Research Article

The Validity and Reliability of Parent's Recall for Routine Immunization in Cameroon

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Abstract

Introduction: In the absence of immunization documentations, parent's recall is used to assess children immunization status. During the 2018 demographic and health survey in Cameroon, parent's recall was the only source of information for 47% of children assessed for immunization coverage. The objective of this study was to determine the validity of parent's recall for immunization using the vaccination card as the reference in Yaoundé-Cameroon.

Methods: The study targeting parents of children aged 0-59months who had their children's vaccination cards. The immunization history of each child was taken based on both parent's recall and vaccination card. Using the vaccination card as a reference, the sensitivity, specificity, positive predictive value, and negative predictive value of parent's recall were calculated. The degree of agreement and the kappa statistics between the two methods were calculated using R version 4.1.0 (2021-05-18).

Results: A total of 529 households were visited and 87 eligible parents enrolled. Approximately 55.2% of the children were girls and 53% of them were aged 12-59 months. In total, 94.25% of the participants enrolled were one of the biological parents of the children, with mothers making the majority 86.20% of participants. When combined for all vaccines in the EPI (i.e. one dose BCG, 4 doses of OPV, 3 doses of pentavalent vaccine, 3 doses of PCV-13, 2 doses of rotavirus vaccine, one dose of measles/rubella vaccine and one dose of the yellow fever vaccine), the sensitivity, specificity, positive predictive value, and negative predictive value of parent's recall were 63%, 60%, 90%, and 23% respectively. The degree of agreement between the two sources was highest for BCG (94%) and lowest with Polio2 (32%). Parent's recall (94%) was most likely to correctly predict BCG vaccination status of a child than using the scars on the forearm (74%).

Conclusion: Our conclusion is that validity and reliability of parent's recall vary a lot across different vaccines and parent's recall is not very reliable for immunization status assessment in children. Parent's recall is preferred for verifying BCG immunization to scars on the forearm. In general, we recommend that parent's recall for routine immunization should be used only as a last resort or for BCG, and measles and Yellow Fever vaccines.

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Introduction

Parent's recall for immunization can be defined as the ascertaining of children immunization history based solely on the parent's/guardian's declaration without any documented proof [1]. During immunization service delivery, the health provider checks the immunization history of the child and identifies vaccines that are due or missed with respect to the child's age. In the absence of any document to prove the real vaccination status of the child, the provider interviews the child's parents or guardians in order to determine the child's immunization status [2]. In the same way, researchers equally rely on parent's recall when the vaccination card is not available to evaluate the vaccination status of a child enrolled in a survey [3]. The use of parent's recalls as a source of information on children immunization varies across countries depending on organization and accessibility of immunization information system [4]. In Cameroon, investigators relied on parent's recall during immunization surveys for 30%-70% of children enrolled [5-8]. The case was different in other context, 3% in Tripura [9], 67% in Pakistan [8], 5% in Tanzania [10]. In Cameroon, immunization data are registered in paper-based registers, stored at the level of the health facility and individual vaccination cards, stored at the level of household [11]. However, the maintenance of the vaccination register is generally very poor and sometimes not updated [12, 13]. Though parent's recall is used to assess the immunization status of children, it is known that data collected through parent's recall does not always match with the real immunization history of the child [14, 15]. In the first place, the parent/guardian accompanying the child might not be the same person who was taking care of the child in the past. This can be the case if the biological parents of the child died at some point or unable to accompany the child because of occupations or illness [16]. Secondly, the parent's recall might be incorrect simple because the parent partially or fully forgot the immunization history of the child in question [17]. Lastly, because the investigator relies on parent's recall, the parent could intentionally decide to give incorrect information and there will be no way to verify [18].

A few numbers of studies have assessed the validity of parent's recall for immunization using vaccination card or vaccination register as the gold standard in some countries [4, 16, 19, 20]. Based on the findings from these studies, the specificity, sensitivity of parent's recall for immunization varies across contexts and vaccines [15, 16]. A systematic review on the validity of parent's recall observed that studies in the subject matter were very few in low-middle income countries (11%) where investigators rely very largely on household information for immunization history assessment [16]. The authors concluded that there is no enough evidence to make a definitive conclusion on the subject [16]. No study has been done in Cameroon to assess the context specific situation. The objective of this study was to determine the validity of parent's recall for routine immunization in Cameroon using vaccination card as the reference.

Materials and Methods

Ethical Approval

This study was authorized by the regional ethics committee for the center region of Cameroon with the authorization reference: No: 01410/CRERSHC/2021. Informed consent was obtained for all participants before enrollment.

Research design

This was an evaluative study targeting parents of children aged 0-59months who had their children's routine vaccination cards. The immunization status of each child was recorded based on parent's recall and compared with the information from the vaccination card (reference sources) to estimate sensitivity, specificity, positive predictive value and negative predictive value of parent's recall. Data were collected through a household survey in which participants were interviewed and vaccination cards verified. However, with the acknowledgement that parent's recall is useful rather to the population subgroup without a vaccination card, we compared the parent's recall ability for BCG vaccine between children with cards and those without card, using BCG scars on the forearm as reference, for quality checks. The reliability of parent's recall was estimated using Kappa statistics and degree of agreement between the two sources of information. Data were analyzed with R version 4.1.0 (2021-05-18).

Research area

This study was done in six [6] health districts in Cameroon: Biyem assi, Cite verte, Djoungolo, Efoulan, Nkolbisson, and Nkolndongo. The study area was Yaoundé Cameroon.

Study population

This study targeted parents (or guardians) of children under five years, living in Yaounde that were in possession of their vaccination cards. All potential participants who could not present the vaccination card of their children were excluded from the analysis. However, participants without card were used for quality check analysis.

Sample size calculation

Sample size needed for this study was calculated using the formula for sensitivity study [21]. The parameters used for the sample size estimation included the following: expected sensitivity of 93.4% [10], $Z\alpha/2$ at 95% confidence interval 1.96, expected vaccination coverage of 42% (3), and the desired precision of 9%. We obtained a sample size of 101 participants. When we considered the vaccination card retention in Cameroon (57%), average household size (4.9), and proportion of children under five years in the

population(3), we estimated to interview 529 households in order to obtain the desired sample size.

Sampling Methods

Household selection in the field was done using a 2-stage cluster sampling. A total of 30 clusters constituting of 24 households each were assessed. Clusters were selected with probability proportionate to population size (PPS) and households within cluster selected by restricted sampling. The restricted sampling here refers to a modified form of systematic sampling in which instead of using sampling interval in a systematic way, we randomly selected one household within successive sampling interval. The sampling interval in each cluster was slightly different depending on cluster size. A total of 24 households were selected and assessed in each cluster. This method was preferred to give more room for chance factor in household selection.

Data collection

The data collection tool used in this survey was the questionnaire used by demographic health survey in Cameroon in 2018 for immunization coverage [3]. However, unlike DHS in which parent's recall was used in the absence of vaccination card, we used both sources at the same time for all participants. Data collection tool was designed in Kobo toolbox and deployed in tablets for electronic data collection. Prior to data collection, data collectors were trained and tools pretested.

Data management and data analysis

Data analysis was done with R version 4.1.0 (2021-05-18). Using vaccination card as our reference source, we calculated sensitivity (se), specificity (se), positive predictive values (PPV) and negative predictive values (NPV) of parent's recall with their corresponding 95% confidence interval (CI). These values were calculated per vaccine dose and for all EPI vaccines combined(i.e. one dose BCG, 4 doses of OPV, 3 doses of pentavalent vaccine, 3 doses of PCV-13, 2 doses of rotavirus vaccine, one dose of measles/rubella vaccine and one dose of the yellow fever vaccine). Besides, we calculated the degree of agreement between the 2 methods and the reliability of the test estimated using Kappa statistics. These values were also calculated per vaccine dose and for all vaccines combined. As a control check, we compared parent's recall ability for BCG vaccine between children with vaccination cards and children without cards. This was to evaluate if the recall ability between the two groups significantly differ, and hence would help in the interpretation of our findings.

Results

Sample description

A total of 529 households were assessed and 304 children aged 0-59 months identified of which 87(24%) had their vaccination cards and 217(76%) without vaccination cards. Table 1 presents the age and sex distribution of the children with card whose parents were enrolled and children without card, not enrolled into the study. Approximately 55.2% of the children with cards were girls and 47% of them were aged 0-11 months. In total, 82(94.25%) of the participants enrolled were one of the biological parents of the children with mothers making the majority 75(86.20%) of participants.

Parent's recall ability between children with cards and children without cards

Table 2 compares parent's recall for BCG vaccine in children with cards and children without cards, using BCG scars on the forearm as the reference. The results show that parent's recall ability does not significantly differ between

Table 1: age and sex distribution of children whose parents were enrolled for parent's recall study in Yaoundé

	Children with vaccination cards				Children without vaccination cards			
	0-11months	12-23months	23-59months	Total_sex	0-11months	12-23months	23-59months	Total_sex
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Boys	23(56.1)	9(36.0)	7(33.3)	39(44.8)	20(57.1)	17(35.4)	76(56.7)	113(44.8)
Girls	18(43.9)	16(64.0)	14(66.7)	48(55.2)	15(42.9)	31(64.6)	58(43.3)	104(55.2)
Total_age	41(47.1)	25(28.7)	21(24.1)	87(100.0)	35(16.2)	48(22.1)	134(61.7)	217(100.0)

Table 2: comparison of parent's recall ability for BCG vaccine between children with cards and children without cards, using BCG scars as the reference

	Children with cards	Children without cards	p-value
Sensitivity	0.77(0.66, 0.85)	0.92(0.87,0.95)	0.8993
Specificity	0.40(0.05, 0.85)	0.31(0.11, 0.59)	0.9026
positive predictive value	0.95(0.87, 0.99)	0.94(0.90, 0.97)	0.9935
negative predictive value	0.10(0.01, 0.30)	0.24(0.08, 0.47)	0.8052
correct classification proportion	0.75(0.64, 0.83)	0.88(0.82, 0.92)	0.9109

Citation: Martin Ndinakie Yakum, Atem Bethel Ajong, Atanga Desmond Funwie, Zahir Shah. The Validity and Reliability of Parent's Recall for Routine Immunization in Cameroon. Archives of Clinical and Biomedical Research. 7 (2023): 560-566.

children having their vaccination cards and children without vaccination card. This finding, suggest that though, our study is conducted in children with vaccination cards, our findings and conclusion can be applied to children without vaccination cards.

Validity of parent's recall

When combined for all EPI vaccine doses assessed, the sensitivity and specificity of parent's recall were 63% and 60% respectively. Also, the positive predictive value and negative predictive value were 90% and 23% respectively. However, the kappa test of agreement shows that parent's recall is not very reliable. Table 3 shows the number of times parent's recall was either in agreement or disagreement with the information from the vaccination cards. Note that though only 87 participants were enrolled, depending on the age of the child, one parent could answer up to 15 times on one child, corresponding to the different vaccine doses. This gives rise to the data in table 3 and hence table 4 which presents the validity and reliability parameters of parent's recall for all vaccines.

Table 4 presents the sensitivity, specificity, positive predictive value and negative predictive value of parents recall with their corresponding 95% CIs calculated from the data in table 3. All EPI vaccines refers to one dose BCG, 4 doses of OPV, 3 doses of pentavalent vaccine, 3 doses of PCV-13, 2 doses of rotavirus vaccine, one dose of measles/ rubella vaccine and one dose of the yellow fever vaccine

Table 5 shows the parameters of parent's recall validity and reliability for different vaccines. The validity and reliability parameters of parent's recall vary a lot across different vaccine doses. Our findings suggest that parent's recall is more sensitive and less specific for vaccines administered at birth(BCG and OPV0) and vaccines administered at 9 months

(Measles and Yellow Fever). When checking the scars on the forearm for BCG compared to vaccination card, the results showed that parent's recall (d.a=94%) is more reliable than scars (d.a=74%) were very similar to that's of the parent's recall for BCG (see table 4). On the other hand, for vaccines administered within 6 weeks-14 weeks, parent's recall turns to be more specific and less sensitive as shown on table 5.

Parent's recall is generally having good PPVs (77% -100%) and less NPVs (11%-80%) for all EPI vaccines except for OPV1, PCV-13 1, and rota1 that presented opposite findings. However, for MR and YF vaccines, the PPVs and NPVs were similar. In general, parent's recall was not very reliable with the kappa statistics ≤5% for all vaccines. However, parent's recall had a good degree of agreement (≥80%) for some vaccine doses such as BCG, OPV0, penta1, pcv-13 1 and YF vaccines.

Discussions and Conclusions

This study aims to assess the validity and reliability of parent's recall for routine immunization in children aged 0-59 months in Yaoundé-Cameroon. Overall for all vaccines in the EPI (i.e. one dose BCG, 4 doses of OPV, 3 doses of pentavalent vaccine, 3 doses of PCV-13, 2 doses of rotavirus vaccine, one dose of measles/rubella vaccine and one dose of the yellow fever vaccine), the sensitivity, specificity, positive predictive value, and negative predictive value of parent's recall were 63%, 60%, 90%, and 23% respectively. The degree of agreement between the two sources was highest for BCG (94%) and lowest with Polio2 (32%). Parent's recall (94%) was most likely to correctly predict BCG vaccination status of a child than using the scars on the forearm (74%). A few number of studies have assessed the validity of parent's recall for immunization using vaccination card or vaccination register as the gold standard in a limited number of countries

Table 3: data on immunization history of children obtained from parent's recall and vaccination cards

		Vaccination card		
		Immunized	Unimmunized	Total
Parent's recall	Immunized	570	66	636
	Unimmunized	337	101	438
	Total	907	167	1074

Table 4: validity and reliability of parent's recall for all EPI vaccines

Parameter	Value	95%CI
Sensitivity (Se)	0.63	(0.60, 0.66)
Specificity(Sp)	0.6	(0.53, 0.68)
Positive Predictive value(PPV)	0.9	(0.87, 0.92)
Negative Predictive Value(NPV)	0.23	(0.19, 0.27)
Degree of agreement (d.a)	0.62	(0.60, 0.65)
Kappa statistics	0.14	(0.09, 0.19)

Table 5: validity and reliability of parent's recall for routine immunization of children per vaccine dose and BCG scars at the forearm using vaccination card as the gold standard.

Vaccine	Sensitivity (Se)	Specificity (Sp)	PPV	NPV	d.a	Ka
BCG	0.98 (0.91, 1.00)	0.50 (0.12, 0.88)	0.96 (0.90, 0.99)	0.60 (0.15, 0.95)	0.94	0.51
Polio0	0.91 (0.83, 0.96)	0.43 (0.10, 0.82)	0.95 (0.87, 0.99)	0.30 (0.07, 0.65)	0.87	0.28
Polio1	1.00 (0.84, 1.00)	0.11 (0.04, 0.21)	0.26 (0.17, 0.37)	1.00 (0.59, 1.00)	0.32	0.05
Penta1	0.93 (0.84, 0.98)	0.62 (0.24, 0.91)	0.96 (0.87, 0.99)	0.50 (0.19, 0.81)	0.9	0.5
PCV-13 1	0.46 (0.19, 0.75)	0.89 (0.79, 0.95)	0.46 (0.19, 0.75)	0.89 (0.79, 0.95)	0.82	0.35
Rota1	0.43 (0.18, 0.71)	0.83 (0.71, 0.91)	0.35 (0.14, 0.62)	0.87 (0.75, 0.94)	0.75	0.23
Polio2	0.25 (0.15, 0.38)	1.00 (0.54, 1.00)	1.00 (0.79, 1.00)	0.11 (0.04, 0.23)	0.32	0.06
Penta2	0.43 (0.30, 0.56)	1.00 (0.54, 1.00)	1.00 (0.87, 1.00)	0.14 (0.05, 0.29)	0.48	0.11
PCV-13 2	0.32 (0.20, 0.45)	0.83 (0.52, 0.98)	0.90 (0.68, 0.99)	0.20 (0.10, 0.34)	0.41	0.07
Rota2	0.64 (0.50, 0.76)	0.43 (0.18, 0.71)	0.81 (0.67, 0.92)	0.23 (0.09, 0.44)	0.59	0.05
Polio3	0.28 (0.16, 0.42)	0.92 (0.62, 1.00)	0.94 (0.70, 1.00)	0.22 (0.12, 0.36)	0.39	0.09
Penta3	0.42 (0.29, 0.56)	0.73 (0.39, 0.94)	0.88 (0.70, 0.98)	0.20 (0.09, 0.36)	0.47	0.07
PCV-13 3	0.40 (0.27, 0.55)	0.64 (0.35, 0.87)	0.81 (0.61, 0.93)	0.22 (0.11, 0.38)	0.45	0.03
MR	0.92 (0.78, 0.98)	0.41 (0.18, 0.67)	0.77 (0.62, 0.89)	0.70 (0.35, 0.93)	0.76	0.37
YF	0.95 (0.82, 0.99)	0.47 (0.23, 0.72)	0.80 (0.65, 0.90)	0.80 (0.44, 0.97)	0.8	0.47
BCG Scars	0.77 (0.66, 0.85)	0.33 (0.04, 0.78)	0.94 (0.85, 0.98)	0.10 (0.01, 0.30)	0.74	0.05

PPV= positive predictive value, NPV= Negative predictive value, d.a = Proportion of agreement between the two methods and ka = Kappa constant for reliability.

[4,16,19,20]. Based on the findings from this studies, it can be observed that the specificity, sensitivity of parent's recall for immunization varies across vaccines [16]. This is similar with our findings as we observed that validity changes with vaccine. A systematic review on the validity of parent's recall suggested that we do not yet have enough evidence to make a definitive conclusion on the subject [16]. On the other hand, another study in Tanzania suggested that sensitivity of parent's recall was very good (>93%) and more stable across different vaccines while specificity varies very widely across vaccines between 16%-95% [10]. However, this particular study in Tanzania included only children borne within 12 months to the survey meanwhile our study targeted children 0- 59 months. In our study, more than 50% of our participants were children aged 12-59 months giving more chance for the parents to have forgotten the vaccines received. In another study, it was observed that parents mostly report correctly the immunization status of children less than 6 months than older children [15]. We therefore expect our study to have more recall bias compared to this study in Tanzania. Several other studies have reported that parent's recall is not reliable for evaluating immunization status of children [15, 22]. However, studies have not attempted to describe the variability of this across vaccines. Because of recall's bias, relying on parent's recall, during routine service delivery exposes the child to the risk of missing some vaccines or being re-vaccinated unnecessarily [15, 16]. Currently, parent's recall sometimes is the last resort and there is no other way

to assess the vaccination status of the child especially in low income countries where the health information system is very weak [18, 23]. There is therefore the need to improve the immunization information system in Cameroon. This is to reduce how much we rely on parent's recall which is less reliable. Our study did not include children who could not present their vaccination cards. It should be noted that parent's recall is used solely in the absence of the vaccination card, because of this, the ideal study would be done rather in children without a card or at least include them. However, this required a reference data source that includes children without cards such as the health facility immunization registers. This was not possible in our context because of poor maintenance of immunization registers in the health facilities, which are often not up-to-date. For this reason, we decided to check the usefulness of our findings by investigating and comparing the parent's recall ability for BCG vaccine in children with cards and children without cards, using BCG scars on the forearm as the reference. It came out from this assessment that the parent's recall bias for BCG among children with cards was not significantly different from recall bias among children without cards. Therefore, parent's recall validity in this study is closely similar to the validity of parents recall in the entire population, including children without cards. The sensitivity, specificity, positive predictive value, and negative predictive value of parent's recall for routine immunization in Cameroon are respectively 63%, 60%, 90%, and 23%. Parent's recall varies from one vaccine to another and it is more sensitive

and less specific for vaccines administered at birth (BCG and OPV0) and vaccines administered at 9 months (MR and YF).

When compared to checking the scars on the forearm for BCG, parent's recall was more reliable in evaluation BCG immunization in children with a recall bias of 6% against 27% for scars. Generally, parent's recall is not very reliable for assessing a child's immunization status. Based on these findings, we propose the following recommendations:

a. Parent's recall for routine immunization should be used only in the absence of vaccination card. However, it could be used with less risk of recall bias if we have to assess only the immunization coverage in BCG, Measles, and Yellow Fever vaccines.

b. To verify BCG immunization status of the child when the vaccination card is not available, we recommend using parent's recall instead of scars on the forearm.

c. Further research is needed to assess the other sources of information for routine immunization in Cameroon such as the vaccination register and vaccination card.

Competing interests

The authors declare no competing interest.

Authors' contributions

MNY conceived the study, designed the study, led data collection and analysis, write the first draft of the manuscript; ABA contributed to study design and writing of the manuscript; ADF conceived the study, contributed to study design and manuscript writing; ZS conceived the study, contributed to study design and manuscript writing.

Acknowledgements

List of Abbreviations

Abbreviation	Definition
BCG	Calmette-Guérin Bacillus (vaccine)
CI	Confidence interval
DHS	Demographic Health Survey
DPT-HepB+Hib	Diphtheria, Pertusis, Tetanus and Hepatitis B + Haemophilus Influenzae type b
EPI	Expanded Program of Immunization
Hib	Haemophilus Influenzae type b
Hepb	Hepatitis B vaccine
IPV	Inactivated Polio Vaccine
Ka	Kappa statistics
MR	Measles and Rubella vaccine
NPV	Negative predictive value
OR	Odds ratio
OPV	Oral Polio Vaccine
PCV-13	Pneumococcal Conjugate Vaccine 13
Penta	Diphtheria, Pertusis, Tetanus and Hepatitis B + Haemophilus Influenzae type b
PPV	Positive predictive value
DPT+Hib+HepB	Diphtheria, Pertusis, Tetanus and Hepatitis B + Haemophilus Influenzae type b
d.a	degree agreement
rota	Rotavirus vaccine
Se	Sensitivity
Sp	Specificity
YF	Yellow Fever

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