

Rural-Urban Differences in Reasons for Incomplete Vaccination in Children Under Six Years, Southeast Iran 2013

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Background: Geographical differences in vaccination programs are a major public health problem, which is often linked to the availability of healthcare services and socioeconomic factors.

Objectives: The current study aimed to identify the differences in the patterns and the reasons for incomplete vaccination of children in urban and rural areas.

Patients and Methods: In the current cross-sectional study, a total of 1039 children under six years (612 rural and 427 urban subjects) were recruited from a databank of partially vaccinated children from March to December 2013. A group of trained Community Health Volunteers completed the study questionnaires by interviewing the parents of the identified children during their routine home visits. The Chi square test and Fisher's Exact test were used to compare the distribution of categorical variable between urban and rural areas.

Results: The patterns of the number of missed doses of vaccine were similar for urban and rural subjects, but urban children 1 - 6 years were significantly more likely to miss subsequent doses of Oral Polio Vaccine (OPV) and Diphtheria-Tetanus-Pertussis (DTP). A statistically significant association was found between mother's age, place of birth and the number of missed vaccine doses. Rural healthcare providers more frequently disseminated vaccination information than urban vaccinators ($P < 0.001$). A greater proportion of rural parents reported the lack of vaccines and healthcare staff misconduct as a reason for postponing vaccination, while over-crowdedness of health center, mother illness and forgetfulness, child illness and following physician recommendations were mentioned by a greater fraction of urban mothers.

Conclusions: Efforts to improve vaccination coverage should be taken into account regarding the differences in the factors that contribute to the incomplete vaccination status of children in the rural and urban areas. The current study findings indicate that vaccination services especially in the urban areas need to be reassessed to ensure that all children are covered. To develop and promote childhood vaccination strategies, special attention should be paid to address maternal barriers for children under-vaccination.

Keywords: Vaccination; Immunization; Rural Health Services; Urban Health Services; Iran

1. Background

Immunization is a well-established public health investment to reduce children illness, disability and death from vaccine-preventable diseases. According to the World Health Organization (WHO), it is estimated that vaccination prevents two to three million children deaths each year (1). In 2013, about 112 million infants worldwide were vaccinated with three doses of Diphtheria-Tetanus-Pertussis (DTP3) vaccine, with a coverage of 84% (1). However, the global vaccination coverage was constant for the past few years. It is estimated that 22.4 million children worldwide did not receive the three basic vaccinations (DTP3) during their first year of life, with the majority of those children living in the developing countries (2). Suboptimal vaccination is a major public health problem and it might result in resurgence of vaccine-preventable diseases (3).

To develop and improve the vaccination coverage strategies, it is necessary to identify the risk factors of non-up-

take of immunization services. Two systematic reviews of the literature show that the most common reasons associated with under-vaccination were related to immunization systems followed by factors related to family characteristics (4, 5).

Another systematic review found that parental-childhood characteristics and healthcare structure-professional features were two main groups of factors contributing to under-vaccination (4). Some of the parental-childhood attributes included; low socioeconomic status, lack of knowledge about vaccine-preventable diseases, and sick child delays (4). Healthcare structure-professional characteristics linked to underuse of vaccination services were mistrust in medical information provided by the health center staff, healthcare providers misconduct, and lack of health infrastructures (4). Another identified systematic problem was lack of a reminding system about

the subsequent doses of vaccines and short duration of vaccination sessions (6).

Few studies investigated the causes of vaccination drop-outs in children in Iran. A study on the immunization status in children under two years showed that 17.8 % of the children were under-vaccinated and in 41.4% of the fully vaccinated subjects a delay of more than one month in the vaccination was observed (7). The main reason included negligence of health care providers and child illness (7). The result of a study on vaccination coverage of DTP3 in children 12 - 24 months old showed that approximately 15% of children did not receive vaccines at the proper time or were not vaccinated (8). Factors contributing to delayed vaccination consisted of parents' education, family income, number of children in the family, birth order, and the type of family file in the healthcare center (active-inactive). Another study reported that lack of access to maternal healthcare services was the main reason of incomplete vaccination in children (9). Lack of time, and child illness were related to delayed vaccination in children. The delay was also associated with maternal age and the number of children in the family (10).

Establishment of a unique Primary Healthcare system in Iran resulted in a significant improvement in all aspects of the population's health including vaccination coverage (11). According to the Islamic Republic of Iran Multiple-Indicator Demographic and Health Survey (IrMIDHS) 2010, there was substantial progress in children vaccination, but the percentage of children completing the recommended vaccination schedule remains below the expected targets in rural areas and also few under-privileged provinces including Sistan and Balouchestan, Southeast Iran (12). The IrMIDHS results showed that in comparison with urban children, the vaccination coverage across all vaccines was lower in rural children and the greatest gap was reported regarding the first dose of Measles, Mumps and Rubella (MMR1) vaccine (93.47% versus 97.20%). Moreover, the vaccination coverage for children 12 - 23 months living in Sistan and Blouchetsan province was lower than 95% for all vaccines except OPV1 (the first dose of oral polio vaccine administered at birth) (12).

2. Objectives

The current study aimed to identify barriers to completing full schedules of vaccination in children under six years old living in the urban and rural areas covered by Zahedan University of Medical Sciences.

3. Patients and Methods

This cross-sectional study was conducted from March to December 2013, in Zahedan, Khash, Iranshahr, Saravan, Nikshahr, Sarbaz, Konarak and Chabahar districts, in Sistan and Balouchestan province, Southeast Iran. The study population included children under six years old with incomplete vaccination. Children with one or more missing doses of vaccine(s) were considered as partially immunized.

According to a 16% difference in the proportion of reasons for delayed vaccination between urban and rural areas (estimated from a pilot study), $\alpha = 0.05$ and $\beta = 0.2$, the estimated sample size was calculated as 200 subjects for each area. To consider the effect of the study design the sample size was doubled for each group. As rural population was much more accessible, researchers decided to increase the rural sample to 1.5 times of the urban population.

The study subjects were recruited from a databank of partially vaccinated children identified through a large scale vaccination coverage promotion campaign in children under six years old. A multi-stage cluster sampling method was employed to identify the subjects. The number of subjects recruited from each district was determined using probability proportional to size based on the number of children under five years old vaccinated during a polio eradication campaign in the previous year.

A 76-item structured questionnaire was used for data collection. The study questionnaire consisted of five parts. The first section included questions on socio-demographic characteristics of the participants. The second section was asking questions regarding children's birth. The third part included questions on the vaccine doses received according the Iranian EPI based on the information recorded in the children's vaccination card. The fourth section included questions on the performance of health center regarding all aspects of vaccination services. The fifth section queried maternal and health center related factors for vaccination delay. A group of trained Community Health Volunteers completed the study questionnaires by interviewing the parents of the identified children during their routine home visits. Verbal consent was obtained before individual surveys were conducted.

The validity of the questionnaire was estimated by calculation of the Content Validity Ratio (CVR) and content validity index using the feedback from a panel of 10 experts including public health professionals, maternal and child healthcare experts and pediatricians. The questions with a CVR less than 0.62 were either modified or removed (13). The reliability of the questionnaire was established with a Kuder-Richardson 20 coefficient of 0.73.

Categorical variables were presented as counts and percentages. The Chi-square test and Fisher's exact test were used to compare the distribution of categorical variable between the rural and urban areas. A P value < 0.05 was considered significant for all analyses. To analyze the data SPSS version 20 (Chicago, IL) was used. The study was approved by Zahedan University of Medical Sciences Ethics Committee.

4. Results

The current study included 1039 partially vaccinated children under six years old, including 538 (51.8%) boys and 501 (48.2%) girls. A total of 612 (58.9%) subjects lived in rural areas and 427 children (41.1%) were residents of urban areas. The socio-demographic characteristics of the subjects are presented in Table 1.

Table 1. Socio-Demographic Characteristics of the Subjects ^{a,b}

Variable	Rural (n = 612)	Urban (n = 427)	P Value
Gender			0.005
Male	339 (55.4)	199 (46.6)	
Female	273 (44.6)	228 (53.4)	
Age group			< 0.001
< 1 year	139 (22.7)	58 (13.6)	
1 - 2 years	221 (36.1)	134 (31.4)	
2 - 4 years	154 (25.2)	160 (37.5)	
4 - 6 years	98 (16.0)	75 (17.5)	
Mother's age			0.151
25 years	214 (35.0)	121 (28.4)	
25 - 30 years	130 (21.2)	105 (24.6)	
30 - 35 years	125 (20.4)	92 (21.5)	
35 years	143 (23.4)	109 (25.5)	
Father's age			0.533
< 25 years	83 (13.6)	45 (10.5)	
25 - 30 years	142 (23.2)	100 (23.5)	
30 - 35 years	124 (20.2)	89 (20.8)	
35 years	263 (43.0)	193 (45.2)	
Mother's age at marriage			0.031
< 15 years	123 (20.6)	111 (26.4)	
15 - 20 years	348 (58.2)	242 (57.5)	
20 years	127 (21.2)	68 (16.1)	
Father's polygamy			0.814
No	542 (88.6)	381 (89.2)	
Yes	70 (11.4)	46 (10.8)	
Mother's education			< 0.001
Illiterate	333 (54.4)	139 (32.6)	
Primary	159 (26.0)	125 (29.2)	
Secondary school	62 (10.1)	64 (15.0)	
High school	51 (8.4)	75 (17.6)	
University	7 (1.1)	24 (5.6)	
Father's education			< 0.001
Illiterate	203 (33.2)	79 (18.5)	
Primary	171 (27.9)	114 (26.7)	
Secondary school	125 (20.4)	104 (24.4)	
High school	89 (14.5)	92 (21.5)	
University	24 (4.0)	38 (8.9)	
Mother's occupation			< 0.001 ^c
Housewife	604 (98.7)	405 (94.8)	
Government employee	7 (1.1)	19 (4.4)	

Worker	1 (0.2)	3 (0.7)	
Father occupation			< 0.001
Government employee	59 (9.6)	81 (19.0)	
Worker	232 (37.9)	107 (25.1)	
Self-employed	235 (38.4)	201 (47.1)	
Unemployed	86 (14.1)	38 (8.8)	
House ownership			< 0.001 ^c
Owner	612 (100.0)	270 (63.2)	
Tenant	0 (0.0)	97 (22.8)	
Others	0 (0.0)	60 (14.0)	
Place of birth			< 0.001
Maternity hospital	278 (45.6)	324 (76.4)	
Delivery facilities	143 (23.5)	50 (11.8)	
Home	188 (30.9)	50 (11.8)	
Birth ranking			0.890
First	171 (27.9)	120 (28.1)	
Second	122 (19.9)	93 (21.8)	
Third	103 (16.8)	68 (15.9)	
Forth and more	216 (35.3)	146 (34.2)	
Household size			0.637
≤ 4	248 (40.5)	170 (39.8)	
5 - 6	187 (30.6)	141 (33.0)	
> 6	177 (28.9)	116 (27.2)	
Having under six years siblings with incomplete vaccination			< 0.001
Yes	265 (43.5)	255 (59.9)	
No	344 (56.5)	171 (40.1)	

^a n = 1039.

^b Values are presented as frequency (percent).

^c P Values for Fisher's exact test.

In comparison with those living in urban areas, a greater proportion of rural children were under one year old (22.7% versus 13.6%). Overall 37.5% of urban subjects were in the age group of -2-4 years, while this figure for rural children was 25.2%, and the differences in the age group composition were statistically significant ($P < 0.001$). Compared with rural mothers, urban mothers were more likely to get married at an age younger than 15 years (26.4% versus 20.6%), while marriage at older than 20 years was more frequent in mothers living in rural areas (21.2% versus 16.1%, $P < 0.031$). A greater proportion of rural mothers were illiterate (54.4% versus 32.6%), while urban mothers dominated in all other educational levels and the difference was statistically significant ($P < 0.001$). A significantly greater proportion of urban children were born in a maternity hospital (76.4% versus 45.6%). On the other hand home deliveries were more frequent in rural children (30.9% versus 11.8%, $P <$

0.001). As compared with rural subjects, partially vaccinated children in urban areas were more likely to have an under-vaccinated sibling under six years old (59.9% versus 43.5%).

No significant differences were observed among children under one year in the proportion of missed vaccine doses according to the Iranian Expanded Program on Immunization (Table 2). Regarding multiple doses vaccines, a greater proportion of dropouts were observed for all vaccines in the subsequent doses of vaccine. In terms of the number of missed doses of vaccine, also no differences were found between urban and rural subjects. The pattern of missed vaccines in children 1 - 6 years for multiple doses vaccine was similar to those of children under one year old. Children living in urban areas were significantly more likely to miss subsequent doses of OPV and DTP. The patterns of the number of missed doses of vaccine were similar among urban and rural dwellers.

Table 2. The Proportion and Number of Missed Doses of Vaccines by Age Group for Different Vaccines ^{a,b}

Variable	< 1, y			1 - 6, y		
	Rural (n = 139)	Urban (n = 58)	P Value	Rural (n = 473)	Urban (n = 369)	P Value
Proportion of incomplete vaccine doses						
BCG	17 (12.2)	5 (8.6)	0.463	41 (8.7)	31 (8.4)	0.891
OPV0	26 (18.7)	9 (15.5)	0.594	52 (11.0)	38 (10.3)	0.746
OPV1	14 (10.1)	8 (13.8)	0.450	28 (5.9)	32 (8.7)	0.123
OPV2	22 (15.8)	14 (24.1)	0.169	49 (10.4)	62 (16.8)	0.006
OPV3	46 (33.1)	22 (37.9)	0.515	93 (19.7)	95 (25.7)	0.035
OPV4	NA	NA	NA	285 (60.3)	225 (61.0)	0.832
OPV5	NA	NA	NA	460 (97.3)	363 (98.4)	0.277
DPT1	14 (10.1)	7 (12.1)	0.679	30 (6.3)	38 (10.3)	0.037
DPT2	21 (15.1)	9 (15.5)	0.942	49 (10.4)	64 (17.3)	0.003
DPT3	45 (32.4)	18 (31.0)	0.854	87 (18.4)	107 (29.0)	0.000
DPT4	NA	NA	NA	284 (60.0)	242 (65.6)	0.099
DPT5	NA	NA	NA	457 (96.6)	362 (98.1)	0.189
Hepatitis B1	15 (10.8)	3 (5.2)	0.212	40 (8.5)	26 (7.0)	0.450
Hepatitis B2	21 (15.1)	8 (13.8)	0.812	36 (7.6)	40 (10.8)	0.105
Hepatitis B3	48 (34.5)	17 (29.3)	0.477	96 (20.3)	85 (23.0)	0.337
MMR1	NA	NA	NA	151 (31.9)	113 (30.6)	0.686
MMR2	NA	NA	NA	300 (63.4)	250 (67.8)	0.191
Number of incomplete vaccine doses in children < one year (out of 12 doses)						
1	59 (42.4)	24 (41.4)	0.682			
2 - 3	33 (23.7)	17 (29.3)				
> 3	47 (33.8)	17 (29.3)				
Number of incomplete vaccine doses in children 1 - 6 years (out of 17 doses)						
< 5	181 (38.3)	143 (38.8)	0.143			
5 - 7	200 (42.3)	136 (36.9)				
> 7	92 (19.5)	90 (24.4)				

^a Abbreviations: BCG, Bacille Calmette-Guerin; DTP, Diphtheria-Tetanus-Pertussis; MMR, Measles-Mumps-Rubella; OPV, Oral Polio Vaccine.

^b Values are presented as No. (%).

Comparing categories of missed doses of vaccine in children under one year old according to different socio-demographic characteristics, a statistically significant association was found regarding mother's age group and birth place but no other variables (data not shown). Children of mothers in the age group greater than 35 years were less likely to have higher numbers of missed doses of vaccine. The proportion of children in the categories with one dose, two to three doses and > 3 doses of missed vaccine in this age group decreased from 44.7% to 36.8% and 18.4%, respectively ($P < 0.007$). A similar decreasing pattern was observed among the children born in a maternity hospital. Children born at home showed an increasing pattern across categories of missed vaccine doses ($P < 0.008$). Children 1-6 years born in a maternity hospital or a delivery facility were far less likely to miss more than seven doses of

vaccine compared with the ones born at home ($P < 0.001$).

As shown in Table 3, subjects living in rural areas were more likely to have an active household health file (i.e. the last visit to healthcare units no longer than three months ago), compared with those living in urban areas (60.9% versus 39.1%, $P < 0.005$). Rural healthcare providers more frequently disseminated vaccination information than urban vaccinators ($P < 0.001$). Face-to-face vaccination training was more commonly used in rural healthcare centers, while group or class sessions were the predominant method of conferring information in urban healthcare centers ($P < 0.001$). In comparison with urban mothers, mothers living in rural areas were more likely to lose their child's vaccination card (80.5% versus 19.5%, $P < 0.004$) and more likely not to carry the vaccination card when visiting healthcare center for vaccination.

Table 3. Performance of Healthcare Centers and Mothers Regarding Children Vaccination Services by Place of Residence ^a

Variable	Rural (n = 612)	Urban (n = 427)	P Value
Type of household file			0.005
Active	516 (84.3)	331 (77.5)	
Non-active	96 (15.7)	96 (22.5)	
Method of reaching healthcare center			<0.001
On foot	423 (69.1)	298 (69.8)	
Their own vehicle	149 (24.3)	84 (19.7)	
Public transportation	12 (2.0)	38 (8.9)	
Others	28 (4.6)	7 (1.6)	
Vaccine availability at healthcare center			0.630 ^b
Always	227 (37.1)	160 (37.5)	
Most of the time	319 (52.1)	225 (52.7)	
Rarely	59 (9.6)	40 (9.4)	
Never	7 (1.1)	2 (0.5)	
Vaccinator presence			0.308 ^b
Always	448 (73.2)	316 (74.0)	
Most of the time	146 (23.9)	108 (25.3)	
Rarely	17 (2.8)	3 (0.7)	
Never	1 (0.2)	0 (0.0)	
Vaccinator providing vaccination information			< 0.001
Always	444 (72.50)	289 (67.7)	
Most of the time	153 (25.0)	107 (25.1)	
Rarely	12 (2.0)	11 (2.6)	
Never	3 (0.5)	20 (4.7)	
Training methods used to improve mothers' vaccination information			< 0.001
Face-to-face	602 (98.4)	397 (93.0)	
Group/class	7 (1.1)	10 (2.3)	
None	3 (0.5)	20 (4.7)	
Reminding the next vaccination appointment			0.080
Always	455 (74.3)	308 (72.1)	
Most of the time	141 (23)	96 (22.5)	
Rarely	13 (2.1)	15 (3.5)	
Never	3 (0.5)	8 (1.9)	
Vaccination card issued			0.066 ^b
Yes	604 (98.7)	426 (99.8)	
No	8 (1.3)	1 (0.2)	
Vaccination card retention			0.004
Yes	579 (94.6)	419 (98.1)	
No	33 (5.4)	8 (1.9)	
Mother carrying vaccination card when visiting healthcare center			0.002
Always	354 (57.8)	287 (67.2)	
Most of the time	180 (29.4)	113 (26.5)	
Rarely	58 (9.5)	20 (4.7)	
Never	20 (3.3)	7 (1.6)	
Administered vaccines recorded in the vaccination card			< 0.001
Always	487 (79.6)	352 (82.4)	
Most of the time	87 (14.2)	69 (16.2)	
Rarely	19 (3.1)	5 (1.2)	
Never	19 (3.1)	1 (0.2)	

^a Values are presented as frequency percent.^b P values for Fisher's Exact test.

Regarding the reasons for delayed vaccination, a greater proportion of rural mothers reported the lack of vaccines and healthcare staff misconduct as a reason for postponing vaccination, while overcrowding of healthcare center was mentioned by a greater fraction of urban mothers and the differences were statistical-

ly significant (Table 4). Mother illness and forgetting about next vaccination appointment, child sickness and following physician recommendations were significantly less likely to be the reason for delayed vaccination in rural children as compared with urban residents.

Table 4. Reasons for Delayed Vaccine Doses in the Children Under Six Years Old by Place of Residence ^a

Variable	Rural (n = 612)	Urban (n = 427)	P Value
Healthcare center related factors			
No vaccine available			< 0.001
Yes	366 (59.8)	185 (43.3)	
No	246 (40.2)	242 (56.7)	
No vaccinator available			0.352
Yes	54 (8.8)	30 (7.0)	
No	558 (91.2)	397 (93.0)	
Long distance to travel to the healthcare center			0.077
Yes	84 (13.7)	43 (10.1)	
No	528 (86.3)	384 (89.9)	
Overcrowding of healthcare center			< 0.001
Yes	33 (5.4)	56 (13.1)	
No	579 (94.6)	371 (86.9)	
Inappropriate timing of vaccination services			0.062
Yes	48 (7.8)	21 (4.9)	
No	564 (92.2)	406 (95.1)	
Healthcare center staff misconduct			0.038
Yes	43 (7.0)	17 (4.0)	
No	569 (93.0)	410 (96.0)	
Physician recommendations to postpone vaccination			< 0.001
Yes	80 (13.1)	100 (23.4)	
No	532 (86.9)	327 (76.6)	
Mother and child related factors			
Mother's sickness			0.002
Yes	59 (9.6)	70 (16.4)	
No	553 (90.4)	357 (83.6)	
Mother forgetfulness			< 0.001
Yes	159 (26.0)	189 (44.3)	
No	453 (74.0)	238 (55.7)	
Busy mom			0.339
Yes	90 (14.7)	73 (17.1)	
No	522 (85.3)	354 (82.9)	
Travel			0.096
Yes	51 (8.3)	24 (5.6)	
No	561 (91.7)	403 (94.4)	
Mother did know anything about the next dose			0.204
Yes	33 (5.4)	15 (3.5)	0.015
No	579 (94.6)	412 (96.5)	
Child sickness			0.131
Yes	106 (17.3)	101 (23.7)	
No	506 (82.7)	326 (76.3)	
Fear of adverse effects			
Yes	89 (14.5)	77 (18.0)	
No	523 (85.5)	350 (82.0)	

^a Values are presented as frequency percent.

5. Discussion

The current paper examined a number of factors that influence the completeness of vaccination coverage for children younger than six years old in urban and rural areas of Sistan and Baluchestan province, Southeast Iran.

Regional differences between rural and urban vaccination coverage and uptake are common in both developed and developing countries. No significant differences were observed in vaccination coverage for urban and rural children under one year. In contrast, when looking at vaccination coverage for subjects between 1 - 6 years, it was found that children living in rural areas were far less likely to have missed vaccines than urban children. Comparing the contributing factors to incomplete vaccination, it was noted that health system related factors such as lack of vaccines and healthcare staff misconduct played an important role in children under-vaccination in rural areas. However, in the urban setting individual factors such as mother illness and forgetting about next vaccination appointments, child sickness and following physician recommendations were the major reasons for postponing vaccination. The data on reasons for differential vaccination coverage in urban and rural areas are scarce. The current study findings were consistent with those of a study on the determinants of timely vaccination among young children in Burkina Faso that showed rural children were more likely to have a timely vaccination for all vaccines (except for BCG) than urban children (14). A similar study in Iran found that the delay time in vaccination was longer in urban areas (15). Conversely, a study that investigated rural-urban differences in measles vaccination coverage among young Indonesian children showed that the first-dose of measles vaccine coverage in rural areas was lower as compared with that of the urban regions (68.5% versus 80.1%). Parental education and access to skilled healthcare providers were among the factors identified to be addressed to improve vaccination coverage in rural areas of Indonesia (16). A vaccination coverage survey among 12 - 23 month-old children in southern India, showed that the vaccination coverage in rural areas was lower for all vaccines, compared with vaccination coverage in the towns (17). The observed differences were attributed to the fact that vaccines in the towns were provided by private agencies that guarantee the availability of vaccines throughout the week and easy access, compared with government agencies that were the only source of vaccination services in rural areas.

A well-functioning health system is required for a good vaccination program (18). In the current study rural healthcare centers were found to provide better vaccination services. It was reflected in a greater proportion of active household health records, more regular vaccination services, more frequent information dissemination regarding vaccination and reminding mothers about the next vaccination appointment and more frequent follow up of missed vaccination appointments. The unique

system of rural healthcare providers (Behvarz) in Iran plays an important role in providing quality healthcare services in a proactive, efficient, and inexpensive way (19). Behvarz who is local and lives in the same village motivates parents to make an early and sustainable linkage to the healthcare system. The continuity from prenatal care to institutional delivery can result in a better utilization of healthcare services and is found to be the most important factor regarding the complete vaccination of children (20). The number of regular visits to healthcare centers had an inverse correlation with vaccination delay time (7, 15). On the other hand, healthcare services in the urban areas of Iran are provided in a passive way and urban children rely on their mothers' initiative to get vaccinated. Mothers' failure to adhere to timely and complete vaccination of their children in the urban settings needs to be specifically addressed through proper intervention.

Numerous vaccine types were found to be missing among the studied urban and rural children. However, an important point regarding the multiple dose vaccines was the increase of missing the subsequent doses scheduled in the EPI. The dropouts were more prominent in the urban children aged 1 - 6 years. This finding illustrated the need for local health authorities to identify the factors affecting the missed doses and take necessary measures to bridge the gap in the vaccination-series coverage. The use of combination vaccines may simplify the vaccination schedule and increase the adherence of parents by reducing the number of visits to the vaccination unit (3).

In Children under one year, the number of missed vaccine doses was lower in mothers of the higher age groups compared with younger mothers. This is in agreement with the findings of some studies that suggest maternal age is an important factor associated with vaccine coverage and up-to-date vaccination coverage increases as maternal age increases (21). Maternal age could be considered as a proxy for the women's accumulated health literacy, which may have a positive influence on adherence to the full vaccination of children (22).

Child birth at a maternity hospital and delivery facilities were significantly associated with a lower proportion of incomplete vaccine doses. This is consistent with the results of the study that reported dropouts were less likely to occur in children born in a hospital (23). Mothers who give birth at a maternity hospital or a delivery facility are possibly more health conscious and hence more likely to have their children fully vaccinated.

Under-vaccinated urban children were more likely to have a sibling under six years old with incomplete vaccination, compared with rural children. Mothers with several children are likely to under-vaccinate their children (24). Some studies suggest that parental decisions but not inadequate availability of healthcare is a major determinant of delayed immunization (3). This finding further underlines the fact that parents can play an important

role in gaining access to vaccination services for their children. Parents who are generally less educated and not aware of the health of their family members do not know the harmful effects of non-immunization. Moreover, the number of children in the family has a negative association with the vaccination coverage (8).

In summary, multiple reasons were identified for partial vaccination of rural and urban children. The current study indicated that a multi-faceted approach is needed to improve vaccination coverage in the Southeast of Iran. Vaccination program performance issues can be addressed through healthcare providers training and supervision.

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Authors' Contributions

Study design and coordination in study conduction: Seyed Mehdi Tabatabaei; data collection and manuscript drafting: Tahere Mokhtari and Mohammad Salari the study; statistical analysis, data interpretation and paper drafting: Seyed Mehdi Tabatabaei; technical consultations and critical revising the manuscript: Mehdi Mohammadi. Authors approved of the final draft of the paper.

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