Adherence to immunization schedule among children attending a secondary level hospital in Jos, Nigeria

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ABSTRACT

Background: Vaccine Preventable Diseases, major causes of childhood mortality in Nigeria, occur largely due to low vaccination uptake, weak health care system and inadequate personnel. Immunization and adherence to immunization schedules are important in ensuring maximum protection against vaccine-preventable diseases as it has been shown to prevent over 2 million deaths annually. These deaths occur mainly in sub-Saharan Africa, with Nigeria a major contributor of these deaths.

Objectives: The study assessed the adherence to immunization schedules and completion rates of scheduled and routine immunizations among children.

Method: Immunization records of 2,226 children who received their routine immunizations at the Child Welfare Clinic of the Vom Christian Hospital, Plateau State, Nigeria from July, 2011 to April, 2013 were examined. Data on date of birth, age at commencement of immunization, and the date of receipt of various vaccines were retrieved. The Chi-square test and Fisher's exact test were used to determine deviations from range of mean ages at receipt of the various doses of the DPT and pentavalent vaccines.

Results: The result showed disparities between mean ages at receipt of all vaccine doses with recommended ages and a steady increase in drop-out between consecutive doses, with only a small percentage {10 % for Diptheria, Pertussis and Tetanus (DPT) and 8 % for Pentavalent vaccine} receiving up to the third doses. Also, that only a small number of the children were fully immunized (102 for DPT and 98 for pentavalent vaccine).

Conclusion: Adherence to routine immunization schedules was seen to be poor, with only a small percentage of the study population completing the required number of doses.

Key words: Adherence, Immunization, Pentavalent, Schedules, Vaccine preventable diseases

Le respect du calendrier de vaccination des enfants fréquentant un hôpitalsecondaire à Jos, Nigeria

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RESUME

Contexte: Les maladies évitables par la vaccination, principales causes de mortalité infantile au Nigéria, sont dues en grande partie à une faible utilisation de la vaccination, à la faiblesse du système de santé et à un personnel inadéquat. La vaccination et le respect des calendriers de vaccination sont importants pour assurer une protection maximale contre les maladies évitables par la vaccination, car il a été démontré qu'elle prévient plus de 2 millions de décès par an. Ces décès surviennent principalement en Afrique subsaharienne, le Nigéria étant l'un des principaux contributeurs à ces décès.

Objectifs: L'étude a évalué le respect des calendriers d'immunisation et les taux d'achèvement des vaccinations programmées et systématiques chez les enfants.

Méthode: Les dossiers de l'immunisation de 2 226 enfants qui ont reçu leurs vaccinations de routine à la Child WelfareClinic(clinique de protection de l'enfant)de l'hôpital Vom Christian, dans l'État du Plateau, au Nigéria,de juillet 2011 à avril 2013 ont été examinés. Les données sur la date de naissance, l'âge au début de l'immunisation et la date de réception de divers vaccins ont été récupérées. Le test Chi carré et le test exact de Fisher ont été utilisés pour déterminer les écarts par rapport à la tranche des âges moyens à la réception des diverses doses du vaccin DTP et pentavalent.

Résultats: Le résultat a montré des disparités entre les âges moyens à la réception de toutes les doses de vaccin avec les âges recommandés et une augmentation constantede l'abandonentre les doses consécutives, avec seulement un faible pourcentage {10 % pour la diphtérie, la coqueluche et le tétanos (DTP) et de 8 % pour le vaccin pentavalent} recevant jusqu'à la troisième dose. De plus, seul un petit nombre d'enfants ont été entièrement vaccinés (102 pour le DTP et 98 pour le vaccin pentavalent).

Conclusion: Le respect des calendriers d'immunisation systématique s'est avéré médiocre, avec seul un faible pourcentage de la population étudiée ayant obtenu le nombre requis de doses.

Mots-clés: Respect, immunisation, pentavalent, horaires, maladies évitables par la vaccination

INTRODUCTION

Routine and timely immunization is a very effective public health intervention globally, helping to protect against or eliminate many severe childhood diseases.[1] These vaccine-preventable diseases (VPDs) include diphtheria, measles, pertussis, pneumonia, polio, rotavirus, mumps, Haemophilus influenzae Type B (HiB), hepatitis B, diarrhoea, rubella and tetanus.[2] VPDs have been reported to be the major cause of childhood mortality in Nigeria due to low vaccination uptake, poor health care system and inadequate availability of qualified personnel.[3]

Statistics show that 19.4 million children missed out on basic vaccination globally in 2015.[4] This was despite existing immunization programs helping to prevent over 2 to 3 million deaths annually that could have resulted from vaccine preventable diseases (VPDs). The WHO report further stated that an estimated 2.7 million child deaths occur annually from VPDs, with the majority occurring in sub-Saharan Africa. This explains the increasing under-5 years-old mortality rate in sub-Saharan Africa and South Asia, particularly considering that these two regions accounted for 82% of under-5 years-old deaths in 2011.[5] Earlier in 2010, You et al.[6] reported an increase in under-5 mortalities in some developing countries, with India and Nigeria accounting for nearly one-third of the total number of under-5 deaths worldwide (21 % and 10 % respectively).

Immunization is the process that involves the administration of agent-specific, but relatively harmless antigenic components, which in vaccinated individuals can induce protective immunity against the corresponding infectious agent. A vaccination schedule refers to a series of vaccinations, with recommended timing of all doses of each vaccine, aimed at achieving maximum effectiveness.[7] Immunizations are therefore very important and so is the timeliness of receipt of these immunizations.

Nigeria operates the immunization schedule which prescribes five visits to receive a cocktail of vaccines comprising one dose of Bacille Calmette Guerin (BCG), four doses of oral polio vaccine, three doses of diphtheria, pertussis and tetanus vaccine (replaced in 2012 by the pentavalent vaccine) as well as one dose of measles vaccine.[8] In 2004, the country, in line with WHO recommendations included hepatitis B and yellow fever vaccines in its schedule, recommending the receipt of three doses of hepatitis B at birth, at six weeks and at 14 weeks of age, while yellow fever and measles vaccine should be given at nine months of age.[9] Despite its over 30 years of implementation in Nigeria, hundreds of millions of US dollars spent and a significant population of healthcare workers engaged in the program, the national immunization coverage is still less than 30 %.[10,11] This has made it imperative to assess the quality of childhood immunization delivery in terms of adherence to the immunization schedule and completion rates of scheduled and routine immunization among children, as this will in turn maximize individual as well as population protection.

METHODS

Study design

This was a retrospective study carried out to evaluate timeliness of receipt of vaccines and adherence to immunization schedules with respect to Diptheria, Pertussis and Tetanus (DPT) vaccine that was in use and the pentavalent vaccine that is replacing it.

For this study, timeliness of receipt of the vaccines was defined based on the WHO recommended time ranges: BCG (birth to 8 weeks), three pentavalent vaccines (4 weeks-2 months; 8 weeks to 4 months; 12 weeks-6 months) respectively.[12]

Study population/area

The study was conducted among children aged 0 to 12 months that presented for routine immunization at the Immunization and Child Welfare Clinic of the Vom Christian Hospital, located in Vom, Jos South Local Government of Plateau State in North-central Nigeria. In this clinic, the vaccination/immunization practices involved a once in a week clinic day with records (biodata and date of receipt of the various doses of vaccines) kept in a record book. Every child that presented at the clinic received the BCG vaccine however, children born on the other days had to wait till Thursday to receive the vaccine and this could affect timeliness of receipt of the vaccine.

Available records showed that about 1,200 children per year received their immunization at this facility. Other services offered include; growth monitoring, nutrition education, and general health education.

Sample size determination

The sample size was determined using a census approach where all available records in the Child Welfare Clinic were used. A total of 2,226 children presented between July 2011 to April 2013; 1,020 children during the period when the DPT vaccines were used and 1,206 after the pentavalent vaccine was introduced.

Data collection

Clinic records for the 2,226 children that received routine immunization at the facility from July, 2011 to April, 2013 were examined. Data on the number of visits, date of birth, age at commencement of immunization, and the date of receipt of the first and subsequent doses of the various vaccines were retrieved from the clinic records of these children. Age at receipt of immunization was calculated in days using the dates of birth and the dates of receipt of vaccines, while the uptake of vaccines was recorded as simple percentages.

The timeliness of receiving a vaccine at this facility was determined by the recommended age for receiving a given vaccine. Previous studies on timeliness, involving schedules recommending when vaccines are received at specific dates, have allowed 14, 28, and 30 days of the grace period.[8,13]

The three time frames for evaluating the timeliness of receiving three doses of oral polio vaccine (OPV1, OPV2, and OPV3), three doses of diphtheria, pertussis and tetanus vaccine (DPT1, DPT2, and DPT3) and three doses of hepatitis B vaccine (HepB at birth, HepB2, and HepB3) are as follows; too early if the vaccine was received earlier than the recommended age, being on time if the vaccine was received on or before two weeks after the due date and delayed if received after four weeks of the due date.

Full immunization was defined as receipt of BCG, three doses of pentavalent vaccine and OPV vaccines respectively. Drop-out rate was calculated as the difference in percentage coverage in between the consecutive vaccines.

Data analysis

The Chi-square test and Fisher's exact test were used to determine deviations from range of mean ages at receipt of the various doses of the DPT and pentavalent vaccines.

Ethical considerations

Access to the records at the Child Welfare Clinic, as well as ethical approval to conduct the study was granted by the Committee on Research and Ethics of Vom Christian Hospital, Vom dated May 16, 2013.

RESULTS

Demographics and drop out of respondents after BCG vaccine

About 2,226 respondents accessed the facility for these services, out of which 1,250 (56 %) received both DPT and pentavalent vaccines while 976 (44 %) dropped out. A total of 1046 (47 %) of the respondents were male, while 1,180 (53 %) were female children (Table 1).

Table 1. Demographics and drop out of respondents after BCG vaccine

		Number (n)	Percentage (%)
Children that visited clinic during the study period		2,226	100
Children that came back for DPT and Pentavalent vaccines		1,250	56.15
C hildren that dropped out		976	43.85
Sex	Male:	1046	47.0
	Female:	1180	53.0

Uptake of DPT and pentavalent vaccines relative to mean ages at receipt

About 300 (29.40 %) respondents received the first dose of DPT at a mean age of 63 days, while 286 (23.72 %) of them received pentavalent vaccine at a mean age of 73 days (Table 2). For the second doses, 242 (23.70 %) respondents had DPT and 232 (19.24 %) of them were administered Pentavalent vaccines at 107 and 88 days respectively, which fell within the acceptable ranges of 56-168 for DPT and beyond the range of 56-84 days for the pentavalent vaccine. About 102 (10 %) and 98 (8.13 %) respondents took the third doses at 152 and 130 days respectively

Table 2. Uptake of DPT and pentavalent vaccines relative to mean ages at receipt of various doses

Vaccine	Uptake n (%)	Age at receipt (Days)	Recommended age (days)	Difference (+/-)	Acceptable range (days)	Deviation from range (+/-)
DPT1	300(29.40)	63	42	21	28-58	7
Penta1	286(23.72)	73	42	31	28-56	17
DPT2	242(23.70)	107	70	37	56-168	-
Penta2	232(19.24)	88	70	18	56-84	-
DPT3	102(10.0)	152	98	54	84-168	-
Penta3	98(8.13)	130	98	42	84-168	-

**DPT= Diptheria, Pertussis and Tetanus * Penta = Pentavalent. n= number of children*

Early= before 28 days; Timely= within 28-56 days; Late= after 56 days

Completion rates of pentavalent and DPT vaccines

Table 3 shows that the number of children on DPT vaccine was 644, which accounted for 3.10 % of children that visited during the whole study period while 616 accounting for 51.80 % of them received the Pentavalent vaccine. A total of 300 (29.40 %) received the first dose of DPT, 242 (23.72 %}returned for the second dose and 102 (10 %) received the third dose.

Table 3. Completion rates of pentavalent and DPT vaccines

Vaccine	Number vaccinated n (%)	First dose only n (%)	First and Second dose only n (%)	Third dose n (%)
DPT	644 (63.10)	300 (29.40)	242 (23.70)	102 (10.0)
Pentavalent	616 (51.08)	286 (23.72)	232 (19.24)	98 (8.13)

**DPT= Diptheria, Pertussis and Tetanus *Penta = Pentavalent *n = number of children*

Early= before 28 days; Timely= within 28-56 days; Late= after 56 days

Immunization status of children

Table 4: shows that for DPT 1 vaccine, 634 (62.16 %) respondents received the first dose, 6 (0.59 %) of them had no receipt date recorded, 26 (2.55 %) received the dose too early, 292 (28.63 %) got the dose at the right time, while 310 (30.39 %) of them were late in receiving the dose. A total of 320 (31.37 %) respondents were administered DPT 2. For DPT 3, 96 (9.41 %) of them were vaccinated, all had their dates recorded 4 (0.39 %) were too early, 64 (6.28 %) were timely and 28 (2.75 %) were late.

Table 4. Vaccination status of children

Vaccine	Vaccinated n (%)	Missing dates n (%)	Early n (%)	Timely n (%)	Late n (%)
DPT1	634 (62.16)	6 (0.59)	26 (2.55)	292 (28.63)	310 (30.39)
Penta1	616 (51.8)	0	12 (1.0)	210 (17.41)	394 (32.67)
DPT2	320 (31.37)	0	12 (1.18)	182 (17.84)	126 (12.35)
Penta2	322 (26.7)	0	4 (0.33)	236 (19.57)	82 (6.80)
DPT3	102 (10.0)	0	4 (0.39)	70 (6.86)	28 (2.75)
Penta3	98 (8.13)	0	0	92 (7.63)	6 (0.50)

**DPT= Diptheria, Pertussis and Tetanus, *Penta = Pentavalent. *n= number of children*

Early= before 28 days; Timely= within 28-56 days; Late= after 56 days

Age appropriateness of immunization

Considering the 102 (10.0 %) children who received the full doses (3 doses) of the DPT vaccine, only 38 (3.73 %) received all 3 doses on time, 4 (0.39 %) had one of the doses too early, 32 (3.14 %) had one of the doses too late. 2 (0.20 %) had two doses early, 20 (1.96 %) had two doses too late, none of them had all three doses early while 6 (0.59 %) had all three doses late.

Table 5. Age appropriateness of immunization with DPT and pentavalent vaccines (n=1020)

Vaccine	Received 1 dose		Received 2 doses		Received 3 doses	
	Early	Late	Early	Late	Early	Late
	n (%)		n (%)		n (%)	
DPT	4(0.39)	32(3.14)	2(0.20)	20(1.96)	0	6(0.59)
Pentavalent	2 (0.17)	22(1.82)	0	12(1.0)	0	4(0.33)

**DPT= Diptheria, Pertussis and Tetanus, *Penta = Pentavalent*

Early= before 28 days; Timely= within 28-56 days; Late= after 56 days

DISCUSSION

Findings from this study showed a high drop-out rate between the first vaccine (BCG) and subsequent DPT or Pentavalent vaccines. The result showed that 43.85 % of the study population showed up after BCG vaccine (given at birth) to start the DPT or Pentavalent vaccines. This is lower than the National Coverage rates, which as at 2009, were 53 % for BCG, 52 % for DPT 1, 42 % for DPT 2, 42 % for DPT 3.[14] The implication of this is that fewer children were offered the life-saving vaccines, with the resultant increased risk of contracting vaccine preventable diseases. Previous studies also showed that as at 2009, only 46 % of the total number of 774 local government areas in Nigeria had achieved less than 10 % dropout rate from the first dose of DPT to the third dose.[15]

Deviations in mean ages were observed at receipt of all doses of the DPT and Pentavalent vaccines, with the highest deviations seen with the receipt of the first doses; these deviations fell beyond the acceptable range of between 28 to 56 days). This was most likely caused by late presentation to receive the BCG vaccine, which would delay receipt of subsequent vaccines, since they are administered at regular intervals. After the first doses of the both vaccines however, the mean ages of children that received the vaccines fell within the acceptable range.

There was a steady increase in dropout between consecutive doses with only a small percentage (10 and 8.13 for DPT and pentavalent vaccines respectively) receiving up to the third doses of both vaccines. This is consistent with findings from other studies.[16]

It is suggested that as the number of weeks and months

postpartum increases, the greater the tendency of mothers forgetting scheduled visits for immunization.[21] It is however very low when compared to other clinic based studies like one conducted in Benin, Nigeria where 72.4% of the infants studied completed the immunization schedule,[17] and another on timeliness and completion rate of immunization among Nigerian children attending a clinic based immunization service where 44.3% were fully immunized.

Poor adherence may be attributed to improper education on the advantages of the new pentavalent vaccine and this, coupled with side effects experienced from previous vaccinations, may account for this observation.[18] However, the specific reasons were not evaluated in this study.

From this study, it was clearly observed that more than one quarter respondents presented late for the first dose of DPT vaccine and 394 (32.67 %) for the first dose of the pentavalent vaccine. This lateness in turn affected the receipt of subsequent doses since a four-week interval between doses is recommended and followed strictly. Age at presentation is a significant determinant of completion of the schedule as children who present early for the vaccine after birth are more likely to complete the Immunization schedule as compared to children who present late.[21] Reasons for such were not studied in this work.

The early commencement of the first dose administered at birth is important in preventing perinatal or early neonatal transmission; therefore, those children that presented late are at risk of contracting such diseases.
In this study, children that received full immunization (three doses) of both DPT and pentavalent vaccines were further studied for timeliness in the receipt of each dose. The proportion of respondents that received all the doses of the DPT vaccine on time was very low (3.73 %) and 4.81 % for pentavalent vaccine received all doses on time. Other respondents who received all doses as well, had one, two or all doses too early or too late. The implication of lack of timely administration of these vaccines is that a large number of children attending this clinic were unprotected from the vaccine preventable diseases during the study period. This may result in a build-up of a pool of children with incomplete or no immunization with the resultant effect of an increased spread of diseases which could assume epidemic proportions.[19] The clinical pharmacological principles for periodic vaccination is related to $t_{1/2}$ (t-half). This allows a steady therapeutic plasma level of the vaccinogens, critical to production of antibody memory cells. This is similar to dosing of medications in vivo. If these schedules are not maintained, there will be sub-therapeutic doses, poorly synthesized antibodies, failure to achieve herd immunity, risk of disease epidemic, increases in morbidity and mortality risk.[22] The continuous vicious cycle of disease, poverty, ignorance and avoidable childhood deaths are attendant consequences. A previous study by Niederhauser and Markowitz[20] suggested that non-adherence to immunization schedules may be due to the fact that parents feared their children would catch the disease from the vaccine, side effects, the number of vaccinations, and the trauma of the vaccination process for themselves and the child. Timely advocacy could reduce non adherence to the immunization schedule.

CONCLUSION

Adherence to Immunization schedule was found to be better with the pentavalent vaccine compared to the DPT vaccines. Lack of timeliness, poor adherence to immunization schedule and drop-out rates appear to be high in our setting. The epidemiological implication of this is that significant proportions of children in the community being served by this facility were not protected from the vaccine-preventable diseases, with the possibility of increased spread of these diseases in the community. There is thus a need for sustained public health education and advocacy to improve immunization uptake and adherence in our environment.

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