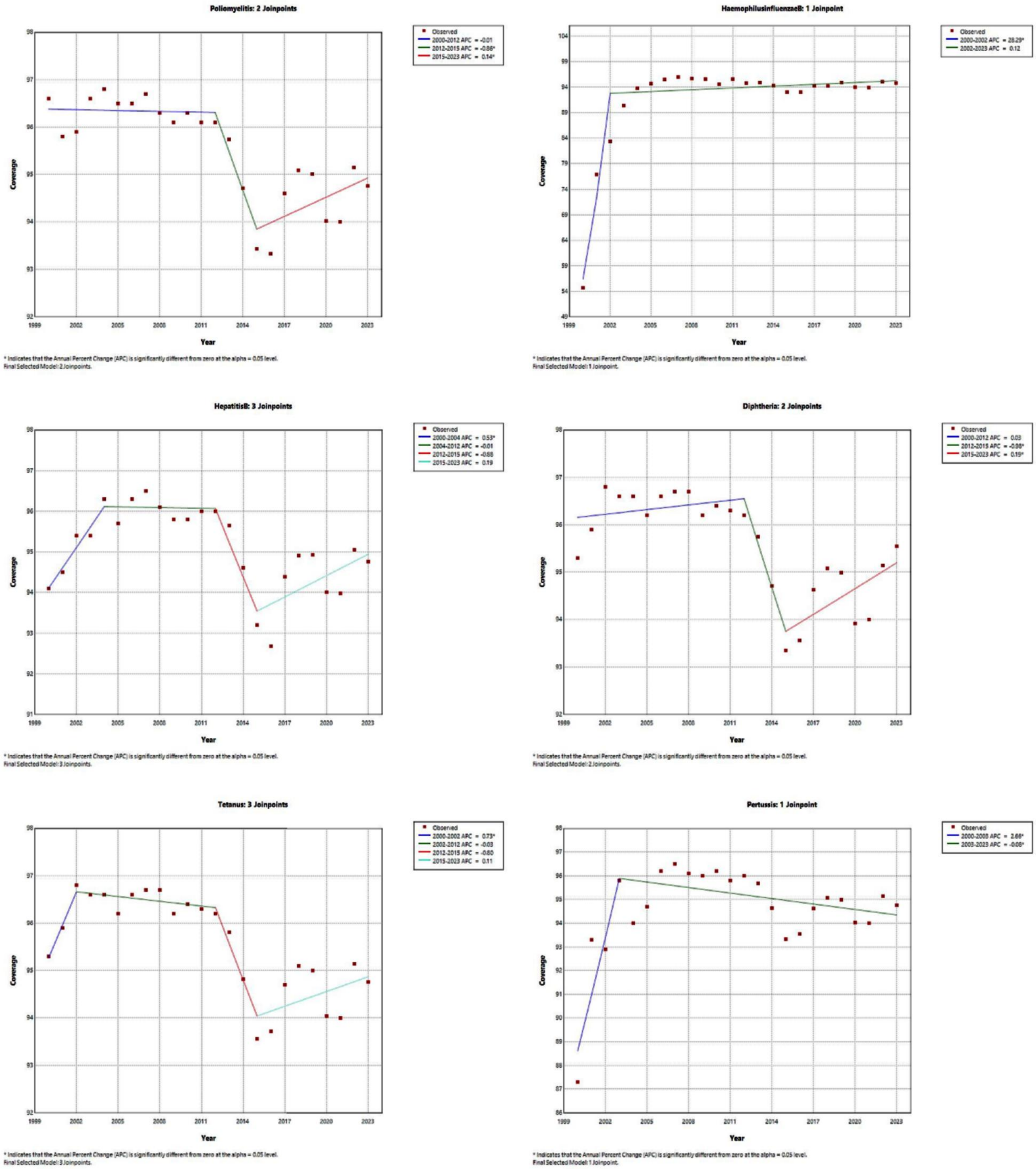

Figure 1. Joinpoint analysis from 2000 to 2023 for poliomyelitis, *Haemophilus influenzae* B, hepatitis B, diphtheria, tetanus, and pertussis.

Meningococcus C and Pneumococcus

Coverage values for both antigens showed a fluctuating trend, never reaching the target of 95% (Table 1). A significant overall increase was observed for pneumococcal disease (CR = 0.485, 95% CI [0.260, 0.710], $P = .001$), whereas the increase was not significant for meningococcus C (CR = 0.435, 95% CI [−0.651, 1.589], $P = .389$) (Supplementary Fig. S3). No joinpoints were identified for meningococcus C, while a joinpoint was observed for pneumococcus in 2018 (Supplementary Fig. S4 and Supplementary Table S1).

Discussion

This study analyses trends related to vaccination coverage of the 10 mandatory and two highly recommended vaccinations in Italy from 2000 to 2023. During the period under consideration, there were two events that might have a direct impact on vaccination coverages, namely Law 119/2017 increasing the number of mandatory pediatric vaccinations from four to 10, and the COVID-19 pandemic. The concerning decline in vaccination coverage observed throughout Italy until 2015, as highlighted by our study, resulted in a rise in

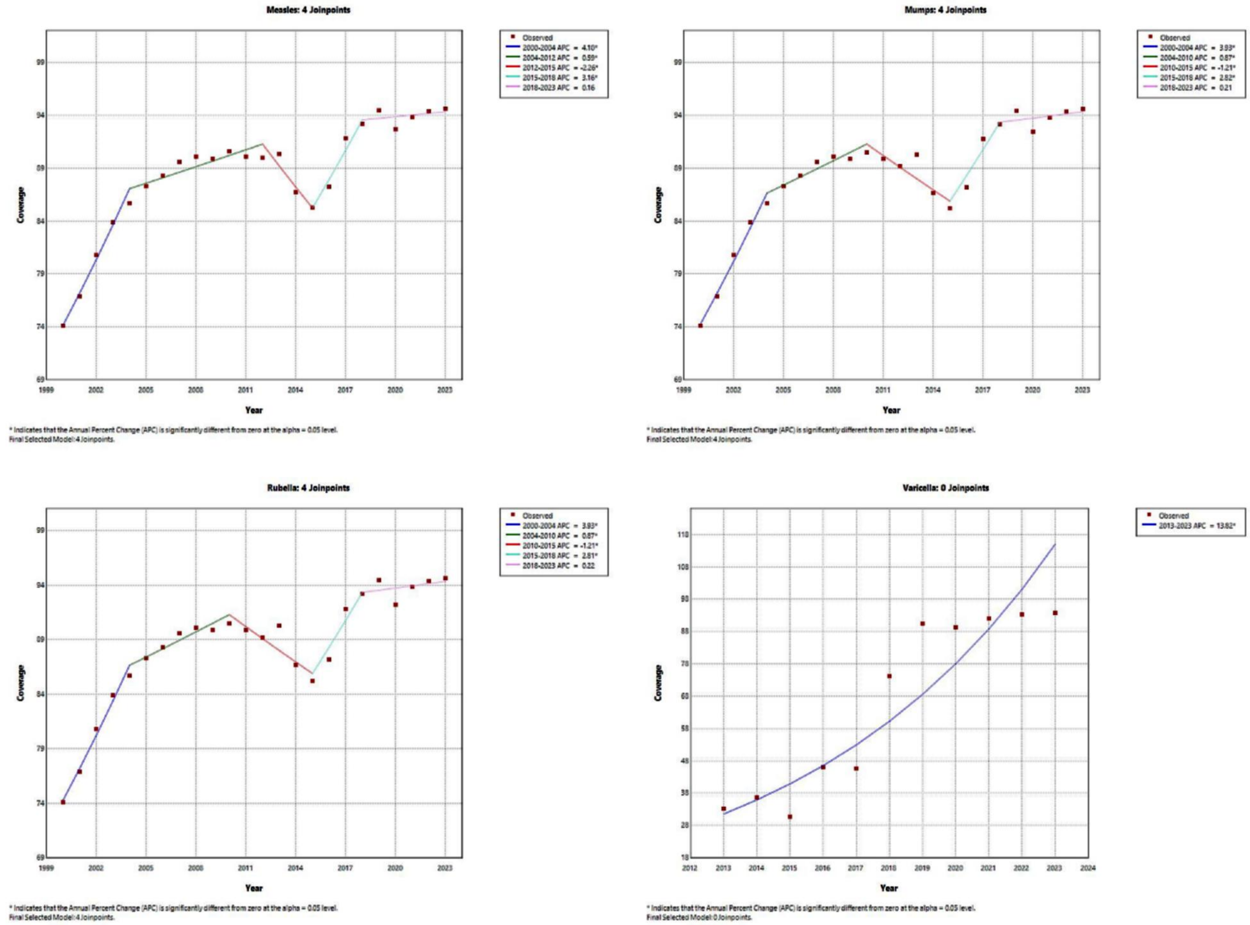

Figure 2. Joinpoint analysis from 2000 to 2023 for measles, mumps, rubella, and varicella.

VPDs, such as measles. This nationwide issue, marked by regional differences stemming from factors like historical hesitancy and logistical and organizational issues [16, 17], determined the need for legislative intervention. The subsequent law played a crucial role in reestablishing uniform coverage, guaranteeing equitable access, and addressing preexisting regional disparities.

Although compulsory vaccination was a debated issue due to its ethical implications [18–20], it is evident that such laws have an important effect on increasing vaccination coverage [14, 19, 21]. Several studies [22–25], in fact, have shown that the institution of mandatory vaccination in pediatric age has had an important effect not only on increasing coverage, but also leading to a marked reduction in the incidence of VPDs [23, 26]. Nevertheless, while vaccination mandates represent one potential strategy for increasing coverage, they should not be considered the sole viable solution. Other countries have successfully employed alternative approaches centered on citizen empowerment, aiming to address vaccine hesitancy within the general population and among parents, thereby positively influencing pediatric immunization rates [27]. However, the effectiveness in reducing vaccine hesitancy and increasing people's involvement and knowledge still seems unclear and country specific [28, 29].

In addition to mandatory laws, the COVID-19 pandemic may also have had an impact on the possibility and ability to ensure vaccinations in the population. In fact, many countries, during the pandemic, reduced or completely suspended some healthcare services, such as vaccinations and screening [30], with difficulty in recovery even three years later the onset of the pandemic [31]. A recent systematic review, e.g. reported a dramatic decline in vaccination coverage (by about 62% in children <2 years old) in the United States compared with the pre-pandemic period [32]. Even in Italy, the decline in coverage may be responsible for changes in the incidence of VPDs [9]. Among these, e.g. measles incidence spiked alarmingly in 2023 and 2024 in EU and Italy [33]. Underlying factors include programmatic and organizational aspects, workforce shifting during the most intense phases of the pandemic from routine activities to urgent care, in addition to the population's fear of COVID-19 infection [34, 35]. Analysing data for other vaccinations in specific populations, such as influenza in the elderly, reveals that the coverage increases observed during the pandemic were not sustained in subsequent years, representing a missed opportunity to ensure high coverages [36]. In contrast, our study highlights the disruptive role of the pandemic, showing a reduction in overall vaccination coverage. This discrepancy might be partly explained by the strong recommendation of influenza vaccination, particularly in the elderly but also across all age groups, including children [37], as a tool to reduce the burden of COVID-19 infection, prompting a higher uptake driven by public concern. Furthermore, while the pandemic led to a reduction in all vaccination coverages between 2019 and 2020, certain vaccines were disproportionately affected, notably meningococcus C (−10%) and MMR (approximately −2%). This disparity could be attributed to varying public perception of these diseases, potentially perceiving their severity as lower compared to others, thus leading to a more pronounced decline in their uptake.

Our study highlights the need for a shared effort aimed at increasing vaccination coverage and close the immunity gaps, continuing the path marked from 2017. Our analysis shows that in 2022 many antigens have increased coverage values compared to 2020, reaching the WHO target. The decline in coverage observed again in 2023, even for mandatory vaccines, underscores the significant challenges in maintaining effective vaccination programs. This situation highlights critical issues that necessitate focused public health strategies to ensure improved and sustained uptake.

To achieve optimal vaccination coverages, public health strategies should prioritize the implementation of consistent and effective communication campaigns and tailored educational programs on childhood immunization for both the general population and, crucially, for healthcare professionals, to ensure accurate recommendations and address vaccine hesitancy effectively. Moreover, achieving and sustaining high vaccination coverage necessitates both a strengthened public health workforce dedicated to immunization services and robust community-based and hospital-based programs. Furthermore, ensuring adherence to and enforcement of relevant vaccination laws is a crucial public health responsibility integral to reaching these targets.

This study has the following limitations. Vaccination data before 2013 may not precisely reflect individual antigen values as Ministry of Health indicators were not disaggregated at that level. However, this is the only nationwide data available, providing a robust overall estimate. For clear overestimations, like with varicella, trend analysis was restricted to data from 2013 onwards. Moreover, while Joinpoint regression identifies trend changes, it does not establish causality or explain the reasons for shifts. Upward trends starting in 2015 could misleadingly suggest improvement before Law 119/2017's impact. However, poliomyelitis and hepatitis B coverage decreased from 2015 to 2016, with other vaccines reporting only marginal increases. Crucially, 2016–2017 saw more substantial increases across nearly all coverages (e.g. +1.05% for tetanus to +5.30% for rubella), often double the increases observed in the previous year.

As other studies at national and international level have shown, both mandatory vaccination laws [23–25] and the COVID-19 pandemic [38, 39] have influenced coverage trends in some countries. Our study confirms this evidence, providing for the first time an analysis in Italy that does not simply assess the percentage differences that occurred exclusively in the years of interest, but considering a 23-year period, providing a more detailed assessment of trends. Finally, our analysis focused on 10 mandatory and two recommended vaccinations, excluding meningococcus B, hepatitis A, HPV, rotavirus, and meningococcus ACYW. These antigens were omitted due to insufficient data availability (less than 10 years), precluding a robust trend analysis.

Maintaining high vaccination coverage remains a critical priority for healthcare systems, as it effectively reduces the incidence, mortality, morbidity, and associated costs of VPDs. Law 119/2017 demonstrably increased vaccination coverage in Italy, reversing a concerning downward trend observed for most of the vaccinations examined. However, public health emergencies, such as the COVID-19 pandemic, can disrupt essential primary healthcare services, including vaccination programs. The recovery of coverage rates in Italy, evident from 2021 and confirmed in 2022, underscores the ongoing priority of achieving the optimal targets established by the WHO and the Italian National Vaccination Prevention Plan.

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Author contributions

All authors contributed to study conception and design. L.V. conceived the research hypothesis. Material preparation and data collection were performed by L.V., C.S., and F.A.C. C.S. and L.V. performed statistical analysis. The first draft of the article was written by L.V., C.S., F.A.C., and C.d.W. C.d.W., R.P., S.B., and W.R. commented on the latest version of the article. S.B. and C.d.W. supervised the study. All authors read and approved the final version of the article.

Supplementary data

Supplementary data are available at *EURPUB* online.

Conflict of interest: The authors declare no conflicts of interest.

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Ethics approval

This study does not require ethical approval as it exclusively utilizes aggregate data and does not involve the collection or analysis of any personal information pertaining to individual participants. Consequently, the research adheres to ethical standards while ensuring the privacy and confidentiality of individuals are maintained.

Data availability

The data underlying this article are available in the article and in its online supplementary material.

Key points

- Assessing trends in vaccination coverage is a key prerequisite to implement targeted efforts and ensure appropriate level of coverage at a national level.
- We observed an increasing trend in vaccine coverages between 2000 and 2023 in Italy, except for tetanus and diphtheria, poliomyelitis and Hepatitis B vaccines.
- Since the introduction of the compulsory law in 2017, a reversal of trends has been observed for most of the antigens considered, with an increase, i.e. maintained until 2019, from which, following the COVID-19 pandemic, a decline in coverage is observed for all antigens.
- Actions at national and regional level are needed to understand the underlying factors and subsequently implement dedicated efforts to reverse such trends.
- Public health must play a leading role by providing scientific support to policymakers, communicating effectively, ensuring adequate education, and increasing the knowledge and skills of healthcare professionals on vaccines.

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