Original Article

Barriers for full immunization coverage among under 5 years children in Mogadishu, Somalia

Mohamed Hayir T. Mohamud[1], Mohamed A. Magan[1], Lul M. Mohamed[1], Mohamed A. Mohamud[1], Abdishakur A. Muse[1]

[1]*Faculty of Medicine and Surgery, Jazeera University, Mogadishu, Somalia*

Abstract

Background: Immunization is amongst the most cost-effective public health interventions for reducing childhood morbidity and mortality. However, globally 9 million deaths of children occur as a result of vaccine-preventable diseases in which 4.4 million are from the sub-Saharan region. Therefore, this study aimed to assess barriers for complete vaccination coverage among under five years children in Mogadishu, Somalia. **Methods:** A community-based cross-sectional study was conducted between April to July 2019 in Mogadishu-Somalia. Two-stage cluster sampling with systematic random sampling was used to select a sample of 820 households. Data was collected through a structured, interviewer administrator questionnaire. In case more eligible children found at a single selected household, one child was randomly selected and the information related to immunization was interviewed from his/her caregiver. **Results:** The overall, fully vaccinated under 5 years children were found to be 45.2%. Immunization was found to be increased by being a younger caregiver (β=-0.024, *P*-Value=0.019) being father with secondary and above education (AOR = 1.755, 95% CI = 1.161–2.655, *P*-value = 0.008), being a young child (β = −0.018, *P*-value = 0.011), being children from birth order of fifth and above (AOR = 1.539, 95% CI = 1.011–2.343, *P*-value = 0.044), being a married caregiver (AOR = 4.101, 95% CI=1.062-15.835, *P*-value = 0.041), increased monthly family income (β =0.003, *P*-value = 0.000), availability of vaccine at the time of visit (AOR = 6.147, 95% CI = 1.943–19.441, *P*-value = 0.002), cost affordability of vaccine (AOR = 1.951, 95% CI = 1.238–3.076, *P*-value = 0.004), being born at health facility (AOR = 1.517, 95% CI = 1.104–2.086, *P*-value = 0.010), having good knowledge on immunization (AOR = 1.125, 95% CI = 1.070–1.181, *P*-value = 0.001), having good practice on immunization (AOR = 2.756, 95% CI = 2.233–3.402, *P*-value = 0.001) and having good perception on vaccine (AOR = 4.976, 95% CI = 2.183–11.340, *P*-value = 0.001). **Conclusion:** The result of this study has revealed that the proportion of fully immunized under-5 children in Mogadishu is very low. Several factors were found to the barriers achieving full immunization coverage. Steps to promote health education and vaccine availability should be lounged.

Keywords: Barriers, coverage, full immunization

Introduction

Immunization is amongst the most cost-effective public health interventions for reducing global childhood morbidity and mortality.[1] In 1974, WHO established the Expanded Program on Immunization (EPI) to ensure that all children get access to vaccination. To synergize EPI, the United Nations General Assembly Special Session (UNGASS) set a goal to ensure full immunization of children under one year at 90% coverage nationally with at least 80% coverage in every district by 2010. Building on this goal, the World Health Assembly endorsed the Global Vaccine Action Plan (GVAP) in 2012 to extend immunization to all children across the globe. GVAP's key targets include achieving and sustaining 90% national Penta coverage and ≥80% Penta coverage in every District by 2015.[2]

When the EPI was initiated in 1974, less than 5% of children in developing countries were receiving the third dose of

Address for correspondence: Mr. Mohamed Hayir Tahlil Mohamud, Faculty of Medicine and Surgery, Jazeera University, Mogadishu, Somalia.
E-mail: xayir070@gmail.com

Received: 19-01-2020 **Revised:** 12-03-2020
Accepted: 14-03-2020 **Published:** 30-06-2020

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_119_20

How to cite this article: Mohamed Hayir TM, Magan MA, Mohamed LM, Mohamud MA, Muse AA. Barriers for full immunization coverage among under 5 years children in Mogadishu, Somalia. J Family Med Prim Care 2020;9:2664-9.

diphtheria-tetanus-pertussis (DTP-3) and poliomyelitis vaccines in their 1st year of life.[3] A report from WHO revealed that around 60% of children who were not reached with routine immunization services are from 10 countries where the majority are from sub-Saharan African countries.[4] Routine immunization coverage is assessed by Penta 3 coverage.[5]

With the support of WHO and UNICEF, the EPI program in Somalia started in 1978, with the strategy of mobile and outreach services. An evaluation of the program in 1985 showed that the strategy achieved very low immunization coverage. Between 1985 and 1988, a strategy of mass immunization campaign was adopted and implemented in major towns of the country. The operation resulted in about 75% coverage of children in towns. However, this could not be sustained and immunization coverage rapidly declined when fighting broke out in 1988. The civil war of 1988–1992 devastated the health infrastructure and dispersed health workers. The modest gains of the program were completely lost due to the war.[6] By the end of 1992, the international community, led by UNICEF, gave priority to the initiation of EPI services; and in 1996, more than 100 MCH centers and 4 zonal cold stores were functioning.[7] The trend of low childhood immunization coverage was evident during the baseline survey conducted in Nov 2017 where we accessed the immunization coverage for the four basic vaccines namely BCG (57%), Measles (47%), Polio (14%), and Pentavalent (28%) vaccines in 9 districts i.e. Kismayo, Adado, Afmadow, Iskushuban, Armo, Alula, Bosaso, Barga, and Ufayn.[8] UNICEF, 2010 reported that the immunization coverage of under-5 children in Mogadishu was 40%.[9]

The Federal government, its member states, and communities with help from international and local agencies established numerous mother and child health care centers which provide immunization services that make immunization among the most cost-effective public health intervention, however, unlike many other developing countries the immunization coverage of Somalia is still relatively very low. Thus this study aimed to find out factors barriers with complete immunization coverage among under five years of age children in Mogadishu, Somalia.

Study design and setting

The community-based cross-sectional study design was carried out among 820 households with one child from each household. Any caregivers with a child of 12 to 59 months lived at the selected Divisions and available at the time of data collection were considered eligible for the study. In case a single selected household has more than one eligible child, one child was selected randomly.

Sample size determination

To calculate the minimum sample size, a Cochrane formula[10] with the design effect of 2 and 10% addition of expected non-response rate was used.

$$\frac{Z^2 p\, q}{d^2} * DEFF$$

Where n = minimum sample size, Z = Standard normal deviate corresponding to 5% significant level, *P* = prevalence in previous studies (40%),[9] q = 1 − p, d = precision set at 0.05, DEFF is set at 2. Z =1.96, *P* = 0.40, q = 0.60. Applying the formula above the calculated minimum sample size was 738. Thus, a sample size of 820 households was used in this study taking into consideration with 10% addition of expected non-response rate.

Sampling techniques

A mixture of two-stage cluster sampling and systemic random sampling was used to select households. At the first stage, Mogadishu was divided into 17 districts, with each district represents a cluster, then one district (Wadajir) was selected randomly. In the second stage, the selected district was divided into four divisions in which again two divisions (Halane and Hawatako) were selected randomly, finally, all households in that selected divisions were selected through systemic random sampling up to calculated sampled sample size.

Data collection

Data were collected with a pretested, structured, Researcher administered questionnaire which was initially developed in English and later translated into the Somalia language. The questionnaire comprised three sections; a section on sociodemographic variables of the child's current caregiver, child and father, a section on the immunization status of the child and section on the barriers affecting immunization coverage. Any household with an eligible child was selected and the caregiver of that was interviewed through face-to-face interviews. In the presence of immunization cards, information about child immunizations was collected from immunization cards or the mother's verbal reports with the verification of the presence of a BCG scar.

Data analysis

Data were entered into Statistical Package for Social Sciences (SPSS-IBM) version 20. Data entry, cleaning, processing, preliminary analysis, and final write-up were done by the researchers. Frequencies and percentages were used to display the immunization status of the children. The binary analysis was used to assess the association between independent and dependent variables. Odds ratios (ORs) and their 95% confidence intervals (CIs) were calculated. A *P* value < 0.05 was considered as statistically significant. Bivariate analysis was done to identify the crude association between dependent and independent variables. Then, all variables that showed statistical significance in the bivariate analysis were included in the multivariate logistic regression model to determine the barriers to full immunization coverage among children aged under 5 years. Full immunization status of the children (card plus mothers recall) was included in the logistic regression model as a dependent variable, while sociodemographic characteristics of the caregiver, child characteristics, father characteristics, health center related factors and sociocultural factors were used as independent

variables. Adjusted ORs with their 95% CIs were computed to determine the association.

The following operational definitions were used

Fully immunized/Complete immunization

An under 5-year child who received one dose of (Bacillus Calmette-Guerin) BCG, one dose of measles, at least three doses of DPT-HepB-Hib (pentavalent) and four doses of (Oral Polio vaccine) OPV and one dose of (Inactivated Polio Vaccine) IPV was considered to be fully immunized/complete immunization.

Not fully immunized/Incomplete immunization

Any under 5-year child who didn't receive any or partially received but did not complete all of these five vaccines was considered to be not fully immunized/incomplete immunization.

Results

Immunization Status of the children their confirmation

A total of 741 caregivers of children aged under 5 years old were interviewed, with a response rate of 90.4%. Of the total 741 children, 335 (45.2%) were fully immunized by whom 38% were confirmed by card [Table 1].

Table 1: Immunization coverage and Confirmation Method

Vaccination Status	Frequency (%)	Confirmation	
		By Card (%)	By Recall (%)
Fully Vaccinated	335 (45.2)	127 (38)	208(62)
Not fully Vaccinated	40 (654.8)		

Barriers of complete immunization

Multivariate logistic regression of sociodemographic factors and vaccination coverage

Table 2 shows the multivariate logistic regression of sociodemographic factors on vaccination coverage. Younger caregivers were more likely to fully vaccinate their children than older caregivers (β = −0.024, *P* value = 0.019). Fathers with Secondary/above education were 43% and 42.3% more likely to vaccinate their children than those with nonformal or primary education respectively [(AOR = 0.570, CI = 0.377–0.862, *P* value = 0.008) and (AOR = 0.577, CI = 0.382–0.871, *P* value = 0.009)]. For an additional one-unit increase in household monthly family income, there was an increase in vaccination coverage of the children by a factor of 0.003 (β =0.003, *P* value = 0.000). Young children were more likely to be fully vaccinated than older children (β = −0.018, *P* value = 0.011). Children from birth order of fifth/above were 36.1% more likely to be vaccinated than those from third or fourth and 35% more likely than those from first or second birth order. This again shows that younger children were more likely to be vaccinated. This is maybe due to the child vaccination campaign (AOR = 0.639, CI = 0.426–0.957, *P* value = 0.030) and (AOR = 0.650, CI = 0.427–0.989, *P* value = 0.044). Lastly, married caregivers were 75.6% more likely to vaccinate their children than single caregivers (AOR = 0.244, CI = 0.063–0.94, *P* value = 0.041)

Table 2: Multivariate logistic regression of socio-demographic factors and vaccination coverage

Variable	β	*P*	AOR for 95% CI
Age of caregiver	-0.024	0.019	0.976 (0.957-0.996)
Sex of caregiver			
Male		0.952	0.976(0.437-2.177)
Female			1
Marital status of caregiver			
Widowed		0.611	1.490(0.320-6.940)
Single		0.041	0.244(0.063-0.94)
Divorced		0.200	1.344(0.855-2.114)
Married			1
Educational level of caregiver			
No formal education		0.248	0.749 (0.459-1.222)
Primary education		0.165	0.706(0.432-1.154)
Secondary and above			1
Educational level of child's father			
Non-formal education		0.008	0.570(0.377-0.862)
Primary education		0.009	0.577(0.382-0.871)
Secondary and above			1
Employment of caregiver			
Employed		0.310	0.823(0.566-1.198)
Unemployed			1
Household monthly income	0.003	0.000	1.003(1.001-1.004)
Age of child	-0.018	0.011	0.982(0.968-0.996)
Birth order of child			
First or second		0.044	0.650(0.427-0.989)
Third or fourth		0.030	0.639(0.426-0.957)
Fifth and above			1

KEY: β (Beta), AOR (Adjusted Odd Ratio), CI (Confidence Interval=95%), P-value <0.05 is significant

Multivariate logistic regression of health system factors and vaccination coverage

As shown in Table 3, availability of vaccine at the time of visit, cost affordability of vaccine and being born at health facility were found to increase the chance of immunizing children (OR = 6.147, CI = 1.943–19.441, *P* value < 0.05), (OR = 1.951, CI = 1.238–3.076, *P* value < 0.05), (OR = 1.517, CI = 1.104–2.086, *P* value < 0.05).

Multivariate logistic regression of sociocultural factors and immunization coverage

For additional one-unit increase of caregivers' knowledge and practice was found to increase the immunization coverage of children by factor of 0.117 and 1.014, respectively (β =0.117, *P* value < 0.05 and β =1.014, *P* value < 0.05) respectively. Caregivers who believed immunization was useful for the children were nearly five times more likely to immunize their children than those who had a neutral perception of immunization [Table 4].

Discussion

The proportion of under-5 children with complete immunization coverage in Mogadishu was found to be 45.2% and out of this

Table 3: Multivariate logistic regression of health system factors and vaccination coverage

Variable	*P*	AOR for 95% C.I
Distance to health center		
<1km	0.127	0.754(0.524-1.084)
1km	0.465	0.850 (0.549-1.316)
>1km		1
Health care provider availability		
Yes	0.813	1.167(0.324-4.209)
No		1
Vaccine availability		
Yes	0.002	6.147(1.943-19.441)
No		1
Cost affordability		
Yes	0.004	1.951(1.238-3.076)
No		1
Vaccine acceptance		
Yes	0.141	2.074(0.786-5.476)
No		1
Place of delivery of child		
Health facility	0.010	1.517(1.104-2.086)
Home		1

KEY: AOR (Adjusted Odd Ratio), CI (Confidence Interval=95%), *P*-value <0.05 is significant

38% of them were confirmed through immunization cards and 62% were confirmed through caregiver's recall. This is coverage is very small compared to the goals of Global Immunization Vision and Strategy[11] of at least 80% vaccination coverage in every district.

The study found that the age of the caregiver had a negative significant association with immunization coverage of the children. Younger caregivers immunize their children compared to older caregivers (β = −0.024; 95% CI: 0.976–0.996, *P* value = 0.019). This finding is consistent with a study conducted in Iraq by[12] which found that the frequency of unvaccinated children was greater among older mothers. This disparity sends a positive message of little improvements in community awareness on vaccination. The study also found that the educational level of the child's father was significantly associated with immunization coverage of the children. Fathers with no formal education or primary school education were less likely to vaccinate their children than fathers with secondary educational level/ above educational level (AOR = 0.577; 95% CI: 0.377–0.862, *P* value = 0.008) and (AOR = 0.577; 95% CI: 0.3982–0.871, *P* value = 0.009), respectively. Our findings are in line with studies done in Nigeria,[13] Zimbabwe,[14] Ghana,[15] and Kenya.[16] This may be fathers with higher educational level were more aware of the vaccination importance than their counterparts.

The results of this study also showed that there was a significant positive association between monthly household income and immunization coverage of the children. For an additional one unit (USD) increase in household monthly income is likely to be associated with an increase by a factor of 0.003 on immunization coverage of the children (β =0.003; 95% CI: 1.002–1.005, *P* value = 0.000).

Table 4: Multivariate logistic regression of socio-cultural factors towards vaccination coverage

Variable	β	*P*	AOR For 95% C.I
Knowledge	0.117	0.000	1.125(1.070-1.181)
Practice	1.014	0.000	2.756(2.233-3.402)
Perception			
Useful		0.000	4.976(2.183-11.340)
Harmful		0.998	0.000
Neutral			1

KEY: β (Beta), AOR (Adjusted Odd Ratio), CI (Confidence Interval=95%), *P*-value <0.05 is significant

Concerning the age of the child, our study found that the age of the child had a negative association with immunization coverage, That is older children were less likely to be immunized when compared to younger children (β = −0.018; 95% CI: 0.968–0.996, *P* value = 0.011). This is contradicting findings of a study from Khartoum state, Sudan which showed that vaccination coverage of children increases with the increase of his age.[17]

Also, birth order of the child was associated with immunization coverage, first/second and third/fourth-born children were 0.650 and 0.639 times less likely to be vaccinated than the fifth/ above birth order children. [(AOR = 0.650, 95% CI: 0.427–0.989, *P* value = 0.044) and (AOR = 0.639, 95% CI: 0.426–0.957, *P* value = 0.030)].

This analysis also found that there was a significant association between vaccine availability in the center at the time of visit and immunization coverage of the children. Mothers who got vaccines available in the center by the time of visit were six times more likely to vaccinate their children when compared to those who did not get it. (AOR = 6.147; 95% CI: 1.943–19.441, *P* value = 0.002). our findings were supported by a study in Nigeria showed that (26.2%) of them were not fully immunized because of unavailability of the vaccine at the level of the health center and this was the most common reason of not completing or immunizing their children[18] and it is obvious that vaccine availability is the cornerstone for vaccine coverage.

We found that the affordability of costs incurred to the vaccine had a significant association with immunization coverage of the children. Caregivers who afforded the costs were two times more likely to vaccinate their children when compared to caregivers who could not afford it. (AOR = 1.951; 95% CI: 1.238–3.076, *P* value = 0.004) this is a consistent study from Togo that also supports the notion that economic conditions influence the incompleteness of immunization coverage in children. This is probably because access to immunization services can be affected by indirect costs linked to vaccination such as the purchase of immunization records cards, transport cost, or medication for vaccine-related care.[19]

In our study, the place of child delivery was significantly associated with immunization coverage of the children. Children born at a health facility were 1.5 times more likely to be vaccinated than those born at home. (AOR = 1.517; 95% C: 1.104–2.086,

P value = 0.010). Our findings are in line with a study in central Ethiopia which also showed that immunization coverage of children delivered in a health facility was higher than children delivered at home[20] and the reason behind this may be the parents get health education when the child is delivered in a health facility and gets vaccination card starting with BCG vaccine in the 1st day of life.

For an additional one-unit increase in caregivers' knowledge on immunization was found to increase the immunization coverage of children by a factor of 1.125 (AOR = 1.125, 95% CI: 1.070–1.181, *P* value = 0.001). Our findings agreed study carried out by[21] in the rural settings of western Uganda, mothers with a basic understanding of the importance of childhood immunizations were more likely to have timely, full vaccination of their children compared to those with less knowledge.

Caregivers who had positive perceptions of immunization were nearly five times more likely to immunize their children than those who had a neutral perception of immunization (AOR = 4.976, 95% CI: 2.183–11.340, *P* value = 0.001). This result is in line with the finding from the previous study in Somalia by[9] that showed "children's immunization status was significantly associated with caregivers' positive perceptions on the usefulness of immunizations to children."

For an additional one-unit increase in the practice of the caregivers was found to increase the immunization coverage of children by a factor of 2.756 (AOR = 2.756, 95% CI: 2.233–3.402, *P* value = 0.001). Two different studies conducted in Saudi Arabia[22] and Italy[4] showed similar results to this.

This study assessed barriers for full immunization coverage among under-5 years of children in Mogadishu, Somalia. The study relied on primary data collected by the researchers. However, it has certain limitations.

The actual proportions of children who have no vaccination cards were greater than those with vaccination care thus; information obtained from caregivers on the immunization status of their children is not as reliable as that of vaccination cards due to recall bias. However, any child with no vaccination card was checked with the BCG scar. The explanatory variables were selected based on previous studies and relied on the information available from the dataset. Therefore, there might be some other potential predictors that might be influenced by full immunization which were not captured in this study. Besides, this study did not include a qualitative method to answer why questions. Despite the above limitations, our findings are important to understand barriers for full immunization coverage among under 5 years children. A locally contextualized comprehensive strategy with the strengthening of the primary health system is needed to improve the immunization coverage of under-5 years in Mogadishu, Somalia.

Conclusion

In conclusion, the present study found that immunization coverage of under 5 years of children is very low (45.2%), steps to promote population awareness and community mobilization should be undertaken urgently.

Being older and single marital status of caregivers, low fathers' educational level, low monthly family income, early birth orders, younger age of children, vaccine unavailability at the health center, vaccine-related cost unaffordability, delivered at home, and caregivers' low knowledge, low attitude, and low practice on immunization were found to be the barriers for full immunization coverage among under-5 aged children in Mogadishu.

Ethical considerations

The study protocol was reviewed and approved by the Institutional Review Board of the Jazeera University. Permission to undertake the study was obtained from the Ministry of Health, the Federal Republic of Somalia. Written informed consent was obtained from the participants prior to participation in the study, and data collection was conducted confidentially.

Acknowledgements

The authors would like to thank the Ministry of Health, authorities of the elected clusters (Halane and Hawotako) for their permissions of data collection. In addition, the authors would like to thank Jazeera University and all the study participants.

Financial support and sponsorship

This study was partially supported by the Faculty of Medicine and Surgery, Jazeera University, Mogadishu, Somalia.

Conflicts of interests

The authors declare that they have no conflict of interest.

References

1. Maman K, Zöllner Y, Greco D, Duru G, Sendyona S, Remy V, *et al*. The value of childhood combination vaccines: From beliefs to evidence. Human Vaccin Immunother 2015;11:2132-41.
2. CDC. Global routine vaccination coverage--2012. MMWR Morbidity and mortality weekly report 2013;62(43):858.
3. Uwizihiwe JP, Bock H 40th anniversary of introduction of expanded immunization program (EPI): A literature review of introduction of new vaccines for routine childhood immunization in sub-Saharan Africa. Int J Vaccines Vaccin 2015;1:4.
4. Sanou A, Simboro S, Kouyaté B, Dugas M, Graham J, Bibeau G. Assessment of factors associated with complete immunization coverage in children aged 12-23 months: A cross-sectional study in Nouna district, Burkina Faso. BMC Int Health and Hum Rights 2009;9(Suppl 1):S10.
5. UNICEF. UNICEF Somalia-About us-Immunization Equity

Assessment Consultant [Internet]. 2017 [cited 2019 Dec 10]. Available from: https://www.unicef.org/som alia/about_19568.html.

6. EPI team of Somalia. Expanded Programme on Immunization: A Comprehensive Multi-Year Plan 2011–2015.
7. WHO, UNICEF. WHO and UNICEF estimates of immunization coverage 2011;1-22.
8. Save the Children. Strengthening demand creation for immunization 2018;(June):1-2. Available from: https://somalia.savethechildren.net/sit es/somalia.savethechildren.net/files/libra ry/FS11 Immunization coverage.
9. Mohamed A, Karanja S, Udu R. Barriers to full immunization coverage of under five years children in Benadir Region, Somalia. J Chem Biol Phys Sci 2016;6:1-39.
10. Cochran W. Sampling techniques [Internet]. 2nd ed. New York: John Wiley and Sons Inc; 1963 [cited 2019 Dec 26]. Available from: https://www.coursehero.com/file/p4cc hnk/COCHRAN-W-G-1963-Sa mpling-techniques-2nd-Ed-John-Wiley-and-Sons-Inc-New-York/.
11. Save the Children. Strengthening demand creation for immunization [Internet]. 2018 [cited 2019 Dec 26]. Available from: http://www.who.int/immunization/monito ring_surveillance/who-immu niz-2015.pdf?ua=1.
12. Al-Lela OQB, Bahari MB, Baderden SK, Basher AY, Kareem H. Factors affecting on immunization compliance: Iraq. J Pharm Pract Community Med 2017;3:246-53.
13. Obasohan PE, Anosike BU, Etsunyakpa MB. Determinant of full immunization coverage and reasons for its failure for children in Bida Emirate Area, Niger State, Nigeria. Merit Res J Med Med Sci 2015;3:476-83.
14. Mukungwa T. Factors associated with full immunization coverage amongst children aged 12–23 months in Zimbabwe. Afr Popul Stud 2015;29.
15. Adokiya MN, Baguune B, Ndago JA. Evaluation of immunization coverage and its associated factors among children 12–23 months of age in Techiman Municipality, Ghana, 2016. Arch Publ Health 2017;75:28.
16. Wanjala S. Determinants of immunization coverage in Kenya. School of Economics, University of Nairobi; 2014.
17. Ibnouf A, Van den Borne H, Maarse J. Factors influencing immunisation coverage among children under five years of age in Khartoum State, Sudan. South Afr Fam Pract 2007;49:14-14.
18. Adedire EB, Ajayi I, Fawole OI, Ajumobi O, Kasasa S, Wasswa P, *et al*. Immunisation coverage and its determinants among children aged 12-23 months in Atakumosa-west district, Osun State Nigeria: A cross-sectional study. BMC Public Health 2016;16:905.
19. Landoh DE, Ouro-Kavalah FF, Yaya I, Kahn A-LL, Wasswa P, Lacle A, *et al*. Predictors of incomplete immunization coverage among one to five years old children in Togo. BMC Public Health 2016;16:968.
20. Etana B, Deressa W. Factors associated with complete immunization coverage in children aged 12–23 months in Ambo Woreda, Central Ethiopia. BMC Public Health 2012;12:566.
21. Vonasek BJ, Bajunirwe F, Jacobson LE, Twesigye L, Dahm J, Grant MJ, *et al*. Do maternal knowledge and attitudes towards childhood immunizations in rural Uganda correlate with complete childhood vaccination? PLoS One 2016;11:1-16.
22. Habib RF, Alsubhi RA, Saadawi DW, Hatim RFLAL, Saleh A, Alrashidi AA, *et al*. Assessment of knowledge, attitude and practice of parents towards immunization of children in Saudi Arabia, 2018. Egypt J Hosp Med 2018;71:2585-90.