ISSN: 2457-0400

WORLD JOURNAL OF ADVANCE HEALTHCARE RESEARCH

www.wjahr.com

Impact Factor: 7.675

Volume: 10, Issue: 9

Page N. 107-116

Year: 2026

Original Article

Coden USA: WJAMA3

DELAYED VACCINATION AND ASSOCIATED FACTORS AMONG CHILDREN LESS THAN 2 YEARS IN A SAMPLE ATTENDING PRIMARY HEALTH CARE CENTERS IN BAGHDAD CITY

[*1]Zahraa Sabah Hashim, [2]Ali Abd Ali Sahib

[1]Baghdad Health Directorate-Al-Karkh, Baghdad, Iraq.
[2]College of Medicine/Al-Nahrain University, Baghdad, Iraq.

Article Received: 22 July 2026 **Article Revised: 12 August 2026** **Article Published: 01 September 2026**

***Corresponding Author: Zahraa Sabah Hashim**

Baghdad Health Directorate-Al-Karkh, Baghdad, Iraq.

DOI: https://doi.org/10.5281/zenodo.22160362

How to cite this Article: [*1]Zahraa Sabah Hashim, [2]Ali Abd Ali Sahib (2026). Delayed Vaccination And Associated Factors Among Children Less Than 2 Years In A Sample Attending Primary Health Care Centers In Baghdad City. World Journal of Advance Healthcare Research, 10(9), 107-116.

ABSTRACT

Background: Vaccination is one of the most cost-effective preventive interventions, helping to prevent 2–3 million deaths per year; however, infectious diseases still affect Iraqi children, even though they receive vaccines free of charge. **Objectives of study:** To determine the rate and reasons for vaccination delay among a sample of children aged less than 2 years in Baghdad city. **Method:** An across-sectional study was carried out during the period from March to October 2020. A convenient sample of 30 Primary Health Care Centers (PHCCs) was distributed across the Al-Karkh and Al-Russafa Health Directorates in Baghdad. The information was obtained through direct interviews with the caregivers of a sample of 600 children under 2 years old who attended the health facility for immunization, using a structured questionnaire to assess each child's immunization schedule status. **Results:** Out of the 600 enrolled participants, 154 (25.7%) of their children had a vaccination delay. Of the delayed vaccinated children, 87% of the reasons were family-related, and only 13% were related to PHCCs. The main direct reasons for vaccination delays were a busy family schedule (41.7%), followed by social events such as death, sickness, or separation (22.4%), the perception that the child is too sick (14.9%), and changing the place of residence (17.8%). Indirect reasons include low mother's education, living in a rural area, and the accessibility to health care centers, including the difficulty and time needed to reach the health facility, especially during the month of emergency declaration in the country because of the COVID-19 pandemic. The study indicated that the highest percentage of vaccine delays was for the measles vaccine (22%). **Conclusion:** Major reasons for delay were related to family decisions, especially since the families were spending more effort and time trying to maintain an unusual balance of responsibilities after the COVID-19 pandemic. Families considered participation in the immunization process a lesser priority despite the health facility's continued provision of services, especially immunization.

KEYWORDS: Delayed, vaccination, children, less than 2 years.

INTRODUCTION

Vaccination is one of the most successful and cost-effective public health interventions for preventing childhood morbidity, disability, and mortality. Vaccines stimulate the immune system to develop protection against specific pathogens and have substantially reduced the burden of numerous vaccine-preventable diseases (VPDs), including measles, poliomyelitis, diphtheria, pertussis, tetanus, and meningitis. The World Health Organization (WHO) estimates that immunization prevents millions of deaths annually and considers vaccination an essential component of primary health care and global health security.[1] The establishment of the Expanded Programme on Immunization (EPI) by WHO in 1974 represented an important milestone toward ensuring equitable access to essential childhood vaccines worldwide.[2] Despite substantial improvements in vaccine availability, incomplete and delayed vaccination remain important public health challenges. In 2019, approximately 20 million children worldwide were unvaccinated or inadequately vaccinated.[3] Maintaining high vaccination coverage alone is insufficient because vaccines should also be administered at the recommended ages and intervals. Delayed administration prolongs the period during which children remain susceptible to VPDs and may contribute to the accumulation of susceptible individuals within communities, thereby facilitating outbreaks.[4] Vaccination timeliness is influenced by a complex interaction of child-, caregiver-, household-, and health-system-related factors. Parental knowledge and attitudes, misconceptions regarding vaccine contraindications, competing family responsibilities, socioeconomic circumstances, place of residence, transportation difficulties, distance from health facilities, missed opportunities for vaccination, and limitations in vaccine availability may contribute to delayed immunization.[4,5] These barriers may be particularly important in countries experiencing health-system instability or inequalities in access to primary health care. In Iraq, routine childhood vaccination is provided through primary health care centers (PHCCs), and considerable efforts have been made by the Ministry of Health in collaboration with WHO and UNICEF to strengthen immunization services. Nevertheless, gaps in vaccination coverage have persisted. In April 2020, WHO and UNICEF reported that fewer than half of Iraqi children aged 12–23 months were fully immunized and approximately two-thirds were protected against measles.[6] These concerns became particularly important during the coronavirus disease 2019 (COVID-19) pandemic. Movement restrictions, transportation difficulties, fear of exposure to infection, economic pressures, and disruption of health services affected routine immunization worldwide.[7] WHO and UNICEF reported substantial disruption of vaccination programmes during 2020, raising concerns about the re-emergence of VPDs.[7,8] Because vaccination delay is influenced by local social, demographic, and health-service circumstances, identifying its determinants within individual communities is essential for designing appropriate interventions. Therefore, this study aimed to determine the rate of vaccination delay and identify its main reasons among children younger than two years attending selected PHCCs in Baghdad, Iraq.

METHODS

A cross-sectional study with an analytical component was conducted in Baghdad, Iraq, from March to October 2020. The study was carried out in 30 primary health care centers (PHCCs), including 15 centers within Al-Karkh Directorate of Health and 15 within Al-Russafa Directorate of Health. The PHCCs were selected by convenience sampling from seven health sectors (four in Al-Karkh and three in Al-Russafa). The study included 600 children aged <24 months who attended the selected PHCCs with their caregivers for routine vaccination. Children were eligible if they were younger than two years and had an available vaccination card. Preterm and low-birth-weight children and children attending the PHCC for purposes other than vaccination were excluded. Vaccination cards were reviewed to obtain the dates and number of vaccine doses and previous PHCC visits. Data were collected through face-to-face interviews with caregivers using a structured questionnaire developed based on previous studies and reviewed by the study supervisor. The questionnaire collected information on parental sociodemographic characteristics, child age, sex and birth order, place of residence, family type, household characteristics, accessibility to the PHCC, and interpersonal communication between caregivers and healthcare providers during vaccination sessions. Caregivers were also asked about potential reasons for vaccination delay, which were categorized as family-related, PHCC-related, accessibility-related, or other reasons. Vaccination delay was defined as failure to receive an age-recommended vaccine for more than 30 days beyond its scheduled date. Children receiving the recommended vaccine within the specified period were classified as not delayed. A pilot study involving 20 children attending Shuhadaa Al-Shalgia PHCC was conducted to assess questionnaire clarity, interview duration, and potential administrative difficulties; these children were excluded from the final sample. Official approvals were obtained from the relevant scientific and health authorities, and verbal informed consent was obtained from caregivers before participation. Data were analyzed using SPSS version 25. Continuous variables were summarized using means, standard deviations, and ranges, while categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test. A P-value <0.05 was considered statistically significant.

RESULTS

A total of 600 participants were the subjects of this study. All of them were mothers, fathers, or relatives of children aged < two years. The distribution of respondents by socio-demographic data is shown in table (1). A structured questionnaire was filled through direct interview with the 600 participants. The mother was interviewed in 578 (96.3%) of cases, while other relatives in the remaining 22 (3.7%). Less than three quarters (73%) of participants live in urban area and 65.3% live in owned homes. Type of family was extended in 61.3% of participants, and 59.3% live in crowded homes (crowding index ≥ 3). Concerning time of arriving, most of families (81%) can arrive to PHC in ≤ 30 minutes.

Table 1: Distribution of respondents by certain socio demographic data.

Socio-demographic Data	No. (n= 600)	Percentage (%)
Interviewee		
Mother	578	96.3
Others	22	3.7
Residence		
Urban	438	73.0
Rural	162	27.0
Home		
Owned	392	65.3
Rented	208	34.7
Type of Family		
Nuclear	232	38.7
Extended	368	61.3
Crowding Index		
< 3	244	40.7
≥ 3	356	59.3
Time to Arrive PHC (min.)		
≤ 30	486	81.0
> 30	114	19.1

The distribution of parents by certain general characteristics is shown in figures (1 and 2) and table (2). Mothers' age was ranging from 18 to 49 years with a mean of 35.54 and standard deviation (SD) of ± 9.77 years. Most of mothers (80%) were found in age group of (20-40) years, and most of them (88.3%) were married. Regarding the educational level and occupation, more than two thirds of mothers (66.3%) finished primary or secondary school, and 46.3% were housewives. In this study, 20 women were widowed, so the total number of included fathers was 580. Fathers' age was ranging from 19 to 58 years with a mean of 38.89. Majority of fathers (93.1%) were aged (20-40) years, 54.8% had a higher education, and 45.9% of them were governmental employees.

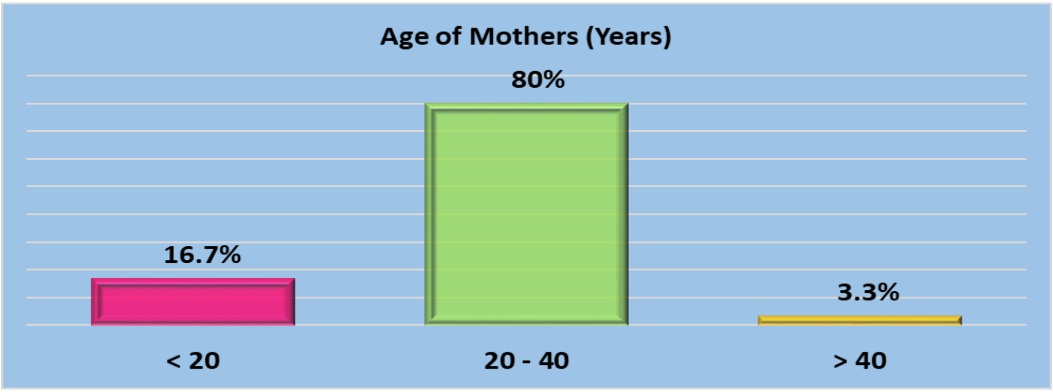


Figure 1: Distribution of mothers by age.

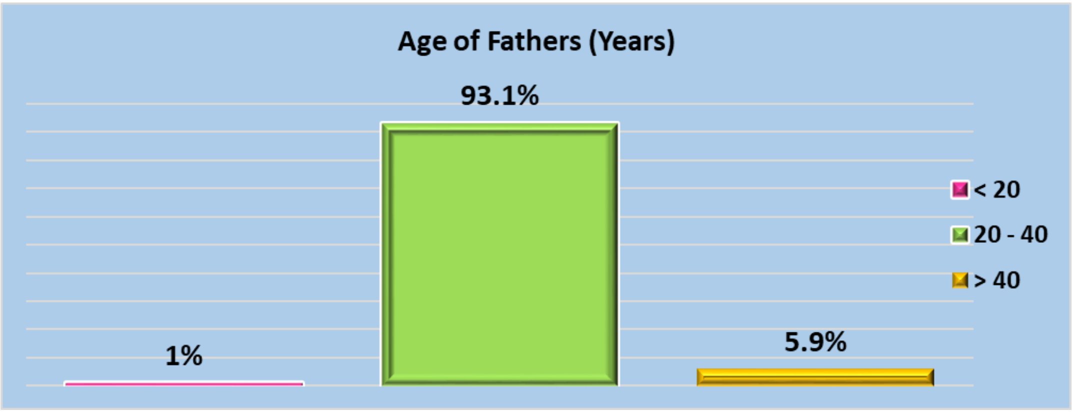


Figure 2: Distribution of fathers by age.

Table 2: Distributions of parents by certain general characteristics.

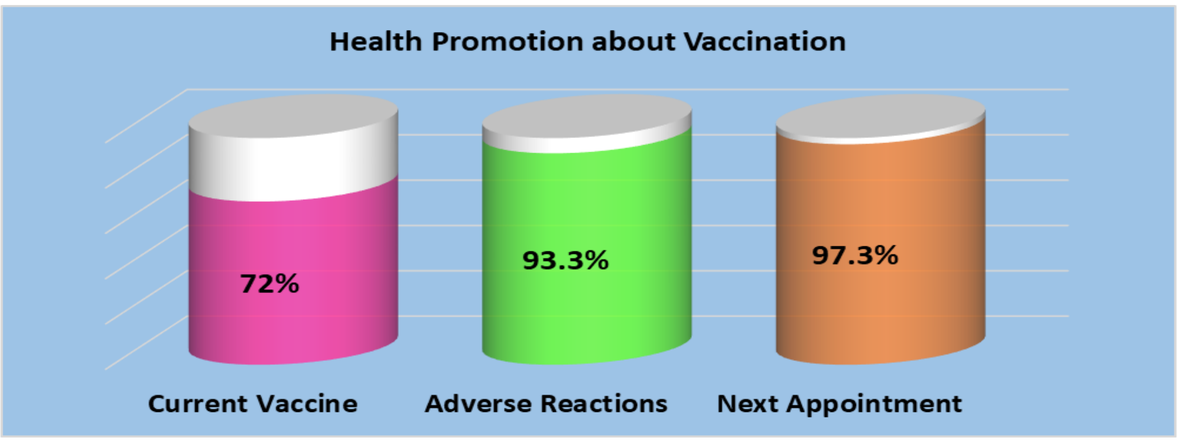
Variable	No. (n= 600)	Percentage (%)
Mother's Education		
Illiterate	12	2.0
Prim. or Second. School	398	66.3
Higher Education	190	31.7
Mother's Occupation		
Housewives	278	46.3
Student	86	14.4
Employee	236	39.3
Marital Status		
Married	530	88.3
Others	70	21.7
Father's Education	**n= 580**	
Illiterate	38	6.6
Prim. or Second. School	224	38.6
Higher Education	318	54.8
Father's Occupation	**n= 580**	
Not Employee	30	5.2
Student	44	7.5
Governmental Employee	266	45.9
Self-Employee	240	41.4

Table (3) shows the distribution of children by certain general characteristics. In this study, 40.3% of children were aged ≤ 6 months, 51.7% females with female to male ratio of 1.07: 1. Concerning child birth order in the family, 62% were the 3rd child or more.

Table 3: Distribution of children by certain general characteristics.

Variable	No. (n= 600)	Percentage (%)
Age of Child (Month)		
≤ 6	242	40.3
7 - 12	226	37.7
13 - 24	132	22.0
Child Gender		
Male	290	48.3
Female	310	51.7
Child Birth Order		
1st	82	13.7
2nd	146	24.3
≥ 3rd	372	62.0

From the 600 recruited participants, more than 90 percent received information about next appointment (97.3%), and possible adverse reactions (93.3%), while 72% of them received information about current vaccine, as shown in figure (3).



Out of the 600 enrolled participants, 154 (25.7%) of their children had vaccination delay, while the remaining 446 (74.3%) completed their vaccination schedule, as shown in figure (4).

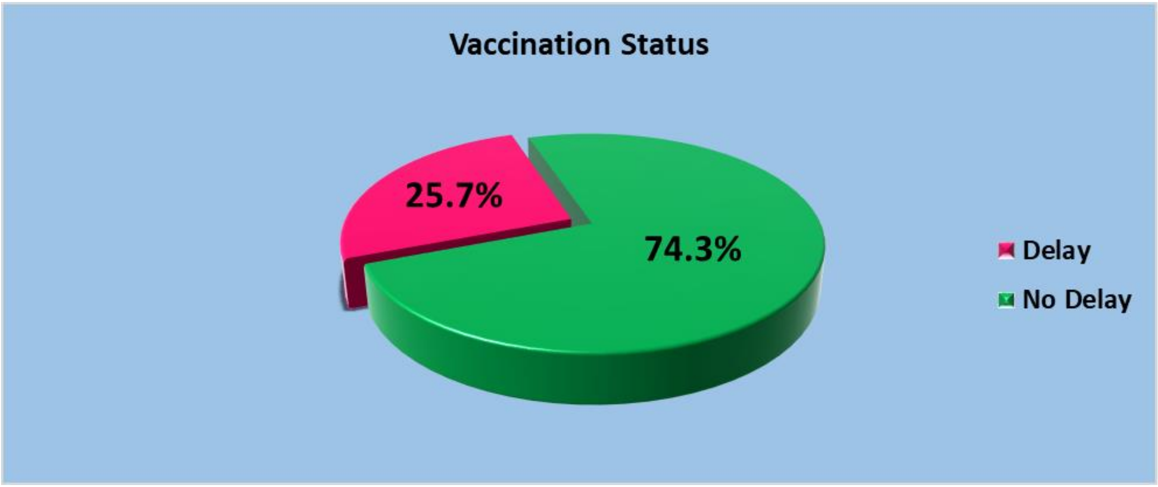


Figure 4: Distribution of participants by incidence of vaccination delay.

Of the 154 children with delayed vaccination, 60 (39%) had previous delay, and the highest proportion (63.3%) of them delayed once for more than 4 weeks to receive the vaccine, as shown in figure (5).

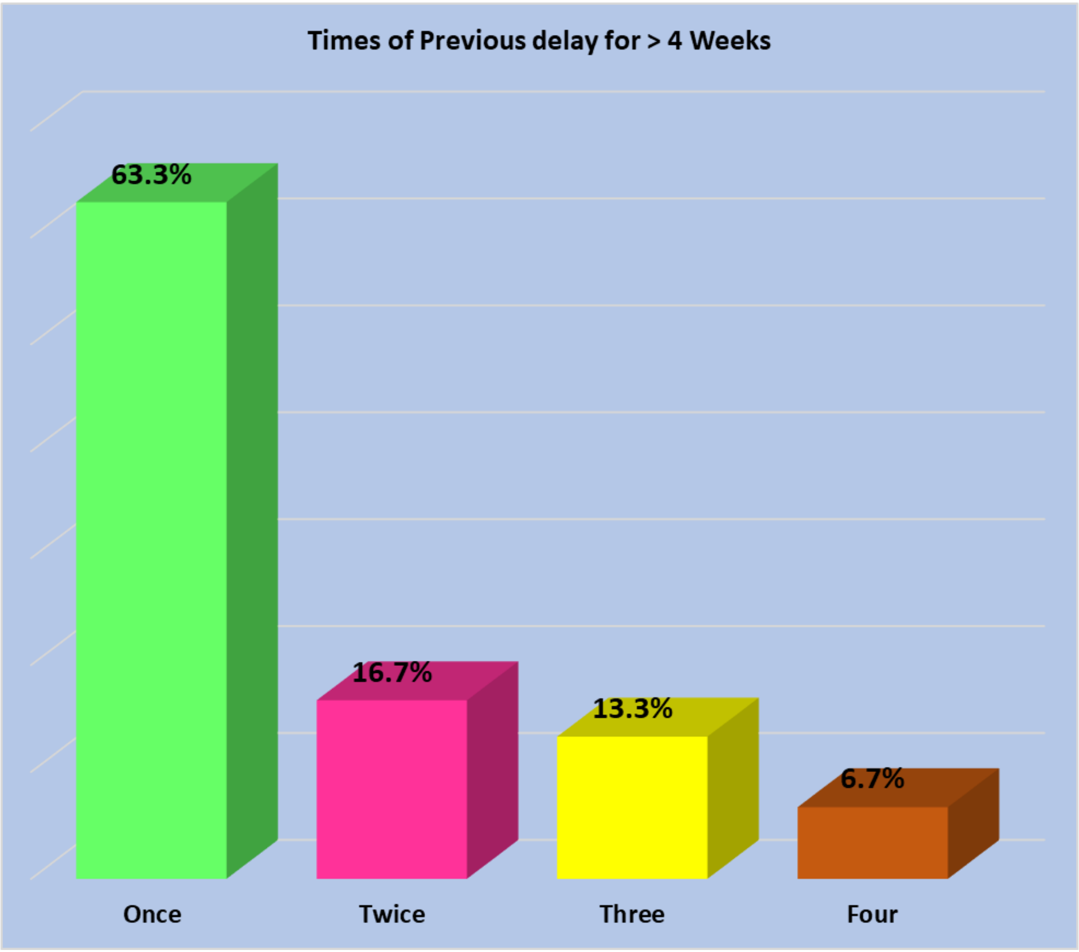


Figure 5: Distribution of participants by times of previous delay in vaccination.

In this study, 34 (22%) of children had delayed vaccination for measles vaccine, while 32 (20.8%) and 30 (19.5%) had delayed for vaccination of (OPV3, Penta3, PCV3, and IPV2) and MMR1 respectively, as shown in table (4).

Table 4: Distribution of respondents according to type of delayed vaccination.

Vaccination Delay	No. (n= 154)	Percentage (%)
OPV0, HBV1, BCG		
Yes	8	5.2
No	146	94.8
OPV1, Penta1, PCV1, Rota1		
Yes	10	6.5
No	144	93.5
OPV2, Rota2, Penta2, PCV2, IPV1		
Yes	14	9.1
No	140	90.9
OPV3, Penta3, PCV3, IPV2		
Yes	32	20.8
No	122	79.2
Measles		
Yes	34	22.0
No	120	78.0
MMR1		
Yes	30	19.5
No	124	80.5
Tetra, OPV Booster1, MMR2		
Yes	26	16.9
No	128	83.1

It has been found that out of 154 delay vaccinated children, 134 (87%) of the reasons were related to family, only 20 (13%) were related to PHCCs. The main reported cause for delay which reported by 56 (41.7%) was related to family reasons and family decision especially the families were spending more efforts and time trying to maintain an unusual balance of responsibilities after COVID -19 pandemic, Family considered the participation in the immunization process of lesser priority despite the health facility continued provision of services especially the immunization services. Followed by family events (death, sickness, separation) and perception that child is too sick, which reported by 30 (22.4%) and 10 (14.9%) of respondents, respectively. The remaining 20 (13%) were related to PHCCs, Child illness on the day of vaccination represented the most frequent reason as it was reported by 13 (65%), children were seen by doctors in health facility and child was too ill then the vaccine session was deferred until he/she got well. Vaccine problem was reported by 5 (25%), which include either not vaccination day, unavailable vaccine or the health workers were not opened vaccine vial in order to safe vaccine in case the children numbers not compatible with doses in the vial. While bad communications reported by 2 (10%) of participants. Distribution of participants by reasons of vaccination delay is shown in table (5).

Table 5: Distribution of respondents by reasons of delayed vaccination that related to the family and PHCCs.

Family related reasons		
Reasons of Incomplete Vaccination	**No. (n= 134)**	**Percentage (%)**
Busy Family /decision		
Yes	56	41.7
No	78	58.3
Family Events		
Yes	30	22.4
No	104	77.6
Perception that Child is Too Sick		
Yes	20	14.9
No	114	85.1
Change the place of residence		
Yes	16	11.9
No	118	88.1
Travel outside of Iraq		
Yes	8	5.9
No	126	94.1

Vaccine Adverse Reactions		
Yes	4	2.9
No	130	97.1
PHCC related reasons		
Reasons of Incomplete Vaccination	No. (n= 20)	Percentage (%)
Child illness		
Yes	13	65
No	7	35
Vaccine problem		
Yes	5	25
No	15	75
Bad communication		
Yes	2	10
No	18	90

Table (6) shows the distribution of participants by vaccination status and certain socio-demographic data. In this study, there was a statistically significant association between vaccination status and each of residence and time of arriving to PHC. The proportion of delayed vaccination was significantly higher among participants who live in rural area (40.1%, P= 0.001) and those who need more than 30 minutes to reach the PHC (38.6%, P= 0.001). Other socio-demographic factors didn't show statistical significance (P> 0.05) with vaccination delay.

Table 6: Distribution of participants by vaccination status and certain socio-demographicdata.

Variable	**Vaccination Status**		**Total (%) n= 600**	**P- Value**
	Delay (%) n= 154	**No Delay (%) n= 446**		
Interviewee				
Mothers	146 (25.3)	432 (74.7)	578 (96.3)	**0.242**
Others	8 (36.4)	14 (63.6)	22 (3.7)	
Residence				
Urban	89 (20.3)	349 (79.7)	438 (73.0)	**0.001**
Rural	65 (40.1)	97 (59.9)	162 (27.0)	
Home				
Owned	104 (26.5)	288 (73.5)	392 (65.3)	**0.506**
Rented	50 (24.0)	158 (76.0)	208 (34.7)	
Type of Family				
Nuclear	50 (21.6)	182 (78.4)	232 (38.7)	**0.067**
Extended	104 (28.3)	264 (71.7)	368 (61.3)	
Crowding Index				
< 3	48 (21.2)	178 (78.8)	226 (37.7)	**0.54**
≥ 3	106 (28.3)	268 (71.7)	374 (62.3)	
Time to Arrive PHC (min.)				
≤ 30	110 (22.6)	376 (77.4)	486 (81.0)	**0.001**
> 30	44 (38.6)	70 (61.4)	114 (19.0)	

Table (7) shows the distribution of participants by vaccination status and certain general characteristics of parents. It was clear that educational level and occupation of mothers was significantly associated with vaccination status of their children. The proportion of delayed vaccination was significantly higher among mothers of lower educational level (66.7%, P= 0.009) and student mothers (44.2%, P= 0.001). No significant association was found between vaccination status and age of mother (P= 0.091), marital status (P= 0.079), age of father (P= 0.207), educational level (P= 0.160), and occupation of fathers (P= 0.296).

Table 7: Distribution of participants by vaccination status and certain general characteristics of mothers.

Variable	Vaccination Status		Total (%) n= 600	P- Value
	Delay (%) n= 154	No Delay (%) n= 446		
Mother's age				
< 20	32 (32.0)	68 (68.0)	100 (16.7)	**0.091**
20 – 40	120 (25.0)	360 (75.0)	480 (80.0)	
> 40	2 (10.0)	18 (90.0)	20 (3.3)	
Mother's Education				
Illiterate	8 (66.7)	4 (33.3)	12 (2.0)	**0.009**
Prim. or Second. School	90 (22.6)	308 (77.4)	398 (66.3)	
Higher Education	56 (29.5)	134 (70.5)	190 (31.7)	
Mother's Occupation				
Housewives	32 (11.5)	246 (88.5)	278 (46.3)	**0.001**
Student	38 (44.2)	48 (55.8)	86 (14.3)	
Employee	84 (35.6)	152 (64.4)	236 (39.3)	
Marital Status				
Married	130 (24.5)	400 (75.5)	530 (88.3)	**0.079**
Others	24 (34.3)	46 (65.7)	70 (11.7)	
Father's age	**n= 138**	**n= 442**	**n= 580**	
< 20	2 (33.3)	4 (66.7)	6 (1.0)	**0.207**
20 – 40	132 (24.4)	408 (75.6)	540 (93.1)	
> 40	4 (11.8)	30 (88.2)	34 (5.9)	
Father's Education	**n= 138**	**n= 442**	**n= 580**	
Illiterate	6 (15.8)	32 (84.2)	38 (6.6)	**0.160**
Prim. or Second. School	62 (27.7)	162 (72.3)	224 (38.6)	
Higher Education	70 (22)	248 (78)	318 (54.8)	
Father's Occupation	**n= 138**	**n= 442**	**n= 580**	
Not Employee	4 (13.3)	26 (86.7)	30 (5.2)	**0.296**
Student	8 (18.2)	36 (81.8)	44 (7.5)	
Governmental Employee	62 (23.3)	204 (76.7)	266 (45.9)	
Self-Employee	64 (26.7)	176 (73.3)	240 (41.4)	

As shown in table (8), there was a statistically significant association (P= 0.001) between age of children and vaccination status, 42.4% of children who aged > one year had a delayed vaccination, while no statistically significant association was found between vaccination status and gender (P= 0.074), and birth order of children (P= 0.118).

Table 8: Distribution of respondents by vaccination status and certain general characteristics of fathers and children.

Variable	Vaccination Status		Total (%) n= 600	P- Value
	Delay (%) n= 154	No Delay (%) n= 446		
Child's age (Month)				
≤ 6	32 (13.2)	210 (86.8)	242 (40.3)	**0.001**
7 - 12	66 (29.2)	160 (70.8)	226 (37.7)	
13 - 24	56 (42.4)	76 (57.6)	132 (22.0)	
Child Gender				
Male	84 (29.0)	206 (71.0)	290 (48.3)	**0.074**
Female	70 (22.6)	240 (77.4)	310 (51.7)	
Child Birth Order				
1st	14 (17.1)	68 (82.9)	82 (13.7)	**0.118**
2nd	36 (24.7)	110 (75.3)	146 (24.3)	
≥ 3rd	104 (28.0)	268 (72.0)	372 (62.0)	

DISCUSSION

Timely childhood vaccination is essential for maintaining individual and population protection against vaccine-preventable diseases. The present study found that 25.7% of children younger than two years attending selected PHCCs in Baghdad experienced vaccination delay. This proportion is comparable to findings from Saudi Arabia, where approximately 23–24.2% of children had delayed vaccination[9,10], and to reports from the United States (25.8%)[11] and Saudi Arabia (28%).[12] In contrast, considerably higher rates have been reported in India (31%)[13], Norway (44.7%)[14], China (63%)[15], Gambia (63.3%)[16], and Pakistan (79.2%).[17] Such variation may reflect differences in vaccination programmes, accessibility of health services, socioeconomic conditions, parental attitudes, and definitions of vaccination delay across studies. Repeated vaccination delay was also an important finding. Among children with delayed vaccination, 39% had experienced a previous delay, suggesting that failure to receive one dose on time may influence the timeliness of subsequent doses. Similar findings were reported in France, where delayed administration of the first doses of several vaccines was associated with delayed subsequent doses.[18] Repeated delays may prolong periods of susceptibility to vaccine-preventable infections and compromise the effectiveness of routine immunization programmes.[19]

The measles vaccine showed the highest proportion of delay (22%). This finding is particularly important because measles is highly contagious and requires high and timely population coverage to prevent outbreaks.[20] The observed delay was lower than the nearly 80% reported in Baghdad in 2010[21], possibly indicating improved vaccination availability, health education, and caregiver adherence over time. Nevertheless, the current proportion remained higher than those reported in Ghana (16.5%), Gambia (10.8%), Saudi Arabia (9.3%), and Pakistan (4.5%).[10,16,17,22] Delayed measles vaccination extends the period during which children remain susceptible and may facilitate outbreaks when community transmission occurs.[23] Family-related factors accounted for 87% of the reported reasons for vaccination delay, whereas PHCC-related factors accounted for only 13%. Being busy with family responsibilities was the leading reason (41.7%), followed by social and family circumstances such as illness, death, or separation (22.4%). Family-related barriers reported in Saudi studies were lower, ranging from 24.4% to 33.7%.[9.10] The particularly high contribution of family factors in the present study may partly reflect the exceptional circumstances surrounding the COVID-19 pandemic, during which families faced competing responsibilities, movement restrictions, and disruptions to their usual routines. The perception that a child was too ill to receive vaccination was another important reason for delay (14.9%), consistent with previous findings from Saudi Arabia.[10] This highlights the need for clear caregiver education regarding true and false contraindications to vaccination. Appropriate communication by healthcare professionals may prevent unnecessary postponement of vaccination due to minor childhood illnesses. Vaccination delay was significantly more frequent among children living in rural areas and among those requiring ≥30 minutes to reach a PHCC. Similar associations between geographic accessibility and vaccination timeliness have been reported in Ethiopia, Nigeria, and Gambia.[16,24,25] Lower maternal educational attainment was also significantly associated with delayed vaccination, consistent with findings from Iraq and several other countries.[9,16,17,21,24,25] Conversely, child sex, birth order, and household crowding showed no significant associations with vaccination delay. Overall, these findings indicate that vaccination delay in Baghdad was determined predominantly by family and accessibility factors rather than PHCC-related barriers. Strengthening caregiver education, appointment reminders, counseling about vaccination during minor illnesses, and strategies to improve access for geographically disadvantaged families may therefore contribute to improving vaccination timeliness.

CONCLUSION

Vaccination delay affected approximately one-quarter of children. Family-related factors were the predominant reasons, particularly competing family responsibilities and social circumstances. Delays were associated with lower maternal education, maternal occupation, rural residence, and previous vaccination delays. Measles vaccination showed the highest delay, highlighting the need for targeted interventions to improve vaccination timeliness.

REFERENCES

1. World Health Organization. Vaccines and immunization [Internet]. Geneva: World Health Organization, 2020 [cited 2020 Feb 23]. Available from: http://www.who.int/topics/immunization/en/
2. André FE, Booy R, Bock HL, Clemens J, Datta SK, John TJ, et al. Vaccination greatly reduces disease, disability, death and inequity worldwide. Bull World Health Organ, 2008; 86(2): 81-160.
3. Centers for Disease Control and Prevention. Vaccine safety: ensuring vaccine safety [Internet]. Atlanta (GA): Centers for Disease Control and Prevention [cited 2020 Feb 23]. Available from: http://www.cdc.gov/vaccinesafety/ensuringsafety/history/index.html
4. World Health Organization Regional Office for the Eastern Mediterranean. Expanded Programme on Immunization: Iraq [Internet]. Cairo: WHO Regional Office for the Eastern Mediterranean [cited 2020 Feb 23]. Available from: http://www.emro.who.int/irq/programmes/expanded-programme-on-immunization-epi.html
5. World Health Organization. Expanded Programme on Immunization: benefits of immunization [Internet]. Geneva: World Health Organization, 2013 [cited 2020 Feb 23]. Available from: http://www.who.int/immunization/programmes_systems/supply_chain/benefits_of_immunization/en/
6. Lafta R, Hussain A. Trend of vaccine preventable diseases in Iraq in time of conflict. Pan Afr Med J, 2018; 31: 130.

7. Ministry of Health, Republic of Iraq. High level meeting on cost efficiency in procurement of vaccines and quality data coverage of vaccination in Iraq [Internet]. Baghdad: Ministry of Health, 2019. Available from: https://moh.gov.iq/upload/upfile/ar/995.pdf
8. World Health Organization. WHO vaccine-preventable diseases: monitoring system, 2020 global summary: WHO-UNICEF estimates time series for Iraq [Internet]. Geneva: World Health Organization, 2020 [cited 2020 Feb 26]. Available from: https://www.who.int/immunization/monitoring_surveillance/data/irq.pdf
9. Alrowaili GZR, Dar UF, Bandy AH. May we improve vaccine timeliness among children? A cross-sectional survey in northern Saudi Arabia. J Family Community Med, 2019; 26(2): 113-7.
10. Banjari MA, Alamri AA, Algarni AY, Abualjadayel MH, Alshardi YS, Alahmadi TS. How often do children receive their vaccinations late, and why? Saudi Med J, 2018; 39(4): 347-53.
11. Smith PJ, Humiston SG, Marcuse EK, Zhao Z, Dorell CG, Howes C, et al. Parental delay or refusal of vaccine doses, childhood vaccination coverage at 24 months of age, and the Health Belief Model. Public Health Rep, 2011; 126 Suppl 2: 135-46.
12. Basham K, Al Mutairi F, Baw B, Al Said L. Exploring influential factors in childhood vaccine delays in Riyadh, Saudi Arabia. J Family Med Prim Care, 2024 Aug; 13(8): 3165-3172. doi: 10.4103/jfmpc.jfmpc_95_24. Epub 2024 Jul 26. PMID: 39228617; PMCID: PMC11368322.
13. Shrivastwa N, Gillespie BW, Kolenic GE, Lepkowski JM, Boulton ML. Predictors of vaccination in India for children aged 12-36 months. Am J Prev Med, 2015; 49(6 Suppl 4): S435-44.
14. Riise ØR, Laake I, Bergsaker MAR, Nøkleby H, Haugen IL, Storsæter J. Monitoring of timely and delayed vaccinations: a nationwide registry-based study of Norwegian children aged <2 years. BMC Pediatr, 2015; 15: 180.
15. Hu Y, Chen Y, Liang H, Wang Y. Routine vaccination coverage of children aged 1-7 years in Zhejiang province, China. Hum Vaccin Immunother, 2018; 14(12): 2876-2883. doi: 10.1080/21645515.2018.1504523. Epub 2018 Aug 27. PMID: 30047821; PMCID: PMC6343626.
16. Odutola A, Afolabi MO, Ogundare EO, Lowe-Jallow YN, Worwui A, Okebe J, et al. Risk factors for delay in age-appropriate vaccinations among Gambian children. BMC Health Serv Res, 2015; 15: 346.
17. Noh JW, Kim YM, Akram N, Yoo KB, Cheon J, Lee LJ, et al. Determinants of timeliness in early childhood vaccination among mothers with vaccination cards in Sindh province, Pakistan: a secondary analysis of cross-sectional survey data. BMJ Open, 2019; 9: e028922.
18. Rybak A, Vié le Sage F, Béchet S, Werner A, Thiebault G, Bakhache P, et al. Timeliness of routine immunization in non-preterm children less than 2 years old using electronic data capture in an ambulatory setting in France in the context of vaccine hesitancy. Arch Pediatr, 2019; 26(2): 56-64.
19. Zhao Z, Smith PJ, Hill HA. Missed opportunities for simultaneous administration of the fourth dose of DTaP among children in the United States. Vaccine, 2017; 35: 3191-5.
20. Gay NJ. The theory of measles elimination: implications for the design of elimination strategies. J Infect Dis, 2004; 189 Suppl 1: S27-35.
21. Fadil L, Al-Lami F. Proportion and determinants of incomplete vaccination among children aged less than two years in Baghdad City. Iraqi Postgrad Med J, 2010; 10(2).
22. Laryea DO, Abbeyquaye Parbie E, Frimpong E. Timeliness of childhood vaccine uptake among children attending a tertiary health service facility-based immunisation clinic in Ghana. BMC Public Health, 2014; 14: 90.
23. Bielicki JA, Achermann R, Berger C. Timing of measles immunization and effective population vaccine coverage. Pediatrics, 2012; 130(3).
24. Geremew TT, Gezie LD, Abejie AN. Geographical variation and associated factors of childhood measles vaccination in Ethiopia: a spatial and multilevel analysis. BMC Public Health, 2019; 19: 1194.
25. Olorunsaiye CZ, Degge H. Variations in the uptake of routine immunization in Nigeria: examining determinants of inequitable access. Glob Health Commun, 2016; 2(1): 19-29.