

## Bridging the Knowledge–Vaccination Gap: A Comparative Cross-Sectional Study of Tetanus Toxoid KAP among Female Students in Sindh, Pakistan

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### Abstract



Tetanus still is a preventable cause of maternal and neonatal mortality in Pakistan where tetanus toxoid (TT) vaccination coverage among women of reproductive age is still below the elimination threshold. This study evaluated and compared knowledge, attitude and practices (KAP) about TT vaccination among medical and non-medical female students of child bearing age in Sindh. A comparative cross-sectional study was carried out on 400 female students (200 medical and 200 non-medical) of the age group of 15-49 years at two public universities of Jamshoro, Sindh. Data were collected using a self-administered questionnaire, which was developed based on the Health Belief Model. Categorical variables were compared using the chi-square test. Composite domain scores were compared between groups. Crude odds ratios and adjusted prevalence ratios were used to identify determinants of uptake. The inter-domain relationship was examined using Pearson correlation. Significance was considered at p-value < 0.05. Medical students had significantly better knowledge (mean  $7.57 \pm 1.42$  vs  $4.33 \pm 3.20$ ), attitude (mean  $29.08 \pm 2.92$  vs  $26.59 \pm 4.10$ ) and practice (mean  $1.96 \pm 1.45$  vs  $0.70 \pm 1.03$ ) scores than non-medical students (all  $p < 0.001$ ). No non-medical students had ever received a TT vaccine (0.0%) versus 45.0% of medical students. Reported refusal was uncommon and similar between groups ( $p = 0.628$ ). We found that rural residence (adjusted PR 0.38, 95% CI 0.21–0.67) and marital status (adjusted PR 0.08, 95% CI 0.01–0.43) were significant barriers to uptake. Knowledge was more related to practice ( $r = 0.515$ ) than attitude ( $r = 0.324$ ). TT vaccination coverage among young women of childbearing age was critically low, due to lack of awareness and access rather than refusal.

Further to the elimination for maternal and neonatal tetanus, it is highly suggested to improve the practical vaccine based knowledge and to design university level vaccination accessible, especially for the students of non-medical.

**Keywords:** Tetanus Toxoid; Vaccination; Knowledge Attitude Practice; Women of Childbearing Age; Pakistan; Health Belief Model.

### Introduction

Tetanus is a serious, vaccine-preventable bacterial infection caused by *Clostridium tetani*, an organism found in soil, dust and animal faeces that enter the body through broken skin, wounds or the cutting of the umbilical cord at birth. The illness causes painful muscle rigidity and spasms. The case-fatality rate is extremely high, close to 100 % in untreated cases and 10 % to 60 % even with hospitalization. Maternal and neonatal tetanus (MNT) is of particular concern in resource-poor settings where poor hygiene at delivery and limited access to health services put mothers and newborns at increased risk. Critically, there is no natural immunity exist to prevent tetanus so vaccination for CBA age is essential and remain the best way to prevent both mothers and newborns.

Pakistan is one of the few countries where MNT is still a public-health problem and where the World Health Organization elimination standard has not yet been attained, although global MNT mortality fell sharply in the first years of this century. Data from the Pakistan National Demographic and Health Survey show that TT vaccination coverage among pregnant women in Pakistan remains

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low and only just over half of recent live births in Sindh were protected against neonatal tetanus. Low coverage is associated with poor antenatal care-seeking, poor vaccination-related knowledge, family structure and local decision-making dynamics. Low coverage has been observed even among literate, relatively well-off populations implying that education and income alone are not protective.

Elimination of maternal and neonatal tetanus (MNTE) has been a long-standing priority of the global public-health community. The joint initiative led by the World Health Organization (WHO), the United Nations Children's Fund (UNICEF) and the United Nations Population Fund aims to reduce neonatal tetanus to less than one case per 1,000 live births in every district. In this context, the main strategy is the protection of women of reproductive age with tetanus toxoid-containing vaccines, and promotion of clean delivery and clean cord-care practices. Pakistan has made measurable progress but several districts in Sindh remain below the validation threshold. The persistence of sub-optimal coverage underscores the need to complement the WHO and UNICEF promoted 'high-risk approach' of supplementary immunisation activities targeted at under-served populations with durable demand-generation among young women before and during their childbearing years. The knowledge, attitudes and practices of this population are therefore of interest not only to academics but are directly relevant to the operational priorities of national immunisation programmes and their international partners.

A common theme in the global and regional literature is that knowledge of tetanus toxoid vaccination seldom translates directly into completed vaccination. Awareness of the vaccine is often widespread, but functional knowledge of the recommended schedule, dosing intervals and booster requirements remains poor; even women who know of the vaccine often fail to complete the full course (sub-Saharan Africa and South and Southeast Asia). This gap has been explained by low perceived susceptibility, lack of motivation, logistical barriers and reliance on informal information sources rather than outright refusal. But equally striking is the finding that formal education does not reliably guarantee accurate knowledge or protective behaviour: misconceptions persist among educated women and university students alike, challenging the notion that schooling alone secures vaccine uptake.

The evidence base has these features within Pakistan, and Sindh in particular, but with additional limitations. Most studies have recruited pregnant or married women attending antenatal clinics. Young, unmarried women and female students who fall within the recommended age range, yet remain outside maternal-health services, have been largely unstudied. Few studies compare groups by educational discipline and even fewer are based on an explicit behavioral theory, with most adopting a purely descriptive approach. These observations point out four interlocking gaps that the current study addresses: a population gap (neglect of female students of childbearing age), a comparative gap (absence of medical vs. non-medical comparisons), a theoretical gap (limited use of frameworks such as Health Belief Model) and a regional gap (absence of focused, multi-institution evidence from Sindh).

It is generally assumed that medical students have a higher level of knowledge of and adherence to vaccination than non-medical students; however, empirical evidence supporting this assumption in the Pakistani context is scarce. Very few studies have directly compared the knowledge, attitude and practices (KAP) of medical and non-medical students regarding TT vaccination, and even fewer have focused on female students of childbearing age, the priority population for the vaccine. Hence, the present study was carried out to assess and compare the KAP regarding TT vaccination among the medical and non-medical female students of 15-49 years of age in Sindh, to find out the socio-demographic determinants of vaccine uptake and to examine the correlations among the three domains of KAP. The study was framed using the Health Belief Model. The model attempts to explain health behaviour through perceptions of susceptibility, severity, benefits, barriers and cues to action.

## **Materials and Methods**

### ***Study design and setting***

It was a comparative cross sectional study conducted in two public sector universities i.e. Liaquat University of Medical and Health Sciences (medical stream) and University of Sindh (non-medical stream) of Jamshoro, Sindh among the female students. Data were collected using a structured self-administered questionnaire during the study period.

**Study population and sampling\***

The study population comprised female students of reproductive age (15-49 years) regardless of their marital status, enrolled in the undergraduate programmes in the two universities. A stratified sampling approach was adopted to ensure that samples were drawn separately from the medical and non-medical strata, allowing for comparison of findings. Sample size was calculated using the formula  $n = z^2pq/d^2$  where  $z = 1.96$  at 95% confidence level,  $p =$  estimated proportion of awareness, taken as 0.5,  $q = 1-p$  and  $d =$  margin of error, taken as 0.05, giving 384. This was inflated by 10% to allow for non-response giving a target sample size of about 422 we obtained a balanced analytic sample of 400 participants (200 medical and 200 non-medical).

Participants were current undergraduates aged 18 years or older who provided written informed consent. Excluded were students who could not recall their vaccination history, had a history of allergy or adverse reaction to the TT vaccine, had a contraindication to the vaccine or refused to consent.

**Data collection instrument**

The questionnaire was developed from previous studies and constructs of the Health Belief Model and included sections on demographic information, knowledge about tetanus and TT vaccination, attitudes towards vaccination, and vaccination practices. It was developed in English, translated to Urdu and back-translated to avoid translation errors. The questionnaire was pretested before formal administration. The survey was done electronically via online forums on tablets and Android devices, with required fields to minimize missing data, and contact information of the surveyors was provided in case respondents needed clarification.

**Statistical analysis**

The data were analysed using statistical software. Categorical variables were summarized as frequencies and percentages and compared between groups using Pearson chi-square test. Continuous variables were summarized as median (interquartile range) or mean (standard deviation) and compared between the two independent groups. Composite scores were generated for each KAP domain and dichotomized into poor and good categories based on pre-defined cut-offs . The determinants of ever receiving the TT vaccine were identified by computing crude odds ratios (OR) and mutually adjusted prevalence ratios (PR) with 95% confidence intervals (CI). Associations between KAP domains were measured by Pearson correlation coefficients, overall and by stream. The level of statistical significance was set at  $p$ -value  $<0.05$ .

**Ethical considerations**

Ethical approval was taken from the Ethics Review Committee, Department of Sociology, University of Sindh. Informed consent was obtained online from each participant before completing the questionnaire. Confidentiality of the participants’ personal information was maintained and only accessible to the principal investigator.

**Results**

**Socio-demographic characteristics**

The median age was 22 years in both groups of the 400 participants. Medical students were more likely to be urban residents (69.0% vs 41.0%), single (98.0% vs 80.5%) and from households earning  $>$  PKR 100,000/month (40.5% vs 11.5%) than non-medical students (all  $p < 0.001$ ). Table 1 Socio-demographic characteristics of the two groups.

**Table 1. Socio-demographic characteristics of participants (N = 400).**

Variable	Medical n (%)	Non-Medical n (%)	p-value
<b>Age, years — median (IQR)</b>	22 (21–23)	22 (21–29)	0.021
<b>Residence</b>			
Urban	138 (69.0)	82 (41.0)	$<0.001$
Rural	62 (31.0)	118 (59.0)	
<b>Marital status</b>			
Single	196 (98.0)	161 (80.5)	$<0.001$
Married	4 (2.0)	39 (19.5)	
<b>Monthly household income (PKR)</b>			
$<$ 25,000	35 (17.5)	23 (11.5)	$<0.001$
25,000–50,000	43 (21.5)	98 (49.0)	
50,001–100,000	41 (20.5)	56 (28.0)	
$>$ 100,000	81 (40.5)	23 (11.5)	

Chi-square test;  $p < 0.05$  significant.

**Knowledge, attitude and practice**

Medical students scored significantly higher than non-medical students on all knowledge and attitude items (all  $p < 0.001$  ). It is worth mentioning that 76.0% of the non-medical students never heard about the TT vaccine and none of the non-medical students knew the number of doses needed for the life-long protection. Composite domain scores confirmed the medical advantage across all three domains and the categorical classification indicated that 100.0% of non-medical and 94.0% of medical students had poor practice. Table 2 presents domain scores and categorical levels.

**Table 2.** Composite KAP scores and categorical levels by educational stream (N = 400).

Domain	Medical	Non-Medical	p-value
<b>Mean score (mean ± SD)</b>			
Knowledge	7.57 ± 1.42	4.33 ± 3.20	<0.001
Attitude	29.08 ± 2.92	26.59 ± 4.10	<0.001
Practice	1.96 ± 1.45	0.70 ± 1.03	<0.001
<b>Good level — n (%)</b>			
Knowledge	163 (81.5)	71 (35.5)	<0.001
Attitude	187 (93.5)	111 (55.5)	<0.001
Practice	12 (6.0)	0 (0.0)	<0.001

SD, standard deviation. Levels dichotomised by predefined cut-off; chi-square / group comparison,  $p < 0.05$  significant.

**Vaccination practices**

Uptake of vaccination was abysmally low. Of the non-medical students none (0.0%) had ever received a TT vaccine compared to 45.0% of medical students ( $p < 0.001$ ), and only 14.0% of medical students had completed the five dose schedule. However, reported refusal of vaccination was rare and did not differ statistically between groups (10.0% vs 11.5%;  $p = 0.628$ ) suggesting that low uptake was not due to conscious rejection. Table 3 lists the main practice indicators.

**Table 3.** Selected TT vaccination practices by educational stream (N = 400).

Practice (Yes responses)	Medical n (%)	Non-Medical n (%)	p-value
Ever received a TT vaccine	90 (45.0)	0 (0.0)	<0.001
Completed 5-dose schedule	28 (14.0)	0 (0.0)	<0.001
Encouraged others to vaccinate	125 (62.5)	78 (39.0)	<0.001
Would consent for daughter*	86 (74.1)	16 (25.8)	<0.001
Ever refused TT vaccination	20 (10.0)	23 (11.5)	0.628
Possesses vaccination card	42 (21.0)	23 (11.5)	0.010

\*Among eligible respondents. Chi-square test;  $p < 0.05$  significant.

**Determinants of vaccination uptake**

In the adjusted analysis, rural residence (PR 0.38, 95% CI 0.21–0.67) and married status (PR 0.08, 95% CI 0.01–0.43) were significant independent barriers to ever having received the TT vaccine, as were the middle household-income bands relative to the lowest. The vaccination coverage was limited only to medical students and those who were already aware of tetanus and thus ratio calculation for these variables was not possible. The determinants are shown in table 4.

**Table 4.** Determinants of ever-receiving the TT vaccine (N = 400).

Variable	Received Yes n (%)	Crude OR (95% CI)	Adjusted PR (95% CI)
<b>Marital status</b>			
Single	88 (97.8)	Ref	Ref
Married	2 (2.2)	0.14 (0.03–0.62)*	0.08 (0.01–0.43)*
<b>Residence</b>			
Urban	64 (71.1)	Ref	Ref
Rural	26 (28.9)	0.41 (0.24–0.68)*	0.38 (0.21–0.67)*
<b>Monthly household income (PKR)</b>			
< 25,000	15 (16.7)	Ref	Ref
25,000–50,000	22 (24.4)	0.53 (0.25–1.11)	0.30 (0.12–0.70)*
50,001–100,000	15 (16.7)	0.52 (0.23–1.17)	0.38 (0.16–0.92)*
> 100,000	38 (42.2)	1.65 (0.81–3.35)	1.11 (0.47–2.60)

OR, odds ratio; PR, prevalence ratio; CI, confidence interval; Ref, reference. \* $p < 0.05$ .

***Correlation among KAP domains***

For the total sample, the three domains correlated positively and significantly ( $p < 0.001$ ). Knowledge correlated more with practice ( $r = 0.515$ ) than attitude ( $r = 0.324$ ), and knowledge correlated with attitude ( $r = 0.572$ ). On stratified analysis, the correlations were significantly stronger in non-medical students (knowledge-practice  $r = 0.528$ ) compared to medical students (knowledge-practice  $r = 0.242$ ; attitude-practice  $r = 0.058$ , non-significant), which may imply a ceiling effect in the medical cohort and a greater potential behavioural return from educating non-medical students.

**Discussion**

The findings of this comparative study showed that medical female students had significantly higher knowledge, positive attitude and better practice concerning TT vaccination than non-medical students but the prevalence of adequate vaccination was very low in the whole sample. The findings provide direct comparative evidence in an area where such evidence has been scarce, and confirm the common but previously under-tested assumption that health-professional education is associated with better vaccine knowledge and behavior.

The most important finding is the profound gap between generally positive attitudes and negligible practice, especially among non-medical students, none of whom had ever been vaccinated despite a measurable level of positive attitude. The knowledge-attitude-practice gap is well recognised in health-behaviour research and the present correlation analysis localised its source: attitude was only weakly associated with practice, while knowledge was more strongly associated with it. This is consistent with regional evidence that demand failure in seeking care and high risk for tetanus infection are due to poor knowledge and lack of awareness, and with reports that the majority of women have poor knowledge of tetanus and importance of TT vaccination.

Importantly, the finding that reported refusal was rare and comparable in the two groups reframes the issue as one of awareness and access rather than vaccine hesitancy. This interpretation is supported by the very high proportion of non-medical students unaware of the vaccine, the low rate of possession of vaccination card and international evidence that showed that most of the non-vaccination was due to misconception and to the vaccine being unavailable at nearby centres rather than to active rejection. From the perspective of the Health Belief Model, the positive perceptions of benefit and the high trust in health authorities were not transferred to action due to the lack of cues to action and the basic awareness of the vaccine.

Determinant analysis revealed that rural residence and marital status were significant barriers to uptake. The lower vaccination among rural residents points to the continued urban-rural inequity in access to immunization in Pakistan and is consistent with the evidence that socio-economic status and residence affect adequate antenatal tetanus vaccination. The much lower uptake in married women is counter-intuitive, as this is the traditional priority target for TT immunisation, and most plausibly reflects missed opportunities at antenatal and reproductive-health contacts — a programmatic failure to capture a priority group. The complete confinement of vaccination to the medically educated and to those already aware of tetanus underscores the importance of health literacy as the most direct lever for improving coverage.

These results must be viewed in the context of the limitations of the study. The cross-sectional design enables identification of association but not causation. The practice data were self-reported and had the potential for recall and social-desirability bias that could not always be verified due to the low card possession rate. The study was limited to two universities in Jamshoro, which might affect its generalizability to other settings and to non-student populations. Although substantively informative, the full separation of educational stream and prior awareness precluded estimation of adjusted ratios for those variables. Strengths include the balanced comparative design, the theory-based and pretested instrument, the use of multivariable adjustment, and the focus on the priority population for TT vaccination.

**Conclusion**

Coverage of TT vaccination was critically low among female students of reproductive age in Sindh, particularly among non-medical and rural students, and was driven by lack of awareness and access rather than refusal. Since attitudes were generally favourable and refusal infrequent, relatively low-cost interventions such as targeted, vaccine-specific health education and accessible, university-based vaccination drives are likely to yield substantial gains in coverage, especially if special attention is given to non-medical and rural women and to the integration of TT vaccination into reproductive-

health services. These interventions would contribute to the national and global goal of maternal and neonatal tetanus elimination.

**Declarations**

**Conflict of interest:** The authors declare no conflict of interest.

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**Ethical approval:** Obtained from the Ethics Review Committee, Department of Sociology, University of Sindh, Jamshoro.

**Authors' contributions:** SR conceived and designed the study, collected and analysed the data, and drafted the manuscript. PAK and HK supervised the study, contributed to design and interpretation, and critically revised the manuscript. All authors approved the final version.

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