RESEARCH ARTICLE

REVISED Tetanus vaccine coverage in recommended and more than recommended doses among mothers in a West Cameroon health district: a cross sectional study [version 2; peer review: 3 approved with reservations, 1 not approved]

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v2 First published: 29 Apr 2020, 4:46
<https://doi.org/10.12688/gatesopenres.13105.1>

Latest published: 10 Mar 2021, 4:46
<https://doi.org/10.12688/gatesopenres.13105.2>

Abstract

Background: Vaccination is the best way to protect newborns and mothers against tetanus. The number of doses of Td vaccine recommended by the Expanded Program of Immunization is based on documented protective immune response. During this decade, the Fouban Health District (FHD) was the seat of an epidemic despite the satisfactory administrative immunization coverage. This study was conducted in 2019 in the FHD to assess tetanus vaccine coverage among mothers for their last pregnancy and the cumulative number of vaccine doses administered to the mothers.

Method: This was a descriptive cross-sectional study conducted in the FHD in 2019. Mothers living in the district with at least one child younger than five years were included and were selected by random stratified cluster sampling. Trained surveyors used a face-to-face questionnaire, data extraction grid and data-tracking grid to review and collect data from antenatal care booklets, vaccination cards and the women's own reports of immunization. The immunization coverage per vaccine dose and vaccination completeness rate were estimated.

Results: From 621 women visited, 602 (96.9%) responded. A total of 176/511 women (34.4%) had evidence of vaccination. For the last pregnancy, the two-dose immunization proportion was 21.7% (111/511) for documented coverage and 47.6% (243/511) for undocumented coverage. 306/570 women (53.7%) had received more

Open Peer Review

Approval Status

	1	2	3	4
version 2 (revision) 10 Mar 2021			 view	 view
version 1 29 Apr 2020	 view	 view		

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than the recommended five doses necessary for lifetime protection. The recruitment, two and five doses completeness rates were 99.9% (569/570), 95.8% (546/570) and 65.3% (372/570), respectively.

Conclusion: More than half of mothers received more doses of tetanus toxoid vaccine than necessary in FHD. This increased the resources needed and the cost of vaccination. Health personnel should be trained and supervised to assess pregnant women's vaccination status before planning the number of vaccine doses to be administered during pregnancy.

Keywords

Cameroon, child, mother, tetanus, vaccination, EPI

Switzerland

Any reports and responses or comments on the article can be found at the end of the article.

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Competing interests: No competing interests were disclosed.

Grant information: This work was supported by the Bill and Melinda Gates Foundation [OPP1190786].

The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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How to cite this article: Nguemouo Nguengang I, Nguetsop M, Eba Ze LE *et al.* **Tetanus vaccine coverage in recommended and more than recommended doses among mothers in a West Cameroon health district: a cross sectional study [version 2; peer review: 3 approved with reservations, 1 not approved]** Gates Open Research 2021, 4:46 <https://doi.org/10.12688/gatesopenres.13105.2>

First published: 29 Apr 2020, 4:46 <https://doi.org/10.12688/gatesopenres.13105.1>

REVISED Amendments from Version 1

In the second version, more precisions were done concerning some points in the introduction and the methodology.

Any further responses from the reviewers can be found at the end of the article

Introduction

Tetanus is a non-communicable and dangerous disease caused by a toxin released from *Clostridium tetani* bacteria. In maternal tetanus, considered as tetanus during pregnancy or within six weeks of the end of pregnancy, infection can occur after abortion, miscarriage, or unhygienic delivery practices¹. Neonatal tetanus is defined as tetanus that occurs in the first 28 days of life. It can be contracted through unhygienic delivery practices. Claiming thousands of lives worldwide every year^{2,3}, maternal and neonatal tetanus (MNT) are an important cause of maternal and neonatal mortality, almost exclusively in developing countries. In some countries, it is considered as an indicator of inequity of access to immunization and other maternal, newborn and child health services⁴.

Maternal and neonatal tetanus prevention relies on unsafe delivery avoidance, abortion and umbilical cord care practices, and the promotion of tetanus immunization^{2,5}. Maternal immunization with tetanus toxoid-containing vaccines (TTCVs) protects both the mother and her newborn, and is therefore a cornerstone in preventing both maternal and neonatal tetanus^{2,3,5–8}. In addition to unhygienic practices during delivery, no or incomplete immunization with TTCV can be considered as a risk factor for maternal and neonatal tetanus².

By the end of 2017, tetanus immunization had a global coverage of 86%⁹ and a Cameroon coverage of 87%¹⁰. These data for vaccine coverage derived from hospital immunization registers misestimate the true proportion of protected women because of unregistered doses of tetanus toxoid². In addition, unlike a second dose of tetanus vaccine (Td2+), protection at birth (PAB) is effective when the mother has previously received protective doses for the last pregnancy, and when the mother received one dose without documentation of previous doses received. According to the immunization schedule for pregnant women and the fact that women can start vaccination against tetanus before or during their first pregnancy, the tetanus immunization coverage evaluation cannot inform on the estimated total dose of vaccine received by a woman.

The aim of this study was to assess tetanus vaccine coverage in the Fouban Health District (FHD) among mothers in terms of the number of recommended protective doses for the latest pregnancy and for the cumulative number of vaccine doses administered.

Methods

Ethical statement

This study was implemented following national and international regulations in research participant's protection. All heads of

household were informed and their permission obtained before meeting eligible participants. All participants were informed about the study via the information sheet and their written consent for participation and publication of the collected data was obtained before collecting their data. The information contained in their antenatal care (ANC) booklet was kept confidential and only data needed for the study were collected. We obtained ethical clearance from the National Ethical Committee for Human Health Research (N° 2019/05/20/CE/CNERSH/SP of May 6, 2019) and an administrative authorization letter from the FHD Medical Officer (N° 247/L/MINSANTE/SG/DRO/DS/FBAN of November 22, 2018).

Study design

This was a descriptive community-based cross-sectional survey conducted among former parturient women of the FHD in 2019. A cluster randomized sampling design was used to select participants from whom trained surveyors collected the data using a face-to-face method.

Study period

The study was conducted from July 2018 to July 2019. Recruitment and data collection were conducted from May 2019 to June 2019, following receipt of ethical approval for the study.

Study area

The FHD is located in the west region of Cameroon, bordered by four other health districts of the same region and by the North West Region in the North. It has a surface area of 1,734 km². The FHD is made up of 22 health areas with a total population of 235,828 inhabitants in 2018¹¹. This district was chosen because it gives an opportunity to pilot the exploration of access to immunization among pregnant women in an environment with strong religious and socio-cultural influences on access to care.

Study population

The target population was women of childbearing age with at least one child aged 0–59 months living in FHD for at least three months. Those absent from selected households for two visits in a week were not included.

Sample size

The sample size was estimated at 620, using a confidence interval of 95% and precision of 5% and assuming the immunization coverage in the Cameroon general population to be 73.9% from a previous demographic health survey (DHS 2011)¹², a design effect due to cluster sampling of two and response rate of 94.4% from DHS 2011.

Sampling procedure

The estimated sample size was assigned to 10 health areas (HA) selected from the 22 HA of the FHD by a stratified random sampling process. At the HA level, 62 quarters were selected using a systematic sampling method. The number of clusters per HA was proportional to the total population of the HA and 10 mothers were included per quarter. The listing of all localities was done in alphabetical order with the cumulative population frequency. The sample interval in each HA was determined by dividing the total population of the area by

the allocated number of clusters. In each village/quarter, one direction or street was randomly selected from the center. We included the first household on the right and another one after, skipping two households. We further chose the participant in the selected households. If there were two or more mothers in a household, we randomly chose one, and if there were no eligible woman, the next household was included in the study.

Data collection instrument

The data collection tools were developed by the study team and pre-tested among 14 women in the community for fluency, acceptance by participants and precision. Following pre-testing, the questionnaire was divided into a questionnaire, a data extraction grid and a data tracking grid and some questions were adapted or removed to make questions more pertinent and reduce the time taken to administer the questionnaire (from ~30 minutes to ~10 minutes). The questionnaire (see *Extended data*)¹³ was used to collect via face-to-face method data on socio-demographic variables, knowledge of ANC and the tetanus vaccine. One data extraction grid and one data-tracking grid were also used; the first when ANC booklet or immunization card were available and the second when they were not (see *Extended data*)^{14,15}.

Data collection procedure

Trained surveyors conducted a face-to-face interview at the participant's home to collect data from eligible mothers. Surveyors were male and female community health workers with at least three years of experience. Before beginning, the aim of the study was explained in the information sheet and written informed consent was obtained. Interviews were 5–10 minutes in duration. Data collected included: age; education level; marital status; profession; parity; knowledge of tetanus vaccine; availability of ANC booklet and immunization card; and doses of tetanus toxoid vaccine received since their first pregnancy, during their last pregnancy and during their last three pregnancies, with earlier pregnancies not considered to reduce the possibility of memory bias. The information sources were recall and evidence of vaccination (Td cards and ANC booklets).

Bias

There was a high probability of recall bias as data were collected using a questionnaire. We cannot be certain of the respondent statements, as some may not have a good memory of vaccination from many years ago or some could for some reason hide or deform some answers. The research team could not overcome this weakness as it cannot be avoided when data are collected using questionnaires. Nevertheless, some key variables were collected from vaccination cards filled out by health personnel and we believe these have less risk of being affected by information bias.

Data analysis

We assessed the survey coverage and response rate per cluster to mitigate the risk of selection bias. Data were analyzed by estimating the proportion of mothers with each dose of tetanus vaccine received, the proportion of documented immunization coverage, undocumented immunization coverage

and stratification by education level. Attempting to infer results to the general population, proportions were estimated with 95% confidence intervals. Data were entered and analyzed using Epi Info version 7.2.2.6¹⁶. Missing data were considered missing and were not replaced; however, the common denominator for the groups of variables was kept unchanged.

Results

Socio-demographic characteristics

Out of 621 participants reached, 602 responded, giving a response rate of 96.9% (CI 95%: 95.6–98.3). The mean age of participants was 28.4±8 years. The coverage rate of the 62 clusters was 100% and the response rate varied from 94.3% to 100%. Out of 602 participants, 483 were Muslim (80.2%, CI 95%: 77.1–83.4) and 319 were housewives (52.9%, CI 95%: 49.0–56.9). Secondary education was the most represented education level among participants. [Table 1](#) shows the distribution of participants by socio-demographic characteristics¹⁷.

Tetanus immunization coverage for last pregnancy

In our study, 176/511 (34.4%, CI 95%: 30.3–38.6) women had ANC booklets or immunization cards (Td card). 111/511 (21.7%, CI 95%: 18.1–25.3) participants had documented immunization coverage of two or more tetanus doses (Td2+) and 243/511 (47.6%, CI 95%: 43.2–51.9) had undocumented immunization coverage. The high proportion of unprotected births 102/280 (36.4%, CI 95%: 30.8–42.1) was among those education to secondary education level. [Table 2](#) presents the distribution of tetanus vaccination coverage at the last pregnancy.

Cumulative and completeness vaccination coverage

The recruitment, two and five doses completeness rates were 569/570 (99.9%, CI 95%: 99.5–100), 546/570 (95.8%, CI 95%: 94.2–97.5) and 372/570 (65.3%, CI 95%: 61.4–69.2), respectively. Among former parturient women, 306/570 (53.7%, CI 95%: 49.6–57.8) had received more than five tetanus vaccine doses ([Table 3](#)). The number of doses increased with the number of pregnancies. [Table 3](#) and [Table 4](#) present the distribution of tetanus immunization coverage per dose by education level and the variation of distribution of estimated cumulative tetanus vaccine dose received with the number of pregnancies.

Discussion

The documented vaccination coverage of at least two doses of tetanus vaccine at the end of the previous pregnancy was 21.7% and increases to 69.3% when the mother's statements about their vaccination status (undocumented vaccination coverage) are taken into account. Taking into account the total number of tetanus vaccine doses received during all pregnancies by each woman, the first contact, two and five doses completeness rate was 99.9%, 95.8% and 65.3%, respectively. Over half (53.3%) of participants had received more than five tetanus vaccine doses.

To protect the child from tetanus, it is recommended that a minimum of two doses of this vaccine be administered to each woman before the end of pregnancy^{9,18}. Routinely, the estimation of two-dose vaccination coverage is done by calculating the proportion of women who received the vaccine in the

Table 1. Distribution of participants according to socio-demographic characteristics.

Socio-demographic characteristics (N= 602)	Frequency (n)	Proportion (%)	CI 95%	
Age (years)				
≤19	50	8.4	6.4	10.8
20–24	164	27.4	23.9	31.1
25–35	270	45.1	41.1	49.1
>35	115	19.2	16.2	22.6
Education level				
Illiterate	30	4.9	3.2	6.7
Primary	239	39.7	35.8	43.6
Secondary	321	53.3	49.3	57.3
Higher	6	1.0	0.2	1.8
Main profession				
Civil servant	35	5.8	3.9	7.7
Farmer	32	5.3	3.5	7.1
Trader	112	18.6	15.5	21.7
Housewife	319	52.9	49.0	56.9
Other	92	15.3	12.4	18.2
Marital status				
Single	69	11.5	8.9	14.0
Married	477	79.2	76.0	82.5
Divorced	33	5.5	3.7	7.3
Widow	20	3.3	1.9	4.8
Age of first pregnancy (years)				
<=19	410	71.4	67.6	74.9
20–24	137	23.9	20.6	27.5
25–35	27	4.7	3.3	6.8
>t35	0	0.0	0.0	0.0

antenatal consultation follow-up register¹⁹. However, since not all women attend antenatal consultations, the community-based survey is more suitable for this estimation. The best source of data for this estimation is the vaccination card or ANC booklet. The present study shows a significant difference between documented and declared vaccination coverage and highlights the need to identify and respond to the reasons for this difference and to decide on the data sources to be used to monitor vaccination coverage²⁰. In the present paper, we considered and discussed vaccination coverage, taking into account the

vaccination card and the mother's declarations. This approach is supported by the argument that the survey was done less than five years after the last pregnancy, with good chances that mothers remember their vaccination status.

The two-dose immunization coverage from immunization cards and declarations indicates that three out of 10 babies are born unprotected against tetanus. The fact that a significant proportion of newborns are unprotected against tetanus is concerning for our national elimination status. This could be explained

Table 2. Distribution of mother tetanus vaccine coverage at the last pregnancy in the Fouban Health District.

Tetanus dose received during ANC	Education level [n (%)]				Total (n=511)
	Illiterate (n=23)	Primary (n=203)	Secondary (n=280)	Higher (n=5)	
Immunization status from Td card or ANC booklet					
Less than two vaccination doses	0 (0.0)	17 (8.4)	48 (17.1)	0 (0.0)	65 (12.7)
At least two vaccination doses	2 (8.7)	46 (22.7)	62 (22.1)	1 (20.0)	111 (21.7)
Subtotal	2 (8.7)	63 (31.0)	110 (39..3)	1(20.0)	176 (34.4)
Undocumented Immunization status					
Less than two vaccination doses	5 (21.7)	32 (15.8)	54 (19.3)	1 (20.0)	92 (18.0)
At least two vaccination doses	16 (69.6)	108 (53.2)	116 (41.4)	3 (60.0)	243 (47.6)
Subtotal	21 (91.3)	140 (68.9)	170 (60.7)	4 (80.0)	335 (65.6)
Documented and undocumented Vaccination status					
Less than two vaccination doses	5 (21.7)	49 (24.1)	102 (36.4)	1 (20.0)	157 (30.7)
At least two vaccination doses	18 (78.3)	154 (75.9)	178 (63.6)	4 (80.0)	354 (69.3)

Td card, tetanus vaccine immunization card; ANC, antenatal care.

Table 3. Distribution of tetanus immunization coverage per dose classified by education level in the Fouban Health District.

Estimated cumulative Td vaccine dose received	Education level [n (%)]				Total (n=570)
	Illiterate (n=25)	Primary (n=230)	Secondary (n=309)	Higher (n=6)	
0	0 (0.0)	0 (0.0)	1 (0.32)	0 (0.0)	1 (0.2)
At least 1	25 (100.0)	230 (99.9)	308 (99.7)	6 (100.0)	569 (99.9)
At least 2	25 (100.0)	226 (98.3)	289 (93.5)	6 (100.0)	546 (95.8)
At least 5	21 (84.0)	169 (73.5)	179 (54.9)	3 (50.0)	372 (65.3)
More than 5	17 (68.0)	149 (64.8)	140 (45.3)	0 (0.0)	306 (53.7)

Table 4. Variation of distribution of estimated cumulative tetanus vaccine doses received with the number of pregnancies in the Fouban Health District.

Estimated cumulative vaccine dose received	Number of pregnancies [n (%)]				Total (n=576)
	1 (n=89)	2 (n=104)	3 (n=105)	More than 3 (n=278)	
0	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.2)
1 – 5	89 (100.0)	95 (91.4)	42 (40.0)	39 (14.0)	265 (46.0)
6 – 10	0 (0.0)	9 (8.7)	62 (59.1)	141 (50.7)	212 (36.8)
11 – 15	0 (0.0)	0 (0.0)	0 (0.0)	71 (25.5)	71 (12.3)
>15	0 (0.0)	0 (0.0)	0 (0.0)	27 (9.7)	27 (4.7)

by limits in the supply of vaccination²¹, the limited access of pregnant women to organized vaccination sessions or the fact that the estimate of vaccination coverage fails to include vaccine doses administered during previous pregnancies. Taking into account the fact that in most health facilities, ANC and vaccination against tetanus are integrated²², noted in the ANC booklet and given to the pregnant woman, and that these women change their booklet from one pregnancy to the next, we opted in this study to estimate the cumulative vaccination coverage of the mother taking into account all vaccine doses administered in previous pregnancies.

The tetanus immunization schedule during pregnancy in Cameroon is based on the WHO recommendations¹⁸. This schedule recommends administering at least two doses at least four weeks apart, the last of which must be administered at least two weeks before delivery; the three booster doses administered with an interval of at least six, 12 and 24 months after the second dose, which provide five, 10 and all childbearing age years protection, respectively^{10,23}.

Our results showed that 65.3% of mothers had completed five doses of the tetanus vaccine and that 53.7% had received more than the five maximum recommended doses for lifetime protection²⁴. Without evidence of an existent study, this is the first study that assesses the cumulative administered vaccine to this targeted population. The present study did not investigate reasons for this situation. From our experience in observing and supervising vaccination sessions, it can result from some weaknesses in planning, delivering and monitoring tetanus toxoid vaccination in pregnancy. These may include the fact that: 1) in practice, the denominator recommended by the Expanded Program on Immunization to monitor the coverage of tetanus toxoid vaccine is the estimated number of pregnant women (assuming all of them have not been previously vaccinated)¹⁹; 2) the evaluation of vaccination status is not conducted before planning the number of vaccine doses to be administered in each pregnancy and; 3) ANC booklets also serve as vaccination cards and are renewed with each pregnancy. No study has shown any danger administering more doses of tetanus vaccines than necessary to pregnant women. However, there is no doubt that this situation increases the cost of vaccination, as shown in previous studies^{21,25}, in terms of the number of vaccine doses to be purchased and human resources needed to organize vaccination sessions and also leads to underestimates of the performance of the Expanded Program on Immunization.

Limitations and strengths of the study

The estimated coverage of vaccination during the last pregnancy and cumulative number of doses from all pregnancies was expected to be based on data collected from the Td card or ANC booklet; however, only a third of the participants had evidence of vaccination. We had to collect this data using a tracking tool to assess the vaccination status of women that had no evidence of vaccination. Using two data sources to estimate this coverage can lead to information bias that may question the validity of our results. This is a difficulty encountered in almost all of the vaccination coverage surveys that we tried to solve by using a vaccine status-tracking grid. The

limitations of the current study have lead our team to launch two other studies: a study to document and respond to reasons for the unavailability of evidence of vaccination and a study to test tools that allow with certain reliability to determine the vaccination status of women who have no evidence of vaccination.

Conclusion

The present study indicates that more than half of the participants received more doses of vaccines than recommended for adequate protection against tetanus of the mother and the child during the mother's childbearing years. This increases the need for resources and the cost of vaccination. This study also showed that the vaccine coverage and the level of protection of this vaccine in pregnant women are underestimated if estimates do not take into account the cumulative number of doses of vaccine received by the mother before and during previous pregnancies. To improve the situation, we recommend training health personnel to assess the vaccination status before planning the number of doses of vaccines to be administered to a pregnant woman. Moreover, the same document should be used for all antenatal consultations across pregnancies to allow a better assessment of the number of vaccine doses already administered. Scientists should identify and respond to the reasons for the unavailability of evidence of vaccination and test vaccine status tracking tools in women who have no source of verification of vaccine status.

Data availability

Underlying data

Figshare: Tetanus vaccine coverage in recommended and more than recommended doses among mothers in a West Cameroon Health District: MetaData. <https://doi.org/10.6084/m9.figshare.11803248.v1>¹⁷

Extended data

Figshare: Questionnaire. <https://doi.org/10.6084/m9.figshare.11828625.v1>¹³

Figshare: Data extraction grid. <https://doi.org/10.6084/m9.figshare.11828643.v1>¹⁴

Figshare: Data tracking grid. <https://doi.org/10.6084/m9.figshare.11828697.v1>¹⁵

Data are available under the terms of the [Creative Commons Zero "No rights reserved" data waiver](#) (CC0 1.0 Public domain dedication).

Acknowledgements

We are grateful to the Health District Service of Foumban, the Faculty of Medicine and Pharmaceutical Sciences of the University of Dschang and the National Ethical Committee for Human Health Research for giving us formal authorization to carry out this study. We thank the non-governmental organization M.A. SANTE (Foumban Office) for technical and logistical support. We thank all the participants, and the Health Areas Chief of Foumban Health District for facilitating data collection. We also thank all those who contributed to the realization of this work.

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[Reference Source](#)
- Centre Pasteur du Cameroun: **Calendrier de vaccination**. [Accessed: 31st December 2019].
[Reference Source](#)
- World Health Organization: **Tetanus vaccine: WHO position paper= Vaccin antitétanique: Notes de synthèse: position de l'OMS concernant les vaccins antitétaniques**. *Weekly Epidemiological Record= Relevé épidémiologique hebdomadaire*. 2006; **81**(20): 198–208.
[Reference Source](#)
- Mvundura M, Kien VD, Nga NT, et al.: **How much does it cost to get a dose of vaccine to the service delivery location? Empirical evidence from Vietnam's Expanded Program on Immunization**. *Vaccine*. 2014; **32**(7): 834–838.
[PubMed Abstract](#) | [Publisher Full Text](#)

Open Peer Review

Current Peer Review Status: ? ? ? X

Version 2

Reviewer Report 12 July 2021

<https://doi.org/10.21956/gatesopenres.14440.r30778>

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X M. Carolina Danovaro-Holliday

Strategic Information Group, Expanded Program on Immunization (EPI), Department of Immunization, Vaccines and Biologicals (IVB), World Health Organization (WHO), Geneva, Switzerland

The authors report the results of a survey (not using probability sampling) to assess vaccination with a tetanus toxoid containing vaccine (TTCV) conducted in a health district in Cameroon in 2019. While the main results will likely stand, i.e., excess TTCV vaccination for some women and not enough vaccination for others, more clarifications are needed to fully evaluate the findings.

My main suggestions are:

- Consider properly reviewing the existing literature to put the findings into context, notably the most updated WHO Recommendations synthesized in the 2017 Tetanus vaccine Position paper: <https://www.who.int/teams/immunization-vaccines-and-biologicals/policies/position-papers/tetanus> . The main WHO reference used https://www.who.int/reproductivehealth/publications/maternal_perinatal_health/immunization_tetanus is outdated (2002).
- Provide the reader with information about the TTCV recommendations in Cameroon. What is the recommended schedule? How many booster doses are recommended? Which vaccine is used, TT or Td (and since when, if Td)?
- Describe better the survey methods used. The study reported used a method of quota sampling no longer endorsed by the World Health Organization (WHO), see: <https://www.who.int/teams/immunization-vaccines-and-biologicals/immunization-analysis-and-insights/global-monitoring/immunization-coverage/survey-methods> .
 - Why did the authors chose this methodology rather than probability sampling?
 - Why were women who gave birth, but with stillbirths and infants who died, excluded? (against current WHO recommendations – see Survey Manual in link provided above).
 - Provide more information about the survey implementing teams and analysis. Where can the reader find the database and analytical code?

- Mention that this method assumes self-weighting and that the uncertainty estimates (95% Confidence intervals in this case), thus, are difficult to interpret. Also unclear how the sampling design was handled in the analysis
- With all these, the limitations section must be expanded to also discuss selection bias (non-probability sampling, unclear revisit procedures, who selected households and documentation of HHs approached vs. surveyed) and ascertainment bias linked not only to long recall period, limited availability of written records, but also to who asks and how questions are asked to ascertain vaccination status.
- Tell us how the findings of the survey results are going to be used to change policy and/or practices in Cameroon.

Comments by section:

Abstract:

- Consider adding “and safe birth and umbilical cord care practices” to this sentence “Vaccination is the best way to protect newborns and mothers against tetanus”.
- Please revise this sentence “During this decade, the Foumban Health District (FHD) was the seat of an epidemic despite the satisfactory administrative immunization coverage”.
 - Tetanus does not result in epidemics.
 - What is meant by “satisfactory administrative immunization coverage”? Infant coverage with three doses of diphtheria-tetanus-pertussis (DTP3)? TTCV coverage among...women of reproductive age? Pregnant women? Provide a level, >80%, 90%, something else?
- Tell us about occurrence of maternal and neonatal tetanus in FHD, the MNT still a public health problem?
- In the methods subsection, indicate the recall period, i.e., mother of children born aged 0-59 months at the time of the survey.
- I suggest explaining the recommendation briefly in the abstract, as two doses of TTCV during each pregnancy is *not* a blanket recommendation. It only applies in certain circumstances. In fact, the 2017 WHO Position Paper on Tetanus Vaccines states: “Women who have documented evidence that they received all of the doses needed for full protection, i.e. either 6 TTCV doses in childhood or 5 doses if first vaccinated during adolescence/adulthood, should not be further vaccinated during pregnancy in order to avoid the risk of increased local reactions.”
- It is unclear to me why the proportions presented use 511 (the number of women with some evidence of vaccination) as the denominator. We read that the number of eligible women included was 602, and this should be the denominator to calculate proportion vaccinated, as done in most household surveys. Thus, what happened to the other 91 women [602-511]?
- I also don't understand this statement “The recruitment, two and five doses completeness

rates were 99.9% (569/570), 95.8% (546/570) and 65.3% (372/570), respectively” – why 570 as denominator? What does it mean by “the recruitment?”

Introduction:

- Consider a more comprehensive review of existing recommendations, notably the latest WHO position paper.
- Provide background information about the Foumban Health District (FHD), tetanus there, and tetanus recommendations in Cameroon.
- Td seems to be used as synonym with TT. Please clarify. Since when is Td used in Cameroon?
- Explain what is Protection at Birth (PAB) vis-à-vis coverage with a TTCV.
- On the later, “By the end of 2017, tetanus immunization had a global coverage of 86%...” is not supported by the references provided (link is broken), plus WHO only estimated PAB (until 2017) not coverage.
- I cannot access reference 10 either to check this part “... and a Cameroon coverage of 87%” – please revise and update link.

Methods:

- How was written informed consent handled for illiterate women?
- Were the participants informed if they needed a TTCV dose?
- Tell us about data management, cleaning and analysis other than done with EpiInfo. Paper-based data collection? Single data entry?

Results:

- Table 1. It is difficult to interpret the 95%CI included in table 1. Also, as totals don't add to 602, you may want to add a row of missing in each category.
- It may be better to provide mean and dispersion for continues variables in the text.
- This section is missing how we go from 602 to denominators of 511 and to 570 for different indicators. Why?

Discussion:

- The first paragraph just repeats data already provided. Better if the authors summarize in their words the key findings.
- This statement: “To protect the child from tetanus, it is recommended that a minimum of two doses of this vaccine be administered to each woman before the end of pregnancy” must be revised in light of current tetanus vaccine recommendations. Reference 9 is inaccessible using the link provided and reference 18 is outdated.

- Reference 20, about validity of recall in surveys is okay, but there are two more recent and complete reviews on this topic: Modi *et al.* (2018¹) and Dansereau *et al.* (2020²).
- Revise section about WHO recommendations, as citation 18 is outdated as mentioned before.
- A Tunisia paper (ref 19) is used to talk about WHO recommendations. This needs to be supported by a primary document (though the Tunisia experience can be kept as a good explanation on how it was used over twenty years ago).
- This statement is *not* accurate “No study has shown any danger administering more doses of tetanus vaccines than necessary to pregnant women.” In fact, the 2017 WHO Position Paper highlights the increase in adverse reactions following additional doses “The intensity and frequency of both local and systemic reactions tend to increase with an increasing number of previous vaccinations. For instance, redness of the injection site was reported in 12.2%, 16.2%, and 19.4% of vaccinees following the first, second and third doses of DTaP in the primary series, and 31.4% following receipt of any dose including booster doses. There is also a risk of administering excess TT when pre-existing tetanus antibody levels are already high, which can result in increased local reaction rates.” – You can look at the accompanying documentation of the Position Paper to look for primary research so you can cite papers about increases in adverse events, notably local reactions.
- Expand the limitation section to account for potential biases related to the sampling procedures used.

References:

- There are several broken links that must be updated.

Data sharing:

- Where can we access the analytical code used?

References

1. Modi R, King C, Bar-Zeev N, Colbourn T: Caregiver recall in childhood vaccination surveys: Systematic review of recall quality and use in low- and middle-income settings. *Vaccine*. 2018; **36** (29): 4161-4170 [Publisher Full Text](#)
2. Dansereau E, Brown D, Stashko L, Danovaro-Holliday M: A systematic review of the agreement of recall, home-based records, facility records, BCG scar, and serology for ascertaining vaccination status in low and middle-income countries. *Gates Open Research*. 2020; **3**. [Publisher Full Text](#)

Is the work clearly and accurately presented and does it cite the current literature?

No

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Immunization

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Reviewer Report 06 July 2021

<https://doi.org/10.21956/gatesopenres.14440.r30777>

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Maria Rosário Fraga Oliveira Martins

Global Health and Tropical Medicine, Universidade Nova de Lisboa, Lisboa, Portugal

The objective of this study was to **assess tetanus vaccine coverage among mothers for their last pregnancy** and the cumulative number of vaccine doses administered to the mothers. It was conducted during 2019 in Fouban Health District (FHD). FHD is located in the west region of Cameroon, bordered by four other health districts of the same region and by the North West Region in the North. It is made up of 22 health areas with a total population of 235,828 inhabitants in 2018.

Methods

To attain the objective, the authors conducted a descriptive community-based cross-sectional survey conducted among former parturient women. A cluster randomized sampling design was used to select participants.

The sample size was computed using a confidence interval of 95% and precision of 5% and assuming the immunization coverage in the Cameroon general population to be 73.9% from a previous demographic health survey (DHS 2011). A design effect due to cluster sampling of two was considered together with a response rate of 94.4% (from DHS 2011).

The target population was women of childbearing age with at least one child aged 0–59 months living in FHD for at least three months. Those absent from selected households for two visits in a week were not included.

The estimated sample size was 620 women.

In Data analysis the authors referred that in attempting to infer results to the general population, proportions were estimated with 95% confidence intervals.

Comment 1

The authors want to infer which results?

In the main objective and in sample size calculation it is mentioned that the primary outcome is tetanus vaccine coverage among mothers for their last pregnancy. And only for this outcome, it will be possible to infer something to the population. Must be clarified.

Results

Tables 1, 2 and 3

Comment 2

The number of women with Higher education is so low (n=6) that I wonder if the result has real meaning; also there are no women with age of first pregnancy >35 years; does it make sense to have a line of zeros?

Comment 3

I can't see why the CI95% are presented together with socio-demographic characteristics. It should be presented together with the main outcome, but the sample was not chosen to be representative of the socioeconomic level. I am not sure of the added value of this information

Discussion

Comment 4

In my opinion, if the authors want to infer something to the population we need to know more about the target population. Some statistics at the population level would be very useful to compare with the results from this study. For example: what are the sociodemographic characteristics of women of childbearing age with at least one child aged 0–59 months living in FHD? (namely age, level of education, profession and marital status). It's important to compare the sample used in this study with the population characteristics to evaluate the extent to which it is representative or not. If not there will be a possible bias, namely in disaggregated data that should also be mentioned.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Statistics, Public Health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Version 1

Reviewer Report 14 September 2020

<https://doi.org/10.21956/gatesopenres.14270.r29118>

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Ghose Bishwajit

Faculty of Social Sciences, School of International Development and Global Studies, University of Ottawa, Ottawa, ON, Canada

- Fouban Health District is not a standard term, it needs more clarification.
- Year of survey needs to be mentioned in the abstract.
- The definition of outcome variable also needs to be mentioned in the abstract.
- The first 2 paragraphs in the introduction are very general in description and should be replaced by something more substantial: contextual factors, what progress has been made so far, what challenges lie ahead, what should be done etc.
- The following study was not cited: Chiabi *et al.* (2017¹).
- What the present study is contributing to the literature should also be mentioned.

References

1. Chiabi A, Nguetack FD, Njapndounke F, Kobela M, et al.: Vaccination of infants aged 0 to 11 months at the Yaounde Gynaeco-obstetric and pediatric hospital in Cameroon: how complete and how timely?. *BMC Pediatr.* 2017; **17** (1): 206 [PubMed Abstract](#) | [Publisher Full Text](#)

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Maternal and child health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 05 Nov 2020

Igor NGUEGANG, University of Dschang, Dschang, Cameroon

Thank you Sir Ghose Bishwajit for your critical reading and comments on this article; We will consider them when correcting.

Best,

Competing Interests: No competing interests were disclosed.

Reviewer Report 11 June 2020

<https://doi.org/10.21956/gatesopenres.14270.r28822>

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Jayani Pathirana

Medical Research Council, Respiratory and Meningeal Pathogens Research Unit, Faculty of Health Science, University of the Witwatersrand, Johannesburg, South Africa

This is a descriptive cross sectional study from Cameroon to assess receipt of the appropriate doses of tetanus vaccines by mothers for protective immunity against tetanus. The authors interviewed women of child bearing age with at least one child and reviewed ANC and immunisation records and if unavailable relied on maternal recall to determine tetanus vaccination history.

The key finding in this study was that over 50% of women had received greater than 5 doses of tetanus vaccine, the required number for long-term protection against tetanus. The authors also identified 36.4% of births to be unprotected from tetanus.

This is an important study which highlights vaccine wastage as women received more than the required doses of tetanus vaccine. The authors were limited by unavailability of documentation on maternal vaccination status with reliance on maternal recall. There is however a disconnect between the background provided, the aim of the study and the results described. Specific comments are provided below.

Abstract:

Background:

1. The background would benefit from including the justification for the study (why was this study undertaken?).
2. The authors stated: "the number of doses recommended by the Expanded Program of Immunization...". Doses of which vaccine? Please specify the vaccine being studied.

Introduction:

1. "infection occurs after abortion, miscarriage...". This implies that tetanus always occurs following these events. Authors should clarify, providing references, that the main cause of tetanus infection is from unhygienic delivery practices which may occur during childbirths or miscarriage/abortion (spontaneous or induced) and may also result in neonatal tetanus.
2. Suggest that authors include standard definition for PAB with a reference.
3. Have the authors reviewed the literature for similar studies where more than the recommended tetanus doses are administered to pregnant women and the reasons for this? If there are no other studies, clarify this in the methods.

Methods:

Ethical statement:

1. How were heads of household contacted and informed about the study?

Study design:

1. Suggest that authors clarify that method was "face-to-face" interviews.
2. Was a woman with a live birth an inclusion criteria, or were women with stillbirths and miscarriages included.

Data collection instrument:

1. The authors should clarify whether it is standard practice for women to have home based ANC records or whether ANC cards are usually kept at health care facilities. Authors should also clarify whether tetanus immunization is recorded in ANC records or an independent immunization card or both.

Data collection procedure:

1. Suggest the authors clarify whether maternal recall is equivalent to undocumented immunization.

Data analysis:

1. The authors should clarify the importance of stratifying by education level.
2. There is no mention of the source of funding.

Results:

1. It is recommended to not begin sentences with numeric e.g. 111/115 etc.

Tetanus immunization coverage for last pregnancy:

1. The authors mention "unprotected at birth". Was PAB measured and if so how? This would need to be clarified in the methods. Maternal TT/Td coverage is not equivalent to PAB.

Cumulative and completeness vaccination coverage:

1. Expanding on the details of Table 4 would be useful as the results need to be standing alone from the tables.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Vaccinology, epidemiology, public health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 05 Nov 2020

Igor NGUEGANG, University of Dschang, Dschang, Cameroon

Thank you Sir Jayani Pathirana for the time you have taken to review the paper. Your suggestion will be taken into account.

In response to your concerns, the study was conducted to access the Td vaccine community coverage because despite the good national coverage published, this region was victim of many epidemics situation of certain diseases under surveillance.

During the implementation, data were collected:

- using a face-to-face method from women of childbearing age with at least one child, after obtaining the verbal authorization of their husband (according to the cultural reason of the study area) and the written consent of the women concerned.
- from the antenatal care booklets or vaccination cards (depending of their availability at the health facilities) because, in our context, these evidences of immunization are given to the women who are responsible for keeping them.
- from maternal recall in case of absence of the previous document (undocumented immunization).

Cordially,

Competing Interests: No competing interests were disclosed.