Review Article

Perinatal and Child Mortality, Under-Nutrition and Cerebral Palsy: A Cross Sectional Survey in Rural Bangladesh

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Bangladesh has achieved commendable progress in alleviation of poverty in recent years and, in association, the overall nutritional status of mothers and children has improved, and child mortality has fallen [1,2]. According to the regular Bangladesh Demographic and Health Surveys, the Stillbirth Rate (SBR) fell from 37 per 1000 pregnancies in 2004 to 21 in 2014 [3], and the Perinatal Mortality Rate (PMR) fell from 65 deaths per 1000 pregnancies in 2000 to 44 in 2014. And from 1994 to 2014, for every 1000 live births, the Neonatal Mortality Rate (NMR) fell from 52 to 28, the Infant Mortality Rate from 87 to 38, and the <5 year Child Mortality Rate from 133 to 46. While BDHS provide information from many regions, they do not provide specific data from the far north of Mymensingh District where two non-government agencies, Symbiosis International and the Mennonite Central Committee, have, for many years, been involved in developmental projects. In November 2018, in order to review their progress and to plan for the future, these organisations surveyed indices of child and maternal health, and related socio-economic factors, in 25 sites in that region. This paper reviews aspects of morbidity and mortality of children in those sites and compares them with BDHS and other sources. In other reports we examine anthropometry of children and factors relating to maternal health.

Methods

Over two consecutive weeks in November 2018 surveys were performed in 25 sites in and around the administrative centres of Haluaghat and Dhobaura, and the main obstetric facility, Joyramkura Hospital. Cross -sectional data was collected by two teams of Bangladeshi and Australian NGO workers, and senior medical students from Western Sydney University, under the supervision of an Australian general practitioner experienced in rural, remote and indigenous medicine, and the Professor of Paediatrics from Western Sydney University. Data was recorded on paper, transcribed to a computer, and later analysed with reference to WHO standards. Anthropometric data was gained by specially constructed stadiometers with fixed metal measuring 'tapes' and with portable weighing machines which were carried, along with other equipment, into the various villages. Anthropometric data of age, heights and weights was reported as Height Per Age (HAZ), Weight Per Age (WAZ) and Weight For Height (WHZ), and expressed as Standard Deviations (SD) from the mean of the reference population in accordance with World Health Organisation practice [4,5]. Moderate disturbances of anthropometry are defined as greater or less than 2SD from the mean: severe from 3SD. Reduced HAZ ratios denote the presence and degree of 'stunting', mostly due to chronic under-nutrition and or disease. Reduced WHZ suggests 'wasting' from acute malnutrition or disease, and reduced WAZ suggests 'marasmus' associated with acute or chronic loss of weight. SBR is defined as death of a foetus equal to or after 28 weeks of gestation. PMR is defined as the total of Stillbirths and Deaths in the first week of life per 1000 pregnancies. NMR is the number of deaths in the first month of life per 1000 live births. IMR is the number of deaths in the first year of life per 1000 live births. Under 5 CMR is the number of children dying <5 years of age per 1000 live births.No verbal post-mortem assessment of cause of death was undertaken: the mother's simple explanation was accepted. Nor were undertaken any detailed histories of children suffering from chronic disease. Major clinical features were classified and some children were referred for further investigation at Joyramkura Hospital. Those with cardiac abnormalities confirmed by echocardiography were referred to higher centres.

Statistics

Data was cleansed and imported into a relational database enabling cross correlating queries to be executed. WHO anthropometric factors of Height Vs Age (HAZ), Weight Vs Age (WAZ), Weight Vs Height (WHZ) were calculated using the WHO published mathematical algorithms [6]. Outliers were identified according to WHO statements of limits and discarded as per WHO stated process. Data was converted to Z Scores and expressed as the Standard Deviation (SD)

from the mean of the WHO reference standard population for both male and female [7]. Continuous unpaired data was analysed using zTest,. Count data was analysed using Chi-Squared Best Fit assuming equal proportions and trend data analysed using Chi-Squared Tend Analysis. Correlations were performed using Pearson's correlation. In all tests sample size was > 30 and the null hypothesis rejected for results > 95% confidence, resultant P-Values are reported. We perform all comparisons against the combined male-female scores, unless otherwise stated. We used Minitab Express for all statistical analysis.

Ethics

The surveys were approved by governance of both Symbiosis International and Mennonite Central Committees as quality assurance of current programmes and preparation for future activity. Representatives of those NGOs visited the sites in advance, explained the aims and the process, and invited participation. Mothers and their children attended voluntarily. Data was de-identified for analysis but a list was kept in confidence in case of need to contact the parents eg with regard to medical concerns.

Results

Surveys were held in 25 sites, and included 2987 children and 1982 mothers.

Anthropometry

Growth restriction was revealed to be a major problem. In summary, and with regard to combined sexes of children <5 years of age, 36.2% were moderately stunted (HAZ <-2SD) and 14.6% severely stunted (<-3SD). 32.5% were moderately (WAZ <-2SD) and 10.4% were severely underweight (<-3SD). 15.8% were moderately (WHZ<-2SD) and 6.5% were severely wasted (<-3SD). Similar restriction was found in children aged from 5–14 years: 25.6% were moderately (HAZ <-2SD) and 6.5% were severely stunted (<-3SD). 29.4% were moderately (WAZ<-2SD) and 10.7% were severely underweight (<-3SD). Growth restriction was also common in mothers, of whom 15.3% were stunted. That this rate increased to 25.6% in children 5–14, and then to 36.2% in those <5 years, suggests stunting is increasing in recent years.

Mortality

Of 4408 live births, 93 died in the first week of life, 122 within the first month, 199 in the first year, and 275 within the first five years of life. These statistics suggest a PMR of 109.0, and an NMR of 27.7, IMR of 17.5, and an <5 CMR of 62.4. These live born deaths had been preceded by 435 stillbirths, giving an SBR of 89.8. No data was collected on the sex of the deceased. Thus, the SBR in our surveyed sites would appear to be almost four times greater than the national average (89.8 vs 21), the PMR to be over twice the national rate (109 vs 44), the NMR similar to that rate (27.7 vs 28), the IMR half that rate (17.5 vs 38) and the CMR one and half times greater than the national rate (62.4 vs 46). The CMR was 25% higher in stunted mothers, than non stunted (p=0.0326), and was inversely related to family income (p=0.0179) which is a surrogate for maternal education.

Causes of Death

In almost half of the deaths (46.5%), the mother declared she did not know why her child had died. In 18.9% of cases, she thought deaths were related to the birth process. In 12.0%, she declared pneumonia to have been the cause. 6.9% of the children had drowned. 3.3% were reported to have become suddenly 'sick', and diarrhoea featured in another 2.2%. Trauma accounted for 1.8% of deaths, and others appeared to have died of malformations and malignancy.

Morbidity

Children with chronic disease were identified by the mother during the surveys, and significant abnormality was confirmed in 106 children. 52 were suffering from Cerebral Palsy (CP): 12 with serious cardiac disease; 12 with syndromes including 5 with Down Syndrome; 5 with unspecified developmental delay; 5 with external eye problems including severe strabismus and microphthalmia; 4 with deaf-mutism; 2 with congenital dislocation of the hip; and 2 with treated myelo-meningocoele . Overall, this gave a prevalence of physical impairment due to neurological causes of 18.1 per 1000. Sundry cases included one each of elephantiasis, rheumatoid arthritis, urinary incontinence, and renal hydronephrosis, while 5 had inguinal hernias, and one a huge omphalocoele.

Of the 52 children with cerebral palsy, 27 were boys and 25 girls with a mean age of 5.3 years. All were severely affected with Gross Motor Function Classifications in the range of 4 and 5 but none were receiving physiotherapy or special schooling, and none appeared to have mechanical aids. All appeared to have been associated with birthing difficulties, except for one associated with head injury at 3 years of age, another with febrile illness at 18/12 of age, and another with severe gastro-enteritis at a similar age. Under-nutrition was a major complication of CP: 42.3% were stunted (HAZ < -2SD) compared with 25% of local children without CP (PValue 0.0048) and 23.1% were <-3SD. 44.2% were underweight (WAZ<-2SD) compared with 23.7% without CP (PValue 0.0006), and 18 of that 23 were <-3SD. There was no gender difference. Cardiac abnormalities included 3 with Tetralogy of Fallot, 2 with cardiomyopathy, 3 with septal defects, 3 with valvular disease (2 stenoses and 1 incompetence) and 1 patent ductus arteriosus. All appeared to be of congenital origin.

Discussion

The survey revealed severe levels of morbidity and mortality in children in rural areas in the north of the Mymensingh District. The degree of growth restriction rivals the worst in the country and must be fundamental to the high rate of mortality. It is well known that under-nutrition reduces immunity and is associated with a three to four times greater rate of mortality. Our survey confirmed the presence of socio-economic correlations of under-nutrition that have international recognition. As reported elsewhere, the stunting of children was associated with stunting of mothers, and maternal stunting was associated with reduced age at marriage, income, education and proper disposal of human waste. As most of our children were born at home with untrained birth attendants, birth weights are unknown, but the 9% prevalence of in-utero growth restriction recorded in the private

obstetric facility, Joyramkura Hospital, suggests a much higher rate in poor, undernourished mothers delivering in the villages. Intra-uterine growth restriction will contribute to the stunting of children and thus the mortality rate. That the survey revealed the rate of stunting to have increased from 15.3% in mothers, to 25.6% in children 5–14, and then to 36.2% in those <5 years, suggests its prevalence is increasing in the north, despite the nation's fall in poverty. Why this should be so is not clear: perhaps poverty has worsened in the north. Alternatively, the rising prevalence of overweight in stunted and other mothers (as discussed in another report) might suggest disposable income is being spent on calorie dense foods and drinks which fatten the mother but do not provide sufficient nutrition for linear growth in the child.

The very high rate of stunting and underweight in children with CP confirms their special vulnerability. Reasons for under-nutrition include difficulties in feeding and swallowing, problems with consistency of the diet, problems with understanding the cause of CP, and poverty [8]. It was reassuring the rate of undernutrition was similar for males and females because, sometimes, the latter are perceived as a greater burden. Home births, attended by un-trained personnel, distant in time and location from the obstetric facility at Joyramkura, must be the basis of the appalling rate of still and perinatal death rates. The gestational age of babies still born in poor rural areas is often unknown [9] but up to 50% of such deaths are likely to be due to intra-partum difficulties [10]. The low rate of hypertensive and diabetic complications at Joyramkura Hospital would support this concept of 'mechanical' rather than medical causation [11]. Therefore, prolonged and obstructed labour is likely to be a major cause of deaths of children of all ages, and of cerebral palsy in survivors [12].

Given the extraordinary Stillbirth Rate, it may not be reassuring that the NMR and IMR in northern Mymensingh approximate the national rate. It could merely signify that babies are expiring during rather than after birth. The <5 CMR of 62.4 in northern Mymensingh, however, rivals the highest rate in Bangladesh (67 per 1000) reported from rural Sylhet [13]. The striking feature in our survey is that the cause of almost half of the deaths was unknown to the mother. This would suggest reliance on village 'physicians' without recourse to trained opinion. In confirmation, only 1452 emergency visits and 1578 admissions of children <5 years were recorded in 2018 in the government hospital at Dhobaura which serves a population of 225,399 [14]. In the same year, only 1331 emergency visits and 875 admissions of children <5years were recorded in the government hospital in Haluaghat, the other administrative centre in the region, serving a population of 333,065 inhabitants [15]. Only 8 visits a day from a population of over half a million people supports the concept of help being sought elsewhere. While almost half the mothers seemed to have little understanding of why their children had died, some deaths were ascribed to unspecified problems at birth, and others to such recognised causes as pneumonia [16] and drowning [17]. Preventable infections must have played a role: though almost all mothers declared their children had been vaccinated, no details were available, and a 'drop out' rate of around 50% of Bacille Calmette Guerin, Pentavalent, Measles and even poliomyelitis vaccinations was reported by health authorities in Dhubaura. Similarly, there was no guarantee that government distribution of vitamin A had been successful, though

gastro-enteritis was not a prominent cause of death. 52 cases of cerebral palsy from 4408 live births suggests an extremely high rate of CP (11.8 per 1000) compared to the international rate of around 2 per 1000 live births. Regrettably, rates 5 to 10 times higher than the international one may not be unusual in Low to Middle Income Countries [18,19]. In one study in Bangladesh it was calculated to be 3.4 per 1000, but estimated to be much higher because of early deaths and difficulties in diagnosis [20]. The overall rate of Physical Impairment (PI) due to neurological disease in our 'broad brush' survey was 18.1 per 1000, three times higher than the 6.1 per 1000 revealed in a much more sensitive study in Bangladesh [21]. Most likely, our study has seriously underestimated the prevalence of PI. We only counted survivors with gross impairment. Consideration should be given to cause of death, and sensitive screening should be performed to assess true prevalence and plan for intervention.

The consequences of cerebral palsy extend beyond the child to include psychological and financial costs to the family, especially to the mother [22,23]. The quality of maternal life has been shown to be much reduced in association with a child with CP. Early diagnosis, therefore, may provide opportunity for positive intervention: for neurological improvement by taking advantage of cerebral plasticity, for reduction of spasticity, for provision of aids from eye glasses to wheelchairs, for community understanding and cultural acceptance of handicap, and thus for improvement in maternal quality of life. Such early diagnosis might be achieved by the 'Key Informant's Method' developed by the Child Sight Foundation in Shajadpur, Bangladesh, in which 'knowledgeable members of the community (key informants) are trained to effectively identify children with moderate-severe physical impairments, sensory impairments and epilepsy' [24]. Identified children and carers then gather for evaluation and low cost, family and community based intervention. Details are recorded for the creation of a Bangladesh Cerebral Palsy Register [25] which is intended to reveal causes and initiate response. CP incurs cultural, financial, logistic and staffing challenges but surveys should progress from prevalence to intervention [26–28]. At present, interventions are limited. In the Shajadhur study, 78.2% of children had never received rehabilitation, and only a fifth were attending regular school [29]. In northern Mymensingh District, such services do not existent. Our survey revealed 10 children with congenital heart disease and another 2 with dilated cardiomyopathy of possible congenital origin. The mean age was 7.2 years raising the likelihood of under-estimation because of survivor bias. Therefore, our rate of 3 per 1000 does not confront reports of a 'normal' incidence of moderate to severe abnormalities of around 6 per thousand [30]. In rural Bangladesh, one problem is diagnosis, the other is cost of surgery when even the bus fare to Dhaka may be prohibitive.

Our survey has limitations. First, given the propensity for home births attended by untrained personnel, dates, weights and gestations were usually unrecorded and as lamented in BDHS 2014, 'any memory of ages and causes of death, even of stillbirths themselves, dims with passing years in retrospective, cross sectional studies'. Second, associated with decreasing memory is the tendency to 'heap' ages at standard digits of, say, 6 months or 1 year. We sought to minimise this limitation by expressing age in half years. For example, if a mother

declared the child to be 3 years old, we calculated on the basis of it being 3 1/2. We were reassured, however, by the BDHS declaration that the ratio of deaths under one week to those under one month should be around 70 % if estimation of age is reasonable. Our ratio was 76%, probably reflecting increased obstetric difficulties. A third limitation is that we relied on mothers' statements as interpreted through a single translator.

Conclusion

Despite limitations, our survey has revealed major problems of morbidity and mortality of children in northern Mymensingh District. Stunting is prevalent and inter-generational. Home deliveries prevail and are rewarded by an extra-ordinary rate of still and perinatal death, and subsequent development of cerebral palsy. There is also a high rate of death in older children, for reasons often unknown to the mothers. Attendance rates at local government hospitals suggest reliance on village 'physicians'. There is an urgent need for timely referral of obstetric and child health problems to an equipped facility. Screening for cerebral palsy and provision for intervention should be performed…and will be in the near future.

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