

Omomila JO
Ogunyemi AO
Kanma-Okafor OJ
Ogunnowo BE

CC –BY



Vaccine-related knowledge and utilization of childhood immunization among mothers in urban Lagos

DOI:<http://dx.doi.org/10.4314/njp.v47i3.13>

Accepted: 10th January 2020

Ogunyemi AO (✉)
 Omomila JO, Kanma-Okafor OJ
 Ogunnowo BE
 Department of Community Health,
 College of Medicine University of
 Lagos, Lagos Nigeria.
 Email: doyinogunyemi@gmail.com

Abstract: *Background:* Immunization is the single most cost-effective preventive health intervention which saves the lives of 2–3 million children annually. The unsatisfactory immunization coverage numbers have unsurprisingly resulted in abysmal child mortality figures across the country. This study aims to assess mother's knowledge and immunization utilization among under-fives in an urban community.

Methods: A descriptive cross-sectional study was carried out among 232 mothers of under-five children in an urban community in Lagos State. A multistage sampling technique was used to select the respondents. A semi-structured interviewer administered questionnaire was used as the survey tool for data collection and a checklist for sighted immunization cards. The entry and analysis of the data was done using EPI – Info Version 7.2.1.0 software computer program. Chi

square was used to test association. A p-value of <0.05 was considered statistically significant.

Results: All respondents were aware of immunization. Just over half (53.9%) of the respondents had good knowledge about immunization. Less than half (42.5%) of the under-five children were fully immunized. The vaccines most missed were oral polio and pentavalent vaccines. There was a statistically significant association between knowledge of mothers and the immunization status of their children ($p < 0.05$).

Conclusion: The results indicate that mothers with good knowledge of different aspects of immunization were more likely to have fully vaccinated children. It is recommended that health workers enlighten mothers on the benefit of each vaccine.

Key words: Immunization, Under-five, Utilization, Vaccination, Knowledge

Introduction

Immunization stands as one of the most important public health accomplishments of the 20th century, preventing 2–3 million deaths annually.^{1,2} It has definitely earned the title of being the most economical tool for the prevention of infectious diseases.³ Vaccine preventable diseases are an important cause of under-five mortality. About 17% of deaths in children under five can be prevented by vaccines. However, every year, approximately 1.5 million children die from diseases that can be prevented by immunization. Immunization of all children with existing vaccines since 2011 would have saved 25 million lives by 2024.⁴ In 2015, 19.4 million were not reached with routine immunization services, 39% of these lived in just three countries; India, Nigeria and Pakistan.⁵

There has been a rapid decline in immunization coverage in Nigeria, falling from 81.5% in the 90s to 13% in

2003 then there were meagre rises to 23% , 25% and 31% as reported in the Nigerian Demographic Health Survey (NDHS) for 2008, 2013 and 2018^{6–8} respectively and all these still fall short of the of the Global Vaccine Action Plan of achieving at least 90% essential vaccinations coverage.^{9,10} These unsatisfactory immunization coverage numbers has unsurprisingly resulted in abysmal child mortality figures. Neonatal, infant and under-five mortality rates were 39, 67 and 132 per 1000 live births respectively according to the latest NDHS.⁸ The latest NDHS (2018) indicate that the neonatal and under-five mortality rates are worsening when compared with those reported in the 2013 NDHS. The Sustainable Development Goal (SDGs), Goal 3 (good health and well-being), target 3.2 is aimed at ending preventable deaths of newborns and children under 5 years of age in all countries by reducing their neonatal mortality and under-5 mortality to as low as 12 per 1000 and 25 per 1000 live births respectively by the year 2030.¹¹ This can only be achieved by ensuring improved immunization rates

and implementing other child survival strategies.¹² According to experts on immunization, more information about the factors leading to non-vaccination and incomplete vaccination of children will guide to develop strategies to improve the uptake.¹³ Some studies have shown that there are a myriad of determinants of immunization coverage, such as parental education, mother's age, lack of vaccine related knowledge, lack of faith in vaccination and long waiting times at the health facility¹⁴⁻¹⁷. However, most of these studies,^{14,16,17} were undertaken in rural areas with infrastructural deficits and lower educational levels. Studies have shown that children in rural areas consistently have lower vaccination rates than those in the urban areas with the fact that there is a higher chance of the birth occurring in a health care facility in the urban setting than in the rural setting.^{6,18,19} Urban areas are not without their own peculiarities and constraints such as inconvenient timings and lack of effective communication with health personnel serving as barriers to immunization.²⁰ This study is a household study among mothers of under-fives in an urban community to determine vaccine-related knowledge and the utilization of immunization.

Materials and Methods

This descriptive cross-sectional study was conducted in Ikeja Local Government Area (LGA) from August to October 2017 among 232 mothers of children less than five years. A minimum sample size of 227 was calculated using the formula for descriptive studies at 95% confidence interval and prevalence estimates of 82% from a study carried out in Enugu.²¹

Simple random sampling technique in several stages was done. Firstly, simple random sampling by balloting was used to select three of the six administrative wards in Ikeja LGA. The wards were: Alade, Onilekere/Onipetesi and SerikiAro/Adekunle. Ten streets from Alade, three streets from Onilekere/Onipetesi and eight streets from Seriki Aro/Adekunle were selected by simple random sampling after proportionate allocation of streets. On each street, every house was selected consecutively. In houses with more than one eligible household; simple random sampling by balloting was used to select one household. One respondent from each household in each house was selected also by simple random sampling (balloting) where there was more than one eligible respondent. If an eligible respondent had more than one child under 5, simple random sampling was done to select which child was included in the study. All eligible children were recruited in all the 21 selected streets for this study.

Data was collected using an interviewer-administered semi-structured questionnaire adapted from the women's health section of the 2013 National Demographic Health Survey.⁷ The questionnaire comprised of three sections on socio-demography, participant's vaccine-related knowledge and utilization of immunization. Utilization was checked by viewing the child's immunization card

where available. The overall knowledge was based on their knowledge of childhood vaccines, diseases preventable by immunization, antenatal vaccination, vaccines at birth and route of administration of some vaccines. All mothers with children under 5 years old had their vaccine related knowledge assessed. The total possible score was 72. A score of 0 – 35 (<50%) was considered "poor", 36 -50 (50-69%) was regarded "fair" and 51-72 (70 -100%) was "good" knowledge. This scoring method for knowledge was categorized using the modified Bloom's cut-off point.^{22,23}

A child was considered fully vaccinated if she or he had received all basic vaccinations which include BCG vaccination against tuberculosis; at least four doses of the oral polio vaccine; one dose of hepatitis B vaccine; three doses of pentavalent vaccine; one dose of measles vaccine and one dose of yellow fever vaccine in accordance with the National Programme on Immunization (NPI) schedule.^{6-8,24} These vaccines should have been received by the ninth month of life but no later than the age of 1. Therefore, only children who were nine months and older had their immunization status assessed. A child was considered partially vaccinated if he/she had missed at least one dose of the above six vaccines. For utilization, each vaccine taken was scored as 1 while 0 was scored if not taken. However, vaccines not included in the NPI schedule were excluded and recent additions like the Inactivated Polio Virus vaccine, Meningitis A Conjugate vaccine, Pneumococcal vaccine were also excluded as per the basic vaccination list in the NDHS 2018. Children of participants with a score <11 were considered partially immunized while any child with a score 11 was considered fully immunized.

The data was analyzed using EPI info version 7.2.1.0 statistical software. Chi-square was used to test for associations between categorical variables. The analysed data was presented as frequency tables. The level of significance was set at 5% (p 0.05). Ethical approval for the study was obtained from the Health Research and Ethics Committee of Lagos University Teaching Hospital. The respondents were given the choice to participate or not to in the study with confidentiality and anonymity. Written informed consent was obtained from each respondent prior to their participation in the study.

Results

Socio-demographic characteristics are reported in Table 1. The mean age of the respondents was 32.9±6.1years. Majority (92.2%) of the mothers were married and 87.9% were in monogamous family relationships. More than half (58.6%) of the women gave birth to their children in private hospitals. The overall knowledge of mothers about immunization is shown in Table 2. Overall, 125 mothers (53.9%) had good knowledge, 98 (42.2%) had fair knowledge and only 9(3.9%) had poor knowledge about the immunization of under-fives. The immunization status of children aged 9 months to 5

years were based on immunization cards that were sighted. About 92 mothers (39.7%) of the mothers had their immunization cards. Of these, 42.5% were fully immunized, the remaining 57.5% were partially immunized in Table 3. The index children most frequently (31.5%) missed the last dose of the oral polio vaccine followed by the last dose of the pentavalent vaccine (28.8%). The least missed was BCG as there was only one child that had not received it as shown in Fig 1. In Table 4, there was a statistically significant association between respondents' vaccine-related knowledge level and the immunization status of their children as mothers with a good level of knowledge were more likely to fully vaccinate their child ($p < 0.05$).

Table 1: Socio-demographic characteristics of respondents

Variable	Frequency (n = 232)	Percentage (%)
<i>Mothers' age (Years)</i>		
16 – 25	28	12.1
26 – 35	130	56.3
36 – 45	68	29.4
46 and older	5	2.2
<i>Marital status</i>		
Single	14	6.0
Married	214	92.2
Widowed	2	0.9
Separated	2	0.9
<i>Nature of family</i>		
Monogamy	204	87.9
Polygamy	17	7.3
Single Mother	11	4.7
<i>Level of education</i>		
No formal education	13	5.6
Primary	1	0.4
Secondary	53	22.8
Tertiary	165	71.1
<i>Occupation</i>		
Professional	43	18.5
Intermediate	30	12.9
Skilled labour	106	45.7
Unskilled labour	53	22.8
<i>Children's age (in months)</i>		
Under 6	30	12.9
7 -36	165	71.1
37 - 60	37	16.0
<i>Place of birth</i>		
Government owned Facility	86	37.0
Private hospital	136	58.6
Others	10	4.3

Fig 1: Vaccinations missed by children as sighted in the immunization card

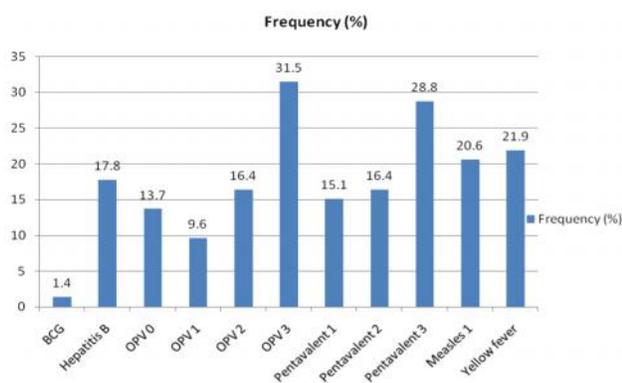


Table 2: Knowledge of mothers about immunization

Variables	Frequency (n = 232)	Percentage (%)
<i>Heard of immunization</i>		
Yes	232	100
No	0	0
<i>Source of immunization information</i>		
Antenatal clinic	115	49.6
Health care workers	39	16.8
Family/friends	43	18.5
Media	25	10.7
Others	10	4.3
<i>Main reason for immunization</i>		
To treat diseases	4	1.7
To prevent all diseases	85	36.6
To prevent major killer diseases	138	59.5
Don't know	3	1.3
Others	2	0.9
<i>Knowledge of vaccines given to babies at birth</i>		
Yes	226	97.4
No	6	2.6
<i>*Methods of administering vaccines</i>		
By injections	224	96.6
By mouth drops	223	96.1
By syrups	15	6.4
<i>Overall level of knowledge</i>		
Good	125	53.9
Fair	98	42.2
Poor	9	3.9

*Multiple responses allowed

Table 3: Utilization of immunization services among mothers of children under five

Variables	Frequency (n = 232)	Percentage (%)
<i>Child has an immunization card</i>		
Yes	223	96.1
No	6	2.6
Not sure	3	1.3
<i>Child has been fully immunized till date (by mother's recall)</i>		
Yes	206	88.8
No	18	7.8
Don't know	8	3.4
<i>Siblings of the child immunized were fully immunized</i>		
Yes	174	90.6
No	8	4.2
Don't know	10	5.2
<i>Where the child was immunized</i>		
Government hospital	179	77.2
Private Hospital	53	22.8
Faith-based centre	0	0
<i>Mother received tetanus toxoid in pregnancy</i>		
Yes	217	93.5
No	9	3.9
Don't Know	6	2.6
<i>Immunization card available and sighted</i>		
Yes	92	39.7
No	140	60.3
<i>Immunization status (of children aged nine months to five years)</i>		
Fully immunized	31	42.5
Partially immunized	42	57.5

Table 4: Association between respondent's variables and immunization status of children

Variables	Fully Vaccinated (n=31)	Partially Vaccinated (n=42)	χ ²	df	P
<i>Marital status</i>					
Married	31(43.6)	40(56.3)	1.51	2	0.50
Single	0(0.0)	2(100.0)			
<i>Education</i>					
No Education	0(0.0)	1(100.0)	0.85	2	0.65
Secondary	7(46.7)	8(53.3)			
Tertiary	24(42.1)	33(57.9)			
<i>Occupation</i>					
Professional	12(66.7)	6(33.3)	1.55	3	0.67
Skilled labour	22(55.0)	18(45.0)			
Intermediate	4(66.7)	2(33.3)			
Unskilled labour	4(44.4)	5(55.6)			
<i>Knowledge</i>					
Good	25 (56.8)	19(43.2)	9.56	2	0.01
Fair	5 (19.2)	21 (80.8)			
Poor	1 (33.3)	2(66.7)			
<i>Birth facility</i>					
Government	11(45.8)	13(54.1)	0.23	2	0.89
Private	19(41.3)	27(58.7)			
Others	1(33.3)	2(66.7)			
<i>Immunization facility</i>					
Government	20(38.5)	32(61.5)	1.19	4	0.20
Private	11(52.4)	10(47.6)			
<i>Had tetanus toxoid in pregnancy</i>					
Yes	29(42.7)	39(57.3)	0.83	2	0.82
No	2(40.0)	3(60.0)			

*(p<-0.05 statistically significant)

Discussion

Mothers' knowledge of vaccine related diseases and usefulness of immunization has been demonstrated to be important to vaccination completion.¹⁷ The commonest source of information about the immunization of under-five children in this study was by health workers at the antenatal clinics similar to studies carried out in urban areas of Oyo state, Nigeria, Pakistan, Ethiopia, and Saudi Arabia.²⁵⁻²⁸ However, this is different from a study carried out in some urban slums in India where family members and relatives were the commonest source of information.²⁹ The practice of conducting health talks before consultations is common in public health facilities and a veritable tool for health education. The respondent's knowledge on vaccines given at birth and the correct route of administration was high in this study but less than half did not know the main reason for immunization. This is in contrast to a study carried out in Enugu where 82% of mothers correctly stated that the purpose of immunization is to prevent major killer diseases.²¹

Overall, more than half of mothers had good vaccine-related knowledge, and only 3.9% had poor knowledge. Another study in Ejigbo local council development area (LCDA) in urban Lagos reported a higher proportion of

the respondents as having good knowledge about immunization.³⁰ Despite majority of the respondents in this study stating that they still had their children's immunization cards, only about 2 in 5 mothers made it available for sighting at the time of this study. This is similar to an Ethiopian study with a mixed picture of rural and urban residents where about a third of the respondents were able to show their immunization cards. Higher rates were found in a study in rural Uganda where 63% of the respondents had their immunization card available to be sighted at the time of the study.^{27,31} It is also reminiscent of the results from the NDHS 2018 where interviewers were able to see a vaccination card for only 40% of children age 12-23 months.⁸ This result has important effect on this study as utilization was assessed based on card history alone. The reasons for the relatively low card retention are numerous and have been explored in literature.^{32,33} For example, in a study done in Nepal on the factors affecting retention of child health card, it was found that mothers who had knowledge on the use of the child health card and mothers that were taught about the use by health workers had higher odds of retaining the card.³³ Therefore, it is possible that mothers did not hold on to their child's immunization cards because they did not appreciate the importance of the cards. Consequently, it is important that health workers emphasize the importance of keeping the card at least for the first five years as it has been shown that there is a positive association of retention of child health cards with counseling by health workers.³⁴ Availability of immunization cards for status verification is ideal to avoid under- or overestimation and also to assess child health coverage metrics in general.

Over half (57.5%) of children under-five in this study were partially vaccinated. Similarly, a study conducted in rural Northern Nigeria recorded 62.8% partial vaccination.¹⁷ This is in sharp contrast to studies carried out in Eastern and rural Southern Africa where the proportions of those fully vaccinated were 76.8% and 88.0% respectively.^{27,31} This clearly highlights the variations that can occur within and among various settings with both rural and urban settings having peculiar barriers to immunization. Concerns about the safety of immunization, long distance to health facilities and long waiting times at the clinic were some reasons for partial vaccination in Nigerian children according to a rural study.¹⁷ Other reasons explored in literature for incomplete vaccinations include lack of information about the days for immunization, stock-out, lack of money and missed opportunities.^{27,35} However in urban areas like where this study was carried out, rapidly growing and socially heterogeneous populations are the major concerns when it comes to the utilization of immunization services.³⁶

Of the children that were partially vaccinated, the most frequently missed vaccination was the last dose of the oral polio vaccine. This is similar to the findings of a study done in rural Uganda where eligible children missed the last dose of oral polio vaccine as ascertained from immunization card history.³¹ This has implications in the country's road map to the eradication of polio

given that Nigeria remains one of the only three countries left to achieve this³⁷ and this problem appears to plague both rural and urban settings as highlighted above. The last dose of the pentavalent vaccine was the next most frequently missed vaccine not surprisingly since both the last doses of oral polio and pentavalent vaccines are usually taken concurrently at 14 weeks. The pentavalent vaccine contains 5 vaccines bundled in one for ease of administration and therefore significant even if one dose is missed. It is also important because the pentavalent vaccine protects against a form of pneumonia that can be particularly common and devastating in the under 5 age group. Reasons for mothers failing to take their children to take these particular vaccines are unclear as polio was one of the most recognized vaccine preventable diseases by mothers in this study. This suggests that there might be other factors at play for the uptake of these particular vaccines and the hindrance to its uptake is probably related to the repeated occasions the mother has to go to the clinic for the exact same vaccines as Oral polio is taken four times and pentavalent taken three times.

Despite the fact that BCG, Hepatitis B and the Oral Polio 0 vaccines are all scheduled to be taken at birth, there was a huge disparity in the percentage of children that missed the Hepatitis B and Oral Polio 0 vaccines in comparison with BCG vaccine in this study. Unlike Hepatitis B and Oral polio vaccines, BCG vaccine vials are often only opened if at least 10-12 infants are present to reduce wastage.^{38,39} Although all three vaccines are to be given at birth, it does not have to be given at precisely the same date based on the above and this may therefore contribute to this disparity seen. Some of the other factors already highlighted above such as stock-out and missed opportunities are among other possible reasons for this finding.^{27,35}

There was a statistically significant association between the level of knowledge of the mothers and the immunization status of their children. Those with good knowledge were more likely to have fully vaccinated children compared to those with fair and poor knowledge. This is congruent with findings from studies done in both rural

and urban settings in places like Ethiopia, Cameroon and Uganda.^{27,31,35} This further highlights the importance of health workers in antenatal clinics in influencing health coverage indices such as immunization utilization. If more mothers are armed with accurate information then it is far more likely that immunization utilization will improve. There was however no statistically significant association between the mother's socio-demographic characteristics and the immunization status of their children. A study by Mugada was similar in terms of mother's education having no significant relationship with the child's immunization status.⁴⁰

Limitations of this study

The card retention rate, though consistent some with other studies, is low and therefore some of the children's vaccination status could not be assessed as this study used vaccination cards as the sole means of assessing utilization. Secondly, the sample population assessed for the utilization of vaccines were only those aged nine months and above thereby reducing the sample size of those whose vaccination status were assessed.

Conclusion

Over half of the mothers in this study had good knowledge about the immunization of under-five children. However, majority of children in this study were partially immunized. The most missed vaccines were the last doses of Oral Polio Vaccine and Pentavalent. There was a statistically significant relationship between knowledge of respondents and the vaccination status of their children. It is recommended that there should be a concerted effort from the health workers in closing the utilization gap that occurs with missed vaccines.

Conflict of Interest: None

Funding: None

References

1. Centre for Disease Control and Prevention. Ten Great Public Health Achievements in the 20th Century | About | CDC [Internet]. [cited 2017 May 2]; Available from: <https://www.cdc.gov/about/history/tengpha.htm>
2. World Health Organization. WHO | Immunization coverage [Internet]. [cited 2017 May 2]; Available from: <http://www.who.int/mediacentre/factsheets/fs378/en/>
3. United Nations Children's Fund. UNICEF | Immunization [Internet]. [cited 2017 May 2]; Available from: <https://www.unicef.org/immunization/>
4. United Nations Children's Fund. Immunization Facts and Figures Nov 2015 Update [Internet]. [cited 2018 Feb 1]; Available from: https://www.unicef.org/immunization/files/Immunization_Facts_and_Figures_Nov_2015_update.pdf
5. World Health Organization. WHO | Weekly Epidemiological Record, 18 November 2016, vol. 91, 46 (pp. 537–548) [Internet]. [cited 2017 May 5]; Available from: <http://www.who.int/wer/2016/wer9146/en/>
6. Ophori EA, Tula MY, Azih AV, Okojie R, Ikpo PE. Current Trends of Immunization in Nigeria: Prospect and Challenges. *Trop Med Health* 2014;42(2):67–75.

7. National Population Commission [Nigeria] and ICF International. Nigeria 2013 Demographic and Health Survey [Internet]. 2014. Available from: <http://www.dhsprogram.com/pubs/pdf/FR293/FR293.pdf>
8. National Population Commission [Nigeria] and ICF International. Nigeria Demographic and Health Survey 2018 [Internet]. 2019. Available from: <https://www.dhsprogram.com/pubs/pdf/FR359/FR359.pdf>
9. United Nations Children's Fund. Immunization - UNICEF DATA [Internet]. [cited 2017 May 5]; Available from: <http://data.unicef.org/topic/child-health/immunization/>
10. World Health Organization. WHO | Immunization coverage reaches 84%, still short of 90% goal [Internet]. WHO [cited 2019 Dec 29]; Available from: https://www.who.int/immunization/newsroom/press-immunization_coverage_july2014/en/
11. World Health Organization. WHO | SDG 3: Ensure healthy lives and promote wellbeing for all at all ages [Internet]. [cited 2018 Jan 30]; Available from: <http://www.who.int/sdg/targets/en/>
12. GAVI. Sustainable Development Goals [Internet]. [cited 2020 Jan 1]; Available from: <https://www.gavi.org/our-alliance/global-health-development/sustainable-development-goals>
13. World Health Organization. Meeting of the immunization Strategic Advisory Group of Experts, November 2007 – conclusions and recommendations [Internet]. [cited 2018 Feb 2]; Available from: <http://www.who.int/wer/2008/wer8301.pdf>
14. Canavan ME, Sipsma HL, Kassie GM, Bradley EH. Correlates of Complete Childhood Vaccination in East African Countries. *PLOS ONE* 2014;9(4):e95709.
15. Mutua MK, Kimani-Murage E, Ettarh RR. Childhood vaccination in informal urban settlements in Nairobi, Kenya: Who gets vaccinated? *BMC Public Health* 2011;11:6.
16. Ahmad J, Khan ME, Hazra A. Increasing complete immunization in rural Uttar Pradesh. *J Fam Welf* 2010;56:65–72.
17. Abdulraheem IS, Onajole AT, Jimoh AAG, Oladipo AR. Reasons for incomplete vaccination and factors for missed opportunities among rural Nigerian children. *J Public Health Epidemiol* 2011;3(4):194–203.
18. Antai D. Rural-urban inequities in childhood immunisation in Nigeria: The role of community contexts. *Afr J Prim Health Care Fam Med* [Internet] 2011;3(1). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4565435/>
19. Ushie BA, Fayehun OA, Ugal DB. Trends and patterns of under-5 vaccination in Nigeria, 1990-2008: what manner of progress? *Child Care Health Dev* 2014;40(2):267–74.
20. Geetu M, Avita RJ, Sulekha T, Ratna K, Aby V. Barriers to childhood immunisation among women in an urban underprivileged area of Bangalore city, Karnataka, India: a qualitative study. *Int J Community Med Public Health* 2016;3(6):1525–30.
21. Tagbo BN, Uleanya ND, Nwokoye IC, Eze JC, Omotowo IB. Mothers' knowledge, perception and practice of childhood immunization in Enugu. *Niger J Paediatr* 2012;39(3):90–6.
22. Seid MA, Hussen MS. Knowledge and attitude towards antimicrobial resistance among final year undergraduate paramedical students at University of Gondar, Ethiopia. *BMC Infect Dis* 2018;18(1):1–8.
23. Aziz S, Ahmad Z, Ghadzi SMS, Abbasi YF, Sivadasan S, Iqbal MZ. Knowledge and practice towards vaccination: a cross-sectional study among the parents in Sungai Petani, Kedah, Malaysia. *Int J Sci Eng Res* 2018;9(8).
24. National Primary Health Care Development Agency. National Primary Health Care Development Agency Child Health Card. 2017;
25. Adeyinka DA, Oladimeji O, Adeyinka FE, Aimakhu C. Uptake of childhood immunization among mothers of under-five in Southwestern Nigeria. *Internet J Epidemiol* 2009;7(2):1–15.
26. Nisar N, Mirza M, Qadri MH. Knowledge, Attitude and Practices of mothers regarding immunization of one year old child at Mawatch Goth, Kermari Town, Karachi. *Pak J Med Sci* 2010;26(1):183–186.
27. Legesse E, Dechasa W. An assessment of child immunization coverage and its determinants in Sinana District, Southeast Ethiopia. *BMC Pediatr* 2015;15:31.
28. Al-Zahrani J. Knowledge, Attitude and Practice of Parents Towards Childhood Vaccination. *Majmaah J Health Sci* 2013;216(1216):1–20.
29. Angadi MM, Jose AP, Ud giri R, Masali KA, Sorganvi V. A Study of Knowledge, Attitude and Practices on Immunization of Children in Urban Slums of Bijapur City, Karnataka, India. *J Clin Diagn Res JCDR* 2013;7(12):2803–6.
30. Sule S, Olawuyi O, Afolabi O, Onajole A, BE Ogunowo. Caregivers Knowledge and Utilization of Child Health Services in an Urban District of Lagos, Nigeria. *West Afr J Med* 2013;32:163–72.
31. 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(2):e0150131.

32. Pahari DP, Bastola SP, Paudel R. Factors Affecting Retention of Child Health Card in a Rural Area. *J Nepal Health Res Counc* [Internet] 2011 [cited 2019 May 9]; Available from: <http://www.jnhrc.com.np/index.php/jnhrc/article/view/277>
33. Paudel KP, Bajracharya DC, Karki K, C AK. Factors Determining Availability, Utilization and Retention of Child Health Card in Western Nepal. *J Nepal Health Res Counc* [Internet] 2016 [cited 2019 May 9]; Available from: <http://jnhrc.com.np/index.php/jnhrc/article/view/797>
34. Kaphle HP, Poudel S, Gupta N, Neupane N. Maternal Awareness on Child Health Card and Factors Associated with its Retention in Salyan Village Development Committee of Kaski, Nepal. *Int Biol Biomed J* 2016;2(4):149–55.
35. Russo G, Miglietta A, Pezzotti P, Biguioh RM, BoutingMayaka G, Sobze MS, et al. Vaccine coverage and determinants of incomplete vaccination in children aged 12–23 months in Dschang, West Region, Cameroon: a cross-sectional survey during a polio outbreak. *BMC Public Health* 2015;15:630.
36. Atkinson SJ, Cheyne J. Immunization in urban areas: issues and strategies. *Bull World Health Organ* 1994;72(2):183–94.
37. Global Polio Eradication Initiative. GPEI-Where We Work [Internet]. [cited 2017 May 6]; Available from: <http://polioeradication.org/where-we-work/>
38. Schaltz-Buchholzer F, Frankel HN, Benn CS. The real-life number of neonatal doses of Bacille Calmette-Guérin vaccine in a 20-dose vial. *Glob Health Action* [Internet] 2017;10(1). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5328326/>
39. BCG Vaccine AJV - Summary of Product Characteristics (SmPC) - print friendly - (emc) [Internet]. [cited 2020 Jan 2]; Available from: <https://www.medicines.org.uk/emc/product/9890/smpc/print>
40. Mugada V, Chandrabhotla S, Divya S, Kaja S, Gopala K, Machara. Knowledge towards childhood immunization among mothers & reasons for incomplete immunization. *J Appl Pharm Sci* 2017;7:157–61.