

Comparison of vaccination coverage of children of the first year of life in the pre-pandemic period and during the COVID-19 pandemic

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Abstract

Introduction. Vaccination remains the most effective measure to combat infectious diseases. The COVID-19 pandemic has made adjustments to the work of pediatric health services around the world, which has affected all aspects of life, including routine immunization of children.

Objective. To analyze the indicators of coverage and timeliness of vaccination of children of the first year of life in the pre-pandemic period and during the COVID-19 pandemic, to assess the frequency and severity of post-vaccination reactions in children of the first year of life.

Materials and methods. A retrospective single-center study of medical documentation (form 112/y) of 414 children was conducted on the basis of GBU RO "City Children's Polyclinic No. 3" in Ryazan, who were divided into 2 groups: group 1 — children born in 2018 (n = 256), among whom 47.5% (n = 122) were girls, 51.5% (n = 134) are boys, group 2 are children born in 2020 (n = 158), of which 49% (n = 77) are girls, 51% (n = 81) are boys. The assessment of intergroup differences was carried out using the Pearson criterion (χ^2), adjusted for small samples. The difference in values was considered statistically significant at $p < 0.05$.

Results. Vaccination coverage in 2018 and 2020 was 95% and 98%, respectively ($p < 0.05$). The post-vaccination period in the majority of vaccinated children in group 1 (85%, n = 208) and in group 2 (81%, n = 128) proceeded smoothly ($p = 0.04$).

Conclusion. The COVID-19 pandemic did not have a negative impact on routine vaccination in the population of children in the first year of life.

Keywords: vaccination, children, pandemic, COVID-19

Competing interests:

The authors declare that they have no competing interests.

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Сравнение охвата вакцинацией детей первого года жизни в допандемийный период и во время пандемии COVID-19

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Аннотация

Актуальность. Вакцинопрофилактика остается наиболее эффективной мерой борьбы с инфекционными заболеваниями. Пандемия COVID-19 внесла коррективы в работу педиатрической службы здравоохранения во всем мире, что отразилось на всех аспектах жизнедеятельности, в том числе на проведении плановой иммунизации детей.

Цель. Проанализировать показатели охвата и своевременности вакцинации детей первого года жизни в допандемийный период и во время пандемии COVID-19, оценить частоту и тяжесть поствакцинальных реакций у детей первого года жизни.

Материалы и методы. На базе ГБУ РО «Городская детская поликлиника № 3» г. Рязань проведено ретроспективное одноцентровое исследование медицинской документации (форма 112/у) 414 детей, которые были разделены на 2 группы: 1-я группа — дети 2018 года рождения ($n = 256$), среди которых 47,5% ($n = 122$) девочки, 51,5% ($n = 134$) мальчики, 2-я группа — дети 2020 года рождения ($n = 158$), из них 49% ($n = 77$) девочки, 51% ($n = 81$) мальчики. Оценка межгрупповых различий осуществлялась с использованием критерия Пирсона (χ^2) с поправкой для малых выборок. Разницу значений считали статистически значимой при $p < 0,05$.

Результаты. Охват вакцинацией в 2018 году и 2020 году составил 95% и 98% соответственно ($p < 0,05$). Поствакцинальный период у большинства вакцинированных детей в 1-й группе (85%, $n = 208$) и во 2-й группе (81%, $n = 128$) протекал гладко ($p = 0,04$).

Заключение. Пандемия COVID-19 не оказала негативного влияния на проведение плановой вакцинации в популяции детей первого года жизни.

Ключевые слова: вакцинация, дети, пандемия, COVID-19

Конфликт интересов:

Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

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INTRODUCTION. Routine immunization is one of the most effective and cost-effective public health measures to control infectious diseases in children [1, 2]. Experts estimate that immunization of the pediatric population saves 2 to 3 million lives annually worldwide, which contributes significantly to the reduction of the global infant mortality rate. As a result of collaborative international initiatives, vaccination

coverage rates for children in low-income countries have increased from 50% to 80% over the past two decades [3]. As vaccination coverage has improved and protection of both vaccinated and unvaccinated populations has increased due to the phenomenon of collective immunity, there has been a significant decline in the registration of infections on the vaccination calendar [4].

On March 11, 2020, the World Health Organization declared COVID-19 a pandemic and a threat to public health and health systems worldwide. One of the pressing issues raised by the pandemic conditions was the continued implementation of routine vaccination as part of the National Vaccination Calendar [1]. The need for self-isolation, social distancing and other quarantine measures significantly reduced the demand for vaccination, and the population became fearful of becoming infected when visiting health facilities [5, 6]. As Henrietta Fore, Executive Director of the United Nations International Children's Emergency Fund (UNICEF), aptly describes this phenomenon: "COVID-19 has turned routine vaccination into a daunting challenge..." [7]. Disruption of immunization schedules, even for short periods, causes an increase in the number of susceptible individuals and increases the likelihood of infectious disease outbreaks. Such outbreaks can cause increased morbidity and mortality, mainly among young children as well as other vulnerable groups [8, 9].

Most studies worldwide have reported decreased rates or delayed routine vaccination during the COVID-19 pandemic. Brazilian researchers Santos V. et al (2023) conducted a retrospective analysis of all administered vaccine doses to children under 6 years of age from January 2019 to December 2020, in which the authors concluded that vaccination coverage decreased during the COVID-19 pandemic [10]. A team of clinicians from the University Clinical Research Center of Bamako, Mali, compared vaccination coverage during the pre-pandemic period in 2019 and during the COVID-19 pandemic in 2020. Coverage in 2019 was higher than in 2020 (88.7% vs. 71.6%), with the lowest proportion of vaccinated children (51.1%) observed in May 2020, two months after the first COVID-19 case in Mali [11]. A similar study was conducted in the United States (2023), where the authors analyzed data from 48,576 children under 24 months of age from 2018 to 2021 using a special questionnaire of the National Immunization Survey-Child (NIS-Child). It is reported that there was no overall decrease in vaccination coverage associated with the COVID-19 pandemic among all children, but vacci-

nation coverage for children living below the poverty line or living in rural areas was reduced [3].

Russian vaccination studies confirm low vaccine coverage during the pre-pandemic period and its decline during the COVID-19 pandemic. For example, the Research Institute of Pediatrics and Child Health Protection (Moscow) conducted a single-stage multicenter study (2020) that included data from 2687 children from different regions of Russia. The authors concluded that immunization coverage and vaccination rates vary widely by age and region, vaccination timelines are not respected, and influenza vaccination coverage is catastrophically low [12].

The role of pediatricians in the development of vaccination adherence is undeniable [13]. It is worth noting that the low level of adherence and the majority of vaccination refusals are due to parents' lack of knowledge on this issue, which is confirmed by numerous studies in this area [13, 14]. However, for many parents, the doctor's opinion is a priority, and that is why it is so important for health workers to be able to build a friendly dialogue and provide up-to-date information about the importance and safety of vaccination [13, 14].

The first case of COVID-19 in the Ryazan region was detected in an adult patient on March 19, 2020. Thereafter, there has been a steady increase in the number of cases, including 530 children as of July 21, 2020. Forced self-isolation and physical distancing measures could undoubtedly have affected routine vaccination of children, especially those in the first year of life.

STUDY OBJECTIVE. Analyze the rates of coverage and timeliness of vaccination of children of the first year of life in the pre-pandemic period and during the COVID-19 pandemic, assess the frequency and severity of post-vaccine reactions in children of the first year of life.

MATERIALS AND METHODS. A retrospective single-center study of medical records (form 112/u) of 414 children living in the city of Ryazan was conducted. Children were divided into 2 groups:

Group 1 included children born in 2018 ($n = 256$), among whom 47.5% ($n = 122$) were girls and 51.5% ($n = 134$) boys. Group 2 included children born in 2020 ($n = 158$), among whom 49.0% ($n = 77$) were girls and 51.0% ($n = 81$) were boys ($p > 0.05$).

The base for the study was SBI RO "City Children's Polyclinic № 3" (chief physician A. O. Burdukova), Ryazan.

Statistical processing of the results was performed using Microsoft Office Excel 2016. Intergroup differences were assessed using Pearson's criterion (χ^2) with correction for small samples. The difference in values was considered statistically significant at $p < 0.05$.

RESULTS. The analysis of vaccination coverage of children in the first year of life showed the following data: in Group 1, 95.7% of children ($n = 245$) were vaccinated in accordance with the National Vaccination Calendar, of whom 53.0% ($n = 130$) were fully vaccinated, 47.0% ($n = 115$) were partially vaccinated, and the parents of 4.3% of children ($n = 11$) completely refused preventive vaccinations for personal reasons. In Group 2, vaccination coverage was 100% ($n = 158$ children), of whom 56.0% ($n = 88$) were fully vaccinated by one year, 44.0% ($n = 70$) — partially ($p = 0.02$) [15].

When assessing vaccination coverage against viral hepatitis B (HBV), an increase in the proportion of vaccinated children in Group 2 was noted. Thus, in Group 1, hepatitis B vaccination coverage by the age of 6 months was 47.0% ($n = 121$), and 86.0% of children ($n = 222$) had been vaccinated by the end of the first year of life. In Group 2, 60.0% of children ($n = 95$) were fully immunized against HBV in a timely manner, and 83.0% of children ($n = 132$) were immunized by the end of the 1st year of life ($p = 0.02$) (Table 1).

According to our data, in Group 1, 4.5% of children ($n = 11$) were not vaccinated against tuberculosis before 1.5 years of age, 7.0% ($n = 18$) were vaccinated before 1.5 years of age due to temporary contraindications, but the majority 88.5% ($n = 227$) were vaccinated on time. In Group 2, all children received BCG-M vaccine, with 94.0% ($n = 149$) of children vaccinated on time and 6.0%

($n = 9$) vaccinated in the 1st year of life ($p > 0.05$) (Table 1).

It is worth noting that children receive their first HBV and BCG-M vaccine in the newborn period, and most received them on time, both pre-pandemic and during the COVID-19 pandemic period.

Vaccination coverage against pneumococcal infection (PCI) was significantly higher in Group 2: 63.0% of children ($n = 100$) were vaccinated on time, compared to only 29.0% ($n = 74$) in Group 1 ($p = 0.001$), and against *Haemophilus influenzae* (Hib): 28.5% of children ($n = 73$) in Group 1 and 89.0% of children ($n = 40$) in Group 2 ($p = 0.000$) (Table 1). This was facilitated by the active use of combined pentavalent vaccine, which entered the national calendar of preventive vaccinations in 2017, and has received the most active use in the last five years.

When analyzing influenza vaccination coverage among children, disappointing results were obtained. In Group 1, only 1.6% of children ($n = 4$) were vaccinated before the age of 1.5 years, and in Group 2, no one received an influenza vaccine ($p > 0.05$) (Table 1). At the same time, according to the National Preventive Vaccination Calendar, annual influenza vaccination is recommended for all children starting from 6 months of life.

When assessing the vaccination coverage of children against diphtheria, tetanus, and pertussis, the following data were obtained: in Group 1, only 38.0% of children ($n = 97$) were immunized three times by 6 months of age, and 48.0% of children ($n = 122$) by one year of age; in Group 2, 68.0% of children ($n = 107$) were immunized on time, and 86.0% ($n = 136$) by one year of age ($p > 0.05$) (Table 1). A similar situation was observed when assessing poliomyelitis vaccination coverage.

When assessing measles, mumps and rubella (MMR) vaccination coverage, it was found that the proportion of children who did not receive the vaccine before 1.5 years of age increased in Group 2. In group 1 this indicator amounted to 5.0% ($n = 15$), in group 2 — 14.0% ($n = 23$) ($p = 0.005$). At the same time, in Group 2, the number of children who received the MMR vaccine in time increased almost 1.5-fold (Table 1).

Таблица 1. Сравнение охвата вакцинацией детей 1-го года жизни (таблица автора)

Vaccine		Done on time			Done from infancy up to 1 year			Done from infancy up to 1.5 years			Not done until 1.5 years					
	Group 1 (n=256)	Group 2 (n=158)	p	OR (CI)	Group 1 (n=256)	Group 2 (n=158)	p	OR (CI)	Group 1 (n=256)	Group 2 (n=158)	p	OR (CI)	Group 1 (n=256)	Group 2 (n=158)	p	OR (CI)
V1	204 (80.0%)	146 (92.0%)	0.001	3.530 (1.530–8.141)	36 (13.8%)	7 (4.0%)	0.003	3.530 (1.530–8.141)	3 (1.2%)	2 (1.0%)	0.807	0.925 (0.153–5.597)	13 (5.0%)	3 (2.0%)	0.171	2.764 (0.775–9.857)
V2	143 (56.0%)	111 (70.0%)	0.005	0.536 (0.352–0.816)	97 (38.0%)	37 (23.0%)	0.003	1.995 (1.277–3.118)	2 (1.0%)	7 (5.0%)	0.026	0.170 (0.035–0.828)	14 (5.0%)	3 (2.0%)	0.128	2.989 (0.845–10.571)
V3	121 (47.0%)	95 (60.0%)	0.015	0.594 (0.89–0.398)	101 (39.0%)	37 (23.0%)	0.001	2.131 (1.365–3.327)	20 (8.5%)	17 (12.0%)	0.311	0.703 (0.356–1.387)	14 (5.5%)	9 (5.0%)	0.902	0.958 (0.405–2.268)
BCG	227 (88.5%)	149 (94.0%)	0.080	0.473 (0.218–1.027)	—	—	—	—	18 (7.0%)	9 (6.0%)	0.740	1.252 (0.548–2.860)	11 (4.5%)	0	0.020	—
V1	80 (37.0%)	108 (68.0%)	0.000	0.210 (0.137–0.322)	67 (31.0%)	17 (11.0%)	0.000	2.940 (1.654–5.226)	14 (7.0%)	12 (8.0%)	0.230	0.704 (0.317–1.563)	55 (25.0%)	21 (13.0%)	0.050	1.785 (1.032–3.087)
V2	61 (29.0%)	100 (63.0%)	0.000	0.178 (0.115–0.274)	65 (31.0%)	12 (8.0%)	0.000	4.140 (2.156–7.951)	26 (12.0%)	6 (4.0%)	0.030	2.675 (1.075–6.660)	57 (28.0%)	40 (25.0%)	0.553	0.845 (1.088–1.344)
V1	141 (55.0%)	121 (77.0%)	0.000	0.375 (0.241–0.584)	93 (36.5%)	34 (21.5%)	0.002	2.081 (1.318–3.286)	9 (3.5%)	2 (1.0%)	0.235	2.842 (0.606–13.327)	13 (5.0%)	1 (0.5%)	0.031	8.399 (1.088–64.840)
V2	104 (41.0%)	113 (71.0%)	0.000	0.272 (0.178–0.417)	123 (48.0%)	29 (18.0%)	0.000	4.114 (2.567–6.592)	15 (6.0%)	12 (8.0%)	0.755	0.757 (0.345–1.663)	14 (5.0%)	4 (3.0%)	0.240	2.277 (0.720–6.891)
V3	94 (37.0%)	107 (68.0%)	0.000	0.277 (0.182–0.421)	115 (45.0%)	21 (13.0%)	0.000	5.321 (3.160–8.960)	34 (13.0%)	20 (13.0%)	0.981	1.057 (0.585–1.910)	13 (5.0%)	10 (6.0%)	0.750	0.742 (0.339–1.851)
V1	141 (55.0%)	121 (77.0%)	0.000	0.226 (0.241–0.584)	93 (36.5%)	34 (21.5%)	0.002	2.081 (1.318–3.286)	9 (3.5%)	2 (1.0%)	0.235	2.842 (0.606–13.327)	13 (5.0%)	1 (0.5%)	0.031	8.399 (1.088–64.840)
V2	104 (41.0%)	113 (71.0%)	0.000	0.272 (0.178–0.417)	123 (48.0%)	29 (18.0%)	0.000	4.114 (2.567–6.592)	15 (6.0%)	12 (8.0%)	0.624	0.757 (0.345–1.663)	14 (5.0%)	4 (3.0%)	0.240	2.277 (0.720–6.891)
V3	94 (37.0%)	107 (68.0%)	0.000	0.277 (0.178–0.417)	115 (45.0%)	21 (13.0%)	0.000	5.246 (3.117–8.832)	34 (13.0%)	20 (13.0%)	0.857	1.057 (0.585–1.910)	13 (5.0%)	10 (6.0%)	0.750	0.742 (0.339–1.851)
V	128 (50.0%)	106 (67.0%)	0.001	0.491 (0.325–0.711)	—	—	—	—	113 (45.0%)	30 (12.0%)	0.000	3.372 (2.112–5.383)	15 (5.0%)	23 (14.0%)	0.005	0.365 (0.184–0.724)
V	73 (28.5%)	140 (89.0%)	0.000	0.051 (0.029–0.090)	—	—	—	—	—	—	—	—	183 (71.5%)	18 (11.0%)	0.000	19.498 (11.123–34.161)
V flu	4 (1.6%)	0	0.289	—	—	—	—	—	—	—	—	—	252 (98.4%)	158 (100%)	0.299	—

In the pre-pandemic period and during the COVID-19 pandemic, there was non-compliance with the vaccine administration dates regulated by the National Vaccination Calendar. Thus, 88.5% of children in Group 1 ($n = 227$) were timely immunized against tuberculosis, and 94.0% of children in Group 2 ($n = 149$) ($p > 0.05$). In Group 1, 60.0% of children ($n = 126$) and 71.0% of children ($n = 112$) in Group 2 received timely PCI ($p = 0.000$). Against diphtheria, pertussis and tetanus, 48.0% of children ($n = 122$) in Group 1 and 86.0% of children ($n = 136$) in Group 2 were immunized three times before the age of 1 year ($p = 0.001$). In Group 1, 50.0% of children ($n = 128$) received the MMR vaccine on time, and 67.0% of children ($n = 106$) in Group 2 ($p = 0.001$). At the same time, the proportion of children who received all vaccines on time increased in Group 2 (Figure 1).

The postvaccinal period in 85.0% of children ($n = 208$) in Group 1 and in 81.0% of children ($n = 128$) in Group 2 proceeded smoothly ($p > 0.05$). In the structure of postvaccinal reactions in Group 1 children, the leading conditions were temperature reaction (87.0%, $n = 32$) and local reaction in the form of local hyperemia (13.0%, $n = 5$). In Group 2 children, the following structure of postvaccinal reactions was observed: in 93.0% of children ($n = 28$) – temperature reaction, in 7.0% ($n = 2$) – local hyperemia ($p > 0.05$).

DISCUSSION

In our study, there was no negative impact of the new coronavirus pandemic on routine immunization

of children in the first year of life. Vaccination coverage remained high despite the ongoing pandemic, moreover, the proportion of children immunized against pneumococcal and Haemophilus influenzae infections increased significantly, but the percentage of influenza vaccine coverage among children remained low.

CONCLUSION. Vaccination coverage of children of the 1st year of life in GBI RO “City Children's Polyclinic № 3” in Ryazan in 2018 and 2020 remained high and amounted to 95.0% and 98.0%, respectively. Pandemic COVID-19 did not have a negative impact on the implementation of routine vaccination, moreover, parents have become more responsible for immunization. Thanks to effective measures carried out in GBI RO “City Children's Polyclinic № 3” in Ryazan, it was possible to implement the plan for immunization of children in 2020, despite the ongoing pandemic of a new coronavirus infection.

The role of immunization in improving the quality of life of the population is undeniable. Insufficient immunization coverage may be related to lack of knowledge and awareness of parents about the importance of vaccination, safety and efficacy of modern vaccines, accessibility issues [16, 17, 18].

Despite the challenges to preventive health care services during the COVID-19 pandemic, continuity of immunization services for children, especially

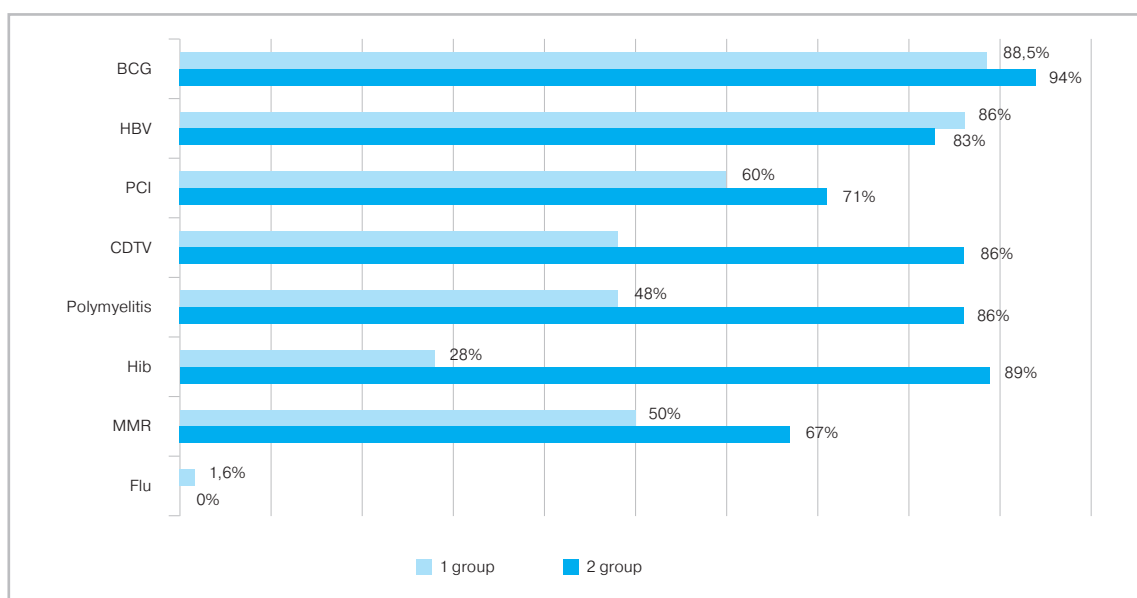


Fig. 1. Comparison of the timeliness of vaccination coverage for children 1 year of age (illustration by the author)
Рис. 1. Сравнение своевременности охвата вакцинацией детей 1 года жизни (иллюстрация автора)

those in the first year of life, is essential to make progress in vaccination as well as to prevent outbreaks of infectious diseases [1, 5]. Against the backdrop of the COVID-19 pandemic and non-compliance with the National Calendar's vaccination schedule or refusal to vaccinate, pediatricians and other health care providers have a particular influence on increasing population adherence to immuniza-

tion [19, 20]. If it is not possible to ensure routine vaccination within the National Calendar dates, district pediatricians should use the opportunity of an individual approach to conduct "catch-up" vaccination using highly effective and safe combination vaccines [21]. Special attention should be paid to influenza vaccination in designated age groups [22].

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THE AUTHORS' CONTRIBUTION TO THE WORK

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CONSENT FOR PUBLICATION

The legal representatives voluntarily signed an informed consent to the processing of personal data.

ИНФОРМИРОВАННОЕ СОГЛАСИЕ НА ПУБЛИКАЦИЮ

Законные представители добровольно подписали информированное согласие на обработку персональных данных.