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Increasing Frequency of Antenatal Care Visits May Improve Tetanus Toxoid Vaccination Coverage in Pregnant Women in Pakistan

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ABSTRACT

Objective: Maternal and neonatal tetanus (MNT) elimination in low-income countries is a major aim of public health endeavors, due to poor vaccination status, lack of antenatal care, and unhygienic birth practices. The objective of this study, thus, was to assess the present state and factors associated with maternal tetanus toxoid (TT) vaccination in Pakistan.

Methods: Overall, 80 pregnant women (26 ± 4 y) during their last trimester were recruited from the district hospital Khanewal, Pakistan. The prevalence of vaccination was ascertained through clinical interviews and examination of health records from each participant. A questionnaire-based interview was conducted to assess the education level, antenatal visits, and sociodemographic variables related to vaccination coverage. A generalized linear model was used for statistical analyses.

Results: Seventy-nine percent of pregnant women were vaccinated with two doses of TT vaccine, while 16% of women were unvaccinated. Overall, 66% of pregnant women received two or more antenatal visits. Two and more than two antenatal visits during pregnancy were associated with significantly increased odds ratios for sufficient TT vaccination (OR = 1.60, CI [95%] 1.34–1.92 and OR = 1.61, CI [95%] 1.32–1.97, respectively) as compared to no or only one antenatal visit.

Conclusion: Regular antenatal care can improve vaccination coverage during pregnancy. Hence, reducing barriers for visiting antenatal care facilities could be key to reach the goal for MNT elimination.

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Antenatal visit; pregnancy; tetanus toxoid (TT); vaccination; Pakistan

Introduction

Tetanus is caused by a wound invasion of the anaerobic bacterium *Clostridium tetani* and subsequent spread of the highly potent neurotoxin, which is produced during the growth of the bacterium.¹ Maternal, neonatal tetanus (MNT) develops from a combination of both, inadequate vaccination and unhygienic delivery practices or births with traditional attendants only.² For the prevention of maternal and neonatal mortality, the WHO has provided a global guideline of tetanus toxoid (TT) vaccination for all pregnant women, depending on the previous vaccination history (<https://apps.who.int/iris/bitstream/handle/10665/250800/WHO-RHR-16.12-eng.pdf>). According to the WHO, a prescribed vaccination schedule, for a woman without a previous history of TT vaccination, two doses of TT/DT (combined tetanus and diphtheria toxoid vaccine) are necessary for maintaining 1–3 y protection. A single dose or vaccination given 10 y or longer ago does not provide sufficient protection against neonatal tetanus deaths.³

The WHO global statistics from 2017 estimated that millions of births were not assisted by trained health staff, which may be a significant reason for an increase in maternal mortality rates.⁴ It is therefore crucially important to increase the women's access to quality care before, during, and after birth.

Hygienic childbirth practices in homes and healthcare centers with sterilized instruments provided are an essential additional preventive measure to reduce MNT.⁵ Besides, regular antenatal care visits and improved vaccination can also result in a reduction of pregnancy and obstetric complications.⁶

Poor maternal vaccination, inadequate antenatal care, home deliveries with the unhygienic umbilical stump, and delivery kits are still triggering MNT in developing countries,⁷ such as Pakistan, that is a low-income country facing this serious public health issue of MNT elimination. In recent years, neonatal tetanus vaccination coverage has increased from about 50% to 75% in Pakistan, and 8 million children between 0 and 11 months are vaccinated under the expanded program of immunization (EPI).⁸ Approximately 6.5 million pregnant women were immunized against TT during 2015–16.⁹ Nonetheless, Pakistan still has not accomplished the WHO targets of MNT eradication.¹⁰ In addition to financial investment, there is an urgent need to establish novel initiatives to improve the vaccination status in Pakistan.

The objectives of this study, therefore, were to evaluate the present situation of maternal TT vaccination in a typical district hospital and investigate different factors, which may be associated with the vaccination status.

Methods

Eighty pregnant women (26 ± 4 y of age) in their last trimester were recruited from the obstetric unit of district hospital Khanewal and inquired around the time of delivery in their third trimester. Maternal tetanus vaccination was ascertained through employing clinical interviews and examination of health records from each selected participant. A questionnaire-based interview was carried out. Questions were based on considerations about potential factors influencing vaccination.¹¹ It included besides age, parity, weight and weight gain, smoking, physical activity, and other socio-demographic variables (see Table 1), education level, income, and antenatal visits. The study protocol was approved by the National Bioethics Committee Pakistan (ref no. 4-87/NBC-281/17/1439), and each participant signed an informed consent form.

For sample size determination, we assumed one-third of women with at most one antenatal visit. Under the assumption that women with two or more antenatal visits will be correctly vaccinated in 90% while only 50% correctly vaccinated women will be found in those with at most one visit, $n = 71$ women must be enrolled to detect this difference at a significance level of 5% with a power of 95%. Because of adding additional covariates to the model, a sample size of $n = 80$ was chosen.

A generalized linear model with a logit link was used with the vaccination status (two TT vaccinations during pregnancy or regular vaccinations before pregnancy) as the dependent variable, antenatal visits, education, and income levels as independent variables and age as a covariate that were chosen a priori from considerations about variables that could affect vaccine uptake. All other variables were tested by a stepwise procedure applying the purposeful selection algorithm with an entry significance level of 10% and a parameter change threshold of 15%; however, no further variables met the inclusion criteria. The analyses were performed with SPSS, version 25 (IBM Corp. NY, USA).

Results

Characteristics of the study participants (Table 1) showed that a total of 53 (66%) pregnant women reported two or more antenatal visits during pregnancy. Regarding vaccination status, 79% of pregnant women were vaccinated with two doses of TT

Table 1. Characteristics of study participants (mean \pm SD or n (%)).

Characteristic	Category/Unit	Pregnant women
		n = 80
Age	Years	26 \pm 4
Income	\$/month	183 \pm 157
Education	No education	45 (56.3%)
	Primary education	30 (37.5%)
	High school or more	5 (6.3%)
Occupation	Housewife	78 (97.5%)
	Working	2 (2.5%)
Marital status	Married	80 (100.0%)
Family type	Single family	21 (26.3%)
	Joint family	59 (73.8%)
Previous miscarriages	Yes	27 (33.8%)
Antenatal visits	No antenatal visit	13 (16.3%)
	1 antenatal visit	14 (17.5%)
	2 antenatal visits	35 (43.8%)
	3–4 antenatal visits	18 (22.4%)

Table 2. Association of education level, antenatal visits, and income with vaccination status (odds ratio for the relative increase in odds of being vaccinated).

Variable	Number of correctly vaccinated/not correctly vaccinated	Odds ratio	95% CI	p-value
Education level				
At least primary education	28/7	0.98	0.83–1.16	0.803
No education	35/10	1 ^a		
Antenatal visits				
3–4 antenatal visits	17/1	1.61	1.32–1.97	<0.001
2 antenatal visits	33/2	1.60	1.34–1.92	<0.001
1 antenatal visit	6/8	0.92	0.74–1.14	0.451
No antenatal visit	7/6	1 ^a		
Income				
Middle level	6/1	1.02	0.76–1.36	0.896
Low income	57/16	1 ^a		

Dependent Variable: Vaccination status (two TT vaccinations during pregnancy or regular TT vaccination), analysis adjusted for age.

^aReference category.

vaccine, whereas 16% were unvaccinated, and 5% of women received more than the required number of vaccinations. There was no significant association of education and income levels with maternal vaccination status during pregnancy (Table 2). However, two and three to four antenatal visits during pregnancy showed a significant association with the vaccination coverage as compared to no prior visit ($p < .001$).

Discussion

Similar to many other low-income countries, Pakistan is also facing profound public health challenges, including a low TT immunization coverage.¹² The problem might be even greater because of underreporting. As barriers for vaccine uptake in Pakistan and especially concerning protection from MNT are largely unknown and potential steps to improve the situation have so far no evidence base, our study assessed potential barriers for vaccine uptake and factors that could ensure optimal MNT vaccine uptake before and during pregnancy.

In our study, only two-thirds of women received two or more antenatal visits during pregnancy. This finding is in line with previous studies reporting poor antenatal care-seeking behavior among pregnant women in Pakistan.^{13,14} Although our results showed that 79% of the women received maternal TT vaccine during pregnancy, yet more than 16% of women were unvaccinated. We found that two or more antenatal visits significantly improved vaccination coverage during pregnancy. Hence, endeavors to reduce barriers for antenatal care visits despite being of value in itself would, according to our findings, also improve vaccination coverage.

Our results are in agreement with two previous Pakistani studies, showing the interaction of vaccination status with the antenatal care visits during pregnancy.^{15,16} These studies have been conducted more than 10 y ago in other districts of Pakistan, which underlines that the problem of MNT protection has not been solved yet. Regular antenatal care is a crucial way to improve TT vaccination and management of obstetric complications during pregnancy and delivery.¹⁷ In addition to poor care-seeking for antenatal visits during pregnancy, the lower vaccination status is also influenced by inadequate vaccination-related knowledge, family structure, and decision-making in the local

communities of Pakistan.¹⁸ Similarly, the lack of awareness about the importance of TT vaccination was reported as the most common reason for low vaccination status.¹⁴ Adequate knowledge and a better understanding of TT vaccination at the individual, community, and national levels may significantly help to improve TT coverage in Pakistan.¹⁰ Considering that we found no effect of education and income on vaccination status, poor vaccination coverage is not in principle due to illiteracy and economic pressure but to a specific problem of the public health system to provide a broad understanding of the importance of TT vaccination.

By highlighting some key determinants associated with low TT vaccination coverage in Pakistan, the present study can be seen as paving the way for future strategies. Even though TT vaccine is one of the most effective, safest, and cost-effective vaccines,¹⁹ there are still misconceptions about its application during pregnancy. Also, immunization in combination with clean, hygienic delivery practices, remains being of central importance to meet global MNT elimination goals. Pakistan Demographic and Health Survey 2017–18 reported that 24% of births are still attended by a Dai or traditional birth attendant, and only 66% of births are delivered in a health facility.¹² Further studies should investigate the success of different strategies to improve the frequency of antenatal care visits and of deliveries in health facilities.

Study limitations

This study was a cross-sectional survey and found associations that cannot directly be causally interpreted. Furthermore, it was conducted in one hospital in one district only and, therefore, cannot be generalized to other settings. Because the study includes women sampled from a hospital located in a town, presumably, their health-seeking behaviors are comparatively better, which would have led to an underestimation of the importance of antenatal care. Moreover, since Pakistan has several subcultures, results of the present study in Punjab may not be generalizable to other regions of the country such as Balochistan and Khyber Pakhtunkhwa provinces. These regions do not merely differ in terms of cultures but also in terms of availability of healthcare facilities.

Furthermore, it has been assumed that some other factors, including residence, type of prenatal care facility, and parity, can influence access to or coverage of the TT vaccine during pregnancy.¹¹ Although, except the type of care facility, we checked these potentially influential conditions and found no evidence for them as factors related to vaccination status, this could be due to lack of power.

Conclusion for practice

Pakistan is one of the 18 countries that still needs to meet the WHO standard regarding the elimination of MNT. There is a need to ensure full vaccination coverage with TT containing vaccines in infancy as a primary means of lifetime tetanus prevention instead of reliance on the vaccination of pregnant women only. Moreover, achieving and sustaining the MNT elimination in the country necessitates targeting rural populations, comprehensive planning (to reach the remote areas as well), practical vaccination campaigns and surveillance programs, community engagement, integrated clean service delivery, a guarantee of maternal, neonatal, and child health services,

and health awareness to improve birth hygiene. The finding that visiting antenatal care facilities significantly improves vaccination coverage indicates that reducing barriers for visiting such units could be key in reaching MNT elimination.

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Ethical approval


The study was approved by the National Bioethics Committee Pakistan (ref no. 4-87/NBC-281/17/1439).

Disclosure of potential conflicts of interest

MK is a member of the Austrian national vaccination council; SI, IA, and CE report no conflict of interest.

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