Original Article

Journal of Infection Prevention

Journal of Infection Prevention
2017, Vol. 18(5) 232–241

DOI: 10.1177/1757177416689722
jip.sagepub.com
SAGE

Knowledge, attitudes and practices related to tetanus toxoid vaccination in women of childbearing age: A cross-sectional study in peri-urban settlements of Karachi, Pakistan

Yasir Shafiq, Asif Raza Khowaja, Mohammad Tahir Yousafzai, Syed Asad Ali, Anita Zaidi and Ali Faisal Saleem

Abstract

Backgound: A higher incidence of neonatal tetanus implies failure of the vaccination program in Pakistan.

Objectives: The objective of this study was to assess knowledge, attitudes and practices related to tetanus toxoid (TT) vaccine in women of childbearing age.

Methods: We performed a cross-sectional survey in peri-urban Karachi, Pakistan, among women of childbearing age, stratified into three mutually exclusive groups as: married pregnant; married non-pregnant; and unmarried. Descriptive and inferential analyses were performed to estimate vaccine coverage and knowledge attributes.

Results: A total of 450 women participated, of which the largest proportion were married and non-pregnant (n = 185/450, 41%). Over 50% of women (n = 258/450) had not received TT vaccine. Most unmarried women (n = 139, 97%) were unvaccinated. Non-vaccination predictors included: women aged <25 years without any formal education (adjusted odds ratio [OR], 2.1; 95% confidence interval [CI], 1.0–4.4), lack of knowledge about free vaccination (adjusted OR, 4.0; 95% CI, 1.64–10.20), poor knowledge of tetanus disease/vaccination (adjusted OR, 4.6; 95%, 2.2–9.6), living with extended family (adjusted OR, 2.0; 95% CI, 1.04–3.96); family non-supporting vaccination (adjusted OR, 5.7; 95% CI, 2.3–13.9); and husband/other family member deciding upon issues related to women's health (adjusted OR, 2.9; 95% CI, 1.3–6.6).

Conclusion: Low coverage of TT vaccine is largely influenced by poor knowledge, family structure and family decision-making in the local communities of Pakistan.

Keywords

Maternal and neonatal tetanus, tetanus immunisation, women of childbearing age

Date received: 21 March 2016; accepted: 14 December 2016

Background

Globally, in 2013, approximately 6.3 million children did not reach the age of five years, and child mortality of 51.8% was associated with infectious diseases (Khan et al., 2015; Liu et al., 2012). *Clostridium tetani* is estimated to cause ~49,000 neonatal deaths annually, of which a vast majority

Department of Paediatrics and Child Health, Aga Khan University, Karachi, Pakistan

Corresponding author:
Ali Faisal Saleem, Paediatric Infectious Diseases, Pakistan Aga Khan University, Stadium Road, P.O. Box 3500, Karachi 74800, Pakistan.
Email: ali.saleem@aku.edu

occur in sub-Saharan Africa and Southeast Asia (Blencowe et al., 2010; Khan et al., 2015; Roper et al., 2007). The literature revealed a declining trend of neonatal mortality due to maternal and neonatal tetanus (MNT) from 0.5 million to 0.25 million during 1980–1997 (Black et al., 2010; Liu et al., 2015; Roper et al., 2007). Recent estimates suggested an annual decline of 8.9% mortality in the last decade (Liu et al., 2015). Several studies on community-based health interventions such as improved umbilical cord care practices, clean delivery environment, supplementary immunisation activities (SIAs) and modification of health-related behaviours, including birth practices, have demonstrated significant reduction in overall child morbidity and mortality (Khan et al., 2013). Tetanus toxoid (TT) vaccine is a safe public health intervention, targeted to decrease MNT deaths in particular (Blencowe et al., 2010; Khan et al., 2015; World Health Organization, 2007). Although TT vaccine is offered at no cost to women, it is one of the least utilised vaccines in developing countries (Blencowe et al., 2010; World Health Organization, 2007).

Pakistan is among 34 countries to have failed the MNT global elimination target of 'less than 1 case per 1000 live births in every district of country' as introduced by the World Health Organization (WHO) (Lambo and Nagulesapillai, 2012; World Health Organization, 2013). The WHO highly recommended greater than 90% TT vaccine coverage in high-risk areas (Lambo and Nagulesapillai, 2012; World Health Organization, 2013). Pakistan's Expanded Program on Immunization (EPI) offers free-of-charge TT vaccine services for all pregnant women and women of childbearing age (Masud and Navaratne, 2012). The existing EPI schedule recommends five TT vaccine doses inclusive of TTV-1 at first contact, TTV-2 at least four weeks after the first dose, TTV-3 at least six months after the second dose, TTV-4 at least one year after the third dose and TTV-5 at least one year after the fourth dose (Masud and Navaratne, 2012; World Health Organization, 2007). Local statistics suggested that more than 50% of districts are at risk of MNT in Pakistan (Hasnain and Sheikh, 2007). It is estimated that 54–70% of women received at least two doses of TT vaccine, and significant coverage disparities exist between urban and rural districts (Hasnain and Sheikh, 2007; Khowaja et al., 2015; Lambo and Nagulesapillai, 2012). Studies conducted elsewhere suggested lack of knowledge about tetanus disease, inadequate information vaccine schedule, misconceptions related to TT vaccine and poor understanding of TT vaccine benefits (Afridi et al., 2005; Hasnain and Sheikh, 2007; Khowaja et al., 2015; Maral et al., 2001).

Community level knowledge gains are critical to improve TT vaccine coverage in Pakistan (Hasnain and Sheikh, 2007). There is a paucity of published literature to support woman's knowledge and preferences for TT vaccination in the local context of Pakistan. The primary objective of this study was to assess knowledge, attitudes and practices (KAP) related to TT vaccination. The secondary objective was to estimate dose specific vaccine coverage of TTV-1 to TTV-2 in pregnant women, and TTV-3 through TTV-5 in women of childbearing age (inclusive of unmarried women, and married and non-pregnant women).

Study methods

Study design and setting

This was a baseline cross-sectional vaccine coverage and KAP survey, which is part of a large research project. We employed a mixed-methodology (quantitative and qualitative) research design using community-based participatory action research (Plan–Act–Observe–Reflect) with baseline and end-line surveys for TT vaccine coverage among women of childbearing age. A baseline KAP survey was conducted during March and April 2014. The study was conducted in four peri-urban low-income settlements in coastal Karachi (Figure 1) covering a total area of 16.13 km^2 (Figure 1a). Residents make their living mostly by fishing, cattle farming for dairy production and small retail businesses. The majority of population resides in a small, one- to two-room houses. Municipal amenities are very poor, the water supply network is not accessible and residents collect water from community tanks or from vendors. Based on our previous vaccine and other maternal and child health-related work, we chose this site to further build on the preventive models for improving vaccination rates in the selected community (Zaidi et al., 2013).

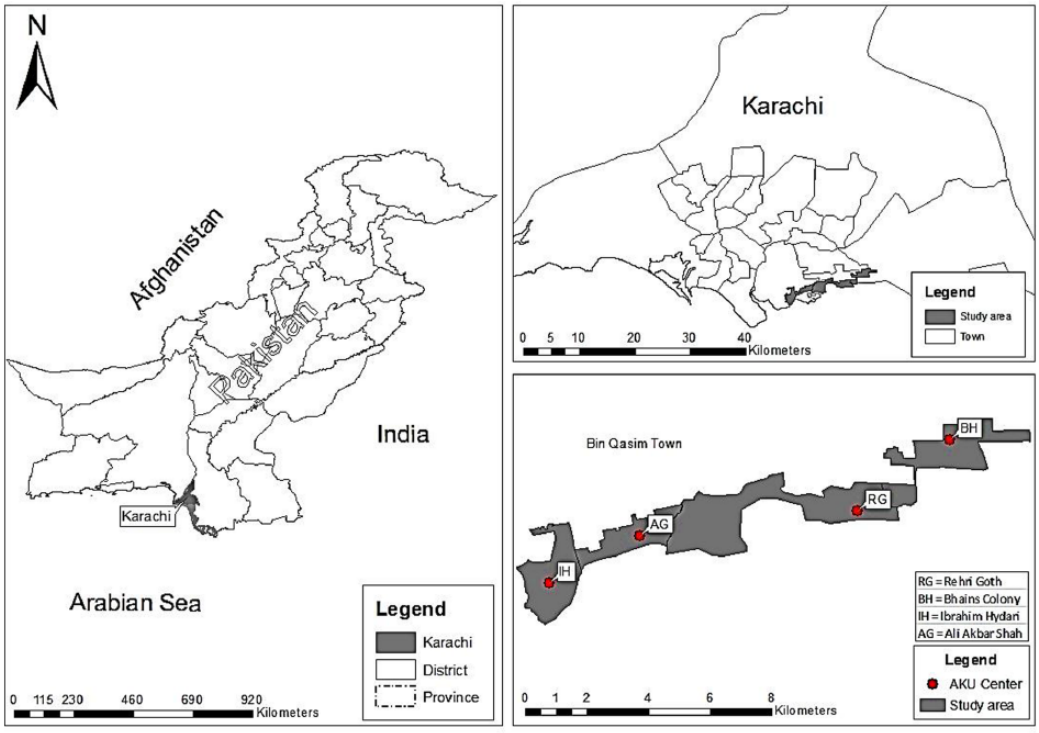
The department of Pediatrics and Child Health at Aga Khan University (AKU) conducted a baseline census in the study area in 2010 (Shafiq et al., 2016). During that year, 200,000 people lived in the study area. Among them, 25% were women of reproductive age (age range, 15–49 years) and 12% were children aged less than five years (Shafiq et al., 2016; Zaidi et al., 2013). The gross fertility rate was 131 out of 1000 women of reproductive age, the under-five mortality rate was 68.8 per 1000 live births and the neonatal mortality rate was 42.7 per 1000 live births (Shafiq et al., 2016; Zaidi et al., 2013). The annual birth cohort is around 8000 and approximately 11% of newborns experience clinically diagnosed sepsis within the first two months of life (Shafiq et al., 2016; Zaidi et al., 2013).

Sampling strategy and population

The target group of this study was women of childbearing age. Women were considered eligible if they were aged 15–49 years, married/unmarried, residents of the study catchment areas for the last six months and willing to participate in the study.

The Department of Pediatrics and Child Health at AKU has established an active surveillance of women and children under five years of age in the selected areas. Line listing with geographical coordinates was available for all the households

Figure 1. Study setting and Vaccination coverage. (a) Site description, showing four peri-urban sites located in Bin Qasim town of metropolitan city Karachi, Pakistan. (b) TT vaccination coverage at study sites.



in the study catchment. Updated listings of all the women of childbearing age and their marital and pregnancy status were available from their surveillance team through the demographic surveillance system (DSS). The investigators used these listings as a sampling frame to randomly select the desired number of participants. Statistical package for social scientists (SPSS) version 20 was used to generate the random list of eligible participants. Lists of the selected households with DSS ID and geographic coordinates were provided to the local community health workers (CHW) in each of the four study sites. The CHWs visited each household, introduced themselves and explained the details about TT vaccine coverage survey. The eligible women were asked for written informed consent to participate in the study. Women who were not available in the household on two different visits (one week apart) were excluded from the study.

Sample size

The sample size required for vaccine coverage was calculated as 384 women of childbearing age, using 50% coverage of TT2 vaccination, 95% confidence interval (CI) and design effect of 1. We inflated sample size by 15%, adjusting for refusal and non-participation rates. Thus, a desired sample size was determined as 450 women (Gumucio, 2011).

Data collection procedure and tools

The investigators adapted a structured survey questionnaire from the literature (Afridi et al., 2005; Hasnain and Sheikh, 2007; Maral et al., 2001). The questionnaire included a demographic profile of household, knowledge, attitudes and practices of the participant regarding tetanus disease, TT vaccine and record of TT vaccination (Naeem et al., 2010; Nisar et al., 2010). The questionnaire was pilot-tested on 5% of the total sample size in neighboring areas similar to that of selected population and content modifications were made accordingly.

Trained CHWs, together with a research associate, visited the households of all consented women and administered the questionnaire in a face-to-face interview. The questionnaires were translated in the local Urdu language and all the interviewers were Urdu speakers. Each interview was approximately 20 min in duration. If the woman was busy or not available for the interview, our research team rescheduled at a suitable time. Senior research staff supervised data collection and 5% of the interviews were conducted under direct observation of the study coordinator to ensure the quality and rigour of data collection. Households were mapped through GIS to identify the high-risk areas, where TT vaccine coverage was low.

Data analysis

The data were entered in a specifically designed data entry program in Microsoft Access 2010 using dual checks of error and double data entry mechanism. The data was imported into SPSS version 20 for analysis. Descriptive analysis was carried out for basic demographic covariates by generating frequencies and percentages. For inferential analysis, a single binary variable 'at least one dose of maternal TT vaccination vs. Zero TT vaccination' was computed from the existing variables on number of TT doses. Differences in KAP in women who received 'at least one dose of tetanus vaccine' was compared to 'un-immunized' using Chi-square bivariate analysis. Crude odds ratio (OR) with 95% CI were calculated using univariate logistic regression. Variables significant at the 15% level of significance in univariate analysis were carried forward to multivariable logistic regression model. Adjusted odds ration (OR) with 95% CI were calculated using multivariable logistic regression analysis. Variables at the 5% level of significance were kept in the final adjusted model. Model fitness of the test was assessed using Hosmer and Lemeshow goodness of fit test ($P = 0.52$).

Ethical consideration

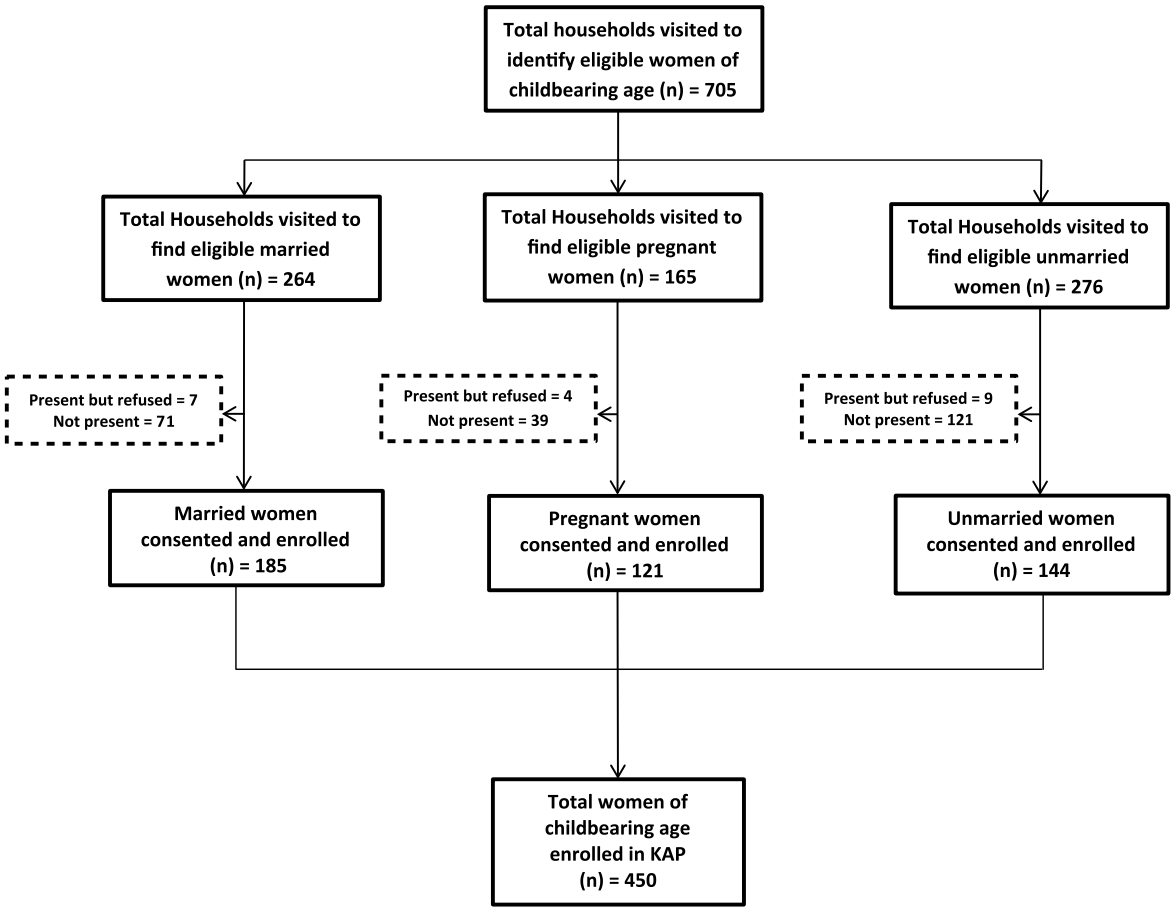
This study received ethics approval from AKU Ethics Review Committee (2835-Ped-ERC-13). Health authority approvals were obtained from Provincial EPI Office Sindh, Executive District Office (EDO) Health Karachi, Town Health Office Bin Qasim Town and EPI centres. Written consent was obtained from all study participants prior to data collection and data confidentiality was maintained through a unique participant identity number. In cases where the age of the participant was less than 18 years, parental consent was obtained. Data were stored under lock-and-key, with only access to the Principal Investigator and senior project staff responsible for data quality.

Results

A total of 705 women of childbearing age were approached, of which 450 (64%) were enrolled in the study (Figure 2). More than half (n = 245, 54%) of women had no formal education. Common languages spoken at the household level were Sindhi (31%), Urdu (21%) and Bengali (20%). Study participants were stratified into three groups as married and non-pregnant at the time of enrollment (n = 185; mean age, 29 years; SD, 7.4), married and pregnant (n = 121; mean age, 25 years; SD, 5.5) and unmarried women (n = 144; mean age, 18 years; SD, 2.9).

Overall, 57% (n = 257) of participants did not receive TT vaccine. The majority of unmarried women (97%, n = 139) were found not to have been immunised against tetanus. Descriptive information on vaccination coverage is presented in Table 1. Women aged younger than 25 years with no formal education (adjusted OR, 2.1; 95% CI, 1.00–4.40), a lack of information about free-of-charge TT vaccine service (adjusted OR, 4.0; 95% CI, 1.64–10.20)

Figure 2. Recruitment process. Flow diagram of the study.



and living in a combined family (adjusted OR, 2.0; 95% CI, 1.04–3.96) were more likely to be associated with not receiving TT vaccine (Table 2). The majority of women were not aware about tetanus disease and TT vaccine. Lack of knowledge of disease and TT vaccine was associated with unvaccinated status (adjusted OR, 4.6; 95% CI, 2.18–9.57).

The attitude of women and support from family towards the importance of TT vaccine were key findings. Participants were unvaccinated if the family was against vaccination (adjusted OR, 5.7; 95% CI, 2.33–13.93). Having another family member as a decision-maker about vaccination and healthcare seeking was associated with unvaccinated status (adjusted OR, 2.9; 95% CI, 1.31–6.58). Poor care seeking for antenatal care during pregnancy largely impacted on TT vaccination status (adusted OR, 2.2; 95% CI, 1.03–4.83) in all married women (pregnant and non-pregnant) (n = 272). Table 2 demonstrates the key variable of attitudes and practices among study participants. Figure 3 provides a snapshot status of KAP related to tetanus disease and TT vaccination.

Discussion

Overall coverage of TT vaccination for at least one dose was found much lower (i.e. 43%) than the WHO recommended range of 90% coverage for women living in high-risk areas (Lambo and Nagulesapillai, 2012; World Health Organization, 2007, 2013). It is clear that TT vaccine coverage in pregnant women in Pakistan is far from universal coverage goals (Hasnain and Sheikh, 2007; Masud and Navaratne, 2012). Such low vaccination coverage remains a large public health challenge in eliminating tetanus disease (Lambo and Nagulesapillai, 2012; Wasay et al., 2008). However, the coverage was comparatively good among participants who were married, whether pregnant or not, reportedly to be 64% and 60%, respectively. Immunisation uptake among unmarried women was poor; where 97% never received any TT dose (Qadir et al., 2010; Zeb et al., 2006). Poor knowledge about tetanus disease and lack of information about the nearby EPI center were key elements for TT vaccination (Naeem et al., 2010). Family-level decision-making was important factor against the uptake of TT

Table 1. Sociodemographic characteristics of study participants and vaccination coverage.

	All participants
	n = 450 (%)
Site wise distribution of study participants	
• Rehri Goth	98 (22)
• Ali Akbar Shah	100 (22)
• Ibrahim Haidri	114 (25)
• Bhains Colony	138 (31)
*Category of woman interviewed**	
• Married, not pregnant (mean age, 29 years; SD, 7.4; age range, 15–47 years)	185 (41)
• Pregnant (mean age, 25 years; SD, 5.5; age range, 15–41 years)	121 (27)
• Unmarried (mean age, 18 years; SD, 2.9; age range, 14–30 years)	144 (32)
Age distribution of participants	
• 14–20 years	178 (40)
• 21–30 years	181 (40)
• 31–40 years	78 (17)
• 41–49 years	13 (3)
Education status of study participants	
• Illiterate or no formal education†	242 (54)
• Primary education (<5 years of schooling)	63 (14)
• Middle education (5–8 years of schooling)	65 (14)
• Matriculation or above	80 (18)
Ethnicity based on languages spoken by participants	
• Sindhi	138 (31)
• Urdu	93 (21)
• Bengali	88 (20)
• Punjabi	44 (10)
• Pashto	26 (6)
• Or ethnic groups	61 (13)
Coverage of tetanus vaccination of study participants	
• Unvaccinated	255 (57%)
• Married but not pregnant	72 (39%)
• Married and pregnant	44 (36%)
• Unmarried	139 (97%)

*Married women only
†n = 77 (30%) have some religious education.

vaccination in our study population. We believe that if a woman is empowered enough to make a decision about receiving vaccination and seeking healthcare, that would significantly improve the TT vaccine coverage (Khan et al., 2013; Nisar et al., 2010).

Knowledge contributes significantly in defining attitudes and behaviours against vaccination (Amin et al., 2013; Berman et al., 1991). The poor understanding of tetanus disease and prevention measures in the community result in demand failure (Berman et al., 1991; Maral et al., 2001). This largely depends upon knowledge construction, belief system, formal education and access to a healthcare system in communities (Naeem et al., 2010). It is evident that poor maternal knowledge not only affects woman's vaccination status, but also hinders vaccination for the infant (Afridi et al., 2005; Hasnain and Sheikh., 2007; Lambo and Nagulesapillai, 2012; Nisar et al., 2010). Equitable access to quality health services is essential for creating demand for vaccination (Amin et al., 2013; Berman et al., 1991; Ensor and Cooper, 2004; Jamil et al., 1999). The awareness of women regarding availability and location of nearby EPI center is essential (Siddiqi et al., 2007).

Table 2. Predictors of tetanus vaccination among women of childbearing age in squatter settlements of Karachi, Pakistan.

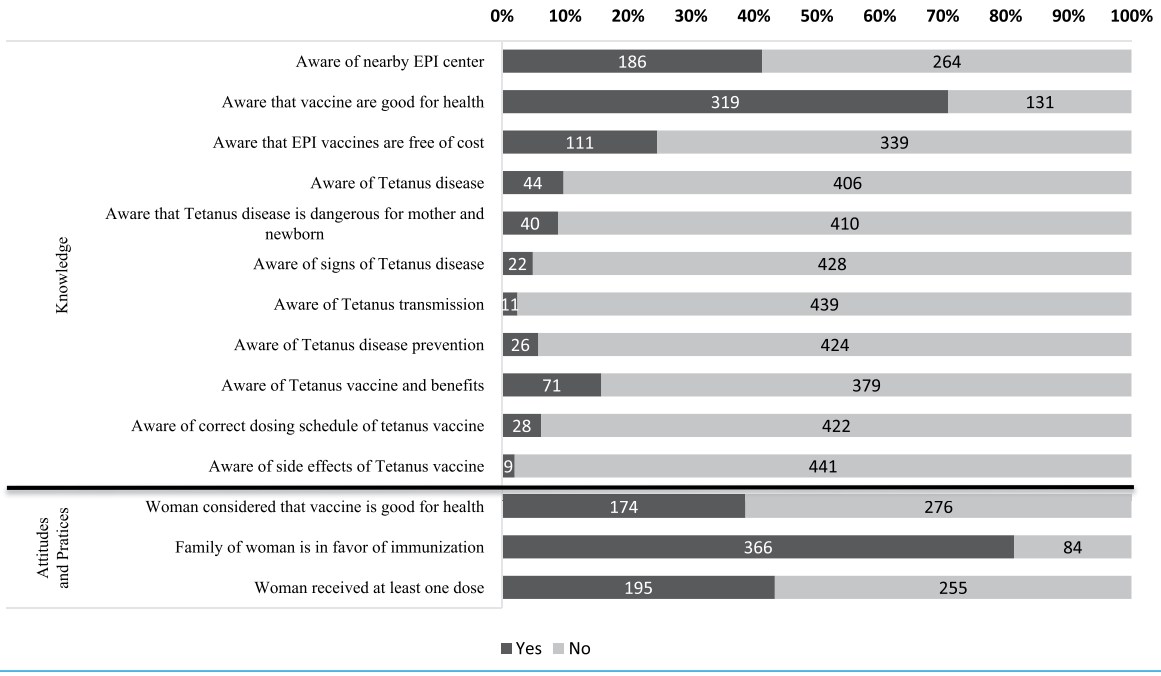
Characteristic	Received at least one dose (n (%))	Never vaccinated (n (%))	Crude OR (95% CI)	Adjusted OR (95% CI)
Demographic predictors of poor vaccination status				
Women aged less than 25 years*	88 (19)	194 (43)	3.7 (2.47–5.49)	
Geographical distance of EPI center from household is greater than 1 km*	78 (17)	95 (22)	0.9 (0.63–1.36)	
No formal education*	100 (22)	145 (32)	1.2 (0.83–1.77)	2.1 (1.00–4.40)
Living in combine family structure*	81 (18)	151 (33)	2.0 (1.36, 2.89)	2.0 (1.04, 3.96)
Living in household where no under-five children are present*	44 (10)	96 (21)	2.0 (1.33–3.09)	
Knowledge related predictors of poor vaccination status				
Not aware of any EPI center nearby*	90 (20)	177 (39)	2.5 (1.73–3.74)	
Not aware that vaccination is good for health*	27 (6)	104 (23)	4.2 (2.60–6.67)	4.6 (2.18–9.57)
Not aware that EPI vaccines are free of cost*	123 (27)	219 (48)	3.3 (2.10–5.14)	4.0 (1.64–10.20)
Not aware that tetanus disease is dangerous for mother and newborn*	168 (37)	241 (53)	2.3 (1.20–4.31)	
Not aware about tetanus vaccine is good for mother and newborn*	140 (31)	242 (53)	5.9 (3.28–10.00)	
Attitude and practices related predictors of poor vaccination status				
Considered that tetanus vaccination is not important for a woman*	89 (20)	190 (42)	3.3 (2.24–4.94)	
Family is not supportive toward vaccination of a woman*	13 (3)	74 (16)	5.6 (3.01– 10.50)	5.7 (2.33–13.93)
Family members are decision-makers*	131 (29)	232	4.4 (2.63–7.21)	2.9 (1.31–6.58)
Cannot pay out-of-pocket if required*	57 (13)	140 (31)	2.9 (1.93–4.25)	3.1 (1.58–6.29)
Never received antenatal care during last pregnancy*†	21 (8)	39 (14)	5.2 (2.80–9.54)	2.2 (1.03–4.83)
Do not receive antenatal care during current pregnancy*‡	17 (14)	17 (14)	2.3 (1.00–5.08)	

*Reference values: age greater than 25 years, EPI center at a distance within 1 km, formal education, nuclear family structure, household with at least one child aged under five years, aware of EPI center nearby, aware that vaccination is good for health, aware that EPI vaccines are free of cost, aware that tetanus disease is dangerous for mother and newborn, aware that TT vaccine is good for mother and newborn, TT vaccine is important for a woman, family is supportive, woman is a decision-maker, can pay out-of-pocket, never received antenatal care during last pregnancies, received antenatal care during current pregnancy.
†Married women only (n = 306).
‡Currently pregnant (n =121).

The literature revealed that information about availability and location of a nearby EPI services improved vaccination coverage (Mangrio et al., 2008; Masud and Navaratne, 2012; Siddiqi et al., 2010). However, unavailability of an EPI center within a catchment area could significantly hamper the overall vaccination coverage (Khowaja et al., 2015; Mangrio et al., 2008). A lack of awareness of free-of-charge EPI services and the availability of a free vaccine was a barrier to uptake. This highlights the importance and need of community awareness about free-of-charge vaccination services available at EPI centers throughout the country (Ahmed and Ahmed, 2014; Masud and Navaratne, 2012).

Social factors, family dynamics and its structure (neutral or combined family system) are important and effective for the vaccination status of a woman (Maral et al., 2001). A combined family system is a typical Pakistani family structure where there could be many decision-makers in a single family (Rahman and Obaida-Nasrin, 2010). In a nuclear family system, a woman herself could be a better decision-maker to decide about care seeking for vaccination. Women as decision-makers could greatly impact on the uptake of vaccination coverage (Berman et al., 1991). However if family members are not supportive and someone other than women is the decision-maker, this significantly affect the vaccination coverage (Amin et al., 2013; Antai, 2012).

Figure 3. Graphical presentation of KAP survey related to tetanus disease and TT vaccination (%).



Almost all of the young unmarried women are unimmunised against tetanus in this study. This finding has significant implications as marriages usually happen in younger women in rural and peri-urban communities in Pakistan. Focusing on these young unmarried women for TT vaccination would be an essential step for tetanus prevention.

Overall, the strategies to improve the awareness of women of childbearing age through effective communication about free-of-charge EPI services and utilisation of these centres improving antenatal care and involving them in decision-making may improve tetanus vaccine coverage in local communities in Pakistan. The role of healthcare providers are deemed important as they play a pivotal role in vaccination in Pakistan. Furthermore, using GIS technology to distinguish high-risk pockets of low reporting uptake and connecting it with other key predictors of poor vaccination and health indicators is very significant for Pakistan (Barau et al., 2014).

The study has several strengths to be reported. First, the study performed GIS mapping of the households to identify the pockets with poor TT vaccination among women of childbearing age. Second, the sampling of the participants was truly random in nature because of the availability of accurate updated line listings of all the households and women of childbearing age in the given communities. Finally, the data were collected using a structured questionnaire adapted from other studies in similar settings.

There are also several limitations in this study which need to be considered. TT vaccination information is predominantly subjective and based on recall. Only 22% of the participants reporting TT vaccination also produced the vaccination card. This was a cross-sectional study and temporal associations could not be ascertained with certainty and there is no way to ascertain whether the factors preceded the outcome. There was a differential response rate in our participants as unmarried women were more likely to refuse participation compared to married women. However, the higher refusals among unmarried women was not because of vaccination status. If this was the case, we would have expected higher or equal TT vaccination among unmarried participants as compared to married (pregnant and non-pregnant). On the contrary, almost all of the unmarried participants were unvaccinated against tetanus. The higher refusal among unmarried women is most likely because of sociocultural factors such as decision power and independence to choose to participate in a study.

Conclusion

TT vaccination coverage in women of childbearing age is marginal at peri-urban settings of Karachi. The coverage was largely influenced by poor knowledge, family structure and family decision-making in the local communities of Pakistan. Public awareness, engaging dyadic decision-makers and women of childbearing age are imperative to improve TT vaccination in Pakistan.

Acknowledgements

Ali Faisal Saleem received research training support from the National Institute of Health's Fogarty International Center (1 D43

TW007585-01). The authors acknowledge special support of Provincial EPI Program Sindh (Dr. Mazhar Ali Khamisani, Dr. Dur-e-Naz, Dr. Raj Kumar), EDO and DO Preventive Karachi (Dr, Zafar Ejaz, Dr. Nargis, Dr. Noor), Town Health Office Bin Qasim Town (Dr. Manzoor, Dr. Ahmed Ali Palijo, Dr. Jabbar) and staff at local EPI centres at study sites. They also thank project staff and other team support of the Department of Pediatric and Child Health, Aga Khan University.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: GAVI-CSO awarded to Ali Faisal Saleem (Partnership Reg. No. PAK/13/200).

Peer review statement

Not commissioned; blind peer-reviewed.

References

Afridi NK, Hatcher J, Mahmud S and Nanan D. (2005) Coverage and factors associated with tetanus toxoid vaccination status among females of reproductive age in Peshawar. *Journal of the College of Physicians and Surgeons – Pakistan: JCPSP* 15: 391–395.

Ahmed V and Ahmed S. (2014) *Poverty and Social Impact Analysis of Expanded Program on Immunization in Pakistan*. Islamabad: Sustainable Development Policy Institute.

Amin R, De Oliveira TJCR, Da Cunha M, Brown TW, Favin M and Cappelier K. (2013) Factors limiting immunization coverage in urban Dili, Timor-Leste. *Global Health: Science and Practice* 1: 417–427.

Antai D. (2012) Gender inequities, relationship power, and childhood immunization uptake in Nigeria: a population-based cross-sectional study. *International Journal of Infectious Diseases* 16: e136–e145.

Barau I, Zubairu M, Mwanza MN and Seaman VY. (2014) Improving polio vaccination coverage in Nigeria through the use of geographic information system technology. *Journal of Infectious Diseases* 210: S102–S110.

Berman P, Quinley J, Yusuf B, Anwar S, Mustaini U, Azof A and Iskandar. (1991) Maternal tetanus immunization in Aceh Province, Sumatra: the cost-effectiveness of alternative strategies. *Social Science & Medicine* 33: 185–192.

Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, Jha P, Campbell H, Walker CF, Cibulskis R, Eisele T, Liu L, Mathers C and Child Health Epidemiology Reference Group of WHO and UNICEF. (2010) Global, regional, and national causes of child mortality in 2008: a systematic analysis. *Lancet* 375: 1969–1987.

Blencowe H, Lawn J, Vandelaer J, Roper M and Cousens S. (2010) Tetanus toxoid immunization to reduce mortality from neonatal tetanus. *International Journal of Epidemiology* 39: i102–i109.

Ensor T and Cooper S. (2004) Overcoming barriers to health service access: influencing the demand side. *Health Policy and Planning* 19: 69–79.

Gumucio S, Merica M, Luhmann N, Fauvel G, Zompi S, Ronsse A, Courcaud A, Bouchon M, Trehin C, Schapman S, Cheminat O, Ranchel H, Simon S and Monde MD. (2011) *Data Collection Quantitative Methods, the KAP Survey Model (Knowledge, Attitude and Practices)*. Saint Etienne, France: IGC communigraphie.

Hasnain S and Sheikh N. (2007) Causes of low tetanus toxoid vaccination coverage in pregnant women in Lahore district, Pakistan. *Eastern Mediterranean Health Journal* 13: 1142–1152.

Jamil K, Bhuiya A, Streatfield K and Chakrabarty N. (1999) The immunization programme in Bangladesh: impressive gains in coverage, but gaps remain. *Health Policy and Planning* 14: 49–58.

Khan AA, Zahidie A and Rabbani F. (2013) Interventions to reduce neonatal mortality from neonatal tetanus in low and middle income countries-a systematic review. *BMC Public Health* 13: 1.

Khan R, Vandelaer J, Yakubu A, Raza AA and Zulu F. (2015) Maternal and neonatal tetanus elimination: from protecting women and newborns to protecting all. *International Journal of Women's Health* 7: 171–180.

Khowaja AR, Zaman U, Feroze A, Rizvi A and Zaidi AK. (2015) Routine EPI coverage subdistrict inequalities and reasons for immunization failure in a rural setting in Pakistan. *Asia-Pacific Journal of Public Health* 27: NP1050–NP1059.

Lambo JA and Nagulesapillai T. (2012) Neonatal tetanus elimination in Pakistan: progress and challenges. *International Journal of Infectious Diseases* 16: e833–e842.

Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, Rudan I, Campbell H, Cibulskis R, Li M, Mathers C, Black RE and Child Health Epidemiology Reference Group of WHO and UNICEF. (2012) Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet* 379: 2151–2161.

Liu L, Oza S, Hogan D, Perin J, Rudan I, Lawn JE, Cousens S, Mathers C and Black RE. (2015) Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis. *Lancet* 385: 430–440.

Mangrio NK, Alam MM and Shaikh BT. (2008) Is expanded programme on immunization doing enough? Viewpoint of health workers and managers in Sindh, Pakistan. *JPMA: Journal of the Pakistan Medical Association* 58: 64–67.

Maral I, Baykan Z, Aksakal F, Kayikcioglu F and Bumin MA. (2001) Tetanus immunization in pregnant women: evaluation of maternal tetanus vaccination status and factors affecting rate of vaccination coverage. *Public Health* 115: 359–364.

Masud T and Navaratne KV. (2012) *The Expanded Program on Immunization in Pakistan. HNP Discussion Paper*. Washington, DC: World Bank.

Naeem M, Khan M, Abbas SH, Adil M, Khan A, Naz SM and Khan MU. (2010) Coverage and factors associated with tetanus toxoid vaccination among married women of reproductive age: a cross sectional study in Peshawar. *Journal of Ayub Medical College, Abbottabad: JAMC* 22: 136–140.

Nisar N, Aziz N and Mumtaz F. (2010) Tetanus toxoid vaccination coverage among pregnant women at tertiary care hospital, Sindh Pakistan. *Med Channel* 16: 272–275.

Qadir M, Murad R, Mumtaz S, Azmi AA, Rehman R, Omm-E-Hani and Aziz N. (2010) Frequency of tetanus toxoid immunization among college/university female students of Karachi. *Journal of Ayub Medical College, Abbottabad: JAMC* 22: 147–149.

Rahman M and Obaida-Nasrin S. (2010) Factors affecting acceptance of complete immunization coverage of children under five years in rural Bangladesh. *Salud pública de méxico* 52: 134–140.

Roper MH, Vandelaer JH and Gasse FL. (2007) Maternal and neonatal tetanus. *Lancet* 370: 1947–1959.

Shafiq Y, Nisar MI, Kazi AM, Ali M, Jamal S, Ilyas M, Jehan F, Sultana S, Qureshi SM, Hotwani A and Zaidi AK. (2016) Implementation of the ANISA Study in Karachi, Pakistan: challenges and solutions. *Pediatric Infectious Disease Journal* 35: S60–S64.

Siddiqi N, Khan A, Nisar N and Siddiqi AE. (2007) Assessment of EPI (expanded program of immunization) vaccine coverage in a peri-urban area. *JPMA: Journal of the Pakistan Medical Association* 57: 391–395.

Siddiqi N, Siddiqi A-E, Nisar N and Khan A. (2010) Mothers' knowledge about EPI and its relation with age-appropriate vaccination of

infants in peri-urban Karachi. *JPMA: Journal of the Pakistan Medical Association* 60: 940–944.

Wasay M, Khatri IA and Salahuddin N. (2008) Tetanus and rabies eradication in Pakistan; a mission not impossible. *JPMA: Journal of the Pakistan Medical Association* 58: 158–159.

World Health Organization. (2007) *Standards for Maternal and Neonatal Care: Intergrated Management of Pregnancy and Childbirth*. Geneva: WHO.

World Health Organization. (2013) *Global Vaccine Action Plan Secretariat Annual Report 2013*. Geneva: WHO.

Zaidi AK, Tikmani SS, Sultana S, Baloch B, Kazi M, Rehman H, Karimi K, Jehan F, Ahmed I and Cousens S. (2013) Simplified antibiotic regimens for the management of clinically diagnosed severe infections in newborns and young infants in first-level facilities in Karachi, Pakistan: study design for an outpatient randomized controlled equivalence trial. *Pediatric Infectious Disease Journal* 32: S19–S25.

Zeb A, Zaidi S and Jehan I. (2006) Knowledge attitude and practices of reproductive age females about tetanus toxoid vaccine: a pilot study. *Journal of the College of Physicians and Surgeons – Pakistan: JCPSP* 16: 791–793.