Brief Report

Predictors of Tetanus Vaccine Uptake among Pregnant Women in Sudan: A Hospital-Based Cross-Sectional Study

Zienab A Ibrahim , Majdi Sabahelzain * , Yasir Ahmed Mohammed Elhadi , Ombeva Oliver , Suad Babiker

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Article

Predictors of Tetanus Vaccine Uptake among Pregnant Women in Sudan: A Hospital-Based Cross-Sectional Study

Zienab A Ibrahim [1], Majdi M. Sabahelzain [2,*], Yasir Ahmed Mohammed Elhadi [3], Ombeva Oliver [4,5,6] and Suad Babiker [7]

[1] Federal Ministry of Health, Khartoum, Sudan; zienabahmedibrahim@gmail.com
[2] Nutrition and Health Center for Training and Research, Ahfad University for Women, Omdurman, Sudan; majdisabahelzain@gmail.com
[3] Public Health Department, Sudanese Medical Research Association, Khartoum, Sudan; hiph.yelhadi@alexu.edu.eg
[4] Department of Child Health and Paediatrics, Egerton University, Nakuru, Kenya; ombevaom@gmail.com
[5] East Africa Centre for Vaccines and Immunization (ECAVI), Namela House, Kampala, Uganda.
[6] Department of Paediatrics & Child Health, Makerere University, Kampala, Uganda
[7] School of Medicine, Ahfad University for Women, Omdurman, Sudan; suadbabiker@hotmail.com
* Correspondence: majdisabahelzain@gmail.com; Tel: +249 12 306 6758

Abstract: Tetanus toxoid (TT) vaccination during pregnancy has been proven as an effective preventive measure to reduce the incidence of maternal and neonatal morbidity and mortality worldwide. This study aimed to assess the determinants of TT vaccine uptake among pregnant women in two public maternity specialized hospitals in Sudan. A hospital-based cross-sectional study was conducted in two public hospitals, Omdurman Maternity and AL-Saudi hospitals in Omdurman, Khartoum State in Sudan, from February to April 2020. Logistic regression analysis was carried out to identify factors associated with receiving three or more doses of TT vaccine among pregnant women (protected against tetanus), presented as Odds ratios, with p-values <0.05 considered significant (at 95% confidence interval). The study recruited 350 pregnant women, with 313 participants included in the analysis. This study found that only 40% of the pregnant women received 3 doses or more (protected) of TT vaccine during their current pregnancy. Pregnant women who attended Al Saudi hospital were less likely to be protected against Tetanus (received ≥ 3 doses) compared to those who attended Omdurman hospital [OR= 0.49 (95%C.I 0.29-0.82), p-value <0.05]. Furthermore, the number of children at home was a significant predictor of mothers' immunization status as those with five children or more were ten times more to be protected against tetanus [OR= 10.54 (95% C.I 4.30-25.86), p-value <0.05]. We conclude that this low rate of TT vaccine uptake found in this study among pregnant women increases the number of new born babies susceptible to contracting neonatal tetanus. This study provides useful information that can inform the will increase the probabilities of morbidities and mortalities that result from maternal and neonatal tetanus. The findings of this study should be considered in development of communication strategies targeting and prioritizing at-risk groups to increase TT vaccine uptake among pregnant women in Sudan.

Keywords: tetanus toxoid vaccine; vaccine uptake; tetanus; pregnant women; Sudan

1. Introduction

Vaccination during pregnancy has been proven as an effective preventive measure to reduce the incidence of child and maternal morbidity and mortality worldwide. Vaccinating pregnant women and infants with the tetanus toxoid vaccine has been credited for significant decrease in tetanus mortality by more than two-thirds (from 1.3 to 0.4 deaths per 1000 live birth) between 2000 and 2012. [1] Despite this success, tetanus remains a main public health problem in many parts of the world where vaccination coverage is suboptimal, especially in low-income countries [2], where under-vaccination is compounded by unhygienic deliveries and abortions, and poor postnatal hygiene and

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umbilical cord care practices [3–8]. As of 2017, maternal and neonatal tetanus was reported as a public health problem in 13 countries globally including Sudan. [2,5]

In Sudan, despite the high coverage of DTP3 vaccine (95% in 2017) among the targeted infants in Sudan [9], the Multiple Indicator Cluster Survey (MICS) in 2014 showed that only 32% of the women received at least two doses of tetanus toxoid (TT) vaccine during their last pregnancy [10]. Additionally, neonatal tetanus is reported as one of the 10 top causes of death among children under 5 years in Sudan in 2017. One of the additional risk factors contributing to the maternal and neonatal tetanus (MNT) burden in Sudan includes the very low rate of institutional deliveries (about 27.7%), where post-natal health checks for the mothers and their newborns occur. [10]

There are little data and reports on the reasons behind the low coverage of tetanus toxoid vaccine among Sudanese women despite the national efforts to eliminate MNT through different strategies [11]. However, an analysis of the MICS data shows that there is geographic inequality in the protection against MNT, as women (aged 15-49 years) who are resident in the urban were more protected against neonatal tetanus (65.9 %) than their counterparts in the rural areas (55.4 %). Moreover, protection against MNT is increased proportionally by the increase of levels of education among women of reproductive age. Similarly, differences were shown among women with varying economic status; the percentage of neonatal tetanus protection among women in the richest quintile was higher than those from the poorest quintile (74.2 % and 44.4% respectively). [10]

This study aimed to assess determinants of TT vaccine uptake among pregnant women in two public maternity specialized hospitals (Omdurman Maternity and Al-Saudi hospitals) to inform future programs and communication strategies to increase coverage of maternal vaccination in Sudan.

2. Materials and Methods

2.1. Study design

A hospital-based cross-sectional study was conducted in two public specialized hospitals (i.e. both provide obstetric and gynecological services), Omdurman maternity and AL-Saudi maternity hospitals in Omdurman district, Khartoum state in Sudan, from February to April 2020.

2.2. Population and sampling

2.2.1. Population

The study population included pregnant women aged 15–49 years residing in Sudan, who attended either of the two hospitals at the time of the study.

2.2.2. Sampling and sample size

The estimated sample size was 315. However, to cover for possible dropouts due to missing information or non-response to crucial questions, a total of 350 participants were recruited for the study.

The sample size as computed using the following formula [12]:

$$\left[n = \frac{z^2 pq}{d^2}\right]$$

Where

n = sample size

z = (1 −α), is the z-score corresponding to a 95% confidence interval and was computed as 1.96.

p = 0.288 which is the probability/percentage of women who received at least two doses of TT vaccine during the last pregnancy in Khartoum state based on the 2014 MICS report.

q = (1 − p) = 0.712

d = desired margin of error of 0.05.

Data from these two hospitals revealed that the minimum numbers of patients' visits per month are 1,500 (Omdurman Maternity hospital) and 1,100 (Al-Saudi hospitals). Therefore, we selected

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proportionally 200 participants from Omdurman Maternity and 150 participants from Al-Saudi hospitals. Systematic random sampling was used to select pregnant women in this study with every eighth woman who attended the public clinics until the estimated sample size was completed from each hospital.

2.3. Data Collection

Data was collected using a structured and pretested questionnaire. The interviews were conducted in the Arabic language. Data was collected using the pretested questionnaires obtained from pregnant women after their consultation with doctors. The dependent variable was uptake of the tetanus toxoid vaccine, which was measured as protected and not protected against tetanus. Pregnant women who did not vaccinate with tetanus vaccine, as well as those who were partially vaccinated (≤ 2 doses), were considered not protected against tetanus. The independent variables included sociodemographic data, perceptions about tetanus and tetanus vaccine, which were measured using five points Likert scale (Strongly disagree/Strongly agree), and reproductive health factors including the number and planning of pregnancy.

2.4. Statistical Analysis

Data analysis was performed using Statistical Package for Social Sciences (SPSS) software (Version 24). Pregnant women who don't know their TT vaccination status were excluded from the analysis. The chi-square, Fisher's exact (when the count is <5 in a cell), was conducted to assess the factors associated with uptake of TT vaccine among pregnant women. A *p*-value of < 0.05 was considered statistically significant. Variables that were significantly associated with the primary dependent variable were included in a multivariable logistic regression model to identify the predictors of TT vaccine uptake among pregnant women.

Ethical Consideration

The study was approved by the Ahfad University for Women's Review Board (IRB) and Permissions to enter the hospitals were obtained from the Khartoum State Ministry of Health and the hospitals' general managers. Written informed consent was obtained from each of the participants.

3. Results

3.1. Characteristics of the study participants

As shown in Table 1, out of 313 participants; 173 (55.5%) attended Omdurman maternity hospital, the age's average of these pregnant women was 28.33 years (SD=6.310). Nearly half of the respondents 142(45.36%) with university level of education followed by those who completed primary school 94 (30%). Moreover, most of the respondents 284 (90.7 %%) self-ranked their family income level medium. One hundred and thirty-five of these pregnant women (42.8%) reported having one or two children (Table 1).

Table 1. Participants' profile and factors associated with tetanus vaccines uptake among pregnant women at Omdurman Maternity and Al Saudi hospitals in Sudan (N = 313).

Participants' profile		**TT immunization status**			
		Not protected (≤ 2 doses) N (%)=186 (59.4%)	Protected (≥ 3 doses) N (%)= 127 (40.6%)	Total N (%)	P-value
Hospital	Omdurman maternity hospital	92(53.2%)	81(46.8%)	173(55.2%)	.0120*

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	AL Saudi hospital.	94(67.1%)	46(32.9%)	140(44.7%)	
Mother Education	Not educated	4(66.7%)	2(33.3%)	6 (1.9%)	0.001*[a]
	Primary	68(72.3%)	26(27.7%)	94 (30%)	
	Secondary	49(69.0%)	22(31.0%)	71(22.68%)	
	University	65(45.8%)	77(54.2%)	142(45.36%)	
Family income	High	9(69.2%)	4(30.8%)	13 (4.15%)	0.1340
	Medium	164(57.7%)	120(42.3%)	284(90.7%)	
	Low	13(81.3%)	3(18.8%)	16 (5.11%)	
Number of Children	1-2 Children	86(64.2%)	48(35.8%)	134(42.8%)	0.001*[a]
	3-4 Children	63(72.4%)	24(27.6%)	87(27.79%)	
	5 children and more	37(40.2%)	55(59.8%)	92(29.39%)	
Mother's employment	Not employed	155(58.3%)	111(41.7%)	266(85.0%)	0.322
	Employed	31(66.0%)	16(34.0%)	47(15.0%)	

* Statistically significant , [a] Fisher's exact test.

3.2. Perception of the pregnant women in Sudan towards TT vaccine

As shown in Figure 1, the majority of participants strongly agreed (i.e. more confident) that TT vaccine is important, safe, effective against tetanus, and perceived tetanus as a serious disease (68.6%, 70.6%, 58%. and 70%, respectively).

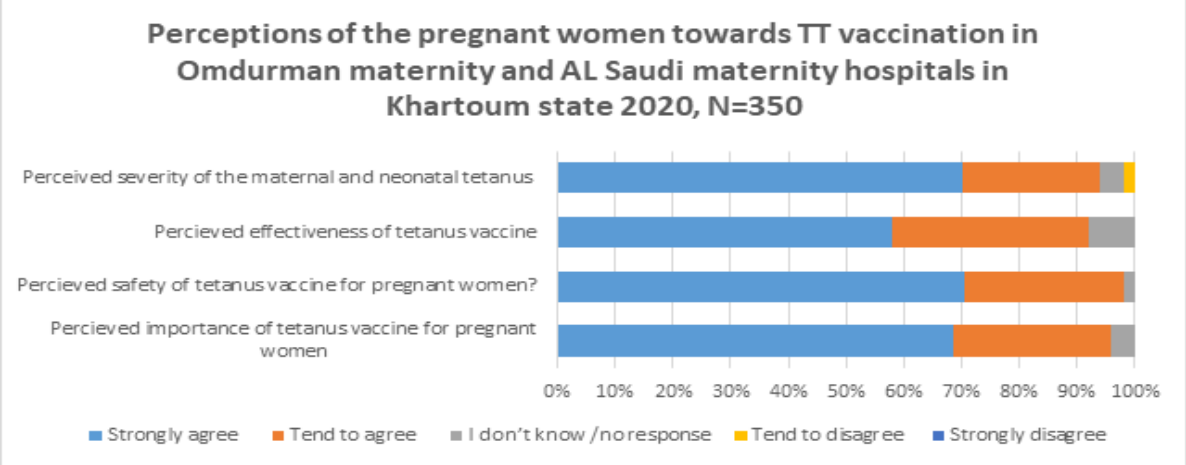

Figure 1. Perceptions of pregnant women towards TT vaccination at Omdurman maternity and AL Saudi hospitals in Sudan.

3.3. Tetanus vaccine uptake

More than half of the pregnant women (51%) reported that they were partially vaccinated (1-2 doses) with the tetanus vaccine. Only 40% of these pregnant women were fully vaccinated with tetanus vaccine (3 and more doses). A very low proportion (7.7%) of these women reported that they have never been vaccinated with tetanus vaccine (Figure 2).

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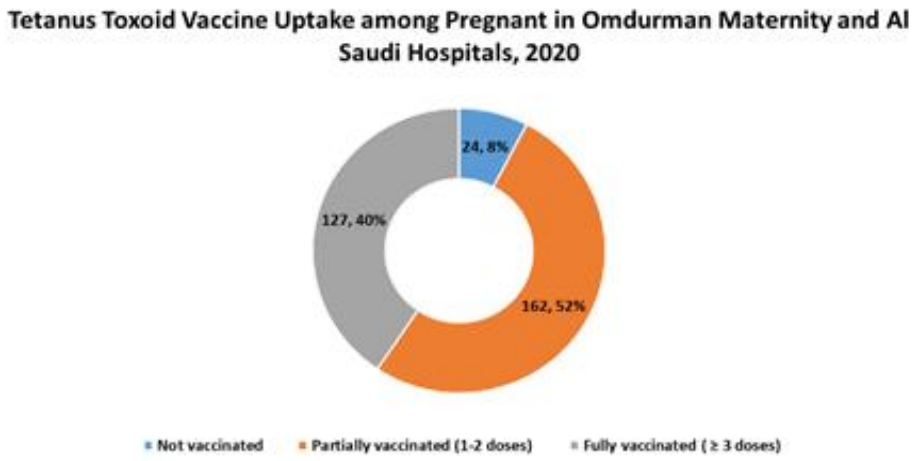

Figure 2. Tetanus vaccine uptake among pregnant at Omdurman maternity and Al Saudi hospitals in Sudan.

3.4. Factors associated with Tetanus vaccine uptake among pregnant women in Sudan

To understand the factors related to TT vaccine uptake among pregnant women, we run the Chi-square test (and sometimes Fisher's exact test when the counts in the cells are less than 5). Pregnant women who did not vaccinate with tetanus vaccine, as well as those who were partially vaccinated (≤ 2 doses), were considered not protected against tetanus. The results were summarized in Table 1. The percentage of pregnant women who received three or more doses of the vaccine (protected against Tetanus) at Al Saudi hospital 46(32.9%) were less than those who attended Omdurman maternity hospital 81(46.8%). In addition, most pregnant women who did not attend university were not protected against tetanus compared to those with a university degree of education. The highest percentage of not protected pregnant women were among those who have had 3-4 children (72.4%) compared to only 27.6% of protected pregnant women. TT Vaccine uptake was significantly associated with the hospital (P<0.012), the mother's education (P<0.001), and the number of children (P<0.001). On the other hand, there was no statistically significant difference in the uptake of TT vaccine related to the family income or employment status of pregnant women.

3.5. Predictors of Tetanus vaccine uptake among pregnant women in Sudan

The predictors of tetanus vaccine uptake among pregnant women in Sudan are displayed in Table 2. The summary of multivariate logistic regression analysis showed that pregnant women who attended Al Saudi hospital were less likely to be protected against Tetanus (received ≥ 3 doses) compared to those who attended Omdurman hospital [OR= 0.49 (95% C.I 0.29-0.82), p-value <0.05]. In addition, the number of children was a significant predictor of mothers' immunization status. Compared to pregnant women who haven't had children yet, those with one to two children were three times more likely to be protected against tetanus [OR= 3.31 (95%C.I 1.67-6.56) , p-value <0.05], While those with three to five children were five times more likely to be protected against tetanus [OR= 5.05 (95%C.I 2.37-10.79), p-value <0.05], and those with five children or more were ten times more likely to receive received ≥ 3 doses (protected against tetanus) [OR= 10.54 (95% C.I 4.30-25.86), p-value <0.05].

Table 2. Predictors of tetanus vaccine uptake among pregnant women in Sudan, N=313.

Predictors	OR (95% C.I. of OR)	aOR (95% C.I. of aOR)
Hospital		
Omdurman maternity hospital		

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AL Saudi hospital	0.56 (0.350-0.882)*	0.49 (0.29-0.82)*
Mother's Education		
Not educated®		
Primary	0.77 (0.13-4.43)	0.5 (0.07-3.51)
Secondary	0.89 (0.15-5.27)	0.62 (0.09-4.72)
University	2.37 (0.42-13.35)	2.05 (0.30-13.99)
Number of childre		
Haven't children yet®		
1-2 children	2.9 (1.522-5.520)*	3.31 (1.67-6.56)*
3-4 children	4.77 (2.34-9.75)*	5.05 (2.37-10.79)*
5 children and more	5.11 (2.26-11.54)*	10.54 (4.30-25.86)*

* Statistically significant at *p*-value< 0.05, aOR= adjusted Odds Ratio, ®= Reference category.

4. Discussion

This study aimed to assess the determinants of Tetanus Toxoid (TT) vaccination among pregnant women in two public hospitals, Omdurman Maternity and Al Saudi Hospitals in Khartoum state in 2020.

The findings of this study showed that the majority of the participants were very confident that the TT vaccine is important, safe, and effective, and the disease itself is serious (Figure 1). These findings are consistent with a global study conducted in over 140 countries in 2018, which found that people in the Eastern African region are more likely to perceive the safety and effectiveness of vaccines (92% and 90%, respectively). Furthermore, the same report revealed that people in Ethiopia and Egypt are most likely to agree about the importance, safety, and effectiveness of vaccines. [13]

Pregnant women, who received 3 doses or more of TT vaccination, are considered to have a significant period of protection against tetanus infection [3]. This study found that about 40% (Figure 1) of the pregnant women received 3 doses or more (protected) of TT vaccine during this pregnancy. This was lower than the result found from the Errer district, Somali Regional State, Eastern Ethiopia, and the proportion reported in Damboya Woreda, Kembata Tembaro Zone, SNNP, Ethiopia (51.8% and 72.5% respectively [14,15]. This difference might be explained as a result of the very low rate of institutional deliveries in Sudan (about 27.7%); where post-natal health checks for the mothers and their newborns occur. [10]

Interestingly, these study findings show that there are many factors increasing the probability of pregnant women being vaccinated or not against tetanus. We found that pregnant women who attended Al Saudi hospital, were less likely to be vaccinated against Tetanus (mostly vaccinated with ≤ 2 doses). In addition, most pregnant women who did not attend university were not vaccinated against tetanus compared to those with a university degree of education. As reported in previous studies, the education level of pregnant women may affect immunization status because it means they are likely to secure gainful employment thus guaranteeing the financial stability that enables easier access to better immunizations services and healthcare in general [16]. Factors such as negative perception of pregnant women about tetanus, poor planning of the upcoming pregnancy, and higher number of pregnancies decrease the likelihood of vaccination against tetanus with a protective dose. However, there was no statistically significant association between family income and immunization status of pregnant women, though previous studies showed a significant association [17–19].

Social determinants have the potential to affect immunization programs around the world, especially factors related to support from the father/male spouse, disposable income available to the pregnant women, general level of knowledge/understanding of the women regarding tetanus

vaccine, and level of formal education all affect immunization and uptake of vaccines. Exploring all these determinants affecting immunization is of great importance in the attempts to increase immunization uptake, reduce hesitancy to immunization and promote a culture that demands for vaccines; and ultimately increase immunization rates, and prevent early infant mortality previously attributed to neonatal tetanus. Access to vaccines, and vaccine equity across communities are key determinants of control of vaccine-preventable diseases, and low income countries require support from developed nations (both financial and logistical) if we are to reduce prevailing inequalities in vaccinations among different populations. [19]

Limitation

Since this was a cross-sectional survey, it is difficult to exolain if c]factors described do cause lack of protection from tetanus vaccine, but the significant factors do explain the factors underlying low vaccination.. Nonetheless, the study provided valuable information that could be used in developing health education interventions to increase TT vaccine uptake among pregnant women in Sudan.

5. Conclusions

We conclude that the low rate of TT vaccine uptake found in this study among pregnant women increases the number of new born babies susceptible to contracting neonatal tetanus. This study provides useful information that can inform the development of communication strategies targeting and prioritizing at-risk groups to increase TT vaccine uptake among pregnant women in Sudan.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and was approved by the Ahfad University for Women's Review Board (IRB).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available from the corresponding author upon request.

Conflicts of Interest: The authors declare no conflict of interest.

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