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Prevalence of Missed Opportunities For Immunization and Its Associated Factors Among Children Below Two Years Old Attending Primary Healthcare Centers In Baghdad/Al-Karkh

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Abstract

Immunization is an effective means for preventing illness and reducing the burden of various infectious diseases. Incomplete or partial immunization poses a serious threat to the health of children in many developing countries, including Iraq. The objectives are to investigate the prevalence of missed opportunities for immunization (MOI) and its associated factors among children aged below two years old attending primary health care centers (PHCCs) in Baghdad/Al-Karkh. A cross-sectional study involving 500 children's companions attending PHCCs in Baghdad/Al-Karkh from the 1st of September 2022 to the 1st of July 2023. The respondents were enrolled using a systematic random sample technique and interviewed with a self-administered questionnaire. Vaccines studied in this study were within the National Programmed on immunization schedule including BCG, Hepatitis B birth dose, OPV, PCV13, Rota, Pentavalent (HBV, Hib, and DPT), IPV, Measles and MMR vaccines. Data analysis was done using Statistical Package for Social Science Version 22. Inferential statistics of the Chi-square test were used to test an association between various socio-demographic variables. The level of significance was <0.05. The results revealed that the overall prevalence of MOI was 31.6%. The commonest vaccines missed were those given at 18th –months of age (MMR2 booster, OPV, and DPT booster) at a rate of 46.9%. Non-availability or lack of vaccine(s), child sickness, visit of client on the wrong day of vaccination, and vaccine not opened for one child, were the major reasons responsible for MOI among children attending PHCCs in Baghdad/Al-Karkh. In conclusion, nearly one of every three children aged below two years old in Baghdad /Al-Karkh was incompletely vaccinated; non-availability of vaccine(s) was the main cause of incomplete immunization.

Keywords: Prevalence, Missed opportunities of immunization, Baghdad

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Introduction

Immunization is an effective means for preventing and reducing the morbidity and mortality of vaccine-preventable diseases in the world [1].

Since the start of the COVID-19 pandemic, it has been a significant health problem and many influences on different determinants of health systems, including routine childhood immunization programs around the world, leading worldwide decline in childhood immunization and putting millions of additional children at risk for vaccine-preventable diseases [2]. Globally, an estimated 67 million children missed out entirely or partially on routine immunization from 2019 to 2021. In the Middle East and North Africa, this figure is 3.8 million children [3].

Missed opportunities for immunization (MOI) constitute an obstacle to raising immunization coverage among children. An opportunity for immunization is missed when a child who is eligible for immunization and who has no contraindication to immunization visits a health service and does not receive all the recommended vaccines [4-5]. Many countries in the Mediterranean region including Iraq have been making efforts to strengthen their health system especially routine immunization to reduce the disease burden from vaccine-preventable diseases. A direct approach to increasing immunization coverage is to provide immunization for all eligible children at every opportunity. The World Health Organization has developed a module for assessing the reasons for MOI and determining effective strategies for its elimination. [6 -7]. This study aims to investigate the prevalence of MOI and its associated reasons or factors responsible for MOI among children below two years old attending primary health care centers (PHCCs) in the Baghdad/Al-Karkh sector.

Patientss and Methods

Study design and study period: A descriptive cross-sectional study was used for conducting this study. It was designed to describe the factors related to MOI among children below two years old attending PHCCs in Baghdad/ Al-Karkh, for the period from the 1st of September 2022 to the 1st of July 2023.

Area of study: This study was conducted across fourteen PHCCs selected from the Iraqi Ministry of Health/Baghdad/Al-Karkh Health Directorate using a multi-stage random sampling technique from the total of one hundred PHCCs providing curative and preventive health services for a population of 4.5 million persons distributed in areas that differ in their socio-economic status. These health centers include Al-Adel, Al-Amerya, Al-Jamea', Al-Mansour, Al-Eskan, Al-Washash, Al-Etafia, Al-Taji 1st, Al-Jaji 2nd, Sabaa' alboor, Abu

Ghareeb, Agargoof, Al-Naser and Al-Salam, Al-Zaitoon . These health centers operate three vaccination days/week (Sunday, Tuesday, and Thursday), from 9.00 AM -2.00 PM. Each health center was visited once or twice per week during the vaccination days. In each visit, 15-20 children were interviewed, and each interview lasted 10- 15 minutes.

Study population: All children below two years old were the source population. Caregivers of eligible Children aged below two years old attending the selected PHCCs during the study period were included as the sampled population. The companions of the children should be adult caregivers (aged>18 years). If a caregiver attended the PHCCs with two or more children, all were included. A systematic random sampling technique was used in selecting the eligible children visiting PHCCs at the day of assessment when the time is needed to filling the questionnaire form that used as a system.

Sample size: The sample size for this study was determined using the following formula [8]: $n = Z^2 P (1-p) / d^2$. n = desired sample size; Z = value of standard normal distribution ($Z = 1.96$); p = the proportion of children who fully immunized 56.2% in the county; d = margin of error with a confidence interval of 95% = 0.05. This calculation gave a minimum sample size of 378 children. We adjusted this minimum sample size by multiplying it by 1.3 to take account of the calculator effect giving a sample size of 491. The final sample size was 500 children.

Instrument for data collection: The instrument used for data collection was a questionnaire. It was adapted from the WHO tool for assessing MOI in health facilities and used for conducting this study [9] .

It was prepared in English language and then translated into Arabic language (local native). It has three parts. Part I was designed to collect information on the socio-demographic characteristics of the children. Part II was designed to collect information on socio-demographics of the child's caregivers. Part III was designed to collect information on the immunization status of the child and factors related MOI.

A pilot study was carried out between (1st to 10th September 2022) on 12 children's caregivers (not included in the study) attending the selected PHCC in Baghdad/ Al-Karkh sector to test the reliability of the instrument (questionnaire), it was calculated using Cronbach alpha. An average reliability coefficient of 0.82 was obtained which indicates a good reliability for the questionnaire. Validity of the instrument was carried out through a panel of three experts in the field to assess the face validity and suitability of items. Corrections and suggestions were integrated into the instrument to make a valid for the

study. The questionnaire was filled by the researcher through direct interview with each eligible children companions attending the health center for vaccination at the visited date and time. The researcher make assurance that each child caregiver has the chance to participate or withdraw prior to the study. All information obtained from the participants was anonymous, confidential, and used for the research. Verbal consent was obtained from each respondent before data collection and after the explanation of the study's purpose to them. An immunization card for each child was observed by the researcher to see the immunization dates, type, number of vaccine doses, and dates of visits. The routine immunization schedule was assessed by extracting information from the child's vaccination card, parents' recall of vaccination, and health facility-based registers. Approval and official permission for conducting this study were obtained from the College of Medicine/ Al-Iraqia University and the Iraqi Ministry of Health/Baghdad Health Directorate/Al-Karkh. This study was proved by the Research Ethics Committee, College of Medicine/Al-Iraqia University.

Statistical analysis: Data analysis was done using Statistical Package for Social Science version 22 (SPSS V. 22). Descriptive statistics were used for frequency and percentage tables, and figures for categorical data. Inferential statistics were done to measure the association between two nominal variables by using the Chi-square test. The level of significance was set at $p\text{-value} < 0.05$.

Results

A total of five hundred children aged below two years old, who visited PHCCs in Baghdad/ Al-Karkh during the study period were included with an overall respondent rate of 96%.

The table 1 showed the overall prevalence of MOI and the type of missed vaccines among the study group. The proportion of MOI was 31.6% (158/500). This table shows that MOI was highest for vaccines administered at 18th month (MMR2, OPV booster, DPT booster) (46.9%), at 4th –month (Pentavalent2, IPV1, Rota2, OPV2) (34.5%), at 12th (MMR1) (32.6%), at 2nd –month (Pentavalent1, OPV1, Rota1) (22.8%); while the lowest MOI were found at 6th –month (Pentavalent3, OPV3, IPV2) (10%) and at 9th -month (Measles) (10.6%). This variation in the proportions of MOI with types of vaccines was found statistically of significance ($p=0.000$).

Table 1.

Distribution of the study group according to the type of missed vaccines.

| Age of child | Type of vaccine | NO. of eligible children N=500 | Frequency of MOI N=158 | Proportion of MOI 31.6 | X ² P-value |
|---|------------------------------------|-----------------------------------|------------------------------|------------------------------|------------------------------|
| During the 1 st week of life | BCG, HBV1, OPV0 | 500 | 62 | 12.4 | 103.42 *0.000 df=6 |
| 2 month | Pentavalent1, OPV1, Rota1 | 369 | 84 | 22.8 | |
| 4 months | Pentavalent2, IPV1, Rota2, OPV2 | 281 | 97 | 34.5 | |
| 6 months | Pentavalent3, OPV3, IPV2 | 212 | 21 | 10 | |
| 9 months | Measles | 160 | 17 | 10.6 | |
| 12 months | MMR1 | 89 | 29 | 32.6 | |
| | | | | | |
| 18 months | MMR2, OPV booster, DPT booster | 32 | 15 | 46.9 | |
| | | | 325*** | | |
| *Significant association at p-value <0.05. ** Pentavalent vaccine contain HBV, Hib, DPT vaccines. *** Many children might missed more than one vaccine. | | | | | |

Figure 1 demonstrates the distribution of incompletely vaccinated children according to the type of missed vaccines. It was found that 61.4% of incompletely vaccinated children were missing the 4th -month vaccines (Pentavalent2, IPV1, Rota2, and OPV2), 53.2% was missing the 2nd-month vaccines (Pentavalent1, OPV1, Rota1), and 39.2% was missing the 1st week vaccines (BCG, HBV1, OPV0); while only 8.9% was missing the 18th -month vaccines (MMR2, OPV booster, DPT booster).

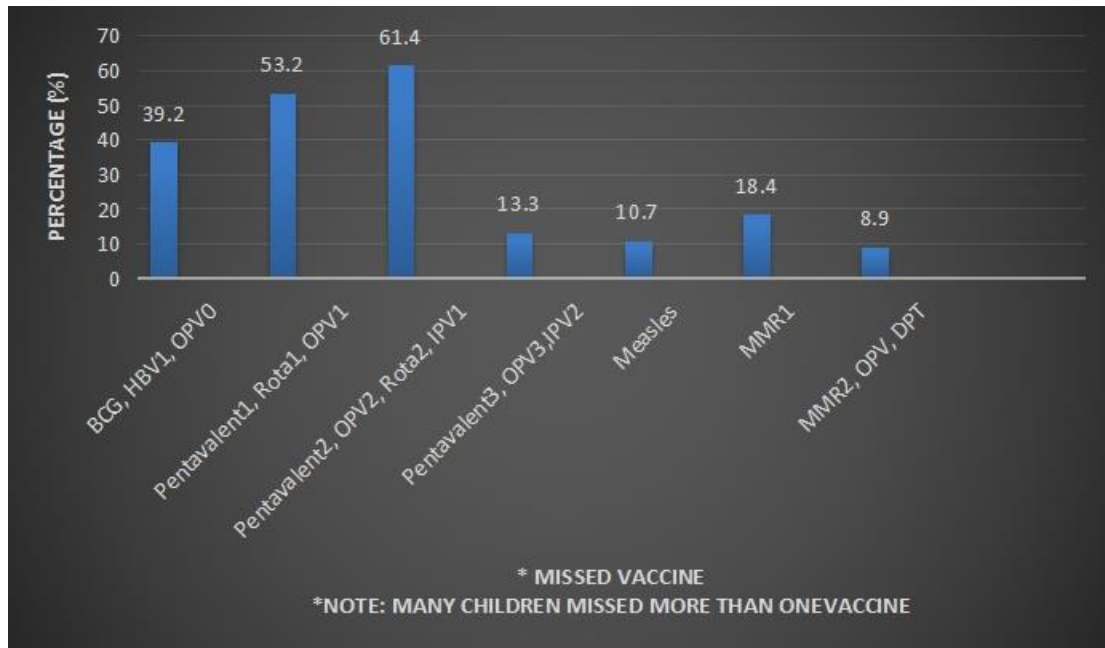


Figure 1.

Distribution of incompletely vaccinated children according to the type of missed vaccine.

General family housing characteristics declared by the companions of the children were demonstrated in **table 2**. From a total of 500 children's companions, three hundred seven (61.4%) live in extended families, four hundred thirty nine (87.8%) live in houses, three hundred fifty eight (71.6%) had house owned, three hundred ninety (78%) live near from the health facility, three hundred eighty four (76.8%) transport to health facility by vehicle and three hundred eighty nine (77.8%) live in urban areas (**Table 2**). The association between immunization status of the study group and family housing characteristics was also demonstrated in **table 2**.

It revealed that there was a significant statistical association between immunization status with type of family ($p=0.001$), the higher proportional of incomplete immunization was observed among children live in extended families (52.5%), while inverse relationship between the distance from PHCCs with the immunization status of the children was seen ($p=0.002$).

Table 2.

Distribution of the respondents according to family housing variables and immunization status.

| Variable | Immunization status | | | | Total | | X ² | P-value |
|--|----------------------|------|------------------------|------|-------|------|----------------|---------------|
| | Completely immunized | | Incompletely immunized | | | | | |
| | N= 342 | % | N=158 | % | N=500 | % | | |
| Type of family | | | | | | | | |
| Extending | 232 | 67.8 | 83 | 52.5 | 307 | 61.4 | 18.916 | *0.001 |
| Nuclear | 110 | 32.2 | 75 | 47.5 | 193 | 38.6 | | |
| Type of Residence | | | | | | | | |
| House | 297 | 86.8 | 142 | 89.9 | 439 | 87.8 | 0.927 | 0.427 |
| Apartment | 45 | 13.2 | 16 | 10.1 | 61 | 12.2 | | |
| Home owners | | | | | | | | |
| Owned | 252 | 73.7 | 106 | 67.1 | 358 | 71.6 | 2.312 | 0.171 |
| Rented | 90 | 26.3 | 52 | 32.9 | 142 | 28.4 | | |
| PHCCs is near | | | | | | | | |
| Yes | 280 | 81.9 | 110 | 69.3 | 390 | 78 | 9.452 | *0.002 |
| No | 62 | 18.1 | 48 | 30.7 | 110 | 22 | | |
| Mood of transport to PHCC | | | | | | | | |
| Vehicle | 260 | 76 | 124 | 78.5 | 384 | 76.8 | 0.366 | 0.645 |
| Walk | 82 | 24 | 34 | 21.5 | 116 | 23.2 | | |
| Family residence | | | | | | | | |
| Rural | 77 | 22.5 | 34 | 21.5 | 111 | 22.2 | 0.062 | 1.000 |
| Urban | 265 | 77.5 | 124 | 78.5 | 389 | 77.8 | | |
| <ul style="list-style-type: none"> • Significant level at p-value of <0.05 | | | | | | | | |

Regarding the reasons or factors responsible for incomplete immunization declared by the children's companions, we found that the most common reasons responsible for incompletely vaccinated children were non-availability of vaccines (24.9%), child sickness (19.5%), the visit day was not a vaccination day (14.4%), and the vaccine vial cannot be opened for one child to avoid wasting (11.2%) (**Figure 2**).

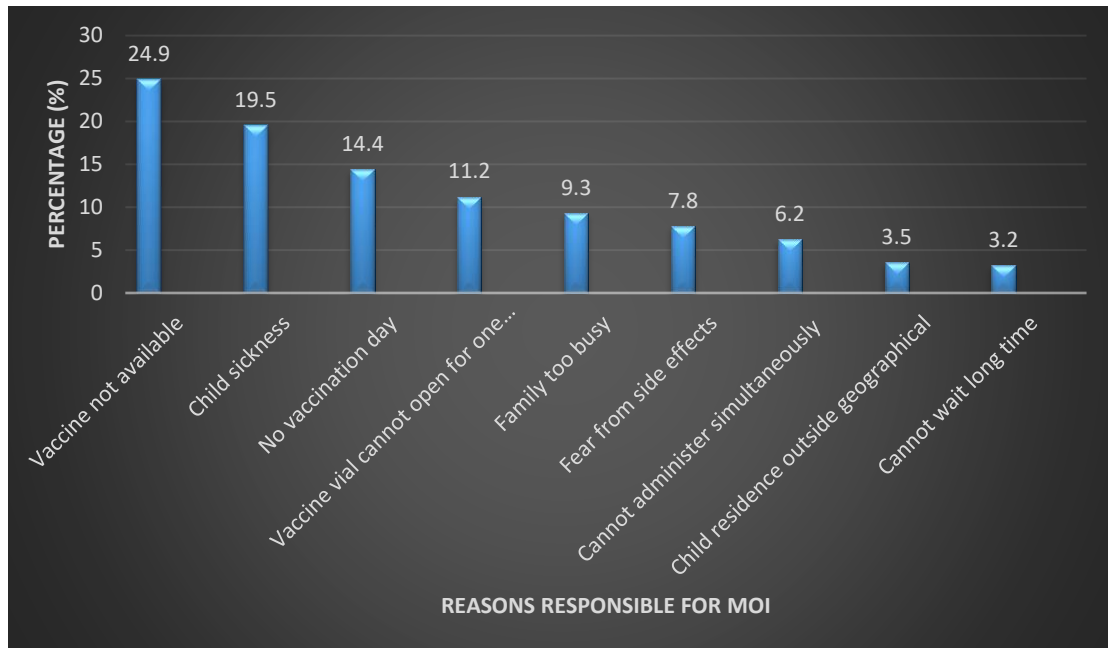


Figure 2.

Reasons responsible for incomplete immunization among the study group.

Discussions

Immunization is an effective means for preventing illness and reducing the burden of various infectious diseases. Incomplete or partial immunization poses a serious threat to the health of children [1]. The overall prevalence of MOI in this study was 31.6% ranging from 26.2% to 36.4% across the different selected PHCCs. WHO [2] estimated that the prevalence of global MOI as 42% and this is relatively higher than our finding. Among the Iraqi studies, our finding was relatively consistent with previous study conducted in Baghdad (36.4%) [10], in Diyala province/Iraq (30%) [11], and also similar to a systematic literature review of MOI in low-and middle-income countries the pool MOI prevalence were (32.2%) [12]. However, our finding was higher compared to those reported in other previous studies conducted in Baghdad (11-22.3%) [13-14] and lower than that reported in other Iraqi Provinces as in Mosul (45.8%) [15] and Babylon (61%) [16]. There may therefore be wide variations across the provinces in the logistics ensuring access to vaccination services and also could be due to differences in the study area, study period, sample size, and sampling technique. However, comparisons of immunization coverage between different countries especially in the nearby countries of Turkey, Jordan, and Arab Gulf States are difficult because of differences in the health service system, vaccine series and immunization schedules. The variations highlight the gradient of vaccination system performance across the country,

given diverse religious, sociocultural, or health service coverage and performance differences. Moreover, it might be related to variations in access to preventive care services and perception of the importance of vaccination between populations of different countries [4, 17].

The finding of this study shows that the most missed vaccines were that administered at 4th-month (Pentavalent2, IPV1, Rota2, and OPV2) (61.4%). However, the current study was higher than the previous study conducted in Baghdad by Alqurishi et al.[14] who found the proportion of incompletely vaccinated children (23%) was missing the 4th-month vaccines (Pentavalent2, IPV1, Rota2, and OPV2) ; It is also higher than that reported by Fadhil and Al-Lami, [18] who found that the proportion of incomplete vaccination among children (53.8%) was missing the 4th -month vaccines (DPT2,T0pvo2), and that reported in South Africa, by Nnaji et al.[19] who found a very low prevalence of MOI of missing the 14-weeks vaccines (DPT-IPV-Hib-HepB)(2.6%) PCV2 (3.2%). Our results were lower compared with a study conducted in 2017, by Le Roux et al. who reported that children with all immunization up to date were 48.6% at 4 months, 73.3% at 6 months, 83.9% at 9 months, 73.3% at 12 months and 73.2% at 18 months. These missed vaccines were related to various reasons such as stock-outs, lack of awareness of the immunization schedules, and lack of some vaccines [20].

A study carried out In Nigeria reported that the commonest vaccines missed were given at 2nd month (OPV1, HBV1, DPT1) (40.4%), followed by vaccines missed at birth (BCG, OPV0) (38.5%) and vaccines missed at 4th month (OPV2, HBV2, DPT2) (11.5%) [21]. This finding could be due to differences in the study period, availability of the vaccines from health facility to another, socio-demographic characteristics of the children's companions, and healthcare providers and delivery system of the studied health facilities.

Family type was found significantly associated with a child's immunization status; a high proportion of incomplete vaccination was seen among children living in extended families. This finding is consistent with many other previous studies conducted in Iraq [14, 22 -23] and in contrast to a study conducted in India [24]. The reason for this finding was that extended families need higher financial costs, also these large families focus on living, food supply and home renting, so they ignore their children's health and immunization, also in small families the mother had more time to take care of her baby.

Type of residence of the family was found insignificantly association with child's immunization status, the higher percentage of completely vaccinated children found among those living in house. This result agreed to other study carried out in Iraq [14] who found a

non-significant statistical association between them. Children live in owned house were more likely to be completely vaccinated than those live in rented one, but there was insignificant statistical association with immunization status. This result disagreed to other study [14] which found a significant association. This result may attributed to the fact that those who had owned a house were less likely to migrate and change their location, contrary to those who rented different houses depending on homeowner's circumstances, and migration was one of the most important causes of MOI.

The distance from the health facility is considered as one of the important factors in predicting the vaccination status of the children. In the present study, it was found that there was an inverse significant statistical association between distance from the health facility and the beneficiary's house with the immunization status. This finding is consistent with other studies [14, 23, 25-27] and in contrast to other studies [10, 28]. These findings could be attributed to difficult access to health facilities when living far from it in addition to financial costs despite providing mobile immunization team services and enhanced vaccination coverage.

Our study found a higher percentage of completely immunized children among families using the vehicle to transport to PHCCs than by walking but without significant statistical association between them. In contrast to other studies conducted in Ethiopia [27] which found a significant association between vaccination status and mood of transport. This may be a possible reason that transportation is the main factor to get the health service timely and properly, and because some of vaccines particularly (BCG and Measles) vaccines are available with limited time and date to avert unnecessary wastage. Therefore to take these vaccines the clients may wait until the number of children reaches ten or twenty to open these vaccines by the health care workers, and this may lead to come again next time which makes the clients get upset even if the transport is easily accessible [27].

Children live in rural area were less likely to be completely vaccinated than those live in urban area, but there was insignificant statistical association with MOI .This finding is supported by studies performed in emerging regions in India and Ethiopia [28-29]. This might be explained by urban resident's parents who might have better information and recognized the importance of immunization. However, this finding is contrary to other studies in which reported that children from urban areas were more likely to be incomplete vaccinated than those from rural areas [16,24,30]. This could be explained by the shortage of coverage by mobile immunization teams resulting from a shortage of resources in health settings. Furthermore, immunization activities are limited to urban areas whereas little

attention is paid to rural areas. In this study, the children's companions presented different reasons for incomplete immunization of their children and these were lack or non-availability of vaccine 24.9% followed by child sickness 19.5%, not visiting on a vaccination day 14.4%, the vaccine cannot open for one child 11.2%, and families were too busy 9.3%. This finding is similar to another study conducted in Iraq [31] which found that 15.8% of the incompletely immunized children were mainly due to unavailable vaccines and child sickness; it was also consistent with a recent MOI assessment study which reported that lack of vaccines was the main reason for MOI [32].

Another study conducted in Libya [33] revealed that the child's sickness was the most common cause for cessation of immunization (54%), followed by non-availability of the vaccine (20%), social reasons (10.5%), and forgetfulness (5.5%). In Ethiopia, Muluneh et al [29] reported that different reasons are responsible for MOI among children including mothers being too busy (11.6%), vaccinator absent(11.1%), fear of side effects(8.5%), place of immunization to far(8.3%), vaccine not available (8.3%), vaccine not open for a single child(7.8%), and long vaccine time(5.2%).

In 2017, Khaliq et al. mentioned that lack of knowledge regarding immunization schedule (28.7%), fear of vaccine side effects (21.3%), child sickness (17.2%), and non-availability of vaccines in health centers (4.1%) were the prominent reasons responsible of incomplete immunization among children in Pakistan [34]. Occasionally, vaccines may not be available in the PHCCs at the appointment of vaccination dates due to logistic problems and poor distribution networks. However, the lack of vaccines as noted may be due to the inability of health center staff to forecast properly the vaccine needs of the center, since there was no report of vaccine shortage in the country during the period of the study. This study has its limitations. Firstly, when vaccination cards were not available, data on vaccination uptake were based on self-reports from the children's companions, so there is the risk of recall bias that is not unique to our study; it is a shortcoming inherent in a cross-sectional study, as they obtain information on potential risk factors and the outcome at the same time. Secondly, we did not study the health facility factors such as staff attitudes towards immunization, heavy workload, pharmacy stock practice, and lack of training in immunization guidelines. Thirdly, this study involved children aged below two years old and focused on PHCCs. These limit the generalizability of the study findings and their implication for all children and all health settings in the reference population of Iraqi provinces.

Conclusions

Nearly, one out of three children below two years old had missed the opportunity for immunization. The various family housing variables of the children's companions are important predictors for increasing the rate of MOI among children. Different reasons attributed to incomplete immunization including reasons related to caregivers, health care workers, and health care logistics and organization, the highest rate of MOI found among non-availability of vaccines. Addressing these opportunities through concerted actions involving caregivers, healthcare workers, and related healthcare systems can improve immunization coverage. Therefore, the immunization status of the children should be evaluated for each healthcare visit to avoid or decrease missed opportunities for immunization.

Abbreviations

Not applicable

Declarations

Ethics approval and consent to participate

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Authors' contributions

Baraka Safaa' Mustafa: the research article proposal, preparing materials, design study, explaining the findings, and article writing. Jalil Ibrahim Saleh: Data curation, Statistical analysis, and review and editing.

Competing Interests

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest.

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