Time to focus child survival programmes on the newborn: assessment of levels and causes of infant mortality in rural Pakistan

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Objective Population-based surveys were conducted in selected clusters of Pakistan's least developed provinces, Balochistan and North-West Frontier Province (NWFP), including the Federally Administered Tribal Areas (FATA), to assess levels and causes of neonatal and postneonatal mortality.

Methods Interviews were conducted in a total of 54 834 households: Balochistan, 20 486; NWFP, 26 175; and FATA, 8173. Trained interviewers administered questionnaires after obtaining verbal informed consent from the respondents. Verbal autopsy interviews were conducted for infant deaths reported for the previous year.

Findings The infant mortality rate based on combined data from the different sites was 99.7 per 1000 live births (range 129.0–70.1). The contribution of neonatal deaths to all infant deaths was much higher for NWFP (67.2%), where the overall rate was lowest, than for Balochistan (50.8%) and FATA (56.8%). Around 70% of all neonatal deaths occurred in the early neonatal period. The three main clinical causes of infant deaths were diarrhoea syndrome (21.6%), tetanus (11.7%) and acute respiratory infections (11.6%). In the neonatal period, however, tetanus (18.3%), small size for gestational age or low birth weight (15.3%), and birth injury (12.0%) accounted for nearly half (45.6%) of all deaths, while the contributions of diarrhoea syndrome (5.1%) and acute respiratory infections (6.0%) were less significant (11.1%). Tetanus was the cause of death for 21.7% and 17.1% of all infant deaths in FATA and NWFP respectively.

Conclusion The results suggest that there should be a shift in child survival programmes to give greater emphasis to maternal and neonatal health, in particular to maternal tetanus immunization, safe delivery and cord care.

Keywords Infant, Newborn; Infant mortality; Cause of death; Rural population; Sampling studies; Pakistan (*source: MeSH, NLM*).

Mots clés Nouveau-né; Mortalité nourrisson; Cause décès; Population rurale; Etude échantillon; Pakistan (*source: MeSH, INSERM*).

Palabras clave Recién nacido; Mortalidad infantil; Causa de muerte; Población rural; Muestreo; Pakistán (*fuente: DeCS, BIREME*).

Introduction

The introduction of child survival interventions, immunization and oral rehydration among others, has resulted in a sustained decline of infant and child mortality in much of the developing world. One consequence of this decline is that an increasing proportion of infant deaths occurs during the neonatal period. However, there is limited epidemiological information on levels and clinical causes of neonatal and postneonatal deaths from developing countries, although such information is readily available for developed countries.

Infant mortality is the sum of neonatal mortality and postneonatal mortality. However, the clinical causes and determinants, and consequently the preventive public health strategies, for these two phases of infant life differ considerably. Neonatal deaths are generally associated with elements linked to maternal care during pregnancy and delivery, while socioenvironmental factors become more important determinants of infant survival during the postneonatal period. It is estimated that neonatal deaths can account for nearly 50–60% of all infant deaths in developing countries (*1*). Approximately 30–40% of all neonatal deaths are explained by neonatal infections, amounting to approximately 1.5–2 million neonatal deaths per year (*2*). WHO has estimated that approximately 400 000 cases of neonatal tetanus occur annually, the vast majority in a limited number of developing countries, resulting in an annual toll of 340 000 neonatal tetanus deaths (*3*).

Risk factors for neonatal tetanus in developing countries largely relate to lack of immunization of mothers with tetanus toxoid, unhygienic delivery, and unhygienic cord care during the first week of life. Unhygienic cord care may include practices such as the application of ghee to the umbilical cord and bundling of the neonate for prolonged periods in a sheepskin after applying dried cow dung to the lower abdomen (*4, 5*). Maternal tetanus toxoid coverage (two or more doses) in Pakistan has been reported as 23.3% (*6*); in the more conservative rural areas, where nearly all deliveries occur at home, it will be much lower.

This study was conducted to determine the levels and clinical causes of infant, neonatal and postneonatal mortality,

highlighting the role of neonatal tetanus and concomitant implications for preventive strategies.

Materials and methods

Population-based surveys were conducted in selected sites in the provinces of Balochistan (Pishin, Loralai, Lasbela and Khuzdar; for security reasons, two subdistricts of the Pishin district were excluded from the sampling frame), and the North-West Frontier Province (NWFP) (Dera Ismail Khan, Peshawar and Hazara), including the Federally Administered Tribal Areas (FATA; for security reasons, village clusters were selected in the FATA division of NWFP), to collect information on the level and clinical causes of maternal and infant mortality and their associated risk factors. We conducted the field work during 1990–91 in Balochistan, 1991–93 in NWFP and 1994 in FATA. These regions were selected as they reflect various levels of socioeconomic development, accessibility and availability of health care personnel. However, they are all largely rural and have a poorly developed health services infrastructure, in particular in terms of obstetric and neonatal care. More than 90% of births occur at home, with the assistance of traditional birth attendants or family members (7). Women have limited access to adequate health and family planning services, and fertility, and maternal and neonatal mortality are high.

The sampling technique comprised a simple random cluster sample in each district. Samples of 10–15 village clusters, each with an average of 200 households, were randomly selected. Interviews were conducted in all households in each cluster giving a total of 54 834 households: Balochistan, 20 486; NWFP, 26 175; and FATA, 8173. The Human Subjects Protection Committee, Aga Khan University, reviewed and approved the study design and verbal informed consent guidelines.

The data gathering procedures were similar in the three regions. Following enumeration of all households in the selected cluster, trained interviewers obtained verbal consent from the respondents and then conducted two rounds of interviews. For the first round, pre-coded questionnaires were administered to all households to elicit information on deaths of household members in the five years preceding the survey, household composition and selected socioeconomic factors. For each death reported, the age and sex of the deceased were obtained. The primary respondent was usually the wife of the head of the household. The second round of interviews was conducted on ever-married women aged 15–49 years who were current residents of the sampled households, using a comprehensive questionnaire designed to obtain demographic information, a detailed history of pregnancies in the preceding five-years, and information on intrapartum care and current contraceptive use.

Reported deaths of infants in the previous year were investigated further through verbal autopsy interviews. Health personnel (female employees of the provincial health department) who had been extensively trained in the administration of the questionnaire used conducted these interviews shortly after the first round. Verbal informed consent was obtained prior to the interviews, which were generally conducted with the mother. Where possible, additional information was obtained from other relatives. Of the 1532 verbal autopsy questionnaires administered, 391 were excluded from the

analysis because they were incomplete (Balochistan, 285; NWFP, 68; and FATA, 4) or proper identification was lacking (Balochistan, 20; NWFP, 12; and FATA, 2). The verbal autopsy tool had five parts: identifying information, verbatim open-ended history (which was not included in the Balochistan questionnaire), care-seeking behaviour for the fatal illness, screening questions directed to syndrome modules, and eight or nine syndrome modules targeting common causes of death among infants. The interview therefore contained detailed questions on age at death, time and place of death, and major symptoms and signs during the fatal illness. A paediatrician and a general physician independently reviewed the completed questionnaires to determine the probable cause of death. In case of disagreement between the two reviewers, the cause of death was designated as unknown.

The calculation of mortality rates was based on infant deaths and live births recorded for the previous year only. Similarly, the clinical causes of infant deaths were restricted to those identified in the previous year. For example, a classification of birth asphyxia was based on reported signs and symptoms including date of death (under 7 days), type of delivery (breech, prolonged labour), poor suck, weak cry, etc. A classification of acute respiratory infection was based on cough, difficult or rapid breathing, chest indrawing, etc.; and a designation of birth injuries was based on visible defects. Subsequent to the classification, several of the categories were consolidated. For example, diarrhoea syndrome includes acute watery diarrhoea, dysentery and persistent diarrhoea.

Results

The neonatal, postneonatal and infant mortality rates for the study areas are shown in Fig. 1. The overall rate combining the data from the different sites was 99.7 per 1000 live births (1532/15 360), ranging from 129.0 per 1000 live births (827/6410) for Balochistan to 70.1 per 1000 live births (478/6816) for NWFP. Similar variations in the range of neonatal and postneonatal mortality rates were observed for the three regions, although the contribution of neonatal deaths to all infant deaths was much higher for NWFP (67.2%), where the overall infant mortality rate was the lowest, than in Balochistan (50.8%) or FATA (56.8%). Specifically, there were 420, 321 and 129 neonatal and 407, 157 and 98 postneonatal deaths reported from Balochistan, NWFP and FATA respectively.

Table 1 illustrates the major causes of infant, neonatal and postneonatal death as assessed from verbal autopsy reports. The three main causes of infant deaths were diarrhoea syndrome (21.6%), tetanus (11.7%) and acute respiratory infections (11.6%). However, maternal health consequences during pregnancy and delivery were significant contributors to neonatal deaths. Tetanus (18.3%), small size for gestational age or low birth weight (15.3%), and birth injury (12.0%) accounted for nearly half (45.6%) of all these deaths, while the contributions of diarrhoea syndrome (5.1%) and acute respiratory infections (6.0%) were less significant (11.1%). During the postneonatal period, infectious diseases dominated as the leading cause of mortality; diarrhoea syndrome accounted for the largest number of deaths (43.3%) followed by acute respiratory infections (18.9%).

Examining the clinical causes of infant deaths by geographical location (Table 2), it is important to note that, for Balochistan, diarrhoea syndrome (25.1%) and acute

Fig. 1. **Infant, neonatal, and postnatal mortality rates by site, Balochistan and North-West Frontier Province (NWFP), including Federally Administrated Tribal Areas (FATA), Pakistan 1990–94**

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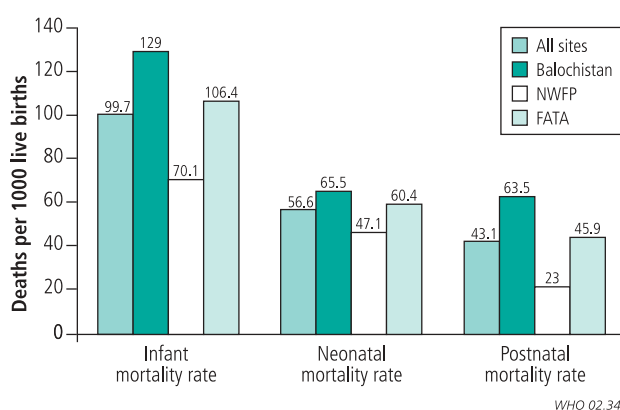
respiratory infections (11.9%) together contributed some 37% of all infant deaths with maternal health consequences during pregnancy and delivery contributing significantly less (15.6%). In NWFP and FATA, however, maternal health consequences during pregnancy and delivery were the major contributors to infant mortality at 40.2% and 37.0%, respectively. Despite the variations, diarrhoea syndrome was one of the two main causes of infant deaths in all three regions: Balochistan, 25.1%; NWFP, 17.8%; and FATA, 19.9%. The contributions of acute respiratory infections to all infant deaths were 11.9%, 8.5% and

16.3%, respectively. Tetanus was the cause of death for 21.7% and 17.1% of all infant deaths in FATA and NWFP, respectively; considerably fewer tetanus deaths were reported for Balochistan (3.3%). In the neonatal period, tetanus contributed only 5.0% to all clinical causes of neonatal deaths in Balochistan but was the predominant cause of neonatal deaths in NWFP (23.0%) and FATA (36.2%).

Similarly, the proportionate infant mortality rate (cause) for Balochistan is skewed to diarrhoea syndrome (20.4 per 1000 live births) and acute respiratory infections (9.7 per 1000 live births). In NWFP and FATA, however, tetanus contributed a larger proportion, 10.0 and 22.5 per 1000 live births, respectively (Table 3).

Although sex differences were observed in the infant mortality rates (males 105.2 and females 94.0 per 1000 live births), with respect to the cause of death there were few major differences. Tetanus contributed 12.4% and 10.8% of all male and female infant deaths respectively; for small size for gestational age and low birth weight, there were fewer deaths reported among male (8.3%) than among female infants (11.3%) (data not shown, available on request).

Discussion

Our results illustrate that as infant mortality decreases the proportion of neonatal deaths rises. For the reported infant mortality rates of 129.0 (Balochistan), 106.4 (FATA) and 70.1 (NWFP) per 1000 live births, the corresponding proportions of neonatal mortality were 50.8%, 56.8% and 67.2%. For all

Table 1. Clinical causes of neonatal, postneonatal and infant deaths in Balochistan and North-West Frontier Province (NWFP), including Federally Administered Tribal Areas (FATA), Pakistan 1990–94

Clinical cause	All infants		Neonatal period		Postneonatal period	
	No.	%	No.	%	No.	%
Diarrhoea syndrome[a]	246	21.6	33	5.1	213	43.3
Tetanus	133	11.7	119	18.3	14	2.8
ARI	132	11.6	39	6.0	93	18.9
SGA/LBW	111	9.7	99	15.3	12	2.4
Birth injury/asphyxia	79	6.9	78	12.0	1	0.2
Congenital anomaly	33	2.9	23	3.5	10	2.0
Sepsis	25	2.2	20	3.1	5	1.0
Prematurity	25	2.2	25	3.9	0	0.0
Cyanosis	22	1.9	21	3.2	1	0.2
Meningitis[b]	19	1.7	11	1.7	8	1.6
Breathing syndrome[c]	19	1.7	13	2.0	6	1.2
Others[d]	48	4.2	16	2.5	32	6.5
Unknown	249	21.8	152	23.3	97	19.7
Total deaths[e]	1141	100.0	649	100.0	492	100.0

ARI = acute respiratory infection; LBW = low birth weight; SGA = small size for gestational age.

[a] Acute watery diarrhoea, dysentery and persistent diarrhoea.

[b] Brain infection + meningitis.

[c] Asphyxiation, suffocation, noisy breathing and breathing problems.

[d] Malnutrition including wasting, pertussis, seizure disorders, fits and convulsions, measles, epidermolysis bullosa, rashes, skin eruptions and chicken pox, electric shock, jaundice, hypothermia, snake bite, fever, powdered milk/aspiration of food.

[e] Verbal autopsy interview questionnaires for 391 infants (221 neonates; 170 post-neonates) were excluded owing to incomplete information or lack of proper identification coding.

Table 2. Clinical cause of infant deaths, by site, in Balochistan and North-West Frontier Province (NFWP), including Federally Administered Tribal Areas (FATA), Pakistan 1990–94

Clinical cause	Balochistan		NWFP		FATA	
	No.	%	No.	%	No.	%
Diarrhoea syndrome[a]	131	25.1	71	17.8	44	19.9
ARI	62	11.9	34	8.5	36	16.3
SGA/LBW	40	7.7	59	14.8	12	5.4
Birth injury/asphyxia	24	4.6	33	8.3	22	9.9
Cyanosis	22	4.2	0	0.0	0	0.0
Sepsis	20	3.8	2	0.5	3	1.4
Tetanus	17	3.3	68	17.1	48	21.7
Breathing syndrome[b]	14	2.7	0	0.0	5	2.3
Congenital anomaly	11	2.1	15	3.8	7	3.2
Others[c]	30	5.7	44	11.1	18	8.1
Unknown	151	28.9	72	18.1	26	11.8
Total deaths[d]	522	100.0	398	100.0	221	100.0

ARI = acute respiratory infection; LBW = low birth weight; SGA = small size for gestational age.
For footnotes a, b, c, d, see Table 1, footnotes a, c, d, e, respectively.

three sites this was within or slightly above the reported range for developing countries of 50–60% of all infant deaths (1).

Concern has been expressed regarding use of the verbal autopsy method to identify clinical cause of death. The verbal autopsy is an epidemiological tool that is being widely used to ascribe clinical causes of death by interviewing bereaved relatives of children who were, by and large, not under medical supervision at the time of death. In most developing countries, where a large proportion of infant deaths occurs at home, the verbal autopsy approach can provide valuable insights into the common causes of infant deaths (8–11). However, its limitations, such as less-than perfect sensitivity and specificity should be taken into consideration, although recent studies have demonstrated that, for such conditions as neonatal tetanus, measles, malnutrition and trauma-related injuries, the sensitivity (greater than 75%) and specificity (greater than 80%) were high (12). The verbal autopsy tool used in the three sites in this study had not been validated when it was administered, although subsequent validation of a revised version indicated a sensitivity (verbatim and syndrome sections combined) ranging from 42% for low birth weight to 84% for neonatal tetanus (13).

Another limitation of our study is the large number of deaths classified as being of unknown cause, representing approximately 20% of all cases for which a completed verbal autopsy form was available. Moreover, the proportion of unknowns was higher in Balochistan (28.9%) than in NWFP (18.1%) or FATA (11.8%), just as there was a larger number of incomplete forms from Balochistan compared to the other two regions. However, the proportions of unknowns in the neonatal and postneonatal periods were similar. It is likely that the cause of death for many of the unknowns would have been in the "others" category rather than the more common categories such as diarrhoea, acute respiratory infections or neonatal tetanus. If so, their influence on the distribution of the most common causes of death would not have been

significant. Alternatively, the unknowns might have been equally distributed among the most common causes of death, which would have resulted in increased contributions of the most common causes but no change in their ranking.

While diarrhoea syndrome (21.6%), tetanus (11.7%) and acute respiratory infections (11.6%) together contribute to nearly 45% of infant deaths in the three sites, the significant contribution of neonatal tetanus to infant deaths in NWFP (17.1%) and FATA (21.7%) strongly supports a significant shift in child survival programmes to give greater emphasis to maternal and neonatal care. The maternal tetanus toxoid coverage (two or more doses) reported in the Pakistan Demographic and Health Survey for 1990–91 (4) was 23.3%. We believe, however, that coverage at the study sites was much lower, as nearly 90% of all births in these conservative societies occurred at home with minimal contact with the formal public health system (7). In addition, cultural cord-care practices, including application of ghee to the raw stump and bundling for warmth and strength, which are reported to be common in the northern areas of Pakistan, have been shown to contribute to neonatal tetanus (5, 6). Furthermore, nearly 71.1% of all neonatal deaths occurred in the early neonatal period, with small size for gestational age or low birth weight (17.7%), birth injury (15.8%) and neonatal tetanus (13.6%) contributing to nearly half of these deaths. To achieve a reduction in neonatal mortality in these regions a two-pronged public health strategy aimed at mothers and the newborn is needed, with maternal tetanus immunization as part of routine antenatal care, safe delivery, and neonatal care (specifically cord care). Tetanus toxoid immunization should not be restricted to the antenatal care package; it should be available to women at any point of contact with the health delivery system, including well baby and family planning clinics.

In the postneonatal period, diseases of infectious etiology (diarrhoea and acute respiratory infections) were the leading clinical causes of death accounting for nearly

Table 3. Proportionate infant mortality rates (IMR) (cause), by site, in Balochistan and North-West Frontier Province (NFWP), including Federally Administered Tribal Areas (FATA), Pakistan 1990–94

Clinical cause	Balochistan No.	Balochistan IMR	NWFP No.	NWFP IMR	FATA No.	FATA IMR
Diarrhoea syndrome[a]	131	20.4	71	10.4	44	20.6
ARI	62	9.7	34	5.0	36	16.9
SGA/LBW	40	6.2	59	8.7	12	5.6
Birth injury/asphyxia	24	3.7	33	4.8	22	10.3
Cyanosis	22	3.4	0	0.0	0	0.0
Sepsis	20	3.1	2	0.3	3	1.4
Tetanus	17	2.7	68	10.0	48	22.5
Breathing syndrome[b]	14	2.2	0	0.0	5	2.3
Congenital anomaly	11	1.7	15	2.2	7	3.3
Others[c]	30	4.7	44	6.5	18	8.4
Unknown	151	23.6	72	10.6	26	12.2
Total deaths[d]	522	81.4	398	58.4	221	103.6
Total live births	6410		6816		2134	

ARI = acute respiratory infection; LBW = low birth weight; SGA = small size for gestational age.
For footnotes a, b, c, d, see Table 1, footnotes a, c, d, e, respectively.

62.2% of all postneonatal deaths in the three study sites. Similar findings have been documented in other developing countries (14, 15). Child survival intervention programmes in Pakistan must therefore maintain and strengthen their strategies for prevention and control of these infections. This is especially crucial in Balochistan, where they make a substantial contribution (37%) to the high infant mortality rate of 129.0 per 1000 live births.

On the basis of our findings in all three regions, but specifically in NWFP and FATA, we recommend a focus on strategies aimed at reducing neonatal mortality by improving maternal and neonatal health. The Government of Pakistan is making efforts to increase the provision of skilled birth attendants (health care professionals with midwifery skills). However, adequate coverage in the near future is unlikely, especially for the rural areas of Balochistan, NWFP and FATA where there are cultural barriers to health-seeking behaviour for pregnant women. Provision of maternal tetanus toxoid immunization is therefore currently the only effective, operationally feasible intervention against neonatal tetanus. Appropriate tetanus toxoid immunization strategies should be evolved to increase coverage by improving access, increasing awareness of the potential benefits of tetanus toxoid immunization to women in the reproductive age group and disseminating information to ensure that all women in these traditional societies can obtain immunization. In the immediate future, most deliveries in these areas will continue to be at home, largely assisted by relatives or traditional birth attendants. Birth attendants should therefore be appropriately trained in safe delivery and cord care. Finally, the current child survival strategies for reduction of diarrhoeal and acute respiratory infections should be strengthened. ■

Acknowledgements

Conflicts of interest: none declared.

Résumé

Le moment est venu d'axer les programmes de survie de l'enfant sur les nouveau-nés : évaluation des taux et des causes de mortalité infantile dans des zones rurales du Pakistan

Objectif Des sondages par grappes ont été réalisés parmi la population des provinces les moins développées du Pakistan, le Béloutchistan et la province de la frontière du Nord-Ouest (NWFP), y compris les zones tribales sous administration fédérale (FATA), pour évaluer les taux et les causes de mortalité néonatale et post-néonatale.

Méthodes Des entretiens ont été conduits dans 54 834 ménages : 20 486 au Béloutchistan, 26 175 dans la NWFP et 8173 dans les FATA. Des enquêteurs expérimentés ont administré les questionnaires après avoir obtenu verbalement le consentement informé des intéressés. Des autopsies verbales ont été réalisées pour les décès de nourrissons rapportés au cours de l'année précédente.

Résultats Le taux de mortalité infantile calculé d'après les données regroupées des différents sites était de 99,7 pour 1000 naissances vivantes (intervalle : 129,0-70,1). La contribution des décès néonatals à l'ensemble des décès infantiles était beaucoup plus élevée dans la NWFP (67,2 %), qui avait le taux global le plus bas, qu'au Baloutchistan (50,8 %) et dans les FATA (56,8 %). Environ 70 % de l'ensemble des décès néonatals survenaient au début de la période néonatale. Les trois principales causes cliniques de décès infantiles étaient le syndrome diarrhéique (21,6 %), le tétanos (11,7 %) et les infections respiratoires aiguës (11,6 %). Pendant la période néonatale, en revanche, le tétanos (18,3 %), la petite taille pour l'âge gestationnel ou le faible poids de naissance (15,3 %) et les traumatismes à la naissance (12,0 %) représentaient près de la moitié (45,6 %) de tous les décès, tandis que la contribution du syndrome diarrhéique (5,1 %) et des infections respiratoires aiguës (6,0 %) était moins importante (11,1 %). Le tétanos était responsable de 21,7 % de l'ensemble des décès infantiles dans les FATA et 17,1 % dans la NWFP.

Conclusion D'après les résultats, les programmes de survie de l'enfant devraient être davantage axés sur la santé maternelle et néonatale, et en particulier sur la vaccination antitétanique des femmes enceintes, la sécurité des accouchements et les soins du cordon ombilical.

Resumen

Es hora de centrar los programas de supervivencia infantil en el recién nacido: evaluación de los niveles y las causas de mortalidad de lactantes en el Pakistán rural

Objetivo Se llevaron a cabo encuestas poblacionales por aglomerados en las provincias menos desarrolladas del Pakistán, el Baluchistán y la Provincia de la Frontera Noroccidental (NWFP), incluidas las Áreas Tribales bajo Administración Federal (FATA), a fin de evaluar los niveles y causas de la mortalidad neonatal y posneonatal.

Métodos Se realizaron entrevistas en 54 834 hogares: Baluchistán, 20 486; NWFP, 26 175; y FATA, 8173. Entrevistadores cualificados sometieron a cuestionarios a los encuestados tras obtener verbalmente su consentimiento informado. Cuando se declaraban defunciones de lactantes registradas el año anterior, se hacía una entrevista de autopsia verbal.

Resultados La tasa de mortalidad de lactantes obtenida al combinar los datos de los distintos sitios fue de 99,7 por 1000 nacidos vivos (intervalo: 129,0–70,1). La contribución de la mortalidad neonatal al total de defunciones de lactantes fue mucho mayor en la provincia NWFP (67,2%), donde la tasa global fue en cambio la más baja, que en el Baluchistán (50,8%) y las FATA (56,8%). En torno al 70% de todas las defunciones neonatales se produjeron al comienzo del periodo neonatal. Las tres causas clínicas principales de defunción de lactantes fueron síndromes diarreicos (21,6%), tétanos (11,7%) e infecciones respiratorias agudas (11,6%). En el periodo neonatal, sin embargo, el tétanos (18,3%), el tamaño pequeño para la edad gestacional o el bajo peso al nacer (15,3%), y los traumatismos del nacimiento (12,0%) representaron casi la mitad (45,6%) de todas las defunciones, mientras que las contribuciones del síndrome diarreico (5,1%) y de las infecciones respiratorias agudas (6,0%) fueron menos importantes (11,1%). El tétanos fue la causa del 21,7% y el 17,1% de la mortalidad global de lactantes registrada en las FATA y la provincia noroccidental, respectivamente.

Conclusión Los resultados llevan a pensar que es necesario reorientar los programas de supervivencia infantil para hacer más hincapié en la salud materna y neonatal, sobre todo en la inmunización de las madres contra el tétanos, el parto sin riesgo y la higiene del cordón umbilical.

References

1. Perera T. Perinatal morbidity and mortality trends in South-East Asia. Proceedings of the ASEAN Pediatric Federation Workshop on Perinatal Morbidity and Mortality, Kuala Lumpur, 6–7 June 1982. In: Abdul Kadir H, editor. *ASEAN perinatal health issues.* Kuala Lumpur: ASEAN Pediatric Federation; 1983.

2. *Perinatal mortality: a listing of available information.* Geneva: World Health Organization; 1996. Unpublished document WHO/FRH/MSM/96.7.

3. *Eliminating neonatal tetanus: How near, how far?* Geneva: World Health Organization; 1996. Unpublished document WHO/EPI/GEN/96.01.

4. *Pakistan Demographic and Health Survey 1990-91.* Islamabad: National Institute of Population Studies; and Columbia MD: IRD/Macro International; 1992.

5. Bennett J, Azhar N, Rahim F, Kamil S, Traverso H, Killgore G, et al. Further observations on ghee as a risk factor for neonatal tetanus. *International Journal of Epidemiology* 1995;24:643-7.

6. Bennett J, Schooley M, Traverso H, Agha SB, Boring J. Bundling, a newly identified risk factor for neonatal tetanus: implications for global control. *International Journal of Epidemiology* 1996;25:879-84.

7. Fikree FF, Midhet F, Sadruddin S, Berendes HW. Maternal mortality in different Pakistani sites: ratios, clinical causes and determinants. *Acta Obstetrica Gynecologica* 1997;76:637-45.

8. Fantahun M. Patterns of childhood mortality in three districts of north Gondar Administrative Zone. A community based study using the verbal autopsy method. *Ethiopian Medical Journal* 1998;36:71-81.

9. Awasthi S, Pande VK. Cause-specific mortality in under fives in the urban slums of Lucknow, north India. *Journal of Tropical Pediatrics* 1998;44:358-61.

10. Baqui AH, Black RE, Arifeen SE, Hill K, Mitra SN, Al Sabir A. Causes of childhood deaths in Bangladesh: results of a nationwide verbal autopsy study. *Bulletin of the World Health Organization* 1998;76:161-71.

11. Anker M. The effect of misclassification error on reported cause-specific mortality fractions from verbal autopsy. *International Journal of Epidemiology* 1997;26:1090-6.

12. Snow RW, Armstrong JRM, Forster D, Winstanley MT, Marsh VM, Newton CRJ, et al. Childhood deaths in Africa: uses and limitations of verbal autopsies. *Lancet* 1992;340:351-5.

13. Marsh DR, Sadruddin S, Fikree FF, Krishnan C, Darmstadt GL. *Validation of verbal autopsy to determine the cause of 137 neonatal deaths in Karachi, Pakistan;* 2001. Unpublished document.

14. Bhatia S. Patterns and causes of neonatal and postneonatal mortality in rural Bangladesh. *Studies in Family Planning* 1989;20:136-46.

15. Chen LC, Rahman M, Sarder AM. Epidemiology and causes of death among children in rural areas of Bangladesh. *International Journal of Epidemiology* 1980;9:25-33.