



www.figo.org

Contents lists available at [SciVerse ScienceDirect](#)

# International Journal of Gynecology and Obstetrics

journal homepage: [www.elsevier.com/locate/ijgo](http://www.elsevier.com/locate/ijgo)

## CLINICAL ARTICLE

# The effect of traditional birth attendant training on maternal and neonatal care

Peter C. Miller<sup>\*</sup>, Gul Rashida, Zeba Tasneem, Minhaj ul Haque

Population Council, Islamabad, Pakistan

## ARTICLE INFO

### Article history:

Received 20 April 2011

Received in revised form 17 December 2011

Accepted 2 February 2012

### Keywords:

Maternal Health

Neonatal Health

Pakistan

Traditional birth attendants

## ABSTRACT

**Objective:** To determine whether traditional birth attendants (TBAs) trained via the “SMART Dai” method were superior to untrained TBAs in knowledge and practice regarding maternal and newborn care. **Methods:** In a cluster-randomized trial in the Dera Ghazi Khan District of Punjab, Pakistan, 120 rural communities each with a population of approximately 5000 were randomly assigned to a community-based intervention (CBI) or a health systems intervention (HSI). In the CBI communities, 288 TBAs underwent an innovative 8-day training course on maternal and newborn care, initially evaluated by pre- and post-tests. After an average of 19 months post-training, 277 TBAs, together with 257 comparably chosen untrained TBAs from the HSI communities, were tested and interviewed. Patients from both referred and non-referred deliveries were also interviewed. **Results:** Characteristics of TBAs in the two groups were similar. The TBAs were evaluated according to various measures of knowledge, skill, and practice (including referral), with patient reports on practice compared with TBA reports. By most measures, trained TBAs outperformed untrained ones, often to significant degrees. **Conclusion:** SMART Dai training seemed to be an important factor in the significant reduction in perinatal mortality in the CBI areas. Properly trained TBAs can substantially contribute to improved delivery outcomes. © 2012 International Federation of Gynecology and Obstetrics. Published by Elsevier Ireland Ltd. All rights reserved.

## 1. Introduction

Levels of maternal mortality (276 per 100 000 live births) and neonatal mortality (54 per 1000 live births) in Pakistan are unacceptably high [1]. A key factor is care at delivery: 65% of births take place at home, and 61% are attended by someone other than a skilled birth attendant. The leading causes of maternal death are postpartum hemorrhage (27.2%) and puerperal sepsis (13.7%); for neonatal mortality, the leading causes are asphyxia (39.5%), sepsis (20.0%), and prematurity (16.3%) [1]. Deaths from all of these causes could be substantially reduced by better home care or more prompt referral to hospital.

Universal facility-based delivery would substantially reduce these rates, but in Pakistan this would take decades. However, a considerable body of research over the past 2 decades has shown the great potential, especially for neonatal mortality, of improving community-based delivery care [2,3]. Pakistan is implementing a Community Midwife program to improve delivery care in rural areas [4], but this too will require time and the outcome is uncertain. An interim alternative is to improve the care provided by traditional birth attendants (TBAs), or *dais*, who now deliver approximately 80% of home births in Pakistan. In principle, TBAs can be trained to improve their knowledge and practice but, internationally, attempts to do so have met with mixed results. Araujo et al. [5], Alisjahbana et al. [6], and Bang et al. [7], for example, found positive results from using TBAs,

but more general reviews [8] tend to find that the potential of TBAs is limited. However, the amount of quality evidence is small: the authors of a Cochrane Review in 2009 [9] found only 4 studies meeting their criteria.

In Pakistan, TBA training during the 1980s has generally been judged to have been a failure. However, in a cluster-randomized controlled trial, Jokhio et al. [10] found that “training traditional birth attendants and integrating them into an improved health care system were achievable and effective in reducing perinatal mortality.” Bhutta et al. [11,12] found significant reductions in stillbirths and neonatal deaths using a combination of TBAs and briefly trained Lady Health Workers.

The Safe Motherhood Applied Research and Training (SMART) project was a 3-year trial, cluster randomized at the community level, designed to develop and test community level and health systems level interventions to reduce maternal, perinatal, and neonatal mortality and morbidity in the Dera Ghazi Khan district of southern Punjab, Pakistan [13]. It provides additional evidence to support the potential of TBA training to improve birth outcome in rural Pakistan.

## 2. Materials and methods

The SMART project had 2 intervention sites in rural, non-tribal Dera Ghazi Khan, each consisting of 60 randomly assigned rural *mouzas* (communities) with a population of approximately 5000 each. Communities were sampled using a stratified random procedure, with strata created using distance from hospitals in the 2 main towns. A control site with no services was selected in neighboring Layyah

<sup>\*</sup> Corresponding author at: Population Council, House 7, Street 62, F/6/3, Islamabad, Pakistan. Tel.: +92 51 8445566; fax: +92 51 2821401.

E-mail address: [pcm524@yahoo.com](mailto:pcm524@yahoo.com) (P.C. Miller).

district. In one intervention site, a combination of health systems interventions (HSI) and community-based interventions (CBI) was implemented; in the other, only the HSI component was implemented. The intervention and its evaluation were approved by the Population Council's Institutional Review Board.

In the HSI plus CBI site, 288 TBAs (all active TBAs in the site who met criteria for activity level and agreed to participate) were trained in an innovative 8-day "SMART Dai" training course, which was respectful, participatory, "client centered," hands on, and inclusive of both neonatal and maternal care, in addition to using appropriate teaching methods. The TBAs particularly valued the "client-centered" approach and the training on neonatal care. (Full details on the training are available from the authors.) Training took place between August 30, 2004, and May 31, 2005. A 19-item knowledge test for maternal and newborn care was administered before and immediately after training, and during a field evaluation at 4–6 months post-training. The results seemed to show improved performance but another evaluation, with a longer time after training and with a comparison group, was needed. Because the design of the SMART project meant that TBAs in 120 communities had been randomly assigned to receive training or not, the untrained TBAs in the HSI area presented a near-ideal control group. Hence, an evaluation was conducted comparing the trained TBAs at approximately 19 months after training with comparable TBAs in the HSI-only site using the same instruments. The objectives of the evaluation were to assess improvement of TBAs after training; to determine the knowledge, attitude, and behavior of TBAs regarding maternal and neonatal health care in the 2 sites; to assess and compare the skills of TBAs in the 2 sites; and to determine patient perceptions of TBAs.

The sample included all trained TBAs who could be located (277 of 288) and all untrained TBAs (257) who met the original criteria for TBA training (Fig. 1). In addition, samples of patients of both trained and untrained TBAs who experienced normal and referred deliveries were included. Data collection instruments included a repeat of the initial knowledge test; a structured questionnaire administered to TBAs involving knowledge, usual practice, practice for the most recent normal delivery, and details of up to a maximum of 4 referrals over the previous 6 months; a skills test using dummy female and newborn models; a structured questionnaire for each TBA's most recently delivered patient (250 patients of trained TBAs, 236 of untrained); and a structured questionnaire for referred patients (169 patients of trained TBAs, 114 of untrained). The interviewers (who were trained nurses) visited the TBAs' homes to administer the knowledge test, the questionnaire, and the skills test, and obtained

contact information for patients to be administered in the patients' homes. Informed consent was obtained. Data were entered into computers, edited, and analyzed, primarily by comparing responses for trained and untrained TBAs via *t* tests, using the STATA (StataCorp, College Station, TX, USA) survey variance estimation procedures to account for the sample design. Differences were considered statistically significant at the 0.05 level; differences significant at the 0.01 level were also noted. Owing to the nature of the evaluation, interviewers could not be blinded.

Fieldwork was carried out between June 25 and September 5, 2006. A fuller description of the methods and findings can be found in Miller et al. [14].

### 3. Results

Trained and untrained TBAs did not differ significantly according to age, number of living children, education, or reported number of deliveries in the previous 6 months.

A 19-item knowledge test was administered to the trained TBAs before and after training, during the first follow-up, and during the interview for the present study; it was administered to the untrained TBAs only at the time of the study interviews. The average score of the trained TBAs prior to training was almost identical to the average for the untrained TBAs at the time of the OR interviews (i.e. slightly under 50%). The mean scores of the trained TBAs for all 3 tests post-training were substantially higher ( $P < 0.01$ ) than those of the untrained TBAs (Fig. 2). For each individual item, the trained TBAs scored significantly higher at the time of the OR interviews than did the untrained TBAs.

Comparisons regarding prenatal, delivery, postpartum, and neonatal care were available from TBA reports on usual practice and practice at last delivery, from patient reports on the last delivery, and (except for postpartum care) from skills tests. Comparisons on reported referrals were available from TBAs and patient reports. Skills tests had between 2 and 9 items for each test topic; these were scored as the average number of spontaneous correct responses per TBA for the topic.

On all skills tests (Table 1) and all but 1 individual item, the trained TBAs performed significantly better than the untrained TBAs, usually by wide margins. With regard to prenatal care, trained TBAs knew more about pregnancy danger signs and how to deal with them; had greater awareness of risk factors of pregnancy; and reported more prenatal visits (although patients reported no difference). They were more likely to refer for bleeding and to advise on tetanus immunization. Some key indicators are shown in Table 2.

Trained TBAs had cleaner delivery practices (Table 3). They had better hand-washing and other personal hygiene practices and greater use of clean delivery kits; were far less likely to perform pelvic examination without gloves; and were less likely to perform excessive numbers of such examinations. In addition, trained TBAs reported less use of uterotonics during the second stage of labor compared with untrained TBAs, although this was not generally substantiated by patients. Also, they understood placenta management better than untrained TBAs did and could name substantially more of the possible complications of labor.

With regard to postpartum care (Table 4), trained TBAs reported staying longer after childbirth compared with untrained TBAs, and visiting more often during the postpartum period both as a usual practice and after their last delivery. Patients, however, reported little difference. Both TBAs and patients indicated that few TBAs, trained or untrained, failed to visit at all during the postpartum period. Trained TBAs reported performing considerably more physical checks during postpartum visits and advising on many more topics; patients also reported better performance by the trained TBAs with regard to these topics. In addition, trained TBAs reported themselves to be much more likely to advise on family planning compared with

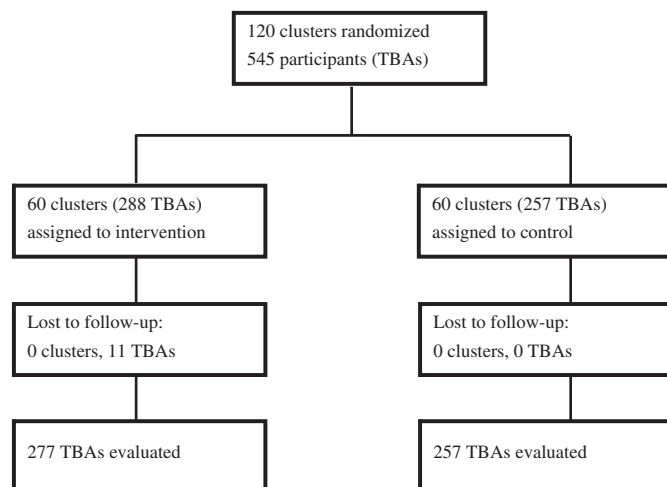
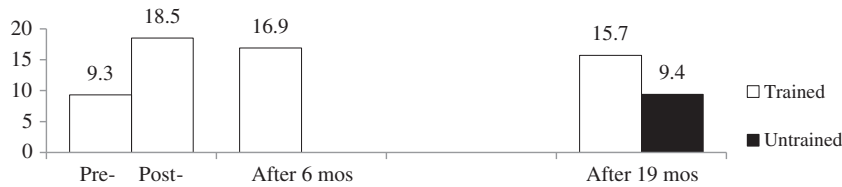


Fig. 1. Trial profile. Abbreviation: TBA, traditional birth attendant.



**Fig. 2.** Mean scores (of 19 items) on basic knowledge test of trained and untrained Traditional birth attendants (TBAs). There were 288 trained TBAs at pre-test and post-test, 193 at 6-months, and 274 at 19 months. There were 257 untrained TBAs.

untrained TBAs; patients agreed but reported lower levels of such advice. The few patients who adopted postpartum family planning were mostly patients of trained TBAs (data not shown).

Traditional birth attendants trained in the SMART curriculum performed better than those not trained with regard to nearly all aspects of neonatal care (Table 5). Trained TBAs were more likely than untrained ones to clean and examine each body part specifically and, because the skills test demonstrated that the trained TBAs were more likely to do so correctly, it is probable that trained TBAs would be considerably more likely to notice when something was wrong with a neonate.

Trained TBAs had far superior knowledge of birth asphyxia and reported much better practice, but the effectiveness of that practice could not be determined. The trained TBAs were more knowledgeable about how to keep the newborn warm and the need to delay the first bath. However, their self-reported better warming practice was not confirmed by the patients, and the difference in the timing of the first bath was not large. Immediate initiation of breastfeeding and avoidance of prelacteals was far more common among the patients of trained TBAs, according to both TBA and patient reports.

**Table 1**  
Average scores on skills tests.

Topic	No. of items	Trained TBAs		Untrained TBAs	
		No.	Average score	No.	Average score
Anemia check	4	275	1.75 <sup>a</sup>	255	0.72
Jaundice check	2	275	0.78 <sup>a</sup>	255	0.40
Abdominal checkup	5	273	1.90 <sup>a</sup>	253	0.98
Hand washing	6	266	3.10 <sup>a</sup>	249	0.63
Use of clean delivery kit	2	274	1.02 <sup>a</sup>	253	0.30
Cleaning of neonates	6	271	2.98 <sup>a</sup>	253	1.90
Examining of neonates	9	272	3.64 <sup>a</sup>	252	2.46

Abbreviation: TBA, traditional birth attendant.

<sup>a</sup>  $P < 0.01$ .

**Table 2**  
Selected indicators on prenatal care.

Indicator	Source	Trained TBAs		Untrained TBAs	
		No. (%)	No. (%)	No. (%)	No. (%)
TBA knows $\geq 3$ danger signs of pregnancy	TBA interviews	276 (92.0) <sup>a</sup>	256 (52.7)		
TBA knows $\geq 3$ risk factors of pregnancy	TBA interviews	277 (61.0) <sup>a</sup>	257 (7.4)		
TBA usually makes $\geq 3$ PNC visits	TBA interviews	276 (64.9) <sup>a</sup>	256 (41.0)		
Referred patients if bleeding last pregnancy	TBA interviews	51 (90.2) <sup>a</sup>	31 (67.7)		
TBA advised on TT (if patient didn't know)	Patient reports	248 (37.9) <sup>a</sup>	188 (14.3)		
TBA visited during prenatal period	Patient reports	252 (65.9) <sup>a</sup>	237 (52.7)		
$\geq 3$ TBA PNC visits last pregnancy	Patient reports	250 (34.8)	235 (34.5)		

Abbreviations: PNC, prenatal care; TBA, traditional birth attendant; TT, tetanus toxoid.

<sup>a</sup>  $P < 0.01$ .

To reduce maternal mortality, timely and appropriate referral is crucial. Trained TBAs referred approximately 40% more cases than did untrained TBAs (Table 6): a significant difference ( $0.01 < P < 0.05$ ). Trained TBAs referred 9.5% of deliveries, compared with 6.8% by untrained TBAs. According to both TBA (not significant) and patient ( $P < 0.05$ ) reports, patients of trained TBAs were more likely to be referred within 4 hours of labor initiation. To some degree, trained TBAs were also more likely to have arranged for money and transport compared with patients of untrained TBAs, resulting in a reduction in the time between making the decision to refer and initiation of travel. However, most of these differences were not significant and there were no differences in the time required to reach the hospital.

#### 4. Discussion

In general, the TBA reports indicated greater differences between trained and untrained TBAs than did the patient reports. Both TBA and patient reports have potential for error; TBAs were knowledgeable about what they did but may have been anxious to show themselves favorably (e.g. trained TBAs reporting that they actually did as they were trained), whereas patients were probably not biased regarding TBA training but may have been less knowledgeable about and aware of TBA activities, especially during delivery. When TBAs and patients disagreed, one could only speculate as to which sources of bias were operating. When TBAs and patients agreed, however, there was a strong inference that the reported differences were real.

Several of the ways in which trained TBAs were superior to untrained TBAs could lead to a substantial reduction in mortality. Trained TBAs knew more than untrained TBAs and had better skills, and there were indications that they used these tools to report more problems and refer more cases. They performed cleaner deliveries, used fewer uterotonics, and managed placentas better. They were

**Table 3**  
Selected indicators on delivery care.

Indicator	Source	Trained TBAs		Untrained TBAs	
		No. (%)	No. (%)	No. (%)	No. (%)
TBA knew of 3 stages of labor	TBA interviews	274 (70.1) <sup>a</sup>	253 (29.2)		
Could name $\geq 3$ complications of delivery	TBA interviews	275 (83.4) <sup>a</sup>	255 (52.1)		
Knew to breastfeed to expel placenta	TBA interviews	271 (32.1) <sup>a</sup>	245 (2.0)		
Washed hands at home before last delivery	TBA interviews	266 (50.0) <sup>a</sup>	245 (11.3)		
Used clean delivery kit in last delivery	Patient interviews	249 (43.9) <sup>a</sup>	236 (2.1)		
Did pelvic exam without gloves last delivery	TBA interviews	254 (18.1) <sup>a</sup>	249 (66.7)		
Did pelvic exam without gloves last delivery	Patient interviews	267 (52.2) <sup>a</sup>	250 (90.9)		
Gave $\geq 2$ injections last delivery	TBA interviews	254 (10.6) <sup>a</sup>	232 (22.4)		
Checked placenta in water last delivery	TBA interviews	263 (43.3) <sup>a</sup>	248 (1.6)		

Abbreviation: TBA, traditional birth attendant.

<sup>a</sup>  $P < 0.01$ .

**Table 4**  
Selected indicators on postpartum care from last delivery.

Indicator	TBA reports, No. (%)		Patient reports, No. (%)	
	Trained	Untrained	Trained	Untrained
Stayed $\geq 4$ (TBA) or $\geq 5$ (patient) hours	274 (32.8) <sup>a</sup>	254 (22.4)	248 (24.2)	236 (22.9)
Checked quantity of bleeding	262 (53.4) <sup>b</sup>	239 (22.6)	237 (19.0) <sup>b</sup>	221 (1.8)
Checked for anemia	262 (32.8) <sup>b</sup>	239 (4.2)	237 (4.6) <sup>a</sup>	221 (0.5)
Advised on diet (spontaneous)	263 (82.1) <sup>b</sup>	241 (47.7)	234 (42.3) <sup>b</sup>	221 (16.7)
Advised on family planning (probed)	275 (86.6) <sup>b</sup>	255 (44.7)	250 (20.0) <sup>b</sup>	237 (5.9)
Referred mother or infant post partum	277 (13.7) <sup>a</sup>	257 (7.8)	–	–

Abbreviation: TBA, traditional birth attendant.

<sup>a</sup> 0.01 < *P* < 0.05.<sup>b</sup> *P* < 0.01.

surprisingly effective in promoting immediate breastfeeding, were better at cleaning and examining neonates, and were more responsive to birth asphyxia. They referred more often, with perhaps an increased proportion of more dangerous cases being referred.

Although the practices of the trained TBAs were better than those of the untrained TBAs in important ways, they were still inadequate in many areas—some of which are of considerable importance. In particular, there is much room for improvement in the use of clean delivery kits, avoiding the use of uterotonics during the second stage of labor, and reducing pelvic examinations, especially without gloves.

In the overall evaluation of the SMART project [13], perinatal mortality decreased in the CBI areas by 22% (*P* < 0.05), with no reduction in the HSI areas. The proportion of births in the CBI area attended by the SMART Dais is unknown but substantial, and the present results indicate that the trained TBAs might have substantially reduced mortality rates associated with their deliveries. There was little effect of other interventions in the CBI area, so TBA training was probably the most important reason for the decrease. The improvements documented in the present evaluation, coupled with the proportion of births delivered by the trained TBAs, make this conclusion plausible.

The implications of the TBA training probably differ for mothers and newborns. For mothers, the essential requirement of the TBA is to identify complications accurately and refer quickly (although prevention of sepsis through clean delivery practice is also essential). For newborns, the most important contribution of the TBA is in implementing simple newborn care practices in the home [2]. The present study shows that TBA training can result in major improvements in both areas.

**Table 5**  
Selected indicators on neonatal care.

Indicator	TBA reports, No. (%)		Patient reports, No. (%)	
	Trained	Untrained	Trained	Untrained
TBA cleaned neonate with cotton or CDK	259 (49.4) <sup>a</sup>	244 (2.0)	243 (27.1) <sup>a</sup>	231 (2.6)
TBA cleaned eyes	262 (95.8) <sup>a</sup>	246 (76.0)	244 (76.6) <sup>a</sup>	231 (58.0)
Mouth-to-mouth if not breathing properly	–	–	57 (43.9)	70 (28.6)
TBA advised (client gave) breast milk first	273 (92.6) <sup>a</sup>	255 (42.5)	244 (53.6) <sup>a</sup>	235 (22.7)
Delayed first bath $\geq 6$ hours	260 (67.3) <sup>a</sup>	246 (43.5)	244 (50.0)	235 (40.9)
Cut cord with new blade	261 (97.7) <sup>b</sup>	245 (93.1)	246 (92.7)	235 (93.9)
Cut cord in 2 places	261 (79.3) <sup>a</sup>	245 (20.6)	246 (38.2) <sup>a</sup>	235 (12.9)

Abbreviations: CDK, clean delivery kit; TBA, traditional birth attendant.

<sup>a</sup> *P* < 0.01.<sup>b</sup> 0.01 < *P* < 0.05.**Table 6**  
Selected indicators on referral.

Indicator	TBA reports, No. (%)		Patient reports, No. (%)	
	Trained	Untrained	Trained	Untrained
Referral within 4 hours of labor onset	298 (16.8)	194 (11.9)	140 (25.0) <sup>a</sup>	108 (7.4)
Money arranged before delivery	298 (82.9)	194 (68.0)	161 (72.7)	111 (69.4)
Transport arranged before delivery	298 (65.8) <sup>a</sup>	193 (49.7)	161 (57.1)	111 (44.1)
Reached hospital within 60 minutes	296 (88.2)	193 (91.2)	159 (97.5)	113 (98.2)

Abbreviation: TBA, traditional birth attendant.

<sup>a</sup> 0.01 < *P* < 0.05.

Under the present circumstances in Pakistan, TBAs have important strengths; they are independent entrepreneurs rooted in their communities with great experience and trust. They could represent the best possible medium for health messages surrounding childbirth. Results from the SMART Dai training indicate that it may be easier in many ways to upgrade skills than to teach a new trainee from scratch. This training was replicated in the PAIMAN project, which was a major maternal and child health intervention in 10 districts in Pakistan, with apparent success but without a formal evaluation [15]. For the foreseeable future, finding complementarities between the new Community Midwife program and suitably trained TBAs will be essential. The SMART Dai training approach needs to be improved in some areas, linked with the formal health system, and tested rigorously in other settings. Continued exploration of this approach is strongly recommended.

## Acknowledgments

Funding for the SMART project was provided by the European Union. Funding for the Dai OR study was provided by the US Agency for International Development and the Population Council.

## Conflict of interest

The authors have no conflicts of interest.

## References

- [1] National Institute of Population Studies (Pakistan) and Macro International Inc. Pakistan Demographic and Health Survey 2006–07. Islamabad, Pakistan: National Institute of Population Studies and Macro International Inc.; 2008.
- [2] Darmstadt GL, Bhutta ZA, Cousens S, Adam T, Walker N, de Bernis L, et al. Evidence-based, cost-effective interventions: how many newborn babies can we save? *Lancet* 2005;365(9463):977–88.
- [3] Bang AT, Reddy HM, Deshmukh MD, Baitule SB, Bang RA. Neonatal and infant mortality in the ten years (1993 to 2003) of the Gadchiroli field trial: effect of home-based neonatal care. *J Perinatol* 2005;25(Suppl. 1):S92–S107.
- [4] National Maternal Newborn and Child Health (MNCH Program), Government of Pakistan, Ministry of Health, PC-1, 2006–12. November 2006.
- [5] Araujo G, Araujo L, Janowitz B, Wallace S, Potts M. Improving obstetric care in northeast Brazil. *Bull Pan Am Health Organ* 1983;17(3):233–42.
- [6] Alisjahbana A, Williams C, Dharmayanti R, Hermawan D, Kwast BE, Koblinsky M. An integrated village maternity service to improve referral patterns in a rural area in West-Java. *Int J Gynecol Obstet* 1995;48(Suppl.):S83–94.
- [7] Bang AT, Bang RA, Baitule SB, Reddy HM, Deshmukh MD. Management of birth asphyxia in home deliveries in rural Gadchiroli: the effect of two types of birth attendants and of resuscitating with mouth-to-mouth, tube-mask or bag-mask. *J Perinatol* 2005;25(Suppl.):S82–91.
- [8] Bergstrom S, Goodburn E. The Role of Traditional Birth Attendants in the Reduction of Maternal Mortality. In: de Brouwere V, Lerbergh VW, editors. *Safe Motherhood Strategies: a Review of the Evidence*. Studies in Health Services Organization and Policy 2001. Antwerp: ITG Press; 2001. p. 77–96.
- [9] Sibley LM, Sipe TA, Brown CM, Diallo MM, McNatt K, Habarta N. Traditional birth attendant training for improving health behaviours and pregnancy outcomes. *Cochrane Database Syst Rev* 2007(3):CD005460.
- [10] Jokhio AH, Winter HR, Cheng KK. An intervention involving traditional birth attendants and perinatal and maternal mortality in Pakistan. *N Engl J Med* 2005;352(20):2091–9.

- [11] Bhutta ZA, Memon AZ, Soofi S, Salat MS, Cousens S, Martines J. Implementing community-based perinatal care: results from a pilot study in rural Pakistan. *Bull World Health Organ* 2008;86(6):452–9.
- [12] Bhutta ZA, Soofi S, Cousens S, Mohammad S, Memon ZA, Ali I, et al. Improvement of perinatal and newborn care in rural Pakistan through community-based strategies: a cluster-randomised effectiveness trial. *Lancet* 2011;377(9763):403–12.
- [13] Rashida G, Miller PC. *Safe Motherhood Applied Research and Training: Project Overview*. Pakistan: Population Council; 2007.
- [14] Miller PC, Rashida G, Wajid A, Tasneem Z, Manmood L, ul Haque M. *Effect of Dai Training on Maternal and Neonatal Care: an Operations Research Study*. Pakistan: Population Council; 2010.
- [15] Mahmood A. *Improving Maternal and Neonatal Health: Measuring the Impact of PAIMAN Project in Ten Districts in Pakistan*. Islamabad: JSI Research and Training Institute; 2010.