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Prevalence of missed opportunities of immunization among children below two years attending primary healthcare centers In Baghdad/Al-Karkh

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Abstract
Background: Vaccine- preventable diseases constitute a major cause of morbidity, mortality and disability in children below 5 years of age in many developing countries, including Iraq.
Objectives: In order to ascertain the prevalence of missed opportunities for regular immunization (MOI) and the factors associated with it among children under the age of two years attending primary health care centers (PHCCs) in Iraq/ Baghdad/ Al-Karkh.
Methods: A cross-sectional study was carried out from September 2022 to July, 2023. It was conducted on 500 parents or relatives attending PHCCs in Baghdad/ Al-Karkh sector whose children were within the aged below two years during the study period. These health facilities were selected randomly using cluster sampling technique. The data was gathered utilizing the conventional missed opportunity method developed by the World Health Organization. Vaccines studied in this study were BCG, Hepatitis B birth dose, OPV, PCV13, Rota, Pentavalent (Hep. B, Hib, DPT), IPV, Measles and MMR vaccines. The assessment of the children's immunization status was conducted using a standardized questionnaire that relied on information obtained from vaccination cards, and parental recall of vaccination history as well as interview with health care providers. The proportion of MOI among children with verified vaccination histories were assessed and statistically analyzed by chi square test using SPSS version 22. The level of significant is considered at P-value< 0.05.
Results: A total of 68.4% of children below the age of 2 who were eligible for vaccination received the complete set of recommended vaccines, while 31.6% received an incomplete set of vaccines.The second dose of the MMR vaccine exhibited the highest incidence of mode of infection (MOI) among single vaccines, with a rate of 46.9%. The variables that exhibited a significant association with the mode of infant feeding (MOI) were the child's age, birth order, and birth place, as well as the antenatal care received. Additionally, the caregivers' marital status, education level, occupation, monthly income, and purpose of visit were also found to be significantly connected with MOI.
Conclusion: Nearly, one out of three children below two years old had missed for immunization. The various socio-demographic variables of the child and child's caregivers are important predictors for MOI among children. Immunization status of the children should be evaluated for each healthcare visit to avoid missed opportunities.

Keywords: Prevalence, missed opportunities of immunization, Baghdad

Introduction
Immunization is considered as one of the most protective measures against serious infectious diseases. Immunization of children has become one of the most cost effective and an impact public health strategy for preventing and reducing infectious diseases related morbidity, mortality and disabilities of children [1].
Expanded program of immunization (EPI) in developing countries has prevented more than two millions child deaths from routine immunization diseases since it's initiative in 1974 [2]. In Iraq, this program was adopted in 1985, in 1987 the immunization coverage had reached 94% and then it was declined after four decades [3]. The declining in the immunization coverage among children <5 years old was due to the fact that within four decades of political struggles, the Gulf war, economic sanctions, internal conflicts, violence, migration, internal displacement in addition to the actions of the Islamic State (ISIS) attacks, Iraq have been left with deteriorating the quality and accessibility of healthcare services resulting in poor outcomes [4-6]. However, there are still thousands of children who do not complete all their vaccines doses and hence not fully protected and they are considered as risk for

outbreaks and reintroduction of infectious diseases [7]. Despite the remarkable achievement of the EPI in Iraq, numerus challenges remain, one of these challenges including missed opportunities for immunization (MOI) which represents a global public health obstacle to raising immunization coverage among children and women of childbearing age as well as reducing child deaths. It is reported by many countries when partially or completely non-immunized child misses the benefit of getting immunization during a visit to health facilities for a sickness or checkup with at least one vaccine due to the national immunization schedule when there is no absolute contraindication for that particular vaccine [8]. The objective of this study was to determine the prevalence of MOI among children below two years old attending different PHCCs located in Baghdad/Al-Karkh sector.

Methods

Study setting

This study was conducted at different PHCCs located in Al-Karkh sector of Baghdad, the capital of Iraq. These PHCCs provided curative, preventive health care services to approximately 4 million people living in this sector. A total of 15 out of 96 PHCCs were randomly selected from Baghdad/AL-Karkh Health Directorate (DOH) using cluster multi-stage random sampling technique to obtain a representative study sample. These health centers are distributed at central level (Al-Adell and Al Karkh health sectors) and peripheral level (Abu Ghraib and Al -Taji health sectors) of health care system. These health centers operate three immunization days per week (Sunday, Tuesday, and Thursday) from 9.00 AM-1.00 PM. Each health facility was visited once or twice weekly during the work time hours; in each visit, 10-15 children's caregivers were interviewed, and each interview lasts about 15 minutes. The PHCCs are situated in regions characterized by varying socio-economic statuses.

Study design and period

A health facility - based cross-sectional design study was conducted from September 2022 to July 2023.

Study Population and participant selection

The study population included mothers, fathers or relatives attending the enrolled PHCCs of Baghdad/ Al-Karkh whose children were within the aged below two years during the study period. All children aged 0-23 months were the source populations. All Children aged 0-23 months who were attended the selected PHCCs in Baghdad/Al-Karkh during the study period were the sampled population. All children aged 0-23 months who attended these health centers for different health complaints on the day of evaluation were considered illegible for inclusion. Children who had an absolute contraindications to immunization and children whom immunization information couldn't be checked through immunization card, or child health care files, were excluded. A systematic random sampling technique was used in selecting the children from each health center where the time needed to complete the questionnaire form that used as a system.

Sample size determination and sampling procedures

The sample size for this study was determined using the following formula [9]: $n = Z^2 Pq / d^2$Let n represent the intended sample size, Z denote the value of the standard normal distribution (Specifically Z = 1.96), p represent the proportion of children who are fully immunized in the county (which is 56.2%), and d represent the margin of error associated with a 95% confidence interval, set at 0.05. The aforementioned computation yielded a minimal sample size of 378 individuals, specifically children. The minimum sample size was adjusted by using a multiplication factor of 1.3 to account for the calculator effect. This adjustment resulted in a sample size of 491. The ultimate sample size consisted of 500 children.

Data collection

The data were gathered via the established World Health Organization's missed opportunities for immunization tool, version 10. The structured questionnaire employed in this study was developed by a comprehensive evaluation of various literature sources. The questionnaire was translated into Arabic, the participants' native language, to ensure ease of comprehension and response. The questionnaire was thereafter distributed to two specialist community physicians affiliated with the College of Medicine/Al-Iraqia University to assess its content reliability and validity. The composition was comprised of two distinct halves.

Section A

Data related to different socio-demographic variables of parents and children related to the personal information of the parents (age, gender, occupation, education, residence) and children (age, sex, birth order, birth place etc.). Section B: Data related to the vaccination status of the children, which are classified into: completely immunized children who received all vaccines in the national EPI schedule according to their age, partially immunized children who did not receive all vaccines in the national EPI schedule according to their age with the absence of unknown contraindication and completely missed their vaccines or un-immunized, who did not receive any vaccine according to age [10]. The inclusion criteria for vaccine completeness in the study stipulated that the child has received vaccination at any point prior to the commencement of the trial, as evidenced by vaccine papers and parental testimony. The questionnaire was tested by a pilot study using 12 parents attended the selected PHCCs for their children's immunization, who completed the questionnaire and commented on questions before initiation this study. These ten subjects were not included in the study.

This pilot study was conducted to give an idea related to time needed for direct interview with each participant, to find any difficulties or unclear questions, and to detect any difficulties or obstacles that may face the researcher. The study protocol was reviewed, approval and official permission to conduct the study was obtained from the Scientific and Ethical Committee in the College of Medicine/ Al-Iraqia University and by the Iraqi Ministry of Health/Baghdad/Al-Karkh Health Directorate, number (13378), date (29/8/2022). Once confidentiality has been ensured and explanation the study purpose to the respondents and their involvement is voluntary, and they would not be identified by name but by an identification number; a verbal consent was obtained from each respondent before data collection and after.

Data analysis

The statistical analysis was conducted utilizing the

Statistical Package for Social Sciences version 22 (SPSS V.22) for both data entry and analytic purposes. The link between various categorical variables was assessed using the Chi-square test (X^2), with a statistically significant association determined by a P-value of less than 0.05.The findings were displayed through the utilization of tables, graphs, and pie charts, which were selected based on the nature of the data.

Results

Socio-demographic characteristics of the respondents

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%. Respondent rates varied from one health facility to another. Routine immunization schedule was assessed by extracting information from child vaccination card, parents recall of vaccination and by health facility based registers. Their age ranged from two days to 23 months with a mean age 8.3±5.2 months. Of 500 children with documented vaccination records, 448 (89.6%) were ≤12 months of age and 52 (10.4%) were between >12 and <24 months of age. There were 284 (56.8%) male children and 216 (43.2%) females, giving the male to female ratio of 1.3:1 (Table 1). This table shows that 430 (86%) of the children were born in health facility (Public and private), while only 70 (14%) children were born at home. Most of 84.6% of the children were born from mothers attended antenatal care. Concerning children birth order, the 1st order was 30.2%, while the 4th and above order was 25.4%. (Table 1)

Table 1: Socio-demographic related characteristics of the children with fully vaccinated and MOI.

Children demographic factors						
Variable	**Category**	**Total No %**	**Vaccinated No %**	**MOI No %**	**X^2**	**P value**
Age (months)	≤12	448 (89.6)	322 (71.9)	126 (28.1)	5.3814	0.023
	>12-24	52 (10.4)	20 (38.5)	32 (61.5)		
Gender	Male	284 (56.8)	195 (68.7)	89 (31.3)	0.02	0.8
	Female	216 (43.2)	147 (68.1)	69 (31.9)		
Place of birth	Health facility	430 (86)	316 (73.5)	114 (26.5)	36.7921	0.000
	Home	70 (14)	26 (37.1)	44 (62.9)		
Birth order	1st	151 (30.2)	121 (80.1)	30 (19.9)	20.5945	<0.001
	2nd	131 (26.2)	93 (71)	38 (29)		
	3rd	91 (18.2)	57 (62.6)	34 (37.4)		
	≥ 4th	127 (25.4)	71 (55.9)	56 (44.1)		
Antenatal care of mother	Attended	423 (84.6)	317 (74.9)	106 (25.1)	54.369	<0.000
	Not attended	77 (15.4)	25 (32.5)	52 (67.5)		

Significant association using Pearson chi-square test at 0.05 level.

The relationship between MOI and various socio-demographic characteristics of the respondents was demonstrated in table 1. Statistical significant association was detected between the age of the children (p=0.023), place of birth (p=0.000), birth order (p=0.001), and antenatal care (p=0.000), while the gender variable did not show statistically significant association.

Socio-demographic characteristics of the caregivers

Table 2 shows that 23 (4.6%) of the caregivers were under the age of 20 years, 215 (43%) were between the ages of 20-29, 213 (42.6%) were between the ages of 30 -39, and 49 (9.8%) were at the age of 40 and above. Most interviewed caregivers were children's mothers (77.2%). About 440 (88%) were married, 37% had completed primary education. Majority, 369 (73.8%) of the caregivers were un-employed, 389 (77.8%) were living in urban area. A high percentage of the caregivers (43%) were living with a monthly family income ≤ 0.5 million (IRQD) ($400 USD) and a low percentage (22.6%) were living with a monthly family income > one million IRQD ($800 USD). Approximately 71% of the visits were for vaccinations and 29% were for medical consultation and for other purposes. (Table 2).

Table 2: Socio-demographic related characteristics of the care givers with immunization status

Care givers demographic factors						
Variable	**Category**	**Total No (%)**	**Vaccinated No (%)**	**MOI No (%)**	**X^2**	**P value**
Relation- ship to child	Mother	386 (77.2)	260 (67.4)	126 (32.6)	3.8127	1.486
	Father	39 (7.8)	24 (61.5)	15 (38.5)		
	Others	75 (15)	58 (77.3)	17 (22.7)		
Gender	Male	69 (13.8)	44 (63.8)	25 (36.2)	0.7945	0.372
	Female	431 (86.2)	298 (69.1)	133 (30.9)		
Age (year)	<20	23 (4.6)	18 (78.3)	5 (21.7)	4.3682	0.224
	20-29	215 (43)	139 (64.7)	76 (35.3)		
	30-39	213 (42.6)	147 (69)	66 (31)		
	≥40	49 (9.8)	38 (77.6)	11 (22.4)		
Education level	Not educated	80 (16)	41 (51.2)	39 (48.8)	23.46	0.000
	Complete primary	185 (37)	119 (64.3)	66 (35.7)		
	Complete secondary	105 (21)	76 (72.4)	29 (27.6)		
	College and above	130 (26)	106 (81.5)	24 (18.5)		
Marital status	Married	440 (88)	315 (71.6)	125 (28.4)	17.2726	0.000
	Single (Divorced, widowed, separated and travelled)	60 (12)	27 (45)	33 (55)		
Occupation	Unemployed (housewife, retired	369 (73.8)	239 (64.8)	130 (35.2)	8.5878	0.003

	Employed (governmental and non-governmental)	131 (26.2)	103 (78.6)	28 (21.4)		
Residence	Urban	389 (77.8)	308 (79.2)	81 (20.8)	94.1629	0.000
	Rural	111 (22.2)	34 (30.6)	77 (69.4)		
Monthly family income in (IRQD)	≤ 0.5 million ($400 USD)	215 (43)	133 (61.9)	82 (38.1)	13.1222	0.001
	> 0.5- 1 million > ($400 USD- 800USD)	172 (34.4)	117 (68)	55 (32)		
	> 1 million ($800 USD)	113 (22.6)	92 (81.4)	21 (18.6)		
Causes of visiting PHCCs	Medical consultation	93 (18.6)	33 (35.5)	60 (64.5)	62.9766	<0.000
	Vaccination	355 (71)	277 (78)	78 (22)		
	Others (accompany)	52 (10.4)	32 (61.5)	20 (38.5)		
Significant association using Pearson Chi-square test at 0.05 level.						

The relationship between MOI with caregivers' socio-demographic characteristics was shown in Table 2. The results found that caregiver's relationship to child, gender, and age did not show statistically significant association. However, statistically significant association was observed between the caregivers' education (p=0.000), marital status (p=0.000), occupation (p=0.003), family residence (p=0.000), monthly family income (p=0.001), and reasons for visiting PHCCs (p=0.000). (Table 2).

Prevalence of MOI among the respondents

Out of 500 children participated in this study, only 31.6% (n=158) were partially immunized for age and 68.4% (n=342) were immunized for age. (Fig 1).

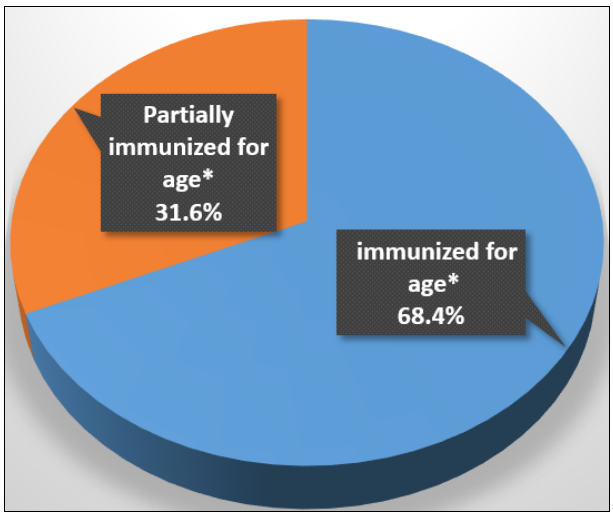

Fig 1: Distribution of the study group according to their vaccination status.

Regarding the type of missed vaccine, the commonest vaccines missed were MMR2 (46.9%), Rota2 (34.5%), MMR1 (32.6%), Rota1 (22.8%) and hepatitis B (12.4%). However, the less common vaccines missed were pentavalent1 (0.27%), OPV1 (0.54%) and OPV2 (3.2%). (Fig 2).

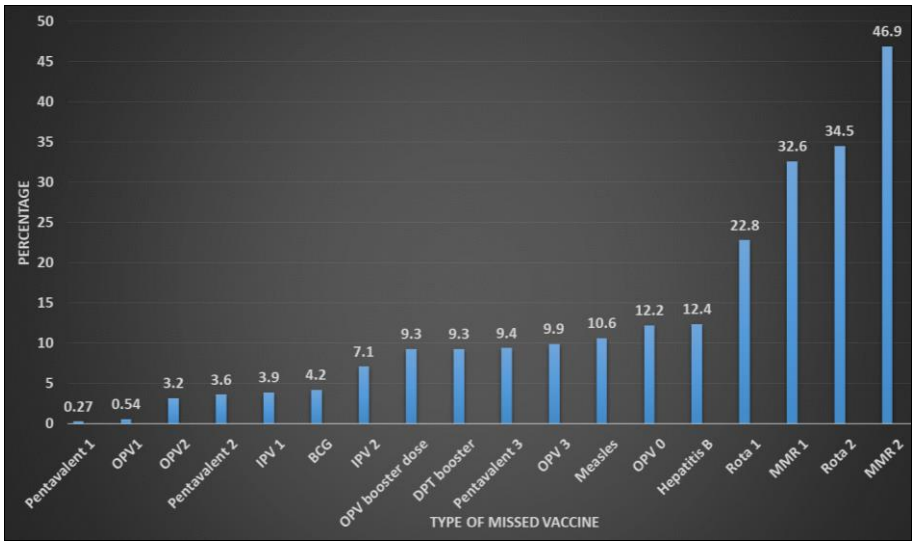

Fig 2: Missed opportunity for immunization per each vaccine among the respondents

Discussion

Immunization is an effective means for preventing and reducing the morbidity and mortality of vaccine preventable diseases in the world [11]. Since the start of the COVID-19 pandemic, it has a significant health problem and many influences on different determinants of health systems,

including routine childhood immunization programs around the world, leading worldwide spread decline in childhood immunization and putting millions of additional children at risk for vaccine-preventable diseases [12]. 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 [13]. MOI pose a serious threat to the health of children, mainly in developing countries, including Iraq. MOI prevalence in this study was found to be 31.6% ranging from 26.2% to 36.4% across the different selected PHCCs. WHO [12] estimated that the prevalence of global MOI as 42% and this is relatively higher than our finding. Among the Iraqi studies, this finding was relatively consistent with previous study conducted in Baghdad (36.4%) [14], in Diyala province/Iraq (30%) [15], and that reported by UNICEF-Iraq-Statistics 2015 (28%) [16]. However, our finding was higher than that reported in other previous studies conducted in Baghdad (11-22.3%) [17-19] and lower than that reported in other Iraqi Provinces as in Mosul (45.8%) [20] and Babylon (61%) [21]. The present study revealed that 68.4% of the respondents were completely immunized. Compared to other regional countries UNICEF statistics report in 2015 shows the following results: Saudi Arabia (96%), Turkey (97.6%), Jordan and Iran (98%) and Syria (58%) [16]. Several reports from other countries revealed higher rates of MOI in comparison to our results; as that reported in Africa (47%) [22], Ethiopia (49.1%) [23], India (65.4%) [24], and in Kenya (75%) [25]; conversely, it was higher than that reported in China (12.6%) [26], and South Africa (14.1%) [27], and relatively similar to that reported in Sudan (35%) [28] and Pakistan (31.78%) [29]. These disparities in the MOI prevalence among the studies could be due to differences in MOI assessment methodologies regarding the study design, the study settings, the study population, study period differences, sample size, sampling techniques and low accessibility for healthcare facility infrastructure. However comparison of vaccination coverage rate between different countries are difficult due to differences in health services systems, vaccine series and immunization schedules.

Our study shows that the dose-specific MOI was highest for MMR2 (46.9%) and Rota1 (34.5%) and lowest for pentavalent1 (0.27%) and OPV1 (0.54%) This finding is in contrast with other studies which revealed that MOI were more common for measles vaccine [14, 18, 27], OPV3 vaccine followed by DPT3 vaccine [24], compared to other vaccines, while Kassa *et al*. [23] reported that major vaccines with a high MOI were BCG (37.9%), OPV0 (35%) and measles (31.1%). Our finding shows that children in Iraq are still at high risk of vaccine-preventable diseases especially outbreak of measles, mumps, rubella, and from the complications of measles, particularly malnutrition and pneumonia.

In this study, children who had a higher proportion of MOI were at age >12 months. This finding was coincide with other studies conducted in Iraq [14, 19] and in other countries [27, 30]. However, our finding was in contrast to that reported in other studies [17, 33]. This finding may be attributed by the inadequate knowledge of the parents toward the national immunization schedules, and healthcare workers were more concerned to follow up the immunization status of infants rather than older children; Furthermore, there is a significant time gap between the administration of vaccines during the initial year of an individual's life and those given in the subsequent year [19, 30].

Although the boys have a higher chance of being vaccinated in most of developing countries due to socio-cultural discrimination against the girls, in this study, there was insignificant association between gender and immunization completeness as in other previous studies from different countries [20-24, 31]. However, it appears that there was no gender discrimination in immunization. Other researchers found a significant statistical relationship between gender and vaccination coverage, being more in females than in males [14, 18, 19, 32] and conversely more in males than in females [34].

This study observed that children delivered at home were more likely to have incompletely immunized than those who delivered at health facility settings. This finding is consistent with other previous studies [30, 33, 34, 36]. The possible reason may be the interaction with healthcare workers during health facility delivery enhances the uptake of vaccination. This study revealed that the MOI prevalence was increased among children whose families with increasing number and birth order. This finding was in agreement with other studies [21, 31, 35]. This finding could be due to an increase in caregiver's experience with increasing number of children. However, our finding is not consistent with other studies [20, 24, 27]. Our finding shows that antenatal care attended by pregnant women increases the chances of the child for being completely immunization. This is in line with other studies [30, 36]. However in contrast to previous study conducted in Ethiopia by Muluneh *et al*. [33] who did not found statistically significant association between antenatal care and MOI. This result may attributed to the fact that women with antenatal care receive more information on routine childhood immunization; regular and frequent visiting to PHCCs lead to good relationship between attended women and healthcare workers and following up their children lead to decrease in the MOI prevalence.

The caregiver's age at child delivery is considered as one of the important factor in the predicting the health status of the children. In this study, we found insignificant statistical association between the caregivers age and vaccination completeness, which is consistent with finding of other previous studies conducted in Iraq [14, 20] and in South Africa [27]. However, previous studies found that the rate of unvaccinated children was high among older caregivers of children [31], whereas other studies reported the opposite [35, 36]. This difference in findings could be related to the ability of the caregivers to provide health care for their children due to their differences in age.

Education level of parent is significantly associated with MOI, the higher percentage of incomplete immunization found among children of non-educated parents, this align with other studies [14, 18, 21, 23]. One study conducted in Sudan [28] showed that there was no significant relationship between educational level and immunization status which is not consistent with our finding. Our finding could be attributed to the fact that educated parents were more aware and knowledge about the benefits of immunization for their children [23].

A significant association was found between marital status and completeness immunization rate of children in this study, which is similar to other studies [19, 20]. Whereas Tawfeeq and Akef found a non-significant association between marital status of the caregivers and immunization

status [14]. The reasons being that two parents have more time to devote the child healthcare than single parents, since a single parent might have tight time constraints. This study showed a significantly higher MOI prevalence among children whose caregivers were unemployed (p= 0.003). This finding is consistent with other study [14] and in contrast to other study [27]. This finding is due to the most of the caregivers were housewives that have low family income, low education, awareness, and knowledge about the importance and benefit of immunization for their children and community; in addition to that they are busy with homework.

Children who lived in rural area were less likely to be completely vaccinated than those who lived in urban area, and there was a significant statistical association with MOI. This finding is similar to other studies [21, 23, 34] and dissimilar to others [24, 33]. This could be explained by the shortage of the coverage by mobile team resulting from shortage of the resources in health settings. The present study showed a high prevalence of MOI among children born from low family income compared to those from high family income. This finding is similar to other previous studies [20, 34]**.** Our finding may be attributed to that the caregivers of low family income might be associated with low education which lead to low child healthcare quality, low knowledge and awareness to the important of immunization to their children. In this study, we found that purpose of visits to PHCCs is one of the factors that significantly associated with MOI (p=0.000). This finding is consistent with the finding of previous study conducted in Baghdad/ Iraq [14] and in Kenya [25] and inconsistent with other study [23]. In this present study, the higher proportion of incomplete immunization found among those visiting the PHCC for non-vaccination-related reasons. This highlights the need for strengthening routine screening of immunization status that must be done irrespective of reason visit.

Conclusion

Nearly, one out of three children below two years old had missed for immunization. The various socio-demographic variables of the child and child's caregivers like younger age, birth place, attended antenatal care, birth order, low education level and low monthly income of caregivers, marital status, and unemployed parents, are important predictors for increasing the rate of MOI among children. Addressing these opportunities through concerted actions involving caregivers, healthcare workers and related healthcare system can improve immunization coverage. Therefore, immunization status of the children should be evaluated for each healthcare visit to avoid missed opportunities.

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Author 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.

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