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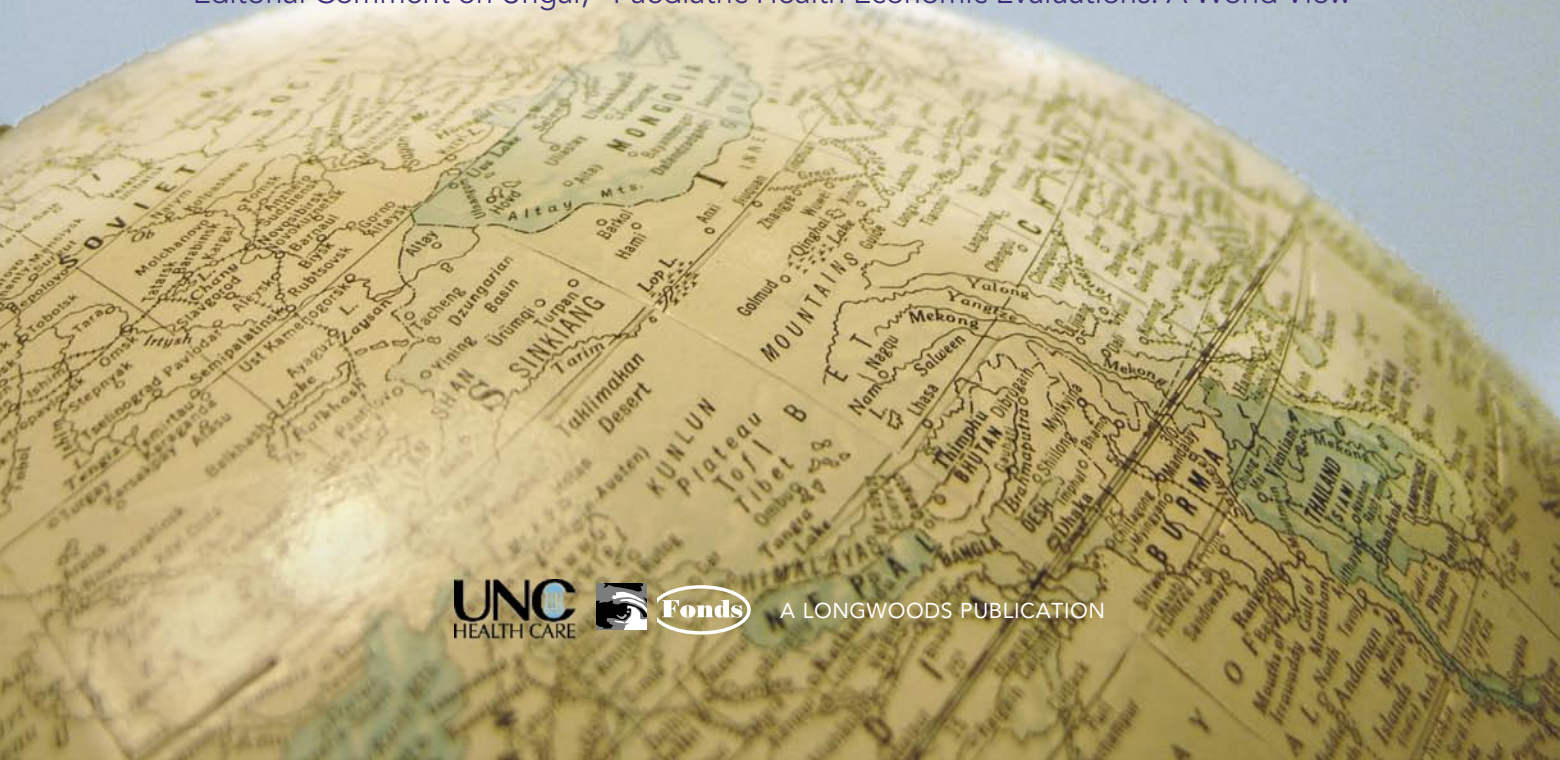

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IN THIS ISSUE

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From the Editor-in-Chief

The papers featured in this issue of *World Health and Population* (*WHP*) represent some of the many interesting and important papers published online by the journal over the last six months. The full set of papers accepted for publication can be viewed through our online link at http://www.worldhealthandpopulation.com. This issue contains, following our mission, papers from "diverse international settings," including three from India, two from Bangladesh, one each from Haiti and Nigeria, and one research overview that has cross-national implications. I would like to comment below on several of the submissions.

The paper by Bangdiwala et al. on the design of intervention studies on neonatal health in India reports first-phase results of a larger research project, the Neonatal Health Research Initiative (NHRI), funded by the United States Agency for International Development (USAID) and the International Clinical Epidemiology Network (INCLEN). The research is highly applicable for developing methods for monitoring of the progress of India toward reaching the ambitious United Nations Millennium Development Goals (MDGs) with regard to reduction of infant and child mortality. In addition to robust survey research-based methods for monitoring progress, however, the project will also be designing interventions. One interesting and notable contribution toward this end is considering residence status more finely than the traditional urban-versus-rural. Recognizing the fast degree of urbanization in South Asia and prolific rural-to-urban migration, with many of the migrants living in slum dwellings[1], Bangdiwala et al. use a four-category residence classification: urban; urban-slum; rural; and tribal. These more realistic categories capture variations due to residence in health status, health seeking behaviors, and health delivery infrastructure better. Moving beyond simple "urban-rural" classifications could be highly useful in research not just in Asia, but in Africa and South America as well.

In his paper, Bimal Paul of the University of Kansas looks at health-seeking behaviors of people in Bangladesh affected by naturally-occurring arsenic contamination of drinking water from tube-wells. Attention to the problem of arsenic poisoning is important from several stances. First, the impact of the poisoning can be minimized if addressed in the early stages, before irreversible damage and even death occurs. Thus, encouraging early health seeking behaviors, and the provision of appropriate (and potentially low cost) health care services is very important. Second, the externalities associated with fear of tube-well water are also important to consider. Many of these wells have been provided over the years by UNICEF and other multilateral and bilateral (e.g., USAID) agencies under the laudable goal of provision of safe, clean drinking water. The results of these efforts are now potentially "tainted," both literally and figuratively. Loss of trust in tube-wells, and loss of trust in "Western" aid and technologies, could result of returning to traditional sources of oftentimes bacterially-contaminated drinking water as well as increased cynicism and rejection of well-meaning development assistance. Naturally-occurring arsenic contamination of tube-wells is clearly a problem requiring multi-tiered attention.

"Indoor Air Pollution and Baby's Size at Birth" is an interesting paper by a Programme Officer of the Population Council, Saswata Ghosh. The paper was first presented at the 2005 conference of the International Society for Environmental Epidemiology in Johannesburg, and examines the relationship between use of biomass fuels in cooling and perceptions of a baby's size at birth, as a proxy for low birth weight (and health risk). Data were utilized from India's second National Family Health Survey (NFHS-2), a large scale survey carried out in 1998 and 1999. Ghosh's analyses verify an association between use of biomass fuels and small baby size, thus adding to the already numerous health and environmental reasons for moving to more efficient, if not entirely alternative, means of cooking in poor and rural areas.

Moving to an article from the Western Hemisphere, Rick Niksha, a medical epidemiologist with the United States Centers for Disease Control and Prevention (CDC), provides an interesting short communication on the relationship of weight and hypertension in poor, rural populations. Typically we consider the relationship of weight and hypertension in terms of overweight or obesity. But what is the relationship in populations where overweight and obesity is rare? In "Hypertension in Rural Haitians: Its Relation to Weight", Niksha points out that hypertension can still be highly prevalent, even in the presence of clinical malnutrition. His conclusions lead to recommendations that researchers look to potentially new, unmeasured factors to explain hypertension in normal or low weight populations.

Finally, a separate editorial comment has already been prepared and published online regarding Wendy Ungar's article, "Paediatric Health Economic Evaluations: A World View." That editorial and Ungar's article are included in this issue. The only editorial comment I would like to repeat is to encourage researchers and policy makers alike to note and act on her conclusion that affected countries continue to rely excessively on "foreign" (i.e., non-locally conceived and based) economic evaluations to inform decisions regarding implementation of health programs, and that there is a "great need for better methods of transferability of data." Her results also robustly support the initiation of research within the appropriate country contexts themselves, something strongly supported in the mission of *WHP*.

The contributing authors and editorial staff of *WHP* would be interested in any comments or suggestions you might have on the articles or journal. Please feel free to write or e-mail us.

Notes

[1] For discussions of health related aspects of rural-to-urban migration in China published in this journal, see Li et al. *WHP*, 8(2), April 2006 and *WHP*, 8(3), July 2006.

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Integrating Results from Formative Phase Studies for Informing the Design of Intervention Studies on Neonatal Health in India

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Abstract

Background The millennium development goal (MDG) for India envisages reducing infant and child mortality by two-thirds between 1990 and 2015. Population-specific, systematic and comprehensive clinic-based strategies are required to reduce neonatal mortality at the national level. The present formative research is a step towards evolving operational strategies to improve infant survival by reducing neonatal morbidity and mortality in the country. It aims at prompt recognition, referral and treatment of sick neonates. It also seeks participation of the community and healthcare providers (a public-private mix) taking into consideration the existing resources and facilities addressing the diverse socio-cultural beliefs that influence the newborn care practices in various strata of the community.

Methods A multi-centric community-based study involving cross-sectional surveys and nested case-control designs was conducted in 10 districts from 9 different Indian states. Cross-sectional surveys were conducted to assess existing healthcare facilities and to assess health-seeking behaviour of various stakeholders. A case-control study nested in a cohort was conducted to identify the risk factors and to validate the verbal and social autopsy tools. A combination of standard qualitative and quantitative research methods was used for data collection purposes by trained research associates with stringent quality checks.

Findings From the cohort study of 10,420 pregnant women, the annual neonatal mortality rate was estimated to be 48.4 per 1,000 live births. The case-control study identified maternal characteristics

like age, low parity and diseases during pregnancy; neonate's characteristics like not crying immediately after birth, low birth weight, congenital anomalies, pre-term birth, non-vaccination, infections and small for date of birth; and community factors like unhygienic practices and no breast-feeding to newborn immediately after birth among the significant risk factors. The cross-sectional survey of health facilities found lack of nurses and midwives (37% in rural vs. 79% in tribal), lack of essential equipment and devices (22% in urban vs. 28% in tribal), lack of supplementary training to health workers in essential newborn clinical care (40% in urban vs. 53% in rural) and inadequate drug supplies (37% in rural vs. 50% in tribal) as barriers in offering effective antenatal and neonatal care services in peripheral rural and difficult-to-reach tribal settings. The cross-sectional study of stakeholders regarding knowledge and perceptions on neonatal health issues suggested community stakeholders have a good perception about common neonatal health problems like respiratory infections, fever and diarrhea, but lacked sensitivity to specific neonatal morbidities like asphyxia, sepsis, low birth weight and hemorrhagic diseases.

Interpretation Population-specific interventions need to be instituted, as perceptions and behaviour of stakeholders, the health facilities and the risk factors for neonatal mortality were found to vary among rural, tribal, urban slum and urban communities. Interventions for health behaviour modification and reduction of sepsis, asphyxia and low birth weight should be undertaken as the next phase of the study.

Introduction

Neonatal care in developing countries, where 96% of the global burden of neonatal death occurs, is practically non-existent (Bang et al. 1999). In India, as many as 1.72 million children die each year before reaching their first birthday, and of these, 72% die during the neonatal period. The millennium development goal (MDG) for India envisages reducing infant and child mortality by two-thirds between 1990 and 2015 (World Bank 2004).

Although a home-based neonatal care approach (Bang et al. 2001) was found effective in reducing neonatal mortality in a rural community in India, it was designed for specific morbidities. The said approach is yet to be replicated in other parts of the country on a larger scale because of certain inherent operational issues. For example, the approach requires provision of an additional community worker (*shishu rakshak*) at the village level, and clinicians are not yet motivated enough for administration by injection of gentamycin to the sick newborn by these untrained community workers. There is thus a need to further explore home-based and clinic-based strategies to reduce neonatal mortality at the national level.

Population-specific, systematic and comprehensive strategies are required to reduce neonatal mortality at the national level. The Neonatal Health Research Initiative (NHRI) is a comprehensive research endeavour funded by the United States Agency for International Development (USAID) in conjunction with the International Clinical Epidemiology Network (INCLEN Trust) to develop and test intervention strategies for neonatal health in India.

Formative research is a step towards developing intervention strategies to improve infant survival (Gittelsohn et al. 2006) and was thus the initial phase of the NHRI program. Steps considered vital for reducing neonatal morbidity and mortality in the country include prompt recognition, referral and treatment of sick neonates with participation of the community and healthcare providers. Strategies must take into consideration the existing resources and facilities and address the diverse socio-cultural beliefs that influence the newborn care practices in various strata of the community.

The objectives of the formative stage were (1) to identify risk factors for neonatal mortality, (2) to assess medical and social causes of neonatal deaths, (3) to assess the neonatal healthcare facilities, (4) to assess health-seeking behaviours of community stakeholders and (5) to recognize patterns for, determinants of and barriers in newborn care. These in turn would inform the development of intervention studies.

Methods

Study Design

Various multi-centre community-based studies were employed, including cross-sectional surveys, cohort studies and nested case-control studies (Rothman and Greenland 1998). Cross-sectional surveys studied selected healthcare facilities and identified stakeholders' health-seeking behaviour. A prospective cohort of pregnant women (in the 3rd trimester of pregnancy) was followed until one month after delivery for the purpose of studying neonatal deaths. Neonatal deaths occurring in the follow-up period constituted cases, and the family members were interviewed using verbal and social autopsy methodology. A random sample of mothers who delivered normal babies (weighing more than 2500 gm at birth) formed the group of controls. Thus, a nested case-control (approximately 1:2 ratio) study of pregnant women enabled identification of risk factors and validation of the verbal and social autopsy tools.

Study Setting

The cross-sectional surveys were conducted in 10 districts from 9 different Indian states, representing varied socio-cultural and geographical regions (see Figure 1 – map). Within each district, three blocks (geographic units covering a population of approximately 100,000 inhabitants) were randomly selected, one each from rural, urban and urban-slum areas. In addition, two sites (Bilaspur and Nagpur) also selected a tribal block each. For the nested case-control study, nine districts participated (Delhi did not) and one block per district was included.

Sampling Methods

For the cross-sectional surveys, a multi-stage, stratified sampling procedure was used, with block as the primary sampling unit. In the first stage, a single district per site was purposively selected from each participating state, taking into consideration feasibility and convenience. Participating states were those where a clinical epidemiology unit (CEU) or partner medical college (PMC) belongs. In the second stage, three blocks per district (plus two tribal blocks) were randomly selected within strata of block type (rural, urban, urban-slum), for a total of 32 blocks. Only one block per district was selected (at least two of each type of block) for the nested case-control study, given financial constraints, in following the expected large number of pregnancies in a four-month period.

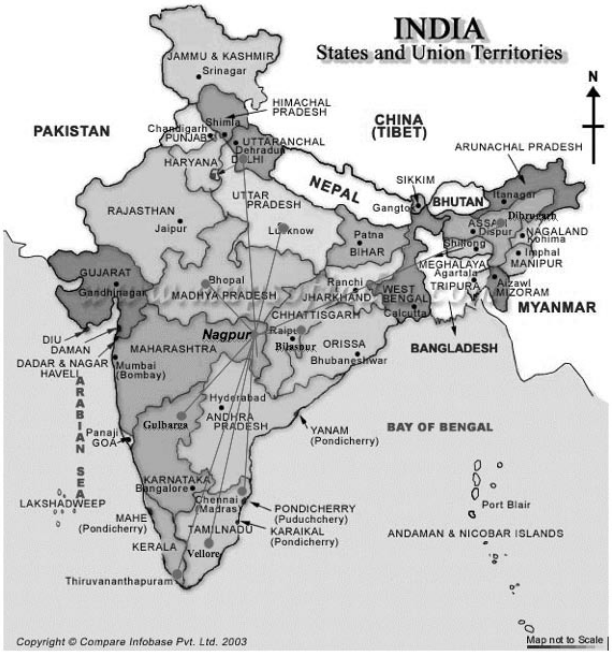
Sample Size

The cross-sectional healthcare facilities survey had a specified number of facilities (one private and one government) per block, and the stakeholders survey identified a specified set of individuals to interview within each block. Since the cross-sectional surveys were qualitative in nature, sample size considerations were only needed for the nested case-control study. All pregnant women in their third trimester in the sampled 10 blocks were recruited into the cohort study that was to yield the subjects for the nested case-control study, from 2002 to 2003. Based on a birth rate in India of 25 per 1,000 population per year, and on an annual neonatal mortality rate in India of 40 per 1,000 live births, we estimated 33 neonatal deaths to occur per block in a four-month period. Accounting for a 20% non-responder rate, we thus expected a total of 260 neonatal deaths for our study in the 10 selected blocks. A total of 250 cases and 491 controls were recruited. This provided at least an 82% power to detect odds ratios of 1.6 or higher in two-sided .05 significance tests, for moderate (35%) risk factor exposures in the control group.

Data Collection and Management

Data were collected by trained research associates in structured, pre-designed, pilot-tested study instruments, following stringent quality assurance procedures developed, monitored and evaluated by the Central Coordinating Office (CCO).

Figure 1. Location of NHRI study sites for data collection in the formative phase



Participating sites:
1. Nagpur, Maharashtra (Central Coordinating Office - CCO)
2. Bhopal, Madhya Pradesh
3. Lucknow, Uttar Pradesh
4. Vellore, Tamilnadu
5. Thiruvananthapuram, Kerala
6. Dibrugarh, Assam
7. Gulbarga, Karnataka
8. Chennai, Tamilnadu
9. Bilaspur, Chattisgarh
10. New Delhi

Qualitative data from the cross-sectional survey of healthcare facilities were gathered by tape recorded interviews from a single health worker per facility (n=62) and from five mothers or caretakers of sick neonates exiting from a physician consultation (n=306). In addition, an equipment check was conducted of each healthcare facility (n=61) and the skills of the interviewed healthcare worker in handling five sick neonates were observed (n=282).

Tape-recorded in-depth interviews of selected stakeholders – medical officers (n=94), village health nurses or multipurpose health workers (VHN/MPHW) (n=100), non-governmental organization (NGO) representatives (n=94) and mothers (n=270) – were done to assess healthcare-seeking behaviours in the selected blocks. The mothers were categorized into three groups: (a) women who had experienced neonatal illness or neonatal death in the last three months and sought some type of health care (n=100); (b) women who had not experienced neonatal illness or neonatal death in the last three months (n=100); (c) women who had experienced neonatal illness or neonatal death in the last three months, but did not seek any type of health care (n=70). In addition, five focus group discussions were conducted per district with: (i) women above 40 years who have grandchildren, (ii) husbands or grandfathers, (iii) women with a child less than six months of age, (iv) VHN/MPHW and (v) birth attendants. In all, data from 792 in-depth interviews and 50 focus group discussions were obtained.

The cohort studied yielded the subjects for the nested case-control study. A cohort of 10,420 pregnant mothers was recruited and followed until the outcome (i.e., neonatal death or live birth). All the neonatal deaths (n=250) were thoroughly investigated and subsequently subjected to verbal and social autopsy (Gray et al. 1989). These were tape recordings, subsequently transcribed. In addition to the qualitative data from the cases, we collected quantitative information from both cases and controls through standardized interview forms.

Statistical Analysis

Qualitative interview data from tape recordings were translated, transcribed and coded manually since they were in a variety of local Indian languages. Coded responses were analyzed descriptively with simple frequency distributions. Whenever multiple observations within a facility or by a health-care worker were taken, adjustments to the variance of estimated percentages were performed to account for the correlated nature of the data. For the nested case-control study, unadjusted odds ratios were initially calculated and then adjusted using the Cochran-Mantel-Haenszel chi-squared statistic to account for the 10 centre strata. Unconditional multiple logistic regression permitted examining the relative importance of various risk factors. All statistical analyses were performed with Stata (version 8.0, 2003).

Results

The survey of the existing healthcare facilities revealed that their geographic distribution is concentrated in urban and urban slum settings, with complete lack of facilities in tribal settings. Health facilities, particularly in rural and tribal settings, were not conveniently located in close proximity of the healthcare seekers (>80% of the facilities were located at >1 km from places of residence), and the facilities did not cater to the specific needs of the community. Approximately 55% of the facilities provided primary care, 40% secondary care and only 5% tertiary care. All three levels of healthcare services were only available in urban facilities, while tribal facilities completely lacked tertiary care. Although the private sector was well represented in urban settings, it was less visible and operational in rural and tribal settings.

Lack of nurses and midwives (37% in rural and 79% in tribal) and inadequate drug supplies (37% in rural and 50% in tribal) hampered the routine antenatal and neonatal care practices in peripheral rural and difficult-to-reach tribal settings. Health facilities in general had very limited capabilities to offer emergency and specialized neonatal healthcare services, due to lack of essential equipment and devices (approx. 22% in urban to 28% in tribal) and lack of supplementary training to health workers in essential newborn clinical care (approx. 40% in urban to 53% in rural).

The cross-sectional study of stakeholders, regarding knowledge and perceptions on neonatal health issues, suggests that the current status of antenatal care is inadequate and did not stand up to the expectations of the mothers. Community stakeholders have a good perception about common neonatal health problems like respiratory infections, fever and diarrhea, but lacked sensitivity to specific neonatal morbidities like asphyxia, sepsis and hemorrhagic diseases. Sensitivity was highest among urban and lowest among tribal stakeholders. Stakeholders did know some correct newborn care practices (e.g., measures for low birth weight babies) and the benefits of seeking newborn care at health facilities. However, the decision to seek care for newborns and pregnant mothers was taken mostly by husbands, particularly so in rural and tribal areas. Lack of time (40%) and family pressures (22%) were the decisive factors against seeking healthcare facilities in urban and slum areas, whereas lack of transportation (54%), lack of money (40%) and rumours about the health system (25%) were the main factors found in rural and tribal areas. The perceived level of satisfaction among the stakeholders was found to be very high in tribal settings (93%), but very low in urban settings (10%). The NGO representatives perceived the lack of awareness (33%) and lack of doctors or treatment facilities (23%) as the main reasons for non-seeking of newborn care services by rural and tribal communities. Urban and slum communities were found to have a better perception about good newborn care practices (e.g., early breast-feeding, colostrums feeding, improved

hygienic care), whereas rural and tribal communities practiced mainly bad newborn care practices (e.g., withholding early breast-feeding, no colostrums feeding, application of unhygienic things, immediate bathing and dressing of the baby).

Healthcare providers did have some knowledge and skills to provide basic healthcare to newborns (respiratory tract infections, diarrhea/dehydration, fever), but they lacked in specific clinical and managerial skills required to treat sick neonates (pneumonia, jaundice, signs/symptoms of sickness and low birth weight).

From the cohort study of 10,420 pregnant women, the overall neonatal mortality rate was estimated to be 48.4 per 1,000 live births per year. Table 1 presents the causes of mortality (note that a child can have multiple causes of death). Respiratory distress syndrome, low birth weight, birth asphyxia and neonatal sepsis complex were the four most common causes of mortality.

Table 1. Causes of neonatal deaths (n=250) in the cohort study of 10,420 pregnant women

Cause	%*
Respiratory distress syndrome	56.4
Low birth weight	48.5
Birth asphyxia	40.2
Neonatal sepsis complex	36.9
Pre-term baby	29.9
Congenital anomaly	12.4
Hypothermia	12.0
Jaundice	4.1
Diarrhea	2.5
Neonatal tetanus	2.5
Unknown	8.3
Unspecified	1.7

* Note that a child can have multiple causes of death

The nested case-control study odds ratios (unadjusted, stratified and adjusted) are presented in Table 2. All maternal, neonate and community factors studied were statistically significant at the 0.05 level in bivariate testing, adjusting for site with the M-H chi-squared statistic. Among the maternal factors, strongest relationships with caseness were seen for young age, low parity, illiteracy, toxaemia or diseases during pregnancy and difficulties during labour. The neonate's factors were in general stronger, with not crying immediately after birth, congenital anomalies, pre-term birth, low birth weight, non-vaccination, infections and small for date of birth being among the strongest risk factors. Finally, one of the strongest risk factors was to not be breast-fed immediately after birth, followed by unhygienic cord care practices. Most of these factors are highly correlated with each other, so that the relative importance of the factors was examined in multiple logistic regressions. The final model (presented) showed that the strongest risk factors were those associated with the neonate itself, with congenital anomalies the strongest, but with preterm and smallness for date very strong as well. Parity (maternal factor) and withholding of breast-feeding (community factor) were also importantly associated with being a case.

Table 2. Risk factors for neonatal mortality identified from the case (n=251) – control (n=591) study

	Bivariate analyses						Multivariate analyses		
	Crude			Stratified (Mantel-Haenszel)			Logistic Regression		
	OR	95%CI	p	OR	95%CI	p	OR	95%CI	p
A. Maternal factors									
Parity (nulli and primipara)	3.98	2.82–5.63	0.0001	4.06	2.90–5.70	0.0001	3.58	1.91–6.76	0.0001
Maternal Illiteracy	1.61	1.13–2.26	0.0054	1.66	1.18–2.35	0.0032	1.79	1.03–3.12	0.0381
Disease during pregnancy	3.11	2.13–4.53	0.0001	3.43	2.34–5.04	0.0001	2.22	1.34–3.98	0.0069
B. Neonate factors									
No cry immediately after birth	10.02	6.03–16.98	0.0001	9.37	5.76–15.2	0.0001	2.27	1.02–5.01	0.0459
Resuscitation	4.15	2.86–6.02	0.0001	5.96	3.87–9.14	0.0001	2.09	1.12–3.91	0.0211
Low birth weight	5.71	3.85–8.48	0.0001	6.41	4.25–9.66	0.0001	3.38	1.72–6.49	0.0001
Preterm	16.63	9.03–32.49	0.0001	17.16	9.34–31.52	0.0001	7.96	3.16–20.05	0.0001
Small for date	11.71	6.84–20.71	0.0001	11.65	6.66–19.73	0.0001	7.12	3.28–15.45	0.0001
Congenital anomalies	16.48	4.89–86.3	0.0001	16.59	4.98–55.28	0.0001	23.66	4.01–139.55	0.0001
Infections (ARI)	11.43	5.13–28.71	0.0001	12.13	5.28–27.88	0.001	6.42	1.98–20.78	0.0019
Non-vaccination	6.71	4.51–10.14	0.0001	9.69	6.15–15.29	0.0001	4.74	2.64–8.48	0.0001
C. Community level factors									
Unhygienic practices	1.46	1.04–2.08	0.0257	1.96	1.25–3.09	0.0016	1.97	1.01–3.86	0.0497
Withholding immediate breast-feeding	23.98	14.96–39.01	0.0001	22.36	14.17–35.28	0.0001	12.27	6.54–23.11	0.0001

Some stratum-specific variations were observed (as assessed by the test of homogeneity in stratified analysis) in neonatal care practices among the sites with respect to distribution of certain important factors like unhygienic practices, incorrect feeding practices, improper care of newborn with low birth weight and inadequate care for mother during and after delivery. This could be mainly attributed to low literacy status and ignorance of the caretakers, especially in rural and tribal communities.

The qualitative studies of verbal and social autopsies helped to understand the quantitative results and to design possible interventions. Mothers and relatives undergoing verbal autopsies were relatively more sensitive to respiratory distress syndrome, but more specific to congenital anomalies and prematurity.

Social autopsies identified a different set of factors related to neonatal mortality. Among these, we note delay in recognition (ranging from 76% in tribal to 94% in urban) and delay in seeking care for neonatal problems (ranging from 37% in urban to 80% in tribal), non-utilization of healthcare facility for treatment of neonatal illnesses (ranging from 41% in tribal to 87% in urban slum), non-involvement of mothers in decision-making actions related to neonatal health (ranging from 73% in urban to 97% in tribal) and unexplained or sudden deaths of newborn (ranging from 8% in urban

to 75% in rural). When compared to healthcare workers, mothers had reasonably high sensitivity (80%) and specificity (57%).

Table 3. Sensitivity and specificity of verbal autopsy in identifying various causes of death

	Sensitivity (%)	Specificity (%)
Respiratory distress syndrome	90	54
Low birth weight	84	65
Birth asphyxia	73	76
Neonatal sepsis complex	41	85
Pre-term baby	82	93
Congenital anomaly	66	96
Hypothermia	57	91
Sudden death	33	82
Neonatal tetanus	100	100

Discussion

Neonatal mortality in India is a major public health problem for the country and without a doubt, one of the most pressing problems to overcome (World Bank 2004). Strategies for addressing the problem can benefit from qualitative studies prior to undertaking intervention studies. Qualitative formative studies are increasingly playing an important role in developing quantitative and intervention studies (Mesko et al. 2003; Milligan et al. 2002). In rural Nepal, quantitative and qualitative components were used to describe the care-seeking practices and care of perinatal illnesses (Mesko et al. 2003). In order to design relevant interventions to improve prenatal care, one requires thoughtfulness, sensitivity and understanding of the specific circumstances of communities (Milligan et al. 2002). Such studies help in determining community specific issues that may present problems for late recognition of neonatal illness or delay in seeking medical treatment. For example, the urban slums in India have specific problems, such as inadequate perinatal care (Fernandez et al. 2003) and inequalities in the distribution and access to basic health services (Awasthi and Agarwal 2003; Kapoor et al. 1996), and these are major determinants of childhood mortality and morbidity. Rural areas of India face many of the same factors, but with slight variations such as poor use of primary care health services and inadequate antenatal care (Bhardwaj and Hasan 1993; Misra et al. 1993). Such differences may be important in the planning of intervention studies. In our studies, the distribution of the identified risk factors was found to vary among rural, tribal, urban slum and urban communities. Thus, stratum-specific interventions need to be instituted to address the issue of neonatal mortality, particularly focusing on the needs of the tribal and rural strata of the population. Different cultural practices by various religious and ethnic groups may also need to be considered when developing possible interventions.

In our case-control study, maternal characteristics were associated with neonatal mortality, but characteristics of the neonate (low birth weight, congenital anomalies and prematurity) and perinatal care practices (incorrect feeding practices, unhygienic cord care and non-vaccination) were much more important factors associated with mortality. The extent to which physical characteristics of newborns such as low birth weight and gestational age relate to neonatal mortality is well known (Tripathy et al. 2002; Kaushik et al. 1998; Sachar and Soni 2000). Maternal factors that make for a

high-risk pregnancy have also been recognized (Gupta et al. 1997; Sehgal et al. 2004). However, the multiple factors are highly correlated, confounded and interactive. Multivariate regression models may tease out some of these effects (Kost and Amin 1992), but integrating qualitative information is not a statistically clear-cut methodology.

The development of interventions is a complex activity, given the multiple factors and specific circumstances of different communities and populations. Hospital-based deliveries (Augustine and Bhatia 1994) may have different factors from home-based deliveries in rural communities (Bang et al. 2001). It is thus essential to contextualize the development of interventions in order to optimize their effectiveness. There have been several suggestions for interventions over the years, from training traditional birth attendants (Bhakoo and Kumar 1990) or women as healthcare providers (Shah 1989), conducting community-level educational outreach (Das et al. 1998), to the more recent home-based neonatal care and sepsis management program (Bang et al. 1999) and the national Integrated Management of Childhood Illnesses (IMCI) approach (Anand et al. 2004). From our qualitative studies, communities also recognized the importance of low birth weight, sepsis, respiratory distress syndrome, asphyxia, pre-maturity and hypothermia as perceived causes of neonatal deaths. Hence cause-specific interventions should be devised to reduce neonatal morbidity and mortality in the country. Since the verbal autopsy and social autopsy tools used in our study were sensitive and specific in recognizing neonatal health problems, they can be used by the health workers in the field to investigate medical and social causes of neonatal deaths.

Our healthcare facility survey identified similar problems of care as Biswas et al. (2004) in West Bengal. There is a need to take a fresh review of the existing healthcare facilities so as to make them more purpose-specific and effective in offering neonatal care services to the community by upgrading their capabilities in terms of resources like drugs, equipments, manpower and training. The stakeholders did not have very precise and accurate information on neonatal diseases, and many socio-cultural factors were found to influence the health-seeking behaviour of parents. Suitable behavioural interventions should be designed to bring in the behavioural change in caretakers and healthcare-providers, thereby leading to correct newborn care practices. These and other interventions are being planned and carried out in India currently under the auspices of the Neonatal Health Research Initiative, as India strives to address the millennium development goal (MDG) of reducing infant and child mortality by two-thirds between 1990 and 2015 (World Bank 2004).

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Health-Seeking Behaviour of People with Arsenicosis in Rural Bangladesh

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Abstract

Arsenic contamination of tubewell water, which constitutes the primary source of drinking water, has emerged as a serious health problem in Bangladesh. Many Bangladeshis are now suffering from arsenic-related diseases ranging from melanosis to skin cancer. The objectives of this paper are to examine the health-seeking behaviour of people exposed to elevated levels of arsenic in rural Bangladesh and to identify the underlying factors for such behaviour. Questionnaire surveys distributed among residents of the two most arsenic-impacted rural areas in Bangladesh provided the major data source for this study. Twelve villages were selected from the two study sites, and a total of 663 people who suffer from arsenic poisoning were interviewed. Analysis of survey data reveals that about 35% of all respondents sought medical treatment for their arsenic-related illnesses. In both study sites, respondents had a variety of healthcare options, but the majority of respondents utilized practitioners with formal degrees in Western medicine. They associate arsenic-related diseases with Western technology and, therefore, they believe that the appropriate treatment for their illness should be obtained from practitioners of Western medicine. Application of logistic regression analysis suggests that illness stage, perceived threat, symptoms identification time and education level were significant for explaining respondent probability of seeking care for arsenicosis symptoms. Based on a rigorous analysis of the survey data, a number of recommendations are offered.

Introduction

Arsenic contamination of tubewell water, which constitutes the primary source of drinking water, has caused a severe public health problem in Bangladesh (Caldwell et al. 2003). Many people in this South Asian nation are believed to be exposed to arsenic in drinking water that far exceeds the World Health Organization's (WHO) recommended level of 10 parts/billion (ppb) (Yu et al. 2003).

Adverse health effects resulting from consumption of this contaminated water range from skin abnormalities to several types of cancers, such as skin, lung, liver, kidney or bladder (WHO 2000). Other adverse health effects include an increase in the prevalence of diabetes mellitus, hypertension and respiratory diseases (Milton and Rahman 2002). An increased risk of stillbirths and pregnancy complications related to arsenic exposure has also been reported (Hasnat 2004).

Millions of Bangladeshis are already suffering symptoms from arsenic-related illnesses, and the incidence of arsenicosis (arsenic poisoning) has been increasing at an alarming rate (Paul 2004). Yu et al. (2003) believe that there are some two million cases of skin lesions in the country caused by drinking arsenic contaminated water, and these researchers estimate 3,000 people die every year in Bangladesh from arsenic-related illnesses. Arsenic poisoning also affects the productivity of the people who suffer its effects and may become liabilities for their families.

Arsenic poisoning results from long-term exposure to this heavy metal. Early symptoms include various skin lesions that develop over an incubation period of 5–10 years after continuous exposure. After 10–20 years of prolonged exposure, afflicted persons often develop arsenic-related cancers (Paul and Brock 2005). Chronic arsenic poisoning has four recognized stages. In the first, or pre-clinical stage, patients show no symptoms, but arsenic can be detected in urine or body tissue samples. In the second stage, visual symptoms begin to appear, which include a darkening of skin on the palms, dark spots on the chest (spotted melanosis), back, limbs or gums. Spotted melanosis is generally a pre-cursor of skin cancer (Paul and De 2000). In the third stage, clinical manifestations become more pronounced, and the internal organs are affected. In the final stage, affected persons may develop skin, lung or bladder cancer.

The first two stages of arsenicosis occur before the condition becomes irreversible. It is therefore imperative that people suffering from arsenic poisoning recognize early symptoms and seek medical treatment so that they can avoid reaching later, irreversible stages. Although no specific treatment has yet proved effective, people experiencing arsenic poisoning tend to seek treatment from health professionals.

Use of antioxidant multivitamins (vitamins A, C and E) along with arsenic-free water and various skin lotions have been shown to be beneficial for people who are in the initial stages (1 and 2) of arsenicosis (Guha Mazumder 1996; Hasnat 2004). Taking drugs, such as d-penicillamine dimercaptosuccinic acid, and eating selenium-rich foods, such as fresh fruits, vegetables, eggs and milk, help to diminish the effects of arsenic poisoning (Paul and De 2000). Arsenic patients who are in the advanced stages (3 and 4) may require amputation of their legs, arms and/or hands; some may also develop arsenic-related cancers.

The objectives of this study are to examine the health-seeking behaviour of individuals exposed to elevated levels of arsenic in rural Bangladesh, and to identify the underlying factors for such behaviour. Such a study is essential to an understanding of how people who suffer from arsenic poisoning and their families respond to a new health crisis. This understanding will not only provide useful insights guiding arsenic prevention efforts in the country, it may, more importantly, help save many lives.

A brief review of health-seeking behavioural studies is presented in the next section to provide necessary background information. This review forms the basis for conceptualizing the health-seeking behaviour of Bangladeshi arsenicosis sufferers and provides a broader context for this research. Research methods employed in the present study are then discussed, followed by a presentation of the results and concluding remarks.

Health-Seeking Behaviour: A Review

Since few attempts have been made to study the treatment-choice behaviour of people who suffer from arsenic poisoning in Bangladesh and other countries, this section presents a careful review of the existing literature focusing on the health-seeking behaviour of people suffering from other illnesses and their determinants. Emphasis in this review is on developing countries where a medically pluralistic healthcare system provides people with a wide range of therapeutic choices – as is the case in Bangladesh.

Health-seeking behaviour refers to the sequence of actions that sufferers and/or their parents undertake in order to recover and/or seek relief from a perceived or actual illness (Ward et al. 1996). This behaviour begins with symptom identification; often, a strategy for treatment is then formulated by the head of the household in consultation with other adult family members (Shaheen and Rahman 2003). Depending on the type of illness, various family members may play the leading role in this decision-making process. For example, in complicated child-delivery cases in developing countries, often the mother or mother-in-law makes the decision to utilize the services of an institutional birth centre (Uzma et al. 1999).

The actual process of seeking healthcare usually involves multiple steps, which are influenced by factors such as illness type and severity, past experience, pre-existing beliefs about illness causation, the range and accessibility of therapeutic options available, their perceived efficacy and cost of treatment (Helman 1995; Shafie 2000). Generally, the steps to consultation are: first, making a decision about whether help from a practitioner is needed; second, mobilizing resources; third, selecting a healthcare provider; fourth, actually seeking medical consultation. Perceived minor illnesses are often dealt with using a "wait-and-see" approach (Manderbacka et al. 1999). Perceived serious problems usually result in seeking some form of care, usually traditional healthcare; and if the condition does not improve, a second practitioner is usually consulted – most commonly a Western practitioner (Paul 1992; Uzma et al. 1999).

As indicated, in many developing countries, treatment choice is undertaken within an existing pluralist medical milieu. Because of the existence of several distinct therapeutic systems in a single cultural setting, with their distinctive ideologies about disease causation and the nature of medical intervention, health-seeking behaviour in such societies is a complex process. The significance of medical pluralism in most developing countries lies in the fact that indigenous and naturalized medical traditions exist along with the Western or scientific (frequently termed allopathic or biomedical) systems.

Kleinman (1980) provides a useful typology of therapeutic choices available in developing countries. He characterized healthcare resources into three overlapping categories, or sectors: (1) the popular sector, consisting of families, members of a larger social network and the patients themselves; (2) the folk sector, consisting of traditional healers; (3) the professional sector, meaning practitioners of biomedicine. His popular sector refers to the lay (non-professional) arena of care where the symptoms of ill health are often first detected and health treatment initiated. This self-care, or "home remedies" option includes traditional and modern forms of self-treatment, such as taking analgesics and antacids, which are readily available without prescription. Existing literature suggests that the search for medical intervention for a particular illness generally begins after the failure of home treatment and/or self-medication (Ahmed et al. 2000).

The "folk" or traditional healthcare sector includes diverse practitioners of secular healing who adopt a holistic approach that takes into account both physical and emotional symptoms in the broader context of people's lives (Ahmed et al. 2000). In Bangladesh, this sector comprises treatment seeking within faith healing and traditional systems of medicine including *Ayurvedic* and *Unani* (Paul 1992). Homeopathy is often included in this traditional sector, although it was developed in the late 1700s in Germany (Ahmed et al. 2000). The homeopathic tradition seeks to stimulate the body's own defence mechanisms and processes so as to prevent or treat illness. Although homeopathic medical degrees are available in Bangladesh, most homeopath practitioners are working without such a degree.

The "professional" healthcare sector refers to organized, legally sanctioned practitioners of Western medicine, who are often called "qualified allopaths" or M.B.B.S. doctors (Kleinman, 1980). They receive a formal medical degree from a five-year medical college and serve one year residency. In the context of Bangladesh, Ahmed et al. (2000) added two additional categories of healthcare resources: (1) "paraprofessional" treatment-seeking, which consists of consultations with *Palli Chikishoks* (village practitioners who receive a year of training in diagnosing and treating the most common local ailments), medical assistants (who complete a comprehensive three-year medical

training program), and government and non-government community health workers who receive only very basic preventive and curative healthcare training and provide treatment primarily with allopathic drugs: (2) "unqualified allopaths," which refers to non-graduate practitioners of Western medicine (Ahmed et al. 2000).

Although both M.B.B.S. doctors and paraprofessionals practice Western medicine, one of the main distinctions between them is the duration of medical course work and training. While the overwhelming majority of M.B.B.S. doctors practice in large urban centres, paraprofessionals are primarily responsible for providing comprehensive (first level) curative services to people living in small towns and rural areas (Osman 2004). Also, the consultation fees are much higher for M.B.B.S. doctors compared to their paraprofessional counterparts.

With the hope of a quick recovery from illness, individuals often seek treatment from two or more medical systems (consecutively or concurrently) for the same health problem (Good 1987). Beals (1976) observed a typical progression in India from the cheapest and most accessible care, to treatments that are more expensive and harder to procure. Gupta and Dasgupta (2003) reported that work status, education, age, household size and household income were significant variables related to explaining the probability of seeking medical care in rural India. These researchers found that people belonging to a relatively high-income group usually use Western practitioners, those with more modest income show a preference for both Western and traditional practitioners, and individuals in the low-income group generally use practitioners of traditional medicine.

Another important factor noted in health-seeking behaviour is the relative proximity of services (Paul and Rumsey 2002; Uzma et al. 1999). The nearest healthcare resources are frequently used whenever possible. Using a set of cross-sectional data collected from Bangladesh, Ahmed et al. (2000) observed a difference in health-seeking behaviour between members of nongovernmental organizations (NGOs) and non-members. These researchers reported that NGO members exhibited a greater tendency to seek treatment from the professional sector than from folk and/or popular sectors. Many factors, then, influence the choice of health service use – especially in medically pluralistic societies. These same factors not only influence which type(s) of medical system might be used, they also often determine whether medical consultation will even be sought.

Methods

The research underlying this study has made use of both primary and secondary data sources. Primary data collection has been based on respondent answers to questionnaire surveys completed by people living in two rural areas in Bangladesh who suffer from arsenic poisoning. Qualitative methods, such as informal discussions with people who suffer from arsenic poisoning, village leaders and health workers, and focus groups were also used to augment information obtained through the questionnaire surveys.

Selection of the Study Area and Subjects

After consulting with several experts on arsenic poisoning, two thanas – Ramganj from the Lakhipur district, and Ramchandrapur from the Chapai Nawabganj district – were selected for this study (Figure 1). A thana is the lowest administrative unit in Bangladesh. It is composed of 10–15 unions, each containing between 10–30 villages. A district is the second largest administrative unit with an average population of two million people or more.

The selected thanas are severely impacted by arsenic contamination and constitute a portion of the high-risk zone for arsenic (BGS/DPHE 2001). From each selected thana, six contiguous villages were chosen for this study. In selecting villages, consideration was given to the logistical support available in collecting information from respondents. Although villages selected represent the arsenic level of their respective thanas, such samples are not representative of Bangladesh as a whole.

Almost all families in the selected villages use tubewell water for drinking and cooking, and more than 90% of all tested tubewells in these two thanas are contaminated with arsenic. The target population of this study was all people with symptoms of arsenicosis within the selected villages.

A complete list of all individuals manifesting symptoms of arsenicosis in the selected villages was compiled by an intensive, house-to-house survey during the first phase of the field work. Arsenicosis is defined as the presence of characteristic arsenical skin lesions combined with a history of drinking arsenic-contaminated water for at least six months (Hasnat 2004).

All people who have arsenicosis were identified by physicians, trained field workers, sufferers themselves and their relatives and friends. Most were diagnosed with arsenicosis by examination of the visible signs and/or symptoms such as the appearance of black spots (melanosis), thickening of the skin on the palm and sole (keratosis), the appearance of black and white patches (leukomelanosis), pustules on the skin (hyperkeratosis), burning of eyes, headache, dizziness and poor vision. For an overwhelming majority of survey respondents, arsenicosis symptoms were identified 0–5 years before compilation of the list of arsenicosis sufferers for this study.

Data Collection and Data Analysis

A structured questionnaire was developed and approved by the Committee for Research Involving Human Subjects (IRB) at the Kansas State University. It was later administered among all 759 arsenicosis sufferers identified in the house-to-house survey. The questionnaire included two broad sections: (1) a socio-demographic section to collect information regarding age, gender, education, occupation and landholding size of participants; (2) a section focusing on health-seeking behaviour. In section two, the nature and order of treatment measures undertaken and other relevant information were recorded. This questionnaire was pre-tested in a pilot study by a trained field survey team, which consisted of six male and two female graduate students in geography from the University of Dhaka, Bangladesh. All members of this team had previous field research experience, including identifying people who have arsenicosis and testing of arsenic levels in tubewell water.

In order to obtain a more complete picture of the health-seeking behaviour of arsenicosis sufferers, four focus group meetings were held with local leaders, NGO and government officials, and village health workers. Two focus group meetings were organized in each study site; one before and one after completion of the questionnaire survey. The first meeting helped to identify the vocabulary the target audience uses for the concepts being studied. The second meeting allowed efficient and effective communication, discussion and clarification of issues raised in the individual interviews. Each focus group was composed of between 6–10 persons, and these group meetings were held in a local school or a government/NGO office. For each of the focus group discussions, a moderator facilitated the process.

Identification of the important determinants of health-seeking behaviour of people with arsenicosis was performed in two stages. In the first stage, chi-square tests were employed to examine whether associations between selected independent variables and health-seeking behaviour were statistically significant. Since the dependent variable is binary in form (sought medical treatment from a physician at any time prior to the questionnaire survey for arsenicosis problem or not), a logistic regression model was used to explore the influence of the selected independent variables on the health-seeking behaviour of people who have been exposed to arsenic (Neter et al. 1983).

Based on the literature survey and focus group meetings, 11 independent variables (age, gender, literacy, occupation, landholding size, annual household income, NGO membership status, stage of illness, symptoms identification time, perceived threat and study site) were included in this analysis. Two focus group meetings organized before administration of the questionnaire survey and subsequent conversations with a number of respondents and key personnel made it clear that access to healthcare resources was not an important factor in influencing the health-seeking behaviour of individuals from both study sites. This was because both sites were regularly visited by physicians and healthcare workers sponsored by both NGOs and public agencies (Paul and Brock 2006). This is the reason distance to nearest health personnel and/or facility was not included as a variable in this study.

Several other variables, such as knowledge of healthcare, cost of care and perceived quality of care were not included for two reasons. First, field visits and focus group meetings revealed that most residents of the study sites had little knowledge regarding treatment options available for people

who have arsenicosis. This is most likely because this illness is relatively new in Bangladesh. Second, since a considerable proportion of the respondents had sought and received treatment free of cost from physicians who visited the study sites several times in the past as members of medical teams, cost of care and perceived quality of care were also not included in the analysis.

Table 1. Selected characteristics of the respondents

Characteristic	Ramganj (n=334) No. (%)	Ramchadrapur (n=329) No. (%)	Total (n=663) No. (%)
Landholding Size			
Landless	49 (14.67)	66 (20.06)	115 (17.35)
Small	273 (81.74)	198 (60.18)	471 (71.04)
Medium and large	12 (3.59)	65 (19.76)	77 (11.61)
χ^2 =51.181 (p<0.001; d.f.=2)			
Occupation			
Farming	98 (29.34)	107 (32.52)	205 (30.92)
Business	100 (29.94)	102 (31.00)	202 (30.47)
Service	61 (18.26)	29 (8.81)	90 (13.58)
Others	75 (22.460)	91 (27.66)	166 (25.03)
χ^2 =13.301 (p=0.010; d.f.=3)			
Annual Household Income (in Taka)			
<30,000	69 (20.66)	81 (24.62)	150 (22.62)
30,000–60,000	163 (30.24)	168 (51.06)	331 (50.08)
>60,000	102 (30.24)	80 (24.32)	182 (27.30)
χ^2 =3.407 (p=0.182; d.f.=2)			
Education (years in schools)			
Illiterate	104 (31.14)	159 (48.33)	263 (39.67)
Up to 5th grade	48 (14.37)	23 (6.99)	71 (10.71)
6–10th grade	122 (31.14)	101 (30.70)	223 (33.63)
>10th grade	60 (17.96)	46 (13.98)	106 (15.99)
χ^2 =24.095 (p<0.001; d.f.=3)			
Age			
<30 years	99 (29.64)	151 (45.90)	250 (37.71)
30–44 years	147 (44.01)	119 (36.17)	266 (40.12)
45–64 years	73 (21.86)	40 (12.16)	113 (17.04)
>64 years	15 (4.49)	19 (5.78)	34 (5.13)
χ^2 =23.835 (p<0.001; d.f.=3)			
Gender			
Male	139 (41.62)	182 (55.32)	321 (48.42)
Female	195 (58.38)	147 (44.68)	342 (51.58)
χ^2 =12.460 (p<0.001; d.f.=1)			
NGO Membership			
Yes	5 (1.50)	58 (17.63)	63 (9.50)
No	329 (98.50)	271 (82.37)	600 (90.50)
χ^2 =50.159 (p<0.001; d.f.=1)			

As indicated, arsenic exposure affects people differently. Infants are more sensitive to arsenic than adults (Paul and De 2000). Physicians suggest that dietary intake is the most vital factor in determining who is afflicted with arsenic poisoning. Poor nutrition renders individuals more vulnerable (Lepkowski 1998). It has been found that protein-rich food is able to delay the effects of arsenic-related manifestations; however, most economically-challenged families in rural Bangladesh are unable to purchase such food. Since women in Bangladesh bear the heavier burden of poverty, there also tends to be a gender bias in arsenic poisoning (Sultana 2006). Nutritional intake is not included in this study as an independent variable primarily because of its high correlation with household income (WHO 2000).

Five of the 11 independent variables considered in this study (landholding size, annual household income, educational level, age and symptom identification time) were treated as interval or ratio scale data in the logistic regression model. Another five variables – NGO membership (no or yes), stage of illness (initial or advanced stage), perceived threat (no or yes), study site (Ramganj or Ramchandrapur) and gender (female or male) – were binary variables, while occupation variable was categorized into four groups (see Table 1). After testing for multicollinearity problem, all 11 variables were included in the logistic regression model. Because of the small sample size, no attempt was made to include interaction effects in the logistic regression model.

Respondent Profile

Of the 759 individuals identified with arsenicosis symptoms, it was possible to interview 697 of them from the two study sites. Additionally, 34 questionnaires had to be discarded from the analysis because they were improperly completed. Accordingly, the analysis in this study was based on 663 properly completed questionnaires. Table 1 shows that 115 (17.35%) of the 663 respondents were landless. The percentage of respondent households possessing small landholdings was slightly over 71. The calculated chi-square value indicates that the two study sites differ significantly with respect to respondent household landholding size. Table 1 indicates that average landholding size is higher among respondents from Ramchandrapur compared to respondents of Ramganj. It is important to note that the chi-square is testing the difference of selected variables between the two study sites.

Table 1 shows respondent occupation is categorized in four groups: farmers, businessmen, service holders and others. The last group includes housewives, labourers, students, unemployed and retired people. Survey data indicate nearly 31% of all study respondents engaged in farming, a lower percentage than for the country as a whole. This is simply because respondents grouped under the housewife and student occupation categories originate from farming households.

Table 1 shows that about 23% of respondent households earned less than Tk. 30,000 (US $520) per year, while 27% earned more than Tk. 60,000 (US $1,040). Table 1 indicates that the largest proportion of respondents belongs to the 30–44 year age cohort. The number of female respondents is slightly higher than male respondents. Analysis of respondent characteristics reveals that, excluding annual household income, the two study sites differ significantly in all other characteristics considered in this study.

Results

Illness Treatment Choice

Data from the survey reveal that nearly 35% of all people who have arsenicosis (230 out of 663) consulted physicians regarding their illness. This rate of physician utilization can be considered relatively high, which indicates that arsenicosis has become a serious health concern in the affected region. Survey data further indicate a discernible difference in the likelihood of health-seeking behaviour between respondents of the two study sites. A greater proportion of Ramganj respondents (39%) sought medical treatment from practitioners (of various medical systems) than their counterparts living in Ramchandrapur (31%). This difference in healthcare-seeking behaviour between respondents of the two study sites is statistically significant at the 0.05 level.

Information regarding frequency and types of physicians consulted by the respondents who sought medical intervention for their arsenicosis problem is presented in Table 2. This table indicates that 230 people who have arsenicosis made 294 visits to physicians, which means each respondent made 1.28 visits. Nearly 46% of all visits were to M.B.B.S. doctors, 20% of visits were to paraprofessionals and about 16% consulted unqualified allopathic practitioners. These figures suggest that respondents were not generally relying on traditional healers for treating their illness. It was revealed both from the focus group meetings and informal conversations that respondents consider arsenicosis a new disease caused by consuming arsenic-contaminated tubewell water. Further, respondents believe that this illness is an outcome of Western technology used to extract water from underground, so they believe it should be treated by practitioners of Western medicine.

Table 2 further shows that physician type consulted differs by study site. As expected, respondents of Ramganj utilized M.B.B.S doctors to a greater extent than respondents from Ramchandrapur. In contrast, respondents of the latter site depended more on other types of modern physicians, such as paraprofessionals (see Table 2). Indeed, respondents of Ramchandrapur reported the use of homeopathic care almost three times as frequently as respondents from Ramganj. At both study sites, only a few respondents consulted practitioners of ethnomedicine for treatment of their illness.

Table 2. Types of physicians consulted*

Healthcare sought	Ramganj (n=129) No. (%)	Ramchandrapur (n=101) No. (%)	Study Area (n=230) No. (%)
Modern			
M.B.B.S.	95 (73.64)	40 (39.60)	135 (58.70)
Paraprofessionals	31 (24.03)	28 (27.72)	59 (25.65)
Unqualified allopaths	22 (17.05)	24 (23.76)	46 (20.00)
Homeopath	11 (8.53)	25 (24.75)	36 (15.65)
Traditional			
Kabiraj	9 (6.98)	5 (4.95)	14 (7.49)
Hakim	4 (3.10)	0 (0.00)	4 (1.74)
Frequency of consultation	172	122	294
Average	1.33	1.21	1.28

*Multiple response possible

The two study sites also differ regarding the frequency of physician consultation by respondents. On average, respondents in Ramganj utilized 1.33 physicians compared with 1.21 physicians consulted by respondents of Ramchandrapur (see Table 2). This pattern is consistent with findings reported on treatment choices by respondents of the two study sites. Survey data show that nearly one-third of the respondents of both study sites consulted more than one type of physician. These respondents either switched from one type of physician to another or utilized more than one type concurrently – probably with the hope of a fast cure from their symptoms. A careful review of field data suggests that this "switching" occurred usually from the care of M.B.B.S. doctors and paraprofessionals to other physicians of Western medicine.

Survey data also show that practitioners with an M.B.B.S. degree were utilized both once and more than once by the majority of respondents from both study sites. No respondent consulted a Kabiraj or a Hakim only, which implies that respondents who consulted traditional practitioners also utilized other physicians. It is likely that these individuals were not completely satisfied with the treatment received from traditional healers, and that is why they switched to other practitioners. As

noted earlier, many people in the study area related arsenicosis with Western technology and many of them believed that the illness could be treated only by consultation of physicians of modern medical systems.

Survey data also suggest that in the quest for therapy, about 14% of the respondents who sought treatment from more than one physician consulted up to four physicians. In each one of these four choices, an overwhelming majority of respondents from both study sites preferred M.B.B.S. doctors for medical consultation. Failure of the treatment from the first referral was the primary reason given by respondents for seeking treatment from another physician(s); further physician consultation was generally attributed to dissatisfaction with a previous provider. In nearly 8% of the cases where treatment by another physician was sought, the reason given was recommendation of the respondent's previous medical care providers, most of whom were practitioners without an M.B.B.S. degree.

Questionnaire survey data reveal that some respondents in both study sites used two different physicians of the same medical system, but from different places. However, respondents who sought treatment from more than one source did not frequently change their treatment modes. Such respondents were usually under the same physician's care for a relatively long period of time before switching to another physician. Switching generally occurred to the same type of physician (i.e., from one M.B.B.S. doctor to another M.B.B.S. doctor or from another physician of Western medicine to a physician with an M.B.B.S. degree).

Respondents who sought treatment from a third and/or fourth physician reported that they were very frustrated with the treatment they received for their illness. Most of these respondents were either moderately or severely affected by arsenicosis and their continuation of symptoms forced them to continue treatment. Their previously held greater belief in modern medicine lessened, and at the time of the interview, these respondents were inclined more toward ethnomedicine treatment options. A similar observation was also reported by Shafie (2000) who studied health-seeking behaviour of arsenic patients in a village in northern Bangladesh. The present study noted that nine respondents from both study sites went back to their original physicians for treatment after seeking help from other medical practitioners.

Determinants of Health-Seeking Behaviour of Arsenic Patients

Table 3 shows that, similar to study site, landholding size is strongly associated with the treatment-seeking behaviour of people in the study area who have arsenicosis. Only 20% of all landless households consulted medical personnel for their illness. Thirty-six per cent of households with small landholdings consulted medical personnel, while 48% of people with arsenicosis from households with medium or large landholdings did so. Surprisingly, annual household income had no significant impact on the treatment-seeking behaviour of arsenicosis sufferers (see Table 3). As expected, respondents employed in non-farming occupations sought medical treatment more frequently than respondents who were farmers.

Table 3 further shows a strong positive relationship between educational level of the respondents and consultation of medical personnel for their arsenicosis symptoms. In contrast, respondent age exhibits an inverted U-shaped relationship with treatment seeking from healthcare professionals (see Table 3). The calculated chi-square value is also highly significant, indicating the health-seeking behaviour of respondents differs by age group.

Contrary to expectation, no gender difference was found with respect to utilization of healthcare personnel for arsenicosis symptoms. This unexpected finding might be associated with the social stigma linked to some arsenicosis symptoms. Because of skin manifestations associated with arsenicosis, parents are often unable to get their afflicted daughters married. For this reason, before skin manifestations become highly visible, parents take them to physicians for treatment. Arsenicosis-afflicted married women also seek treatment to avoid unfortunate consequences. It has been reported that some married women with skin lesions due to chronic arsenic exposure were rejected by their spouse and sent back to their parents, or their husbands took a second wife (Paul and De 2000; Bhuiyan and Uddin 2001).

Table 3. Use of medical personnel for arsenicosis by selected factors

Factor	Used (%)	Not used (%)	Total (%)
Study Site			
Ramganj	129 (38.62)	205 (61.38)	334 (100.00)
Ramchandrapur	101 (30.70)	228 (69.30)	230 (100.00)
χ^2 =4.593 (p-value=0.032; d.f.=1)			
Landholding Size			
Landless	23 (20.00)	92 (80.00)	115 (100.00)
Small	170 (36.09)	301 (63.91)	471 (100.00)
Medium and large	37 (48.05)	40 (51.95)	77 (100.00)
χ^2 =17.431 (p-value <0.001; d.f.=2)			
Annual Household Income (in Tk.)			
<30,000	47 (31.33)	103 (68.67)	150 (100.00)
30,000–6,000	110 (33.23)	221 (66.77)	331 (100.00)
>60,000	73 (40.11)	109 (59.89)	182 (100.00)
χ^2 =3.416 (p-value =0.181; d.f.=2)			
Occupation			
Farming	72 (35.12)	133 (64.88)	205 (100.00)
Business	76 (37.62)	126 (62.38)	202 (100.00)
Service	43 (47.78)	47 (52.22)	90 (100.00)
Others	39 (23.50)	127 (76.50)	166 (100.00)
χ^2 =17.549 (p-value =0.023; d.f.=3)			
Education			
Illiterate	64 (24.33)	199 (75.67)	263 (100.00)
Up to 5th grade	20 (28.17)	51 (71.83)	71 (100.00)
6–10th grade	90 (40.36)	133 (59.64)	223 (100.00)
>10th grade	56 (52.83)	50 (47.17)	106 (100.00)
χ^2 =32.339 (p-value <0.001; d.f.=3)			
Age			
<30 years	70 (28.00)	180 (72.00)	250 (100.00)
30–44 years	112 (42.11)	154 (57.89)	266 (100.00)
45–64 years	42 (37.17)	71 (62.83)	113 (100.00)
>64 years	6 (17.65)	28 (82.35)	34 (100.00)
χ^2 =16.060 (p-value <0.001; d.f.=3)			
Gender			
Male	111 (34.58)	210 (65.42)	321 (100.00)
Female	119 (34.80)	223 (65.20)	342 (100.00)
χ^2 =0.003 (p-value=0.954; d.f.=1)			
NGO Membership			
Yes	17 (26.98)	46 (73.02)	63 (9.50)
No	213 (35.50)	387 (64.50)	600 (90.50)
χ^2 =1.825 (p-value=0.177; d.f.=1)			
Symptoms Identification (months ago)			
<12	13 (24.53)	40 (75.47)	53 (100.00)
12–60	111 (26.37)	311 (73.63)	421 (100.00)
>60	106 (56.09)	83 (43.91)	189 (100.00)
χ^2 =53.476 (p-value <0.001;d.f.=2)			

Table 3. Continued

Factor	Used (%)	Not used (%)	Total (%)
Perceived Threat			
Yes	188 (41.59)	264 (58.41)	452 (100.00)
No	42 (19.91)	169 (80.09)	211 (100.00)
χ^2 =29.864 (p-value <0.001; d.f.=1)			
Illness Stage			
Initial	204 (32.96)	415 (67.04)	619 (100,00)
Advance	26 (59.09)	18 (40.91)	44 (100.00)
χ^2 =12.384 (p-value <0.001; d.f.=1)			

Information presented in Table 3 indicates no significant difference between NGO membership and consultation of healthcare personnel for arsenicosis-related symptoms among survey respondents. Because of empowerment programs sponsored by various NGOs, it was expected there would be a direct relationship between these two variables. However, this unexpected finding might be associated with the small number of survey respondents who are members of one or more NGOs.

Table 3 clearly shows that the remaining three variables (time of symptom identification, perceived threat and illness stage) are strongly associated with the health-seeking behaviour of respondents in the study area. Respondents whose symptoms were identified more than five years before the survey were much more likely to seek treatment from healthcare personnel than respondents whose symptoms were identified less than five years prior to this survey. Similarly, respondents who were in advanced stages of arsenicosis and who perceived it as a life threatening illness were more likely to seek treatment than those respondents who were in more initial stages and did not perceive their arsenicosis symptoms as life threatening. These observed patterns are consistent with expected patterns.

Results of the chi-square tests provided in Table 3 clearly show that in a bivariate analysis, time of symptom identification is the most influential determinant of health-seeking behaviour of people who have arsenicosis in the study area, followed by the education level of respondents, perceived threat, occupation, landholding size, age, illness stage and study site, respectively. This suggests cognitive, symptom-appraisal, as well as social and demographic factors were important determinants of health-seeking behaviour among survey respondents in the study area.

Results of the application of the logistic regression model are shown in Table 4. This model is statistically significant at the 0.01 level and the variables: illness stage, perceived threat, symptom identification time and education level were significant for explaining the probability of respondents seeking care for their arsenicosis-related symptoms. This implies that the economic status of the respondents surveyed does not exert a strong influence on their treatment-seeking behaviour. Paradoxically, both landholding size and annual household income are negatively associated with respondent health-seeking behaviour.

Table 4 also presents odds ratios for the 11 variables included in the final model along with the reference category for binary variables. For example, the initial stage is the reference category for the variable illness stage. The table suggests that the odds of seeking treatment from healthcare personnel by respondents who perceived themselves to be in the most advanced stage of arsenicosis were 11.635 times higher than those respondents who perceived their illness to be in the initial stage. These odds ratios can be interpreted in a similar way for other variables included in the model. Based on these ratios, illness stage emerged as the leading factor for utilization of medical practitioners by respondents for arsenicosis symptoms followed by gender and perceived threat.

Discussion

Several important observations have emerged from the foregoing analysis of the health-seeking behaviour of arsenic-afflicted respondents. First, the rate of utilization of healthcare personnel, particularly practitioners of modern medicine, is relatively high at both study sites. Available studies (e.g., Paul 1992) suggest that people in Bangladesh, in general, avoid treatment until an illness causes a serious physical disability or becomes life threatening. As a result, the overall utilization of healthcare personnel is very low in the country. One reason for the high rate of physician consultation by people with arsenicosis in the study area is associated with mitigation efforts undertaken by both government agencies and NGOs. These organizations dispatched mobile medical teams to arsenic-impacted areas – including the study sites – to identify people who have arsenicosis and provide care to them (Rabbani et al. 2002). These teams consisted of both foreign and domestic physicians of Western medicine. In addition, a number of NGOs conducted health camps in the affected areas. Members of the mobile arsenic teams and participants of the camps provided services to people with arsenicosis either without charge or at minimal cost. Based on informal interviews and focus group meetings, it appears that there was no perceived difference in the coverage of mobile clinics and medical camps among the two study sites.

Table 4. Results derived from the logistic regression model

Explanatory Variable	Coefficient	Odds Ratio
Landholding Size	-0.020	1.046
NGO Membership (yes)	-0.209	1.232
Annual Household Income	-0.000	0.000
Illness Stage (initial)	-2.454**	11.635
Perceived Threat (no)	1.001**	2.721
Study Site (Ramchandrapur)	0.262	1.300
Time of Symptoms Identification	0.030**	1.031
Gender (male)	-13.570	4.817
Age	0.010	1.010
Educational Level	0.128**	1.137
Occupation (farming)		
Business	0.342	1.408
Service	0.100	1.105
Others	0.918	2.504
Intercept	9.804	571.700
-2 Log-likelihood 146.028 (p<0.001)		

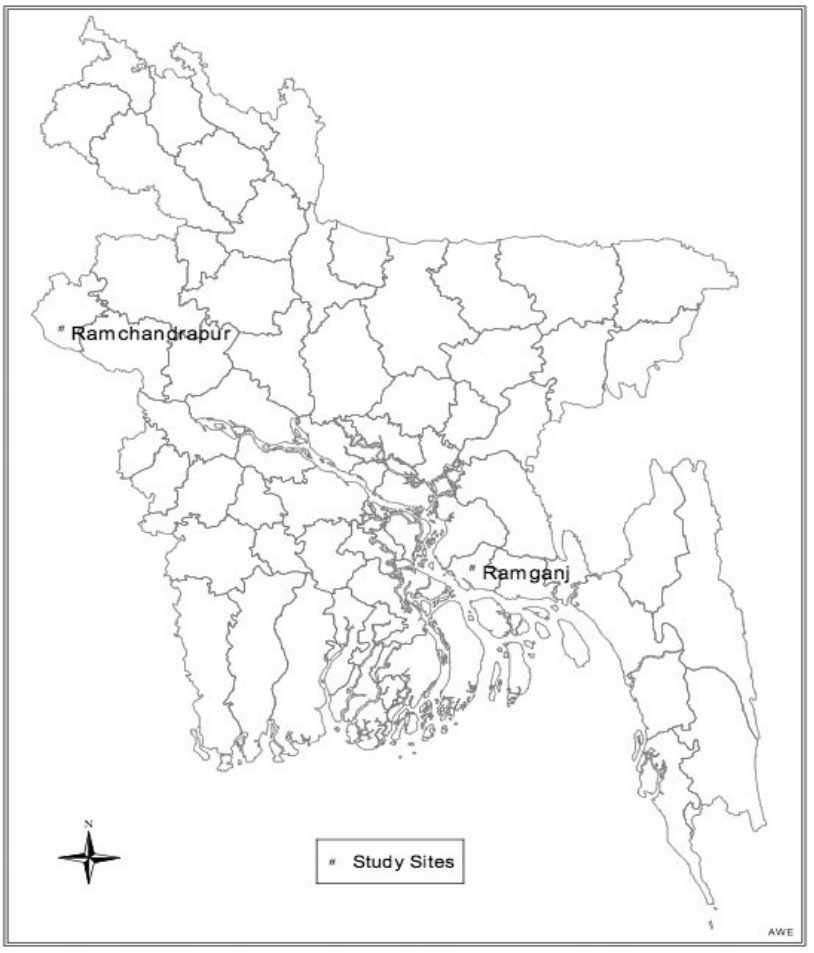
*p#0.05
**p#0.01

Despite this similar coverage, the two study sites do differ in healthcare-seeking behaviour and this may be associated with the level of development of the sites. Ramganj has a better relative location than Ramchandrapur, because the former site is well connected to Dhaka, the capital and development core of Bangladesh (Figure 1). It takes less than three hours by bus to reach Dhaka from Ramganj, while it requires at least 10 hours by bus to reach Dhaka from Ramchandrapur. Also, compared with Ramchandrapur, more Ramganj residents work abroad and regularly send money back to their homes. Fifteen respondents from the latter study site reported that at least one member of their family is currently living in a Middle Eastern country as a guest worker. In contrast, no respondent household member from the former site lives in a foreign country.

It is clear from this study that most respondents consider appropriate treatment for arsenicosis symptoms should be obtained from practitioners of modern medicine. In this context, paraprofessionals can play an important role in providing necessary consultation to people who have arseni-

cosis. Paraprofessionals are a viable alternative to M.B.B.S. doctors whose treatments are much more expensive. As mentioned, members of mobile medical teams, many qualified physicians of Western medicine visited both study sites and provided free consultation to arsenicosis sufferers. Since these visits were one of the important sources of treatment for arsenic-related symptoms among survey respondents, these visits need to be continued in the future.

Figure 1. Study area



Logistic regression analysis performed in this study clearly suggests that cognitive and symptom-appraisal are more important determinants of treatment-seeking behaviour of respondents than are social and economic factors. As noted, both landholding size and annual household income are inversely associated with respondent health-seeking behaviour. This relationship might, however, be explained in the context of the healthcare services provided by members of medical teams frequently sent by both NGOs and government agencies to the study area. These teams, as noted, provided medical care either free of charge or at minimal cost to individuals with arsenic-related symptoms. Additionally, several NGOs and government agencies distributed vitamins – free of cost – among the poorest people who have arsenicosis.

The finding that cognitive and symptom-appraisal are more important than the economic status of the respondents is encouraging in the sense that it is difficult to alter socio-economic characteristics of individuals, but underlying cognitive mechanisms affecting treatment–seeking behaviour may be amenable to change through public campaigns and/or heath education efforts. Health professionals, government agencies and NGOs involved in arsenic mitigation programs should take note of this important finding.

This study, however, has at least two limitations. First, several variables, such as the distance to the nearest healthcare facility and/or personnel, and dietary intake, were not included in this study. These variables are generally considered important determinants of health-seeking behaviour of arsenicosis and other patients, but were excluded for the reasons given earlier. Because this empirical study is based on samples drawn from only two rural areas in Bangladesh, generalizing findings here to all areas of Bangladesh is therefore limited.

Conclusions

Arsenic has been found at levels considered "unsafe" in tubewells that supply drinking water to much of rural Bangladesh. This problem is so pervasive that it may impact as many as two-thirds of the total population of this country. The objectives of this study were to examine the health-seeking behaviour of people who have arsenicosis and to identify the underlying factors affecting their behaviour. Survey data show that only about 35% of all respondents consulted healthcare personnel regarding their symptoms. Although all types of available healthcare resources were utilized by people with arsenicosis, the majority of respondents who sought medical treatment preferred physicians with M.B.B.S. degrees, followed by paraprofessionals.

Based on the results of this study, a number of recommendations are offered to the Bangladesh government and NGOs involved in arsenic mitigation and prevention efforts. These recommendations will help save the lives of many Bangladeshis who live in arsenic-impacted rural areas. Since the surveyed arsenicosis sufferers expressed their faith in Western medicine, paraprofessionals (who are more available, accessible and affordable than M.B.B.S. doctors) should assume a more dominant role in providing healthcare services to people who have arsenicosis. Concerned agencies also need to continue to dispatch mobile medical teams to arsenic-impacted areas. These teams were important sources of quality care for many people who suffer the effects of arsenic poisoning in the study area.

In the absence of sufficient empirical studies on the heath-seeking behaviour of arsenicosis sufferers in Bangladesh and elsewhere, this research provides important and useful insights guiding arsenic prevention and mitigation efforts in Bangladesh. It makes an original contribution to the existing literature on the health-seeking behaviour of people who have been poisoned by arsenic in a country characterized by widespread poverty, illiteracy and a poor state of heath among most of its citizens. For a more complete understanding, further research needs to be directed toward this topic in moderate- and low-arsenic risk zones in Bangladesh. Such research might be able to determine whether health-seeking behaviour differs by risk zone. If so, different policies and programs may be needed to mitigate and prevent arsenicosis in different arsenic-impacted areas of Bangladesh.

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Appendix

Health-Seeking Behaviour of Arsenic Patients in Rural Bangladesh

Sample No.: _____ Study Site: _____
Name of Village: _____ Name of Thana: _____

1. How long ago did you first notice any symptom(s) of arsenic poisoning? _____ months
2. What was the symptom? _____
3. Did you identify the symptom(s)? _____ Yes; _____ No

If answer to question # 3 is no, answer questions 4-5 (otherwise continue with question #6):

4. Who identified the symptom(s)? _____
5. Specify your relation with the person(s): _____
6. After identification of arsenic-related symptom(s), what did you do?

   _____ Nothing _____ Consulted friends/relatives/neighbours
   _____ Consulted physician _____ Other (specify): _____

If answer to question # 6 is consulted physician, answer questions 7-20
(otherwise skip to question # 21):

7. To date, with what type of physicians have you consulted?

   ____ Kabiraj _____ Hakim
   ____ Homeopath _____ Folk Practitioners
   ____ Non-qualified Allopath _____ Qualified Allopath, but not MBBS Doctors
   ____ MBBS Doctors _____ Others (specify): _____
8. Why did you select the above type(s) of physicians(s)?

   _____

   _____
9. How long since symptom(s) were identified before you consulted a physician? ____ months

If answer to question # 9 is more than two months, answer question # 10
(otherwise continue with question # 11):

10. What are the reasons for delay in consulting a physician(s)?

    _____
11. Did you change physician due to arsenic-related symptom(s) since your first visit to a physician? ____ Yes; _____ No

If answer to question # 11 is Yes, please answer questions 12-18 (otherwise skip to question # 19):

12. How many times did you change physician? _____ times

13. Specify the sequence of change from first physician to last/current physician (if you simultaneously sought or are seeking treatment from more than one type of physician, please use same sequence number):

Sequence	Type of Physician	Reason
_____	_____	_____
_____	_____	_____
_____	_____	_____

14. Have you ever visited a medical facility for treatment of arsenic-related illnesses?
_____ Yes; _____ No

If answer to question # 14 is Yes, please answer questions 15-18 (otherwise skip to question # 19):

15. Which medical facility did you visit? _____
16. What was the reason for medical facility visit? _____
17. How many times did you visit medical facility? _____
18. How long did you stay in each visit? _____ days
19. Did you experience any problem(s) in seeking treatment? _____ Yes; _____ No

If answer to question # 19 is Yes, please answer question 20 (otherwise skip to question # 22):

20. Please specify any problem(s) experienced:
_____
_____
21. Why did you not consult a physician?
_____
22. Do you think that arsenic poisoning constitute a serious threat to life? ____Yes; ____ No
23. Do you think that your life is threatened by arsenic-related illnesses? ____ Yes; ____ No
24. What is the main cause of arsenic-related illness? _____
25. What are the diseases caused by arsenic poisoning? _____
26. What medicines are available for the treatment of arsenic-related illnesses?
_____
27. What can a victim do once he/she knows he/she has the symptom(s)?
_____
28. What can be done to prevent arsenic poisoning?
_____
29. What is your gender? ____ Male; ____ Female
30. What is your age?
31. What is your marital status? ____ Single; ____ Married; ____ Widowed; ____ Other
32. Specify number of years you have attended schools (write 0 if you have never attended school): _____

33. Specify your employment status:

_____ Employed (full-time) _____ Employed (part-time)

_____ Student _____ Unemployed

_____ Other (specify): _____

If your answer to question # 33 is employed, please answer question 34 (otherwise skip to question #35):

34. Specify your occupation: _____

35. What is your annual household income? Tk. _____

36. How much land does your family own? _____ acres

37. What is your household size? _____

38. How many people suffer from arsenic-related illnesses in your family? _____

39. Is any person in your family member of a NGO? _____ Yes; _____ No

40. Please specify distance (in mile) from your home to the following:

Kabiraj: _____ Hakim: _____

Homeopath: _____ Folk Practitioner: _____

Non-qualified Allopath: _____ Qualified Allopath, but not MBBS Doctor: _____

MBBS Doctor: _____ Hospital: _____

If the respondent and household head (HD) is not the same person, please ask following questions to HD:

41. What is your gender? _____ Male; _____ Female

42. What is your age?

43. What is your marital status? ____ Single; ____ Married; ____ Widowed; ____ Other

44. Specify number of years you have attended schools (write 0 if you have never attended school): _____

45. Specify your employment status:

_____ Employed (full-time) _____ Employed (part-time)

_____ Student _____ Unemployed

_____ Other (specify): _____

If answer to question # 45 is employed, please answer question # 46 (for others, please stop here):

46. Specify your Occupation: _____

Indoor Air Pollution in India and a Baby's Size at Birth: Is there a Link?

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Abstract

An association between exposure to biofuels and adverse pregnancy outcomes has been reported in some developing countries of Asia and Latin America. In India, where more than 70% of households use biomass for cooking and heating purposes, hardly any research has been done to find out if there is a possible link between exposure to biofuels and adverse pregnancy outcomes. In the present study, an attempt has been made to find out if there is a plausible link between indoor air pollution (as determined by exposure to biofuels) and a baby's size at birth (a proxy for low birth weight), in India, by using data from the National Family Health Survey, 1998–99. The results of logistic regressions show that using biomass as cooking fuel is a very significant predictor in determining a baby's size at birth, even after controlling for a number of confounding variables. In addition, there are other demographic, socio-economic and spatial characteristics that have a very significant influence in determining the size of a baby at birth in India.

Introduction

Contrary to the common perception that air pollution is primarily an urban phenomenon associated with industries and motor vehicles, the problem of indoor air pollution due to use of unprocessed biomass fuels far outweighs that of ambient air pollution in developing countries. Approximately half of the world's population and up to 90% of rural households in developing countries still rely on unprocessed biomass fuels such as wood, dung and crop residues (World Resources Institute 1998). According to the Census of India 2001, more than 72% of households still use unprocessed biomass as cooking fuel. In rural areas this is around 90% (Office of the Registrar General India 2003). It is estimated that some 3.5 billion people, mostly in the rural areas of developing countries,

are exposed to high levels of air pollutants in their homes (World Bank 1992). Although overall use of biomass fuel has been projected to decline over the coming years, reliance on biomass fuel as a major source of energy will remain substantial in the foreseeable future (World Bank 1996; WRI 1998; World Energy Council (WEC) 1999).

Biomass smoke contains many noxious components, including respirable particulates, carbon monoxide, nitrogen oxides, formaldehyde and polyaromatic hydrocarbons (Smith 1987, 1993; WHO 1992). High exposure to these pollutants has been shown to cause serious health hazards such as acute respiratory infections (ARI), chronic obstructive lung disease, tuberculosis, blindness, asthma and lung cancer (Kossove 1982; de Koning et al. 1985; Pandey et al. 1989; Armstrong and Campbell 1991; Dhar and Pathania 1991; Perez-Padilla et al. 1996; Mishra and Retherford 1997; Mishra et al. 1999a, 1999b, 2000, 2002; Bruce et al. 2000). It is estimated that about half a million women and children die every year from indoor air pollution in India (Smith 2000a). Compared to other countries, India has among the largest burden of disease due to the use of unclean household fuels, and 28% of all deaths due to indoor air pollution in developing countries occur in India (Smith 2000a).

Plausible Mechanism

Adverse pregnancy outcomes, such as low birth weight (LBW), still birth and perinatal mortality, are believed to be linked with indoor air pollution, though the mechanisms are only partially known. During pregnancy, women naturally produce carbon monoxide internally, and the natural rate of internal carbon monoxide production can be up to 50% higher than normal levels. As a consequence, women have higher levels of natural carboxyhemoglobin (HbCO) levels during pregnancy (Linderholm and Lundstrom 1969). Pregnant women's blood has 20–30% lower oxygen-carrying capacity due to lower concentration of hemoglobin (Longo 1977). Levels of carbon monoxide in houses using biomass fuels are high enough to raise a person's carboxyhemoglobin to levels comparable to those found in smokers (Dary et al. 1981; Behera et al. 1998). Thus, there is a probability that pregnant women who inhale carbon monoxide due to use of unprocessed biomass fuels can be at higher risk of spontaneous abortions, still births and reduced birth weights. It is worth mentioning that LBW, intrauterine growth retardation (IUGR) and impaired growth in the early years of life are known to influence the subsequent health status of individuals, including increased mortality and morbidity in childhood and an elevated risk of hypertension and coronary heart disease (Barker 1995; Osmond and Baker 2000; Smith 2000a). It is estimated that adverse pregnancy outcomes are responsible for 6% of all deaths, 7.5% of the overall national burden of disease and 20% of the national burden of disease for under-five children in India (Smith 2000a).

Very limited studies have been conducted in developing countries to identify plausible links between unfavourable birth outcomes and indoor air pollution. In India, hardly any large-scale studies have been carried out in this regard. Only one study in India seems to have examined adverse pregnancy outcomes as an outcome of biomass fuel use. This study, carried out in Ahmedabad, found an excess risk of 50% of still births among women using biomass fuels during pregnancy (Mavalankar et al. 1991). In rural Guatemala, babies born to women using wood fuel were 63 grams lighter than those born to women using gas and electricity, even after controlling for all other socio-economic and maternal factors (Boy et al. 2002). A Chinese study of urban ambient air pollution also found a strong relationship of particulate levels with preterm delivery (Xu et al. 1995a). The same group found that particulate air pollution was also associated with LBW (Wang et al. 1997). Some studies have also shown that intrauterine mortality, LBW, pre-maturity and early infant death have been strongly associated with urban ambient air pollution at much lower concentrations than in biomass fuel-using households (Pereira et al. 1998; Ritz and Yu 1999; Scram 1999; Bobak 2000).

Along with biomass fuels, other spatial, demographic and socio-economic factors may also adversely affect birth outcomes in developing countries. It has been found that risks of unfavourable birth outcomes are higher: for very young mothers, or those aged over 35 years; for women in their first pregnancy or after four pregnancies; when there is a short interval between two pregnancies; for women with certain pre-existing health problems related to their reproductive tracts; for

poor, malnourished and uneducated women; and for those women who do not have easy access to adequate healthcare (Herz and Measham 1987; Anandalakshmy et al. 1993; Bhargava et al. 1991; World Health Organization 1994; Population Studies and Research Institute (PSRI) and UNICEF 1996; Magadi et al. 2001). But some contradictory results on the effects of education and occupation have been found in Burkina Faso (Prazuck et al. 1993). A number of studies have demonstrated an association between antenatal care and adverse pregnancy outcomes such as perinatal mortality, LBW and premature delivery (Sadio 1991; Coria-Soto et al. 1996; Hollander 1997; Magadi et al. 2001). Some studies have found that poor maternal nutrition is one of the key factors closely associated with LBW, perinatal mortality and other forms of adverse pregnancy outcome (Voorhoeve et al. 1984; Mavalankar et al. 1991; Achadi et al. 1995; Pelletier et al. 1995; Magadi et al. 2001). Behavioural factors such as tobacco smoking have been found to be an important cause of intrauterine growth retardation and reduced birth weight (Seidman and Mashiach 1991; Gidding et al. 1994; Longo 1977).

The present study seeks to examine the influence of the use of biomass as cooking fuel on a baby's size at birth, in India, after controlling for a number of plausible spatial, demographic and socio-cultural variables that may affect birth outcomes unfavourably.

Materials and Methods

Data

Data for this study were drawn from India's second National Family Health Survey (NFHS-2), a large-scale survey carried out between 1998 and 1999 by ORC Macro and the International Institute for Population Sciences (IIPS). The data on fertility, mortality, morbidity, family planning and important aspects of reproductive health, nutrition and child care were collected from a nationally representative sample of 90,303 ever-married women in the age group 15–49 years, residing in 92,486 households. In addition, the survey collected information on 33,026 children born to those women during the three years preceding the survey. However, the analysis regarding the size of babies at birth is based on 32,470 of these children, for which there was complete information on the variables used in the analysis.

Response Variable

The analysis on how indoor air pollution affects a baby's size at birth presented in this paper is based on mothers' reports for the outcome variable – "small or smaller than average size of the baby at birth." Reporting may be unreliable for the outcome due to possibility of personal biases. Measurement error is likely to be critical for the size of a baby at birth, which is subject to personal perceptions and possible systematic errors.

It must be mentioned that, in a developing country, such as India, more than 70% of babies are not weighed at birth, since most of the deliveries take place at home. It is worth noting that, out of 33,026 surveyed children in NFHS-2, only 8,504 were weighed at birth. In those cases in which the babies were weighed at birth, the possibility of selective representation of some socio-economic groups in the sample distribution may not be ruled out. Table 1 clearly reveals that those babies who were weighed at birth were of higher-educated, middle-aged and well-nourished mothers and belonged to the economically better off section of society. High urban bias has also been observed in this case. Again, from Table 1, it can be noted that those mothers who received complete antenatal care are more likely to have their baby weighed at birth. Table 1 also shows that the weighed babies are basically representative of those households that use cleaner fuels for cooking and heating purposes. Thus, using actual birth weight as a response variable in the present analysis would not be worthwhile, as it may produce biased estimates of the predictor variables and could distort the actual scenario. As such, actual birth weight has not been considered in the initial analysis and an alternate scheme of analysis has been adopted in which actual birth weight has been considered as response variable. Results are presented in a subsequent section.

Table 1. Number and sample distribution of births in the last three years for selected variables used in the analysis by weighed status, India, NFHS-2, 1998–99

Variables	Not weighed at birth		Weighed at birth	
	Number	Percentage	Number	Percentage
Type of cooking fuel				
Biomass fuels	20,854	86.1	3,849	45.3
Cleaner fuels	3,353	13.9	4,655	54.7
Sex				
Male	12,508	51.7	4,566	53.7
Female	11,699	48.3	3,938	46.3
Birth order/birth interval				
First birth	5,720	23.6	3,838	45.1
Birth order 2–3/<24 months birth int.	2,634	10.9	929	10.9
Birth order 2–3/≥24 months birth int.	7,724	31.9	2,833	33.3
Birth order 4+/<24 months birth int.	1,690	7.0	207	2.4
Birth order 4+/≥24 months birth int.	6,439	26.6	697	8.2
Mother's age				
<20	5,213	21.5	1,444	17.0
20–29	14,336	59.2	5,710	67.1
30+	4,658	19.2	1,350	15.9
Religion/caste				
Forward caste Hindu	11,135	46.0	4,772	56.1
SC-ST Hindua	6,900	28.5	1,282	15.1
Other than Hindu	6,172	25.5	2,450	28.8
Maternal education				
Illiterate	16,289	67.3	1,738	20.4
Primary-middle completed	6,089	25.2	3,444	40.5
Higher-educated	1,825	7.5	3,320	39.0
Standard of living				
Low	9,350	39.1	1,237	14.8
Medium	11,731	49.0	4,041	48.3
High	2,843	11.9	3,087	36.9
Mother's BMI				
<18.5 kg/m^2	8,316	37.7	2,286	28.0
≥18.5 kg/m^2	13,756	62.3	5,884	72.0
Complete antenatal care				
No	17,381	71.8	1,999	23.5
Yes	6,826	28.2	6,505	76.5
Place of residence				
Rural	20,207	83.5	4,089	48.1
Urban	4,000	16.5	4,415	51.9
Geographic region				
North	6,351	26.2	1,354	15.9
Central	6,582	27.2	575	6.8
South	1,889	7.8	2,522	29.7
West	1,628	6.7	1,747	20.5
East & North-east	7,757	32.0	2,306	27.1
Number of births*	**24,207**	**100.0**	**8,504**	**100.0**

*Number of births varies slightly depending on the number of missing cases at each variable.
a- Scheduled castes and scheduled tribes

Some previous studies have addressed the issue of the reliability of mothers' reports of the size of their babies at birth, and found that mothers' reports, including approximate sizes, are fairly reliable and can be used as proxies to examine biological and socio-economic correlates of birth weight (Da Vanzo et al. 1984; Boerma et al. 1996; Magadi et al. 2001).

To assess the reliability of a mother's perception of the size of her baby at birth, the average weights of the babies by reported sizes were examined in cases where birth weights were independently available (shown in Table 2), and the test of association (Somers' D test) between perceived size and actual birth weights, when available, was performed. It has been found that, given two babies in the sample chosen at random, the odds are more than three to one that a baby perceived as heavier at birth actually has greater birth weight. Note, however, that only 1,905 babies perceived as average actually have birth weights between 2,300 and 2,900 grams, whereas 2,481 babies perceived as average have birth weights above 2,900 grams. Possibly for this reason that the Somers' D test on the degree of association between these two variables did not confirm their very close agreement.

Table 2. Association between birth weight (in grams) and reported baby size, India, NFHS-2, 1998–99

	Perceived size of baby at birth				
Birth weight (g)	**Larger than average**	**Average**	**Smaller than average**	**Very small**	**Total**
>2,900	1,550	2,481	156	15	4,202
>2,300 and ≤2,900	163	1,905	537	52	2,657
>1,900 and ≤2,300	55	580	488	90	1,213
≤1,900	16	141	258	162	577
Total	**1,784**	**5,107**	**1,439**	**319**	**8,649**

		Value	Asymp. std. error	Approx. sig.
Somers' d	Symmetric	0.495	0.007	.000
	Birth weight (kg) – Dependent	0.523	0.007	.000
	Size of child at birth – Dependent	0.469	0.008	.000

Note that the main objective of the present study is to observe the effect of cooking fuel on a baby's size at birth by performing multivariate analyses, where the response variable is dichotomous (<average and ≥average) in nature. To assess whether mothers' reports affects the multivariate analyses in any way, the data have been further re-classified into actual birth weight (categories are: <2,500 grams and ≥2,500 grams; as according to WHO and UNICEF 1992, LBW is defined as a baby's weight at birth being <2,500 grams), on the one hand, and perceived size at birth (categories are: <average and ≥ average) on the other. Here, the two categories "smaller than average" and "very small" have been pooled into "<average" category and "larger than average" and "average" have together been combined into "≥average" category. The results are presented in Table 3. Table 3 clearly reveals that, of the babies perceived as less than average size at birth, about 54% actually have birth weight less than 2,500 grams (1,037 babies out of a total of 1,928), whereas of the babies perceived as equal or greater than average size at birth more than 87% actually have birth weight equal or greater than 2,500 grams (6,000 babies out of a total of 6,721 babies). These findings suggest that mothers' reports were reasonably reliable, at least for the purpose of the present analysis. However, it is assumed that mothers whose babies were not weighed reported using a similar scale as for those mothers whose babies were weighed.

Table 3. Association between birth weight (in grams) and reported baby size (pooled for multivariate analysis), India, NFHS-2, 1998–99

	Perceived size of baby at birth		
Birth weight (g)	Less than average	Greater than or equal to average	Total
<2,500	1,037	891	1,928
≥2,500	721	6,000	6,721
Total	**1,758**	**6,891**	**8,649**

Predictor and Control Variables

The main predictor variable in this analysis has been created by the combination of two variables: (a) "type of fuel mainly used for cooking" and (b) "other types of fuel commonly used for cooking or heating." Fuel type has also been shown in India to be a good predictor of indoor air pollution levels in households (Mehta 2002; Mishra 2003). The NFHS collected data on a tenfold classification of primary cooking fuel, including wood, crop residues, dung cakes, coal/coke/lignite, charcoal, kerosene, electricity, liquefied petroleum gas (LPG), biogas and a residual category of other fuels. Measurements in India show that the emissions of pollutants from household stoves vary along the "energy ladder," with solid fuels producing substantially more pollution per meal cooked than liquid or gaseous fuels (Smith et al. 2000). It is worth mentioning that in India, as in other South Asian countries, women generally cook under poorly ventilated conditions using biomass fuels, such as wood, crop residues or dung cakes, either in pits or in open U-shaped stoves, called *chulhas*. These stoves are immovable, burn biomass inefficiently and release high volumes of noxious air pollutants, as mentioned earlier. Also, fires from biomass fuels require continuous feeding of biomass to the stove, which results in extended exposure to the noxious pollutants. Though coal, coke and lignite produce similar levels of pollutants as biomass fuels, they are usually burned on portable stoves that are often put on in a courtyard or open area and brought indoors only when the fuels start burning cleanly. Most of the smoke is released outdoors within the first few minutes of the fire's ignition (Mishra and Retherford 1997).

Keeping the above observations in mind, the main predictor variable "type of cooking fuel" (actually meaning "type of fuel used for cooking and heating purposes") has been grouped into two categories: biomass fuels (wood, crop residues or dung cakes) and cleaner fuels (coal/coke/lignite, charcoal, kerosene, electricity, LPG or biogas). The very small category (0.1 %) of "other fuels" has also been included in the category of cleaner fuel.

In addition to cooking smoke, it has been found in various studies that smoking tobacco is also a very significant predictor of adverse pregnancy outcomes (e.g., Mishra et al. 2005). According to NFHS-2 data, in India 97.5% of females more than 15 years of age do not currently smoke tobacco and 97.2% have never smoked. Thus, in spite of immense negative consequences of tobacco smoking on pregnancy outcomes, the effect of this factor cannot be studied, since there is hardly any variation in the level of non-smoking among females in India. Passive smoking or environmental tobacco smoke (ETS), which may be an important determinant of unfavourable birth outcomes, has also not been included in the analysis due to the difficulty of measuring actual exposure levels.

Because the effects of exposure to cooking smoke on the risk of a baby's size at birth are likely to be confounded, either directly or indirectly, by the effects of other risk factors, as suggested by previous studies, it is necessary to statistically control, or adjust, for such factors. The variables included as controls in the analysis on a baby's size at birth are: mother's age (younger than 20, 20–29 and 30 or more years); sex of the child (male, female); maternal education (illiterate, primary-middle completed, higher-educated); mother's body mass index (BMI) (less than 18.5 kg/m^2, greater than

or equal to 18.5 kg/m^2); standard of living index[1] (low, medium, high); receiving complete antenatal care[2] (no, yes); place of residence (rural, urban) and geographic region[3] (north, central, south, west and, east and north-east). Birth order and birth interval have been combined to form a single variable and then controlled for. Birth order and birth interval have been categorized as: first birth, birth order two or three with less than 24 months of birth interval, birth order two or three with equal or more than 24 months of birth interval, birth order four and above with less than 24 months of birth interval, birth order four and above with equal or more than 24 months of birth interval. Religion and caste have been pooled and then controlled for (forward caste Hindu, scheduled caste/scheduled tribe Hindu and other than Hindu).[4]

Method

The analysis focuses on how use of biomass cooking fuels affects a baby's size at birth, after controlling for all these potentially confounding variables. Since two categories exist for the response variable: whether the size of the baby at birth is below average or not, employing logistic regression would be best, rather than multiple regressions (Retherford and Choe 1993). Three different sets of logistic regressions have been conducted to see how various factors affect the response variable at different stages of analyses. In Model 1, only child-level variables viz. sex of the child and birth order/birth interval have been controlled for using the main predictor variable; in Model 2, maternal- and household-level characteristics, such as mother's age at child birth, religion/caste, educational attainment, standard of living, mother's BMI and complete antenatal care for the mother, have been included as control variables along with those of Model 1. In the final model (Model 3), spatial characteristics, such as place of residence and region of residence, have been incorporated into Model 2 and controlled for using the main predictor. The generalized logistic regression equation can be written in the following form:

$$\text{logit } q = \beta_0 + \beta\, \beta_i X_i \quad (i = 1,2, \ldots\ldots,n)$$

where q is the probability that the size of the baby is below average.

logit q = ln [q/(1-q)] and $\{X_i\}$ (i = 1, 2….,n) are the predictor variables, β_0 is the intercept and β_i (i = 1, 2, ……,n) the regression coefficient(s). The results of the logistic regressions of these equations are transformed into simple cross-tabulations of the probability of below-average baby size (small-sized baby) at birth using multiple classification analysis (Retherford and Choe 1993). This involves calculating adjusted values of the response variable for each category of predictor variable from the logistic regression coefficients, keeping other predictor variables at average values/distributions.

Results

Gross Differentials

Gross differentials in a baby's small size at birth by use of cooking fuel and other selected background characteristics can be observed in Table 4. First, the children of those households using unprocessed biomass as cooking fuel are at significantly higher risk of being born small-sized than the children of households using cleaner fuels. The finding reveals that nearly 27% of babies were small-sized at birth in the households using biomass as cooking fuel, whereas this is just above 20% in those households using cleaner fuels. Second, female babies are more likely to be born small-sized than male babies. Third, the second and third order children, born with a minimum spacing of 24 months, are less likely to be born small-sized. Fourth, the children of adolescent mothers are also less likely to be born small-sized.

Among socio-economic characteristics, it has been noted that illiterate, undernourished mothers and mothers belonging to poor households are significantly more likely to deliver small-sized babies. It has also been found that there is a strong negative relationship between mothers who have received complete antenatal care and the birth size of their baby. The differentials according to the place and region of residence can be noticed in the bivariate analysis.

Table 4. Number and percentage of children whose size at birth were below average by type of cooking fuel and other selected background characteristics, India, NFHS-2, 1998–99

Predictors	Number	Percentage
Type of cooking fuel		
Biomass fuels	24,491	26.8
Cleaner fuels	7,979	20.2
Sex		
Male	16,957	23.6
Female	15,513	27.0
Birth order/birth interval		
First birth	9,525	25.3
Birth order 2–3/<24 months birth int.	3,552	26.0
Birth order 2–3/≥24 months birth int.	10,494	23.8
Birth order 4+/<24 months birth int.	1,880	25.7
Birth order 4+/≥24 months birth int.	7,019	26.5
Mother's age		
<20	6,625	28.0
20–29	19,896	24.5
30+	5,949	24.5
Religion/caste		
Forward caste Hindu	15,832	24.6
SC-ST Hindua	8,112	27.2
Other than Hindu	8,526	24.3
Maternal education		
Illiterate	17,829	27.9
Primary-middle completed	9,494	24.5
Higher-educated	5,141	16.9
Standard of living		
Low	10,467	25.6
Medium	15,659	27.8
High	5,930	19.4
Mother's BMI		
<18.5 kg/m^2	10,527	29.3
≥18.5 kg/m^2	19,495	23.2
Complete antenatal care		
No	19,190	27.3
Yes	13,280	22.2
Place of residence		
Rural	24,080	26.0
Urban	8,390	22.8
Geographic region		
North	7,656	26.7
Central	7,099	28.0
South	4,388	25.3
West	3,369	24.5
East & North-east	9,958	22.1
Number of births*	**32,470**	**25.2**

*Number of births varies slightly depending on the number of missing cases at each variable.
a- Scheduled castes and scheduled tribes

Net Differentials

Net differentials of the effects of cooking fuels and selected demographic, socio-economic and spatial variables on the risk of a baby's size at birth have been estimated by using three alternative models. Model 1, in Table 5, shows that the effect of cooking fuel on a baby's size at birth becomes significantly higher when the child's sex, birth order and birth interval are statistically controlled for. Children born to mothers using biomass fuels are at 6.5 percentage points higher risk of being small-sized at birth compared to children born to mothers using cleaner fuels. Interestingly, girls tend to be significantly lighter in weight than boys at birth. The second and third order children, born with a minimum spacing of 24 months, are at significantly lower risk of being small-sized at birth than other children.

Table 5. Predicted probability of children whose size at birth was below average by type of cooking fuel and other selected background characteristics, India, NFHS-2, 1998–99

Predictors	Model 1	Model 2	Model 3
Type of cooking fuel			
Biomass fuels	26.7**	25.4**	25.5**
Cleaner fuels (ref.)	20.2	23.4	22.8
Sex			
Male (ref.)	23.5	23.5	23.4
Female	26.7**	26.6**	26.5**
Birth order/birth interval			
First birth (ref.)	25.6	26.4	26.5
Birth order 2–3/<24 months birth int.	26.0	25.8	25.6
Birth order 2–3/≥24 months birth int.	23.8**	23.8**	23.8**
Birth order 4+/<24 months birth int.	24.9	23.7*	23.2**
Birth order 4+/≥24 months birth int.	25.5	24.6*	24.3*
Mother's age			
<20		25.8	25.4
20–29 (ref.)		24.8	24.7
30+		24.5	24.7
Religion/caste			
Forward caste Hindu (ref.)		25.1	24.7
SC-ST Hindua		25.1	24.7
Other than Hindu		24.6	25.3
Maternal education			
Illiterate (ref.)		27.0	26.5
Primary-middle completed		24.7**	25.2*
Higher-educated		19.1**	19.2**
Standard of living			
Low		25.3	26.3
Medium (ref.)		25.4	25.0*
High		23.4*	22.0**
Mother's BMI			
<18.5 kg/m^2		28.2**	28.0**
≥18.5 kg/m^2 (ref.)		23.3	23.2
Complete antenatal care			
No (ref.)		25.9	25.9
Yes		23.6**	23.4**

Table 5 continued

Place of residence			
Rural (ref.)			24.5
Urban			25.9
Geographic region			
North (ref.)			27.2
Central			27.9
South			26.0
West			25.0*
East & North-east			20.9**
Number of births	**32,470**	**29,665**	**29,665**

Note: Adjusted probabilities are estimated by logistic regression. For any given predictor variable, the set of control variables consists of all other predictor variables shown in the table. When calculating adjusted percentages for categories of a given predictor variable, other variables are held constant at their mean values (for details, see Retherford and Choe 1993).
ref: Reference category
a- Scheduled castes and scheduled tribes
*p<.05, **p<.01

In Model 2, even when additional variables, such as maternal characteristics (age at childbirth, BMI, education, caste and religion, receiving antenatal care and household living standard), are controlled for, the effect of cooking with biomass fuels on a baby's size at birth remains significant, but decreased. In Model 2, children born to mothers using biomass fuels are at two percentage points higher risk of being small-sized at birth compared to children born to mothers using cleaner fuels. Except mother's age at childbirth, religion and caste, all other control variables in Model 2 have a very significant effect on a baby's size at birth. Illiterate mothers are at nearly eight percentage points higher risk of delivering a small-sized baby than their higher-educated counterparts. As expected, a mother's BMI has a large positive effect on the size of a baby at birth. Mothers whose BMI is less than 18.5 kg/m^2 are at nearly five percentage points higher risk of delivering a small-sized baby. Also, receiving complete antenatal care during pregnancy has a positive significant effect in determining a baby's size at birth. The lower risk of delivering small-sized children belonging to the mothers of affluent households compared to the mothers of poorer households stands at two percentage points.

In the complete model (Model 3), when all child characteristics, maternal characteristics, household standard of living, as well as place and region of residence are controlled for, the effect of cooking with biofuels on the size of a baby is further sharpened. It has been found that those children born to mothers using highly polluting biomass fuels have a nearly three percentage points higher probability of being born small-sized, compared to those born to mothers using cleaner fuels. Additionally, controlling for place and region of residence in Model 3 makes virtually no difference in the effects of the Model 1 and Model 2 control variables, though region of residence shows significant effect in determining a baby's size at birth. Children of the western part as well as the east and north-eastern regions of the country are at significantly lower risk of being born small-sized.

Alternate Analysis

In the preceding analysis, a baby's size at birth has been considered as a response variable because of non-availability of birth weight for a large number of children. As described earlier, out of the 33,026 children, actual birth weights were available for only 8,504 cases. It has also been shown in the preceding sections that those cases for which actual birth weights are available selectively represent some socio-economic groups and do not represent the whole sample. Despite these limitations, three alternate models, similar to the previous models, have been developed with these 8,504 observations, and the results are given in the Appendix. With the exception of Model 1, the effect of cooking

fuels, which is the main predictor variable in the analysis, on a baby's size at birth has declined substantially. In addition, the effects of maternal education, religion and caste, and geographic region have been found to be more pronounced in Model 2 and Model 3. This is possibly due to the over-representation of the children of high-income households, of educated mothers and of the southern and the western parts of the country in the reduced sample.

Discussion

It has been revealed from this study that using unprocessed biomass as cooking fuel significantly increases women's risk of delivering a small-sized baby, even after controlling for a number of potentially confounding variables such as child's sex, birth order and birth interval, mother's nutritional status, pregnancy care, maternal education, household standard of living. These results are consistent with the earlier studies of Guatemala (Boy et al. 2002) and Zimbabwe (Mishra et al. 2004) linking solid fuels to reduced birth weight, and provide further evidence that cooking with biomass can increase the risk of unfavourable birth outcomes.

In the absence of any other nationally representative data on birth weight in a developing country like India, the NFHS data provide a unique opportunity to study the relationship between biomass fuel use and a baby's size at birth, a proxy of birth weight, in the nationally representative sample. Moreover, data on a baby's size at birth and cooking fuel use are rarely available from the same source to allow such analyses. Earlier studies in India (e.g., Mavalankar et al. 1991) were based on small sample sizes, and generalization of the obtained results at the national or at least sub-national level was difficult. Nevertheless, several measurement constraints on perceiving a baby's size at birth should be kept in mind when considering the findings of this study. Also, exposure to indoor air pollution is measured here by the use of cooking fuel and does not reflect the actual exposure level as measured through a clinical procedure.

In addition to the type of cooking fuel and the demographic factors, such as sex of the baby, birth order and birth interval, a strong influence of other socio-economic factors in determining a baby's size at birth have also been found, particularly, the influence of maternal education, maternal nutrition and standard of living of the households are of immense importance. Utilization of antenatal care is also found to have some influence on a baby's size at birth, a finding that supports those of earlier studies (Herz and Measham 1987; Ebomoyi et al. 1991; Anandalakshmy et al. 1993; Gonzalez-Perez and Vega-Lopez 1996; Karim and Mascie-Taylor 1997). While the predominance of maternal nutritional indicators and utilization of antenatal care in determining a baby's size at birth has been revealed by most studies (Prazuck et al. 1993; Hollander 1997; Anderson and Bergstrom 1997; Das and Khanam; 1997; Magadi et al. 2001), many of these earlier studies have failed to detect such a significant association between socio-economic factors and poor birth outcomes in developing countries (Xu et al. 1995b; Bener et al. 1996; Peabody and Gertler 1997; Magadi et al. 2001). Regional differences in birth outcomes have also been observed in both bivariate and multivariate analyses, but the reason for those differences is not very clear. It may be due to region-specific cultural factors or to systematic misreporting of size of the sizes of babies by mothers of a certain socio-economic group. A detailed examination of regional-level cultural factors influencing pregnancy outcomes is called for, since these factors cannot be addressed with the available data and are thus beyond the scope of this study.

The results of this study suggest that significant variations in a baby's size at birth exist among different women after controlling for significant observed factors, implying that there may be unobserved or statistically unobservable personal characteristics of women that put some at higher risk of unfavourable birth outcomes than others. Such factors could include biological and genetic factors. It is equally important to acknowledge the fact that the size of a baby at birth may have been influenced by the differential reporting of mothers belonging to different socio-economic groups and may affect the values of the coefficients of other background characteristics to some extent in the regression analysis. On the other hand, some women may report a baby's size relative to the size of another, which would lead to an underestimation of the coefficients.

Conclusions

Recognizing the adverse health consequences of indoor air pollution among women during pregnancy (or otherwise) and also among children, widespread adoption of cleaner fuels would do the most to reduce the level of indoor air pollution. In India, however, poor households currently relying on biomass fuels are unlikely to switch to cleaner fuels soon on account of lack of affordability. It is in this sphere that government-sponsored intervention programs to improve public health in the country have to play a very important role. The intervention program should include: the creation of public awareness on a massive scale through education about the risks of exposure to cooking smoke; the promotion of economically viable cleaner fuels by changing the pattern of fuel use, such as use of *gobar* gas (gaseous fuel made from raw cow dung), subsidized schemes to facilitate switchover from biomass to LPG, use of solar energy; the provision of more efficient and better-ventilated cook stoves by modifying stove design via some mechanism (e.g., chimney) or putting a window above the cooking stove and providing cross-ventilation through the door in the existing houses. Inexpensive but highly-efficient cook stoves that use biomass fuels are an important part of an effective short-run strategy. The most successful cook stove program has been in China, where some 200 million improved stoves have been introduced in recent decades (Mishra et al. 2002). The Chinese program demonstrates that a concrete action with strong political will can achieve remarkable results. Although various programs have been launched in India to promote the use of improved stoves, they have not been widely accepted. Large-scale acceptance of improved stoves would require determined efforts and community participation, as it has been recognized that the most important barriers to new stove introduction are not technical but social (Gopalan and Saxena 1999). There is also a lack of evaluation studies on the effectiveness and efficiency of improved stoves. Effective tackling of indoor air pollution in India requires a multisectoral collaboration and commitment between agencies responsible for health, energy, environment, housing and rural development (Indian Council of Medical Research 2001).

In addition to the above interventions, there are other demographic and socio-economic covariates that are subject to intervention: maternal education and nutrition, household income, ensuring complete antenatal care to every expectant mother and so on. These factors are well-recognized for their strong positive influence on child health and survival (for detailed discussion see Ghosh 2005).

All the indicators of a baby's small size at birth addressed in the analyses vary significantly by region. Consequently, programs aimed at addressing these issues should be sensitive to regional disparities. There is need for qualitative studies to identify the unobserved behavioural and cultural factors contributing to a baby's small size at birth among various communities, especially at the regional level.

As mentioned earlier, information on smoke exposure was ascertained from type of fuel used for cooking and heating. Nevertheless, this research needs to be followed by carefully designed studies with better measures of smoke exposure and clinical measures of pregnancy outcomes including birth weight. Such research is important in light of the fact that a large proportion of households in India and other developing countries in Asia, as well as in Latin America, rely on biomass fuels for household energy and LBW is a known risk factor for childhood ill health and premature death.

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Endnotes

1 As information on household income or expenditure is not directly available, the standard of living index (calculated by NFHS-2) has been taken as the proxy for household economic status. The standard of living index consists of the following household and economic characteristics: type of house, toilet facility, source of lightning, main fuel for cooking, source of drinking water, use of separate room for cooking, ownership of house, ownership of agricultural land, ownership of irrigated land, ownership of livestock and ownership of durable goods. On the basis of the composite score related to these characteristics, the household standard of living has been divided into low, medium and high levels. The scale of standard of living ranges from 0 to 67 (0–14 for low, 15–24 for medium and 25–67 for high).

2 The variable complete antenatal care has been created by three separate variables. These are: (a) at least three antenatal checkups to any qualified medical or paramedic personal, (b) at least two doses of tetanus toxide injections and (c) receiving iron and folic acid tablets during pregnancy.

3 The geographic region variable has been created from NFHS data file: "north" includes Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab and Rajasthan; "central" includes Madhya Pradesh and Uttar Pradesh; "south" includes Andhra Pradesh, Karnataka, Kerala and Tamil Nadu; "west" includes Goa, Gujarat and Maharashtra; and "east & north-east" includes Bihar, Orissa and West Bengal, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura.

4 Scheduled castes and scheduled tribes are castes and tribes identified by the Government of India as socially and economically disadvantageous sections of Indian society and in need of special protection from social injustice and exploitation.

Appendix

Predicted probability of LBW (<2,500 g) by type of cooking fuel and other selected background characteristics, India, NFHS-2, 1998–99

Predictors	Model 1	Model 2	Model 3
Type of cooking fuel			
Biomass fuels	23.3**	20.8	20.6
Cleaner fuels (ref.)	20.0	20.8	20.3
Sex			
Male (ref.)	20.1	19.4	18.9
Female	23.1**	22.4**	22.3**
Birth order/birth interval			
First birth (ref.)	22.1	21.7	21.4
Birth order 2–3/<24 months birth int.	25.3*	24.9*	24.7*
Birth order 2–3/≥24 months birth int.	19.5**	19.1*	18.9*
Birth order 4+/<24 months birth int.	27.8*	25.1	23.8
Birth order 4+/≥24 months birth int.	19.9	17.4*	15.9**
Mother's age			
<20		22.0	21.6
20–29 (ref.)		20.5	20.1
30+		20.9	20.5
Religion/caste			
Forward caste Hindu (ref.)		21.9	21.4
SC-ST Hindua		23.7	23.0
Other than Hindu		17.4**	17.5**
Maternal education			
Illiterate (ref.)		25.6	24.5
Primary-middle completed		21.8**	21.6*
Higher-educated		17.6**	17.4**
Standard of living			
Low		20.3	22.2
Medium (ref.)		20.9	21.4
High		20.8	18.5*

Mother's BMI			
<18.5 kg/m^2		24.1**	23.5**
≥18.5 kg/m^2 (ref.)		19.6	19.3
Complete antenatal care			
No (ref.)			20.4
Yes			20.4
Place of residence			
Rural (ref.)			20.8
Urban			20.1
Geographic region			
North (ref.)			28.4
Central			31.7**
South			15.4**
West			21.7**
East & North-east			19.3**
Number of births	**8,504**	**8,039**	**8,039**

Note: Adjusted probabilities are estimated by logistic regression. For any given predictor variable, the set of control variables consists of all other predictor variables shown in the table. When calculating adjusted percentages for categories of a given predictor variable, other variables are held constant at their mean values (for details, see Retherford and Choe 1993).
ref: Reference category
a- Scheduled castes and scheduled tribes
*p<.05, **p<.01

Factors Influencing Women Receiving Safe Child-Delivery Care in Bangladesh

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Abstract

Worldwide, every minute of every day, a woman dies of pregnancy-related complications, resulting in 586,000 women dying each year (Barkat et al. 1998). Estimates of the maternal mortality ratio in Bangladesh range from 320 to 400 maternal deaths per 100,000 live births, which is considerably higher compared to other developing countries (Hill et al. 2001). The majority of these deaths could be prevented if professionally skilled health personnel were present during child-delivery. Despite the availability of primary healthcare infrastructure at the grassroots level, home births are still common in Bangladesh (90%). About 44% of women do not receive antenatal care. Overall, 71% of urban women receive antenatal care from a medically trained person, compared with 43% of rural women. Only about 13% of women delivered their most recent baby with the assistance of a professionally skilled health provider. This paper examines the factors that influence women receiving safe child-delivery care in Bangladesh using multivariate logistic regression analysis of Bangladesh Demographic and Health Survey (BDHS), 2004 data. The study shows that demographic and socio-economic factors were the most important aspects that influence women receiving safe child-delivery care in Bangladesh. The independent factors influencing women receiving safe child-delivery care included maternal age, antenatal checkup, problems during delivery, education of mothers, place of residence and household economic status.

Introduction

Every minute of every day, a woman dies due to pregnancy-related complications (Barkat et al. 1998), and 99% of all such deaths occur in developing countries (Akhter et al. 1996). In Bangladesh,

approximately four of every 1,000 mothers who become pregnant die of causes related to pregnancy and birth (Hill et al. 2001). Home births are still common in Bangladesh despite efforts to increase institutional care to help promote safe child-delivery care. About 87% of mothers in Bangladesh deliver at home with the help of unskilled birth attendants in poor hygienic conditions – placing the lives of both mother and child at risk. It is well-established that giving birth under the care and supervision of skilled healthcare providers promotes child survival and reduces the risk of maternal mortality and morbidity (Sugathan et al. 2001). Women play a principal role in rearing children and their death due to maternity-related causes is a significant traumatic effect on the child, the family and the community as a whole. Delivery of a child requires a safe and healthy environment and needs to be attended by skilled personnel. The underutilization of the existing health services is a global problem, evidenced in different countries (Hill et al. 2001). Very little is known about the current magnitude and factors that influence women receiving safe child-delivery care in Bangladesh. The purpose of this paper is to assess the factors in Bangladesh affecting women receiving safe child-delivery care.

Materials and Methods

Data for this study were obtained from the Bangladesh Demographic and Health Survey 2004, which is a nationally representative sample survey. The present study is based on 5,416 women, who had at least one child less than five years of age at the time of survey. The women who had births five years prior to the survey were specifically asked about the place of child-delivery and type of person who attended the delivery.

The variables included in the analysis are maternal age at birth, child's birth order, antenatal care, delivery complications, educational status of women, exposure to mass media, place of residence, region and household economic status.

Method of Analysis

The unit of analysis for this study was women who had at least one live birth in the five years preceding the survey. Both bi-variate and multivariate analyses were carried out to understand the factors that influence women receiving safe child-delivery. Since logistic regression analysis was performed, the dependent variable was dichotomized whether or not the women had experienced safe child-delivery (we assumed safe delivery is equal to one; otherwise, it is zero). The results of the logistic regression analysis are presented in the form of odds ratios.

Results

In Bangladesh, according to the BDHS 2004, professional skilled persons attended about 13% of child-deliveries. The information in this regard revealed that traditional birth attendants (TBA) assisted 77% of births (14% assisted by trained TBAs and 63% by untrained TBAs); relatives and friends assisted another 9% of births. Both bi-variate and multivariate analysis suggests that safe child-delivery depends on many factors, which are discussed below.

Age of Mother at Delivery

Results of bi-variate analysis show that older mothers (≥25 years) were somewhat more likely to receive safe child-delivery care than younger mothers. Thirteen per cent of women aged 25 years or over received safe child-delivery care, while 15% of women below age 25 received this care. Logistic regression analysis shows that a woman's age has a positive effect on the odds of safe child-delivery, controlling other variables. Women 25 years and over were 2.16 times more likely ($p<0.001$) to receive safe child-delivery care than women below age 25.

Birth Order

Bi-variate analysis shows that 24% of women received professionally assisted child-delivery care for first-order birth, while this practice for second-, third-, fourth- or higher-order births were

14.8%, 10.0% and 6.5% respectively. Multivariate analysis suggests that, when other variables are controlled, birth order of the child has significant negative effect on whether a woman will receive safe child-delivery care. The odds of safe child-delivery were approximately four times higher for the first-order births as opposed to fourth- or higher-order births. The analysis also suggests that second-, third- and higher-order births – 41%, 65% and 70% respectively – women are less likely to receive safe child-delivery care than first-order births.

Antenatal Care

Despite availability of primary healthcare infrastructure at the grassroots level, the majority of pregnant women (44%) do not seek antenatal care service in Bangladesh. About 23% of mothers who received antenatal care during their last pregnancy had their delivery attended by a skilled health provider; 3.3% of mothers did not receive such care. Poor quality of care, misperceptions regarding need for care and other social barriers underlie the low level of care-seeking behaviour by expectant mothers. Multivariate analysis revealed that antenatal checkup has a large effect on the likelihood of receiving safe child-delivery care. Mothers who received at least one antenatal checkup during their last pregnancy were 3.52 times ($p<0.001$) more likely to receive safe child-delivery care than mothers who did not have an antenatal checkup.

Table 1. Distribution of factors influencing safe child-delivery care in Bangladesh

Factors	Total Women	Received Safe Child-delivery Care (%)	Adjusted Odds Ratio[Y]
Women's age (in years) at delivery			
< 25 years *(Ref.)*	3,417	14.8	1
≥ 25 years	1,999	13.1	2.16*
Child's birth order			
1 *(Ref.)*	1,491	24.2	1
2	1,384	14.8	0.59*
3	993	10.1	0.35*
4+	1,548	6.5	0.30*
Received antenatal checkup			
No *(Ref.)*	2,391	3.3	1
Yes	3,025	22.7	3.52*
Delivery complications			
No *(Ref.)*	3,991	11.7	1
Yes	1,425	21.1	2.38*
Place of residence			
Rural *(Ref.)*	4,293	9.7	1
Urban	1,123	31.1	2.04*

Table 1 continued

Region			
Sylhet *(Ref.)*	400	12.0	1
Chittagong	1,115	12.2	0.69
Dhaka	1,677	16.0	0.99
Rajshahi	1,284	10.9	0.90
Barisal	333	12.3	0.99
Khulna	607	21.7	1.35
Mother's education			
No Education *(Ref.)*	1,997	4.5	1
Primary	1,642	10.0	1.38**
Secondary or higher	1,777	28.8	2.45*
Exposure to mass media			
No *(Ref.)*	2,291	5.2	1
Yes	3,125	20.7	1.44*
Household economic status			
Poor *(Ref.)*	2,421	3.8	1
Middle	2,051	14.0	2.11*
Rich	944	41.0	4.40*
N	5,416	14.2	

Y Adjusted for all variables included in the table.
*p<0.001, **p<0.05

Child-delivery Complications

Among mothers who had any sort of child-delivery complications, about 21% of them received safe child-delivery care; 12% of mothers received safe child-delivery care who did not have any delivery complications. As expected, multivariate analysis also shows that receiving safe child-delivery care was 2.38 times ($p<0.001$) higher among mothers who had faced any kind of complications during delivery.

Place of Residence

A significant association is found between two variables: place of residence and receiving safe child-delivery care. Women from urban areas tended to exhibit the higher use of safe child-delivery care (31.3%) compared to rural areas (9.7%). The adjusted odds ratio indicates that professionally assisted child-delivery care was 2.04 times ($p<0.001$) higher for women who reside in urban areas than for those who live in rural areas. There were significant rural-urban differences; however, by region, the difference in how many women received safe child-delivery care was small. Mothers from Khulna region were more likely to receive safe child-delivery care (21.7%) compared to other regions that were studied.

Women's Education

Receiving safe child-delivery care is positively related with a woman's education. About 29% of women with secondary or higher education received safe child-delivery care, while 10% and 4.5% of women with primary and no education, respectively, received safe child-delivery care. Multivariate analysis shows that a woman's level of education has a large and significant effect on the odds of safe child-delivery.

Exposure to Mass Media

Twenty-one per cent of women who had regular exposure to mass media (i.e., weekly exposure to television, radio or newspaper) received safe child-delivery care; for women not exposed to mass media, the percentage dropped to 5.2. Logistic regression analysis indicates receiving safe child-delivery care was 1.44 times ($p<0.001$) higher among women who were exposed to television.

Household Economic Status

Respondents have been categorized into different economic levels using an index of asset ownership or wealth rather than in terms of income or consumption (Filmer and Pritchett 1998; Gwatkin et al. 2000). Information regarding the household items (i.e., bicycle, television, radio or car) and dwelling characteristics, such as main floor materials, main roof materials, sources of drinking water and sanitation facilities, were assigned a weight or factor score generated through principle component analysis (score is not shown here). Women were ranked according to their total scores and divided into five quintiles (Q1, Q2, Q3, Q4 and Q5) to understand the health inequality. Among the five quintiles Q1 and Q2 were considered as the poorest group, Q3, Q4 as the middle and Q5 the richest group.

Bi-variate analysis showed that only 3.8% women belonging to households of the poorest economic group received safe child-delivery care, while 14% and 41% of women belonging to middle and rich economic groups, respectively, received safe child-delivery care.

Discussion and Conclusion

This study identified several factors that influenced women receiving safe child-delivery care in Bangladesh: maternal age at birth, birth order, antenatal checkup, delivery complications, place of residence, education, exposure to mass media and household economic status. A woman's age has a strong positive effect on receiving safe child-delivery care; on the other hand, birth order has a strong negative effect on receiving safe child-delivery care. The effects of maternal age and birth order indicate that women who delayed childbearing are more likely to receive safe child-delivery care than other women. Overall, the analysis indicates that receiving one or more antenatal checkup is the strongest predictor of institutional delivery. Health professionals who provided the antenatal care are likely to encourage mothers to deliver their baby in a health facility. Antenatal care reduces a woman's health complications and also improves the physical condition of the newborn child. This finding has important program implications. It suggests that it is possible to promote safe child-delivery care by expanding antenatal-care coverage with associated counseling.

Among the other important predictor variables considered, a woman's education has a strong positive effect on the odds of safe delivery. Education and mass media can play important roles in improving women's health-seeking behaviour, but in rural areas, people, especially women, get little access to these facilities. In urban settings, women learn from billboards, day-to-day observations, rallies, television, etc., but in rural areas, these opportunities are mostly absent. As expected, in both urban and rural areas, household economic status also has a positive impact on women receiving safe child-delivery care, that is, the richer the family, the greater the likelihood women will receive safe child-delivery care.

Areas for Focus

A key lesson here is that good quality and sustained supervision and support are indispensable for the improvement of healthcare services of pregnant women. The second key lesson is the need to reach families and communities with targeted messages and information. Families and communities require information to make healthy decisions regarding the care of pregnant women. Recent reviews on neonatal health suggest that other community-based interventions, such as health education to improve neonatal care practices and care-seeking for illness, as well as creating demand for skilled care, can improve neonatal survival.

Among women who experienced complications during childbirth, only one in three sought assistance from trained health providers, another one in three women used the services of unqualified providers and one in three sought no health provider at all. As awareness of the dangers of childbirth is raised, families must be motivated to make use of medically trained providers for these complications. Antenatal care, safe child-delivery care and postnatal checkups must be promoted as a total package of safe maternity care.

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Communication and Contraception in Rural Bangladesh

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Abstract

This paper examines the association of communication in explaining the decision of women in rural Bangladesh to use or not to use contraception. Using survey data from villages in Bangladesh, we found that communication is an important influence on the ideational change for a smaller family norm and the practice of contraception. This is evident even when socio-economic and cultural variables are controlled for. We recommend that to foster the use of contraception, communication factors should be given greater emphasis, especially to target husbands in the family planning program and to improve the image of female children.

Introduction

Limitations of the classic demographic transition model to explain fertility transitions in Europe, Latin America, Africa and Asian countries in the context of widely differing social, economic and cultural conditions have shifted the focus of explaining fertility transition to the theory of *ideational change*. Intrinsic to this theory are the diffusion of innovation concepts and the key role of communication. The interpretation given to "ideational change" here is ascribed to ideas concerning the acceptability and feasibility of birth control, rather than ideas about the economics of family size, as the motivating force for fertility decline (McNicoll 1992). Analyzing family planning (FP) program efforts in 35 countries, Ross et al. (1989) showed a close relationship between communication efforts and the percentage of couples using modern contraception. Separate analyses of demographic and health survey data from Ghana (Olaleye and Bankole 1992), Nigeria (Bankole 1994) and Kenya (Westoff and Rodriguez 1993) indicated that, among women with similar socio-economic characteristics, more exposure to FP messages in the mass media is significantly linked to greater contraceptive use. The work of Bongaarts and Watkins (1996), Entwisle et al. (1996) and Montgomery

and Casterline (1993) emphasizes social interaction as the core of the reasons for fertility decline in less-developed countries. Further investigations of how social networks affect contraceptive decisions have been made by Rogers and Kincaid (1981), Montgomery and Chung (1998), Kincaid et al. (1993), Kincaid (2000), Marten (2002) and Gayen and Raeside (2004). It is presumed in this approach that if people are centrally located in a social system, then they will learn earlier about any innovation, for example, contraception, and the attitude of their network members about contraception will be an import influence on their contraceptive practice. If the majority of the network members or the influential members of the network have a positive attitude about FP and use contraception, then it may enhance women's practice of contraception through an ideational change towards a small family norm. Thus, once perceived as a supporting service, communication is recognized as a key factor in the adoption of FP use in recent decades (see for example, Retherford and Palmore 1983; Cleland and Wilson 1987; Lapham and Mauldin 1987; Bulatao et al. 1993; Mauldin and Sinding 1993).

In Bangladesh, since 1975 an all-out communication effort has been undertaken for the diffusion of FP as a concept, and contraception as a technique, as part of a national FP planning program. This effort was led by the Information, Education and Motivation (IEM) unit of the Information, Education and Communication (IEC) program of the Bangladesh Government. According to the Fifth Five Year Plan, 1997–2002, "in transforming societal conservative attitude towards FP in the mid-seventies to the present level of almost universal support for it, IEC programs which cut across the Ministries of Health and Family Welfare, Social Welfare, Women and Children Affairs, Education and Information, have played an important role. It has emerged from the stage of the traditional use of leaflets, pamphlets, bill boards and *jarigans* (traditional stage songs) to the extensive use of electronic media like radio and television as well as news media, film show, mass rallies, holding of seminars and workshops in addition to the field workers' interpersonal communications and group meetings with eligible couples and community leaders at the village level (Planning Commission 1998). In 1978, a group of young, educated, female grassroots workers, called family welfare assistants (FWAs), were recruited from local areas to motivate eligible women to use modern contraception, providing free contraceptive devices for those willing to use them. Each FWA was assigned to a geographical area comprising approximately 4,000 married women (Koenig et al. 1992) with the aim of reaching them all every two months with this doorstep service delivery.

Unfortunately, although some research focused on the impact of different communication factors on contraceptive practice, the nature and the relative scope of influence of diversified communication factors used were not addressed in a comprehensive way.

In this paper, an attempt has been made to understand the effect of communication on the contraceptive decision of women in rural Bangladesh. To investigate this, a proxy for communication (i.e., sources of information) was used to create models, while controlling for various socio-economic, cultural, health and demographic variables.

This paper has three complementary purposes: First, to assess the influence of communication on the contraceptive behaviour of women in rural Bangladesh. Second, to construct a model of the likelihood of adopting contraception that demonstrates the importance of communication processes on FP. For this latter purpose, control will be made for other demographic, health and socio-economic-cultural variables. Third, to show the relative influence of types of communication on contraceptive use.

Background

The total fertility rate (TFR) in Bangladesh declined from 6.3 children per woman in 1975 to 3.3 in the period 1994–1996, and then remained constant in the period 1997–1999 (Planning Commission 1998; National Institute of Population Research and Training et al. 2000). However, according to the BDHS 2004 report (National Institute of Population Research and Training et al. 2004), TFR has again dropped to 3. This decline of 48% over a 25-year period occurred without a substantial improvement in socio-economic status, health conditions and other factors that were

thought to be essential for fertility decline. This decline created interest among researchers and policy-makers, and demographers commented that the third stage of the fertility transition had begun (see, for example, Cleland et al. 1994; Amin et al. 1994; Mitra et al. 1994). The TFR then remained on a plateau of around 3.3 for about a decade, starting in the early 1990s, causing concern among policy-makers. An understanding of the factors that explain why women in Bangladesh adopt or do not adopt contraception may give some insight as to how to overcome this plateau.

According to the classical demographic transition model, as forwarded by Notestein (1953) and Easterlin (1978), a society's fertility decline is a consequence of the rising cost and declining economic value of children that accompanies economic and social changes such as industrialization, urbanization and education. Like much other empirical research (for example, Hirschman 1994; Kirk 1996; Coale and Watkins 1986; Knodel and van de Walle 1979), the socio-economic-cultural reality of Bangladesh challenges the expected relationship between socio-economic variables and fertility decline. Bangladesh is mainly agricultural, with a per capita income of $275; with its industrial sector in a nascent state, infant and maternal mortality rates remain high and the educational level, especially among women, is very low. This socio-economic condition, along with the continuing strong influence of traditional cultural institutions, persistent low status attributed to women, strong son preference and strong religiosity challenges the theories of demographic change. The argument of this paper is that the key element causing greater uptake of contraception is a consequence of an ideational shift to a small family norm, and that communication is strongly associated with this.

Conceptual Framework and Hypotheses

"Interest in smaller families and in family limitation does not necessarily appear suddenly as an unambiguous rational decision of large masses of people," observed Freedman and Freedman (1992: 44–50); rather, "interest in family planning spreads from one socioeconomic group to the next and from cities to the rural areas throughout a country, depending on available communication channels." This suggests the importance of mass media and communication campaigns in promoting the diffusion of new attitudes about reproduction and the acceptance of contraception, and thus in speeding up reduced fertility. According to the diffusion of innovation theory (Rogers 1995), adoption of a new behaviour/technology is a five-step process: knowledge, persuasion, decision, implementation and confirmation. This theory implies that, if there is sufficient knowledge and a positive attitude about the benefits of an innovation, then the individual will decide to adopt it. After adoption, if it is perceived to be advantageous, then the practice of the innovation will continue. Radio and television reach millions of people – even in remote areas – and are powerful influences on opinions, attitudes and behaviour. In less-developed countries communication processes have been found to promote discussion of family planning, increase clinic visits and raise the levels of contraceptive use. In some countries (for example, Bangladesh, Pakistan) the influence of campaigns on radio and television have helped make family planning a household word and a community norm rather than the taboo subject it had been (Mahmood and Ringheim 1997: 122–129, 145). Though family planning use depends on people's private decisions and actions, these decisions involve individuals, couples, families and even peer groups, especially in traditional societies (Rogers 1973). Rogers goes on to generalize that mass media channels are relatively more useful in creating awareness knowledge about an innovation, while interpersonal channels are better able to persuade individuals to form favourable attitudes about an innovation. After exposure to family planning messages in the mass media, people typically discuss family planning with friends or relatives, or they make contact with a provider promoted in the mass media such as a clinic or family planning field workers. The mass media, as well as the influential elite of the society such as opinion leaders (especially in traditional societies), help create awareness about desired family size, fertility control and the availability of the contraceptive devices; interpersonal, small group and peer group communication influence directly the practice of methods. Communication processes (both mass and interpersonal) thus make people aware of contraception, its proper use and where to find services. Communication processes counter

myths, dispel rumours (sometimes they also foster rumours [Katz and Lazarsfeld 1955]) and correct misinformation about contraceptives and family planning. Thus, communication processes play vital roles in developing each of the preconditions put forward by Coale (1973: 53–57) to allow the adoption of contraception. The preconditions are: people are aware that fertility can be controlled, methods of family planning are known and available and the individual perceives the use of methods as advantageous.

Several communication factors have been identified as important in demographic literature on Bangladesh. Notable among these are: FWA visits in the Bangladesh family planning program (see Janowitz et al. 1999; Kamal and Sloggett 1996; Rob and Cerenda 1992), community resources (Saha 1994), female community workers (Rob and Cerenda 1992) and social interaction (Kincaid et al. 1993; Kincaid 2000; Marten 2002; Gayen 2004). Janowitz et al. (1999) suggest that repeated visits of family planning field workers not only provide a convenient source of contraceptive supply, but also catalyze latent demand for methods through repeated dissemination of information. Citing works of Phillips et al. (1993), Phillips et al. (1996) and Hossain and Phillips (1996), Janowitz et al. (1999) argue that demand for contraceptives would effectively collapse without the stimulus provided by repeated exposure to home visits. In the Fifth Five Year Plan (1997–2002), the Bangladesh government also recognized the importance of the IEC (Information, Education, Communication) program in transforming societal conservative attitudes towards family planning in the mid-1970s to the present level of almost universal support. In these studies, it was mainly the role of government/non-government change agents on contraceptive practice that were addressed, while mass media and other interpersonal communication influences were ignored. Work on the *Jiggasha* project (Kincaid et al. 1993; Kincaid 2000) focused on the influence of social networks compared to family welfare assistants (FWAs), and the work of Marten (2002) indicated the effect of social interaction. The *Jiggasha* project results represent the contraceptive behaviour only of the women who were likely to be within the social networks of centrally located women identified by FWAs (Kincaid 2000). In the work of Marten (2002), the 1993–94 BDHS data (National Institute of Population Research and Training et al. 1994) have been used to test mass media influence, while in-depth interviews of 40 women were used separately to test the influence of social interaction. Thus, the simultaneous influences of mass media and interpersonal communication on fertility behaviour in Bangladesh are yet to be investigated. This paper undertakes an analysis of the influence of various communication factors on women's fertility behaviour using statistical modeling while controlling for other socio-economic-cultural determinants. In addition, the relative roles of different forms of communication will be investigated.

Data and Methods

Data were collected by interviewing 724 women from seven villages and a small town (*mahalla)* in Bangladesh using structured questionnaires from July 2002 to January 2003. A currently married woman who had at least one child was interviewed from each household in each of the chosen villages. The reason for choosing women who had already one child was that it was discovered from the pilot survey that women who were married but had no child were reluctant to think about contraception. This is perhaps because in Bangladesh the social cost of not having a child is much higher than that of having more children.

Villages were taken as the sample areas because 80% of Bangladeshi women live in rural areas. One village was selected from each of the six administrative divisions of Bangladesh. These administrative divisions are different geographically, economically, socially and culturally, and the villages were chosen to reflect this diversity. Another village was chosen where the majority of the inhabitants were Hindu in order to make the comparison that would allow determination of the influence of religion. The pilot survey was made in a *mahallah*. The response from the pilot survey correlated positively with the rural villages, and it was decided to include the pilot data in the data set.

The survey instrument was a structured questionnaire completed by an interviewer. The structure of the questionnaire comprised five domains: demographic, socio-economic-cultural, reproductive,

family planning and sociometric questions. Altogether, 77 questions were asked; similar variables were combined using factor analysis with varimax rotation. Other variables, which existed within a class of variables, such as questions pertaining to possessions held, were cumulated to give overall scores.

This research was conducted as part of a PhD thesis by Gayen (2004) and was funded by Napier University, UK. The survey questionnaire was developed by the researcher under the guidance of the supervisory team for this PhD project and was approved by the university research and ethics committee. While preparing the questionnaire, we consulted BDHS questionnaires and developed some questions particularly to fulfill the aims of this research. The questionnaire was pre-tested in a *mahalla* in Bangladesh. After scrutiny and amendments, the questionnaire was finalized. The questionnaire was then translated into Bangla, and the researcher recruited and trained the survey teams in Bangladesh. Teachers and students from the Department of Mass Communication, Rajshahi University in Rajshahi Division, the Department of Journalism, Chittagong University in Chittagong Division, the Department of Anthropology, Shah Jalal University of Science and Technology in Sylhet Division, the Department of Mass Communication and Journalism, Dhaka University, along with local primary school teachers in Dhaka Division, Pirojpur Government College in Barisal Division and local college students and teachers in Khulna Division, took part in the survey in respective areas. NGO workers, cultural activists and agricultural extension officers also took part in the survey in some places. Altogether, 43 people, on average six to seven in each area, took part in data collection, with the direct participation and guidance of the researcher. At least one FWA [ex-FWA] or midwife or health worker of the concerned village was included, which gave an extra opportunity to cross-check the validity of the health and family planning practice information.

Methods of Analysis

Data collected in the survey were first explored using statistical tools to check variables for consistency and detect any oddities. This involved the use of standard statistical methods to describe the data and allow investigation of the variability between study areas. The variables were then analyzed using logistic regression to construct a model of the likelihood that a woman practises family planning. On demonstrating the influence of communication on the adoption of contraception, the relative importance of different types of communication in sustaining the use of contraception is then shown.

Measurement

Two dependent variables were used in this research. The first was the "current use of contraception," which was measured by means of a simple yes (=1) / no (=0) answer. The second was the "main reason for use of contraception" among those who use contraception.

Past use and knowledge of family planning were measured with an open-ended question: "What method(s) have you used?" This question presented 10 methods to choose from (and allowed for multiple options).

Reasons for the decision to use family planning method(s) were measured by four statements: (i) to limit family size, (ii) to delay next birth, (iii) health reasons and (iv) others. This was followed by an open question: "If the reason is 'limit family size,' why do you want to limit your family size?" This specific question was designed to understand the reasons why women in a predominantly traditional religious society – where "to be the mother of a hundred sons" (*shato putrer janani how*) is the highest blessing for a newly wedded bride – want to limit their family size at all. Answers to this open question were then grouped into categories, which were given numerical codes.

Reasons for the decision not to use family planning were derived from answers to nine statements assigned in the question: (i) husband's objection, (ii) parent-in-law's objection, (iii) fear of health injury, (iv) lack of knowledge, (v) want more children, (vi) sterility, (vii) religious cause, (viii) newly wed and (ix) others. These questions were used to assess the level of awareness about family planning and the attitude towards it.

To assess the influence of communication on contraceptive decisions is notoriously difficult

primarily due to problems of determining direction of causality, particularly in a situation where the awareness about family planning as a concept is almost universal (National Institute of Population Research and Training et al. 2000, 2004). So to illustrate the importance of communication on contraception practice, the sources of general information were measured in the model. Radio, television, newspapers, posters, billboards, friends and relatives as women's sources of general information were measured on a zero to three scale recording frequency of contact (never = 0, monthly =1, weekly = 2 and daily = 3).

Eleven FP information sources were mentioned in the question to measure the source of family planning information, and exposure to these sources was recorded through yes/no answers. Sources of family planning information were not, however, used in the model, as it was considered that they could be highly correlated with the dependent variable.

To illustrate the influence of communication on the decision to adopt contraception, women were asked to report on a 0–10 scale the degree to which 16 communication factors influenced this decision. The items asked in the question, "Who or what factors influenced you most in your family planning decision?" were (i) husband, (ii) parents, (iii) in-laws, (iv) relatives, (iv) friends, (v) FP workers, (vi) poster, (vii) opinion leader, (viii) TV advertisement, (ix) Radio FP programs, (x) village theatre, (xi) magazines, (xii) movie, (xiii) pamphlet, (xiv) mobile van, (xv) public lecture and (xvi) others.

Besides these communication variables, some other new variables were created for controlling purposes. *Women's education level* was measured by no = 0, primary = 1, secondary = 2 and greater than secondary = 3; *women's job* was dichotomized as housewife = 0 vs. other than housewife = 1; *place of giving birth* was dichotomized as home = 1 and otherwise = 0; *income source* was dichotomized as agriculture and agriculture-related income = 1 and otherwise = 0; *micro-credit organization affiliation* was coded as yes = 1 and no = 0; *land property* was dichotomized as cultivable land = 1 and no land = 0.

Housing score was created using factor analysis from the variables house type, roof, wall and floor materials. Each of these variables was scored on the degree to which they were composed of modern materials. The created variable accounted for 51.9% of the original variation. This was combined with a count of economic possessions (whether or not they have electricity, furniture, watch/clock, telephone, bicycle, motorcycle and sewing machine) and level of husband's education. These were combined by first computing z-scores of the count of possessions and husband's education and then averaging all three variables to give a measure of socio-economic status (SES). The internal reliability (alpha) of this measure was 0.695.

"Status of traveling unaccompanied" and "degree of decision- making power in household matters" – these two variables were combined using factor analysis to create the new variable *female autonomy score*, which accounted for 79.1% of the original variation. Women were asked who assisted them in their child delivery. From this, three new dummy variables were created: delivery assistant: health professional (qualified doctor, nurse/midwife, family welfare visitors [FWV]), delivery assistant: friends and relatives (parents, in-laws, brothers and sisters) and delivery assistants: unqualified professionals (trained traditional birth attendants [TTBA], untrained TTBA, unqualified doctors and *dai*).

All variables were used in a stepwise binary logistic regression analysis, and measures of concordance and discordance were used to assess the explanatory power of the model.

Results

Characteristics of the Women in the Survey

The mean age and standard deviation of the interviewed women was 28.2 and 6.6 years, respectively. Their husbands were on average 8.5 years older than they were with a standard deviation of the age difference of 5.1 years, and the average age at which women got married was 15.5 years (standard deviation 2.9 years). The average age of a woman at the birth of her first child was 17.8 years (i.e., teenage pregnancy) with a standard deviation of 2.95 years, almost the same as the national average

of 17.44 years (National Institute of Population Research and Training et al. 2000). The dominant religion of the interviewed women was Islam, 75.5%, and the rest were Hindu, 24.5%; this was higher than the national count of 12% (as a result of the deliberate inclusion of a Hindu village). The mean number of children was 2.64 (standard deviation 1.5), and there was a demand for on average 1.27 further male children, which was 2.54 times more than that of the demand for further female children. Of the women interviewed, 92.7% were housewives and 48.9% could neither read nor write, similar to the national average of 46% (National Institute of Population Research and Training et al. 2000). On average, 64% of women had no freedom to travel unaccompanied and only 32.2% could make decisions on household matters. Only 9.7% of the interviewed women reported that their husbands had any cultivable land, and around 40% of women had affiliation with a micro-credit organization. Displayed in Table 1 are some basic characteristics of the interviewed women.

Table 1. Characteristics of women interviewed in the survey areas

Study area	% FP use	Mean wife's age	Mean age at first child born	Mean number of children	Mean demand for more male children	Mean demand for more female children	Mean level of women's education	Mean housing score	Mean female autonomy score	Socio-economic score	% child death
BN	66.67	25.94	17.94	2.22	0.24	0.17	0.84	-0.78	0.49	-0.29	11.11
BS	66.23	25.84	18.03	2.53	0.51	0.28	0.93	0.13	-0.75	0.18	35.14
JB	36.08	28.62	17.63	3.65	0.49	0.14	0.59	-0.31	-0.43	-0.32	32.99
KP	61.90	28.63	17.59	2.70	0.36	0.14	0.48	-0.25	-0.54	-0.46	29.76
PG	85.28	28.86	17.23	2.59	0.18	0.05	0.89	0.42	0.35	0.23	12.69
RK	68.37	28.66	18.30	2.53	0.39	0.10	1.29	0.14	-0.25	0.20	17.35
MG	72.84	28.06	18.58	2.20	0.30	0.15	0.59	-0.37	0.79	-0.08	2.47
AP	100.0	30.00	18.07	2.33	0.30	0.17	1.07	0.90	0.01	0.58	23.33
Total	69.34	28.17	17.80	2.64	0.33	0.13	0.83	0.00	0.00	0.00	19.48

Ideation about Family Planning: Knowledge, Attitude, Practice

On average, 69.3% of the interviewed women practised at least one family planning method. The reason for practising family planning was mainly to limit family size. Among the women who were practising family planning, 76.67% reported that the reason was to limit family size. Twenty per cent stated that the reason was to delay next birth (their ultimate goal is to limit family size), 2.7% gave health reasons and 0.85% stated other reasons. The reason for limiting family size appeared to be mainly economic. To the open question, "why do you want to limit family size?," 72.89% gave direct economic reasons, 25.13% to avoid probable hazards of raising many children (such as the fear of not providing them with proper food and education), which is also related to economic causes, and only 1.97% gave reasons such as health, philosophical and social commitment. The use of contraception, and thus limiting family size, was reported by the interviewed women as the way to overcome the misery of their present poor economic condition. This is opposite to the popular notion of declining fertility as the outcome of economic advancement, urbanization and moderniza-

tion. Thus, the attitude towards family planning and contraception was positive, and limiting family size was perceived mainly as the way to overcome economic hardship.

Knowledge of family planning was found to be almost universal irrespective of socio-economic-cultural conditions. Though most of the interviewed women could not name family planning devices properly, they could describe what type of devices they used. Overall, they mentioned about four types of device: *bori* (any type of pill, more specifically *maya bori*), *Su(n)i* (injections), *khatam* or *jhamela shesh* (any type of permanent method) and *baichchhya ghuichhya choli* (menstrual regulation, rhythm and calendar). The most popular method was pill, with 66% of the respondents using this method. The second most used method was injectables, mentioned by 17% of the respondents. Next was a mix of pill and injectable (method mix), cited by 5.3% of the women. Female sterilization was the method used by 5.17% of women. Only 3.2% of husbands used a contraceptive method. Condom was the most popular male contraceptive method, but only 2.6% of all husbands used this method. In the *mahallah*, the rate of condom use was highest (10%), and the lowest (0%) was in the Hindu majority village. Male sterilization was cited by only 0.71%.

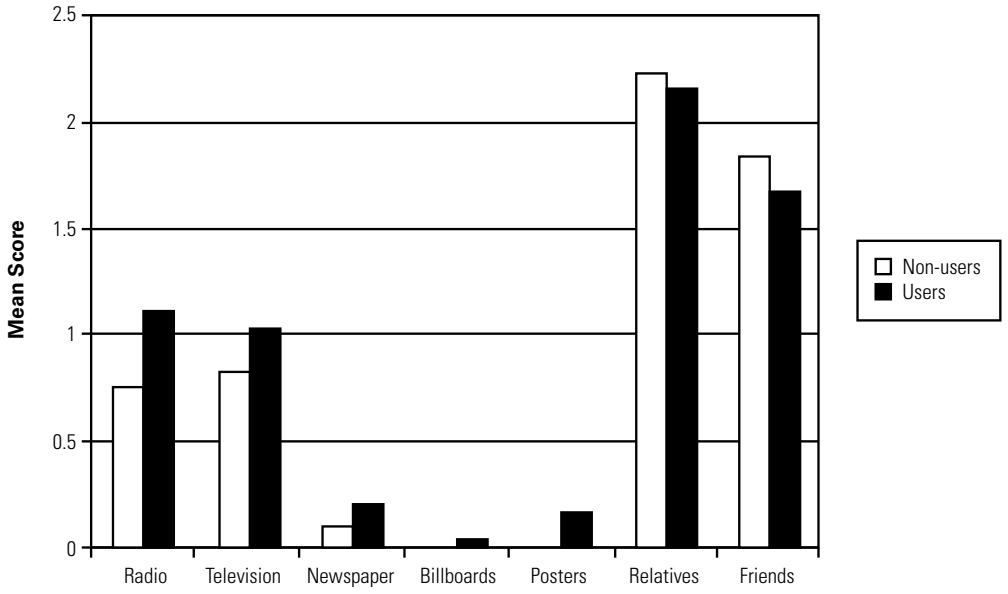
The desire for more children is the main reason for not practising family planning. On average, 10.2% of women wanted more children and hence they did not use any family planning method. Among the women who did not practise any family planning method, 34% wanted more children. The other causes were: health reasons (23%), husband's objection (9.3%), lack of knowledge (8.7%) and religious reasons (5.7%). A further 19.3% gave other reasons; the main one was that their husbands lived overseas (especially in Jobra, where this reason was cited by 52% of women).

We hypothesize that communication played a vital role in this ideation formation about family planning, both as a norm and as a technique. To test this argument, the role of communication was measured in terms of influencing factors for contraception decisions, and information sources for diffusion of family planning.

Sources of General Information and the Practice of Family Planning

Scores of the sources of general information were compared for contraceptive users and non-users; this comparison is portrayed in Figure 1. From this, it is clear that relatives and friends were the most

Figure 1. Sources of general information and use of contraception



important sources of general information (i.e., informal communication; in Bangla, this is known as *mainser mukhe mukhe*, meaning "through other people's mouths"). Relatives, friends, radio and television scored high compared to printed matter, which is hardly surprising for a country with relatively low literacy rates. However, radio and television scored higher among contraceptive users than non-contraceptive users. The scores for relatives and friends were not significantly different between the two groups. This may suggest some polarization in this society in that non-users are discouraged from using contraception by their relatives and friends, while those practising contraception may well be supported by a group of like-minded contacts. When the totals of these information sources are examined in the information score, there is found to be a significant difference at the 5% level (P-value = 0.013) between the mean of contraceptive users (6.40) and the mean of contraceptive non-users (5.79).

Model of the Likelihood of Using Family Planning

Given the socio-economic and cultural situation of the interviewed women and their ideation about family planning discussed above, the impact of explanatory demographic, health, socio-economic-cultural and communication variables on FP use was modeled using binary logistic regression analysis. In total, 25 variables were used, of which eight were demographic variables, four were health variables, nine were socio-economic-cultural variables and the remaining four were communication variables. The four communication variables were formed from subgroups of the general sources of information; these, along with the other variables used in the models, are presented in Table 2.

Table 2. Variables used in the model

Demographic Variables	Total number of children, wife's age, wife's age at birth of first child, number of family members, demand for male child, demand for female child, sex of first child born (1 = male, 0 = female), death of male child
Health Variables	Delivery assistance: professional (no = 0, yes = 1), delivery assistance: relatives (no = 0, yes = 1), delivery assistance: unqualified (no = 0, yes = 1), place of giving birth (home = 1, 0 = otherwise)
Socio-economic-cultural Variables	Women's education level was measured by no = 0, primary = 1, secondary = 2 and greater than secondary = 3, income source (agriculture = 1, 0 = otherwise), wife's job (housewife = 0, 1 = otherwise), female autonomy score, religion (Hindu = 1, Muslim = 0), micro-credit organization affiliation (yes = 1, no = 0), land property ownership (yes = 1, no = 0), food consumption, socio-economic status (SES)
Communication Variables	Radio as a source of general information. Television as a source of general information. Display = average of newspaper, billboards and poster as a source of general information. Relatives and friends = average of relatives and friends as a source of general information.

Bi-variate logistic regression models were run with each of the variables in turn to obtain unadjusted odds-ratios to show the effect of each variable on the likelihood of using family planning. These are displayed in Table 3.

Two of the communication variables, radio and display materials, are significant and have a positive influence on the likelihood of using contraception. Among the demographic variables, only demand for more children and experience of male child death are significant, and these have a negative association with the likelihood of contraceptive use. For the health variables, only when the delivery assistant was a relative was there a significant association with the likelihood of contraceptive use, and this was a negative association. Of the socio-economic-cultural variables, four variables (level of woman's education, socio-economic status, female autonomy scores and micro-credit organization

affiliation) have significant positive associations with the likelihood of using contraception.

These variables were then entered into a multivariate model using Wald's forward selection method. The model was developed sequentially first, in model I, using demographic variables only; the health variables were then added to produce model II. Model III was formed by adding the socio-economic-cultural variables to model II. Finally, the communication variables were added to model III to produce model IV. These models are displayed in Table 4. In this table, only variables that were significant at the 5% level are displayed.

Table 3. Unadjusted coefficients and odds ratios for each variable of the likelihood of FP use

Variable	Coefficients	Odds Ratio
Demographic		
Total Number of Children	-0.038	0.962
Wife's Age	0.735	1.003
Age at First Birth	-0.022	0.980
Number of Family Members	0.022	1.022
Demand for Male Children	-0.461	**0.630**
Demand for Female Children	-0.209	**0.559**
Sex of First Child	0.175	1.190
Death of Male Child	-0.677	**0.508**
Health Variables		
Delivery Assistant Professional	-0.07	0.928
Delivery Assistant Relative	-0.927	**0.396**
Delivery Assistant Unqualified	-0.305	0.737
Place of Giving Birth	0.253	1.288
Socio-Economic-Cultural		
Income Source	-0.240	0.787
Woman's Level of Education	0.235	**1.265**
Wife's Job	-0.071	0.932
Socio-Economic Status	0.422	**1.525**
Female Autonomy Score	0.281	**1.325**
Religion	-0.085	0.919
Micro-Credit Organization Affiliation	0.655	**1.925**
Land Property Ownership		
Food Consumption	-0.005	0.995
	0.078	1.081
Communication Variables		
Radio	0.197	**1.218**
Television	0.114	1.121
Display	0.445	**1.156**
Relatives and Friends	-0.049	0.957

Figures in bold in the odds ratio column are statistically significant at the 5% level

The explanatory power of the model increased when the different subgroups of variables were added. Health variables connected with assistance at delivery appeared in model II but dropped out when socio-economic-cultural variables were added.

From model I in Table 4, "demand for more children" and "death of male child" were the only demographic variables that were significant, and both were negatively associated with FP use. Among the socio-economic-cultural variables from model III, female autonomy score, socio-economic status (SES) and micro-credit affiliation were significant, and all were positively associated. When communication variables were added (model IV), exposure to radio and display materials as a general source of information appeared significant. Overall, the model correctly classified 72.2% of the cases (20.5% of non-users and 95.7% of users were correctly classified). "Women's affiliation

with micro-credit organization" and "women's autonomy score" (of which a major component is to "travel unaccompanied") were both positively associated with the likelihood of contraception use. It is argued that as these variables enable women to meet and exchange information outside the home, they can be considered facilitators of communication (see Steele et al. 1998; Mason 1986).

It was evident in the models that the higher the exposure to communication, the greater the likelihood of using contraception. This raised the question, what role did communication play in this decision? In this research, this question was examined in two ways: (i) communication as a diffuser of family planning information and (ii) communication as a perceived influence by the women who are using contraception.

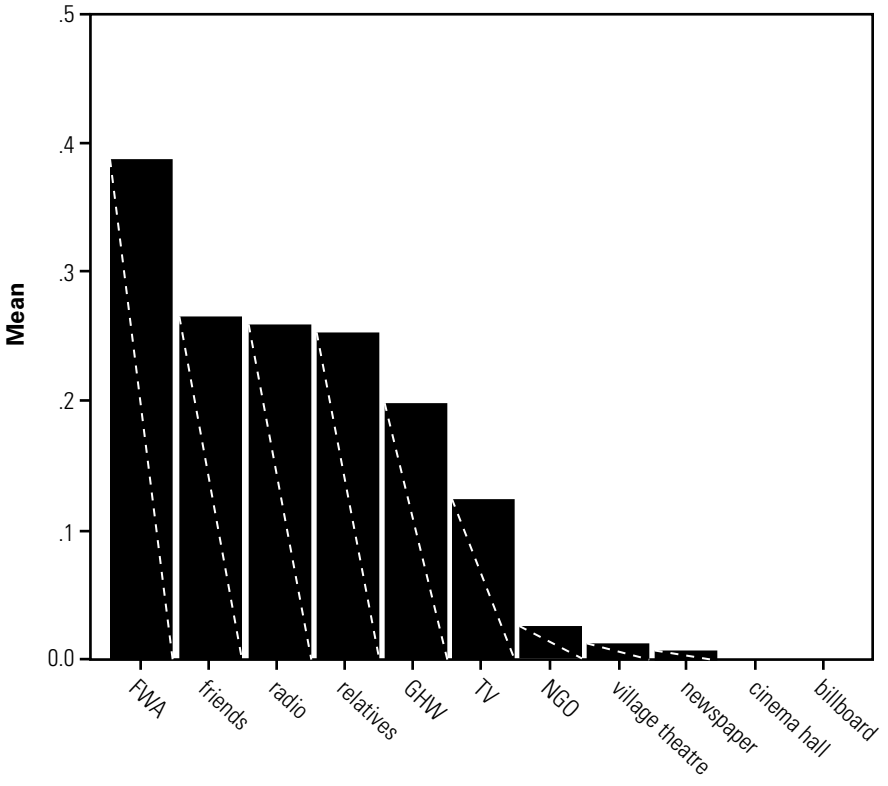
Table 4. Adjusted coefficients and odds ratios for each model of the likelihood of FP use

N = 723	Model I demographic variables		Model II demographic and health variables		Model III demographic, health and socio-economic-cultural variables		Model IV all variables	
Variable	**Coefficients**	**Odds Ratio**	**Coefficients**	**Odds Ratio**	**Coefficients**	**Odds Ratio**	**Coefficients**	**Odds Ratio**
Demographic Variables								
Demand for Male Children	-0.391	0.677	-0.358	0.669	-0.276	0.759	-0.314	0.730
Demand for Female Children	-0.494	0.610	-0.523	0.592	-0.509	0.601	-0.570	0.565
Death of Male Child	-0.686	0.503	-0.590	0.554	-0.650	0.522	-0.640	0.527
Health Variables								
Delivery Assistance Relatives			-0.712	0.491				
Delivery Assistance Unqualified			-0.365	0.694				
Socio-Economic-Cultural Variables								
SES					0.434	1.543	0.261	1.299
Micro-Credit Organization Affiliation					0.627	1.873	0.581	1.788
Female Autonomy Score					0.157	1.170	0.158	1.172
Communication Variables								
Radio							0.132	1.141
Display							0.964	2.622
Constant	1.124	3.076	1.389	0.162	0.866	2.378	0.711	2.035
Pseudo R Square Cox & Snell Nagelkerke	 0.038 0.05		 0.048 0.068		 0.080 0.113		 0.092 0.130	
Total % correct % of Users Correct % of Non-Users Correct	69.6% 97.4% 6.8%		70.8% 76.6% 12.2%		72.0% 95.5% 19.2%		72.2% 95.7% 20.5%	

Diffusion of Family Planning and the Perceived Influence of Communication

To assess the role of different types of communication in the diffusion of family planning, sources of family planning information were recorded for the women who practised contraception. FWA, friends, radio, relatives, government health workers (GHW), TV and NGO were found to be important sources of FP information, whereas exposure to village theatre, newspaper, billboard and cinema were negligible. In Figure 2, the FP information sources cited by the respondents are displayed.

Figure 2. FP information sources



Clearly, the most important source of family planning information is FWA, followed by friends, radio and then relatives. Among mass media, radio was the most important source of family planning information, and then television. Newspapers and magazines do not have much influence, which is perhaps due to the low literacy rate. Only 0.01% mentioned newspapers, and 0.01% mentioned village theatre. As well as being a family planning information source, FWAs were also found to be the most important source of family planning device collection (57.62%). This service delivery (both FP information and device) might have a huge influence on village women who are not allowed to travel unaccompanied outside the home: supply itself creates its own demand (Easterlin and Crimmins 1985).

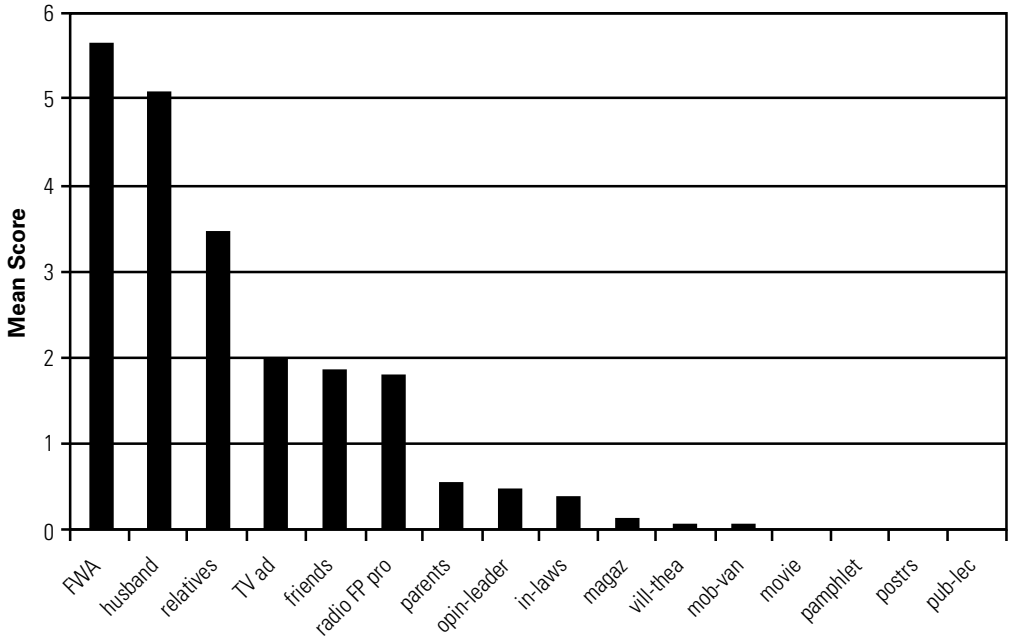
The perceived influence of different forms of communication was also measured for those who practised contraception. From the Pareto chart of influences on the decision to use contraception, displayed in Figure 3, it is clear that interpersonal factors, such as husband, FWA, relatives and friends, are the most important. These are followed by mass media and then displayed messages.

To assess the effect of these variables in promoting the sustainability of contraceptive use while controlling for demographic and socio-economic and cultural variables, a further logistic regres-

sion was developed. In order to prevent post-justification bias while constructing the model, only contraceptive users were included. The dependent variable was whether the main reason to use contraception was "to limit family size" (=1) or "to delay next birth" (=0). As other reasons only accounted for less than 5% of the stated reasons, those were treated as missing values. The model is displayed in Table 5.

Two communication variables appear as significant. These are husband's influence, which leads to the decision to "delay next birth" rather than to "limit family size," whereas the influence of FWAs has the reverse effect. Demand for more children and women who work outside the home make the decision to use contraception "to delay next birth" more likely. The older the mother and the greater the female autonomy score, the more likely the reason is to "limit family size." Thus, interpersonal communication via husbands and FWAs is important in sustaining family planning.

Figure 3. Mean stated influence on decision to use contraception (contraceptive users only)



Discussion

From the descriptive statistics, it was clear that the main reasons for practising family planning among the interviewed women was "to limit family size," in 76.67% of the cases, and to "delay the next birth" in 20% of cases. Thus, it is argued that women who were practising family planning had an ideational shift for a small family norm. It was found that the general communication sources that were most associated with FP decision-making were mass media (see Figure 1). However, of those who adopted contraception, FWA and husband were stated to be the two most important factors influencing contraceptive use. From the logistic regression model IV, in Table 4, radio and display material were found to influence the greater uptake of contraception. Relatives and friends did not appear as significant in the regression and this, we postulate, is a reflection of a polarized society in which there are promoters and rejecters of contraception. Socio-economic status (SES), female autonomy score and micro-credit affiliation were found to have a significant positive effect on the likelihood of using contraception. Increases in both female autonomy and micro-credit organization affiliation enable the exchange of

ideas among women and increase their exposure to interpersonal communication.

As the models develop, their explanatory power increases but remains low, and we postulate that the proportion that remains unexplained is the effect of communication influences. This is hinted at by the results displayed in Figure 3, which shows the importance of interpersonal communication.

Among the demographic variables, only "demand for more children" and "death of male child" appeared significant in model IV, and, as expected, the higher the demand, the less likely the practice of contraception. These demographic variables indicate the strong son preference.

In regard to the diffusion of family planning practice, it was found from descriptive statistics that the main source of general information was interpersonal (i.e., husbands, FWA, friends and relatives [see Figure 1]). The source of family planning information was also mainly interpersonal: family planning field workers and health workers, friends, relatives. These were found to be much more important sources of family planning information than mass media (see Figure 2). However, in order to avoid the problem of the direction of causality, communication sources that influenced the decision to use FP and FP information sources were not used in the logistic regression model of the decision to use family planning; the findings from this study show the importance of interpersonal communication in sustaining the use of contraception. This was borne out by the findings of the logistic regression that was used to model the reason for adopting family planning: here, husbands exerted influence "to delay next birth" rather than "to limit family size," whereas FWAs promoted the limiting of family size.

Table 5. Logistic regression model of reasons for limiting family size

Variable	Coefficients	Odds Ratio
Wife's age	0.128	1.137
Demand for female children	-1.793	0.082
Demand for male children	-2.501	0.166
Wife in work	-1.171	0.310
Female autonomy score	0.338	1.402
Land property	0.658	1.930
Husband's influence	-0.126	0.932
FWA influence	0.135	1.135
Constant	-1.404	0.246
Pseudo R square Cox & Snell Nagelkerke	 0.328 0.516	
Total % correct % of users correct % of non-users correct	86.2% 94.2% 54.8%	

Conclusion and Policy Recommendation

The factors that influence family planning use in rural Bangladesh were assessed in this paper. Ideational change for a small family norm to avoid economic hardship was found to be at the core of family planning use. This was irrespective of socio-economic and cultural conditions. In this ideational change, it is argued that various communication factors played a central role.

The logistic models left much unexplained, which we suggest may be explained by interpersonal influences on women. Although only sources of general information were examined in the model, and of these radio exposure and exposure to display materials appear as relevant, female autonomy score and micro-credit affiliation are strong predictors of contraceptive uptake. Thus, the ideological shift to the acceptance of lower family sizes is observable through these variables.

Though FWAs were found to be of high importance, since 1999, the doorstep service delivery has been withdrawn from the national FP program. This may have been one of the contributing factors to the continuation of the plateau of TFR at 3.3 for a decade (this has dropped to 3 recently, (National Institute of Population Research and Training et al. 2004). Although husbands rarely used contraception themselves (only 3.2%), Gayen (2004) found husbands to be very important factors in deciding family planning use (58%), the methods used (58.4%) and delivery place and assistance (63.8%). It is recommended in this paper that the FWA service delivery be re-established (also see Andaleeb 2004). Son preference still prevails as a negative influence on FP use, so it is recommended that communication channels be used to portray positive images of female children. Husbands should also be targeted in order to reduce their objection to the use of contraception, as this was cited as a significant reason by those who did not practise family planning. The importance of continuing education and communicating information is also highlighted, as "lack of knowledge" was cited as the third most important reason for not practising family planning.

In this research, interpersonal communication factors (FWA and husband) were found to be the most influential on the FP decision-making and, similarly, interpersonal communication channels were found to be the most important sources of general information and family planning information.

To ensure a greater adoption of family planning, it is recommended that various communication channels be used, especially interpersonal, to build awareness for those who are still having a "lack of knowledge about FP," and to target husbands and improve the images of female children to accelerate the ideation about family planning and to use contraception. It is anticipated that these channels can also be used to promote maternal and child health related issues in rural Bangladesh in the absence of developed socio-economic infrastructure.

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Knowledge of the Health Consequences of Female Genital Mutilation in Bere Community, Oyo State, Nigeria

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Abstract

Estimates suggest that more than 130 million girls and women have been subjected to the various forms of female genital mutilation (FGM) worldwide. This paper discusses FGM and the perception of its consequences on women's reproductive health in Bere community, Ibadan, Southwest Nigeria. Data were collected through household surveys using semi-structured questionnaires, in-depth interviews and focus group discussions. Results showed that 93% of women surveyed were circumcised. One hundred per cent of these circumcised women believed that FGM enhances women's fertility, and they attributed their previous safe childbirths (without complications) to being circumcised. A few respondents (33.6%) were aware of the health consequences of FGM. Most respondents (76%) were not willing to stop the practice. Male respondents had better knowledge of the consequences of FGM than female respondents. Similarly, younger respondents and those with higher education knew the health consequences of FGM more than the older respondents and those with little or no education ($p < 0.05$). The findings suggest the need for appropriate health education interventions targeting people in communities where FGM is pervasive, emphasizing the consequences of FGM.

Introduction

Estimates suggest that more than 130 million girls and women have been subjected to the various forms of female genital mutilation (FGM) worldwide (PATH/WHO 1999; Population Reference Bureau 2000, 2001). Nigerians are believed to comprise 24% of this number. In view of the current population growth rate in Africa, estimates suggest that about two million girls are at risk of being subjected to FGM every year, with some 6,000 cases being recorded every day (Toubia 1993; Dorkenoo 1994; Federal Office of Statistics/UNICEF 1996; PATH/WHO 1999; Population Reference Bureau 2001). In Nigeria, FGM is widespread, cutting across regional, ethnic and religious lines. There are estimates that about 60% of the Nigerian female population has undergone some form of FGM (CIHI 1996).

Among several harmful traditional practices in Nigeria is FGM. Female genital mutilation (FGM) involves the removal of part or whole of a female's genitals (Inter African Committee 1997). The health consequences of FGM are both immediate and lifelong, depending on the type of FGM that is done and the proficiency of the circumciser (Kiragu 1995). The consequences of FGM include bleeding, pain, haemorrhage, infections, urine retention, stress and shock, obstructed labour, vesicovaginal fistula (VVF) and rectovaginal fistula (RVF), infertility and death. The complications may be severe and directly responsible for maternal and fetal death. The risk of HIV infection through this practice is a strong possibility through the use of unsterilized instruments (Ras-Work 1991; Koso-Thomas 1992; O'Connell 1994; Brady 1999; WHO 2000; Jackson 2002).

Very little is known about the knowledge and perception of the consequences of FGM, particularly as it affects the reproductive health of women (Kiragu 1995). Information on the perception of the implications of FGM on health is important in understanding the factors that may contribute to the success of designing effective reforms that will support efforts to eradicate the practice. Here we present the knowledge, attitude and perception of the implications of FGM on women's reproductive health in a traditional community in Southwest Nigeria.

Methods

Study Area

The study was carried out in Bere community in the central wards of Ibadan (geographic coordinates: 7° 22N, 3° 58E), Oyo State, Southwest Nigeria. Bere community is essentially a patriarchal society. Family units are patrilocal and strong emotional bonds exist among members of extended families despite rapid social change. The community is a typical traditional Yoruba community with a population of 5,303, of which 52% are females according to the 1991 national population census. The projected population of 2005 was 8,002. The people are predominantly subsistence farmers and small traders.

Clitoridectomy, which involves cutting of the prepuce, sometimes along with part or the entire clitoris, is the pervasive form of FGM in Oyo State where the study community is located. The prevalence rate of clitoridectomy in Oyo State ranges from 60–70% (Onaeko and Adekunle 1985). Bere community has modern basic social infrastructure such as water, telecommunication, educational and health facilities.

Study Design

This study was designed for a cross-sectional description of the knowledge and perception of the consequences of FGM on women's reproductive health.

Data Collection Procedures

A total of 300 respondents, comprising 150 adult males and 150 adult females, were selected for the household survey using the multi-stage sampling procedure that involved both simple random and systematic random sampling techniques. Similarly, 20 of the identified 139 women who reported to have undergone FGM in the household survey were randomly selected for interview.

Interviewer-administered semi-structured questionnaires were used in the household surveys. Similarly, in-depth interview and focus group discussion (FGD) guides were used respectively for the qualitative data collection. A total of six FGD sessions were held among adult males and females in the community. The sessions were held with both sexes separately among participants with similar social background. Anonymity of the FGD participants was ensured until the convergence of each of the sessions started. Each FGD session was held in a comfortable and neutral setting and consisted of an average of eight participants plus a moderator. The discussions were tape-recorded and had an observer who took notes on the conversation and other non-verbal expressions.

Local government and community-level approval was obtained before the study commenced. The study subjects gave their informed consent to participate (in the form of a signature or thumbprint) in the household survey and FGDs after the purpose, benefits, risks and discomforts of participating in the study was explained to them. Those who could neither read nor write were asked to thumbprint their consent form in the presence of a witness.

Data Analysis

The completed questionnaires were first edited for clarity, completeness and uniformity in the responses to the questions. Codes were then assigned to all the responses to the questions using a prepared coding guide to facilitate data entry. Thereafter, the coded data were entered into the computer using the EpiInfo 6.04a software for statistical analysis. Associations between relevant variables in the quantitative analysis were determined using chi-square test.

The qualitative data were analyzed using the Textbase Beta software. The tapes and notes of participant responses from the FGDs were first transcribed, expanded and formalized into English from the local language. The transcriptions were then typed and saved as ASCII text files. Subsequently, a standard node tree of domains and concepts of interest was developed for coding the texts using the software. The texts were thereafter summarized, categorized, coded and sorted into text segments according to similarities and differences in the opinions and views of the FGD participants using the textual analysis program.

Results

Background of Respondents

The age of the respondents ranged from 18 to 90 years with a mean age of 50 years (males, 56 years; females, 44 years). A majority of the respondents (96% males and 92% females) were married. A majority of the respondents (81.4%) were Muslim, 18.9% were Christian and only 2.7% practiced indigenous religions. Generally, the respondents had a low literacy level. While 49.7% had no formal education, 31.7% and 11.3% had primary and secondary education respectively. Only 7.3% had tertiary education. A majority (61.3%) of the female respondents had no formal education compared to 38% for the male respondents. The respondents shared similar educational backgrounds with their spouses, as 78.8% of them had spouses with little or no formal education.

Age at Which FGM Is Performed

One hundred per cent of the respondents reported that FGM is practiced in their community. A majority of respondents (88.2%) indicated that FGM is done alongside body and facial scarifications when girls are in their infancy (<1 year), while 11.8% mentioned FGM is done in childhood (1–12 years).

Two hundred and seven (90%) of the 230 respondents who had daughters circumcised them, while 10% did not. Table 1 indicates the respondents' religious and educational backgrounds and their practice of FGM on their daughters. The respondents' level of education and their spouses' level of education significantly determined the likelihood to have circumcised their daughters ($P < 0.05$). Religion had no significant association with the practice of FGM among the respondents ($p > 0.05$).

Table 1. Did you circumcise your daughter(s)?

	Yes		No		Total	
Religion	**Number**	**%**	**Number**	**%**	**Number**	**%**
Christian	27	67.5	13	32.5	40	17.4
Muslim	170	94.4	10	5.6	180	78.3
Indigenous	10	100	–	–	10	4.3
Total	207	90	23	10	230	100
Respondents' education						
None	112	99.1	1	0.9	113	49.1
Primary	69	95.8	3	4.2	72	31.3
Secondary	20	71.4	8	38.6	28	12.2
Tertiary	6	35.3	11	64.7	17	7.4
Total	207	90	23	10	230	100
Spouses' education						
None	124	99.2	1	0.8	125	54.3
Primary	50	94.3	3	5.7	53	23
Secondary	25	78.1	7	21.9	32	13.9
Tertiary	6	33.3	12	66.7	18	7.8
Total	207	90	23	10	230	100

Knowledge of Consequences of FGM

Table 2 indicates respondents' knowledge of the consequences of FGM. Generally, few (32.3%) respondents were aware of the health consequences associated with FGM. Of respondents with a low literacy level, 24.0% of females compared to 40.4% of males were aware of the consequences of FGM. Respondents mentioned these consequences of FGM: bleeding (45%) and pain (55%). The respondents' age, sex and level of education significantly influenced their knowledge of health consequences inherent in FGM ($p < 0.05$). Similarly, more females than males interviewed during household survey, and more female than male FGD participants reported not having knowledge of the consequences of FGM.

Many male but few female FGD participants reported the occurrence of minor consequences (such as bleeding) associated with FGM performed on their daughters or other girls in the community. FGD participants attributed reported cases of severe FGM consequences to diabolical forces. In recalling her experience, a female FGD participant said,

> some children bleed severely after being circumcised … this is usually caused by the enemies around…by the time certain herbal preparations are applied, in addition [to] some incantations, the bleeding would cease. I actually had the experience when one of my granddaughters was circumcised many years ago … when the bleeding from the open cut did not cease after many minutes, my mother-in-law had to intervene telling us to provide some herbal items that were applied along with incantations she chanted. The bleeding ceased immediately [after] she completed the ritual … that baby girl is now married and has even started having her own children, too.

There was a consensus among the participants of the different FGD groups that without the involvement of any diabolical forces, the open cut is expected to heal within three to five days. They argued that the circumcisers are experienced, knew what to cut and how to do it well.

Table 2. Are you aware of the health consequences associated with FGM?

	Yes		No		Indifferent		Total	
Sex	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Male	61	40.4	88	58.7	1	0.7	150	50
Female	36	24	104	69.3	10	6.7	150	50
Total	97	32.3	192	64	11	3.7	300	100
Age (in years)								
18–25	7	36.8	12	63.2	–	–	19	6.3
26–30	7	36.8	12	63.2	–	–	19	6.3
31–35	10	40	13	52	2	8.0	25	8.3
36–40	10	33.3	19	63.3	1	3.4	30	10
41–45	10	34.5	15	51.7	4	13.8	29	9.7
46+	53	29.8	121	70	4	2.2	178	59.3
Total	97	32.3	192	64	11	3.7	300	100
Education								
None	24	16	121	80.7	5	3.3	150	50
Primary	41	42.7	52	54.2	3	3.1	96	32
Secondary	15	45.5	15	45.5	3	9.1	33	11
Tertiary	17	81	4	19	–	–	21	7
Total	97	32.3	192	64	11	3.7	300	100

In affirmation of the FGD participants' perceived proficiency of the circumcisers, the circumcisers who were interviewed expressed doubts of any consequences relating to FGM. This is illustrated in the words of one circumciser: "For more than 30 years that I have been involved in this job that I learnt from my father, I have never circumcised a girl-child that later had complications … if I circumcise a girl-child now and tell you that the open cut will heal within three to five days, I want to assure you that it will heal within the specified time limit. I am very confident because it is a skill that I acquired from childhood from my father while following him to wherever he went to circumcise." The other circumciser who was interviewed stated that "I can circumcise a girl-child within a very few minutes with high precision since I know what to cut and how to go about it."

Perception of the Implications of FGM on Reproductive Health

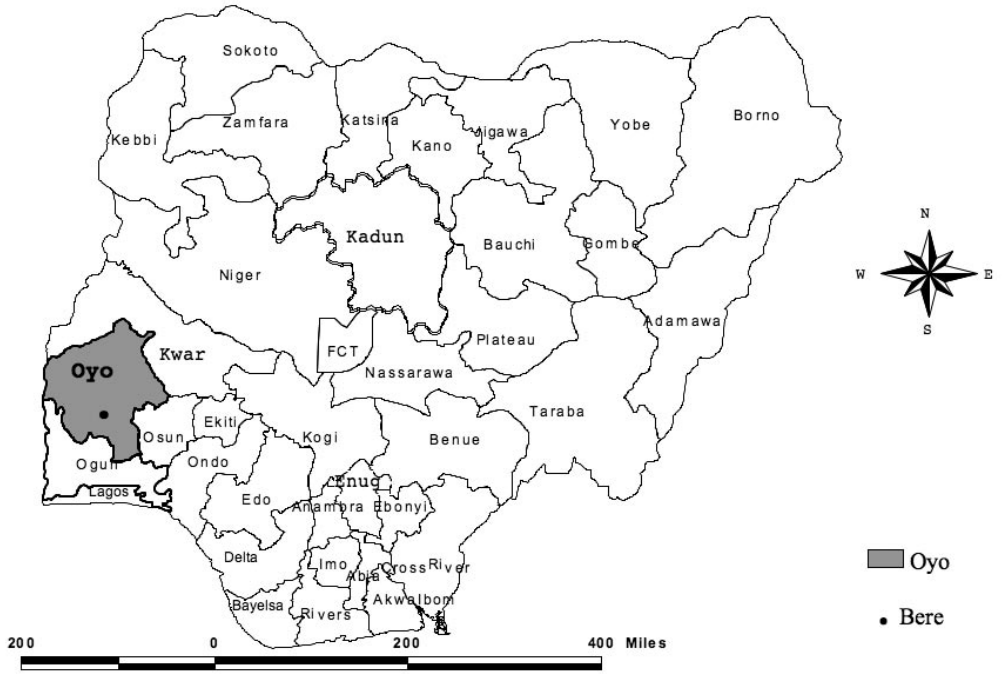
Overall, of the 207 (90%) of the 230 that have daughters and circumcised them, 203 (98%) reported that their children had no consequences from FGM. Only 2% reported their children had severe bleeding following the procedure of FGM.

The personal experience of the female respondents surveyed concerning FGM showed that 93% were circumcised and 7% were not. This is contrary to those interviewed as case studies who were all circumcised. One hundred per cent of the uncircumcised women in the survey were married to men who came from other communities where FGM is not practiced.

One hundred per cent of the circumcised women interviewed believed their being circumcised did not in any way affect their sex and reproductive lives. They reported to have had safe child deliveries without difficulties. On the contrary, they attributed their safe childbirth experiences to being circumcised. A 55-year-old woman, for example, explained that "throughout my childbearing age, I never experienced any difficulty which those campaigning are now attributing to circumcising a girl despite the fact that I was circumcised since my childhood... there were times when I had to deliver my babies myself at home without any assistance, and no complication developed thereafter...the complications that are being used to campaign against FGM could be obtainable elsewhere though,

but there is nothing of such in this our community, because when women go into the labour room, they come out hale and hearty with their babies."

Figure 1. Map of Nigeria showing Oyo State, in which Bere Community is located



Discussion

The limitations of the study should be pointed out before discussing the results. The primary limitation is that the study lacked a national focus, because the data reflect only one community among many ethnic groups and areas of the country. This, however, does not undermine the validity of the study results, as the scope and nature of FGM are still sketchy and incomplete in Nigeria. This implies that further studies are needed with wider coverage of the country using a larger sample.

The study examined the knowledge and perception of the consequences of FGM on women's reproductive health. It is evident from the study that FGM is widely practiced in the study community. A significant proportion of the people who participated in this study, particularly women, are yet to realize the consequences inherent in the practice as identified by health experts and emphasized in the campaign against the practice.

The perception of most female respondents that FGM is of no consequence to their health illustrates either their sincere lack of awareness of the health consequences inherent in FGM, which may perhaps be related to the mild form of FGM that they perform, or a denial of the reality of these consequences. The lack of awareness of the consequences of FGM, particularly among females and those with little or no formal education, exhibits the need for appropriate health education using information, education and communication (IEC) and or behavioural change communication (BCC) materials, including both audio and visual aids, such as posters and video tapes, targeting these groups as successfully applied in other BCC activities such as the control of sexually transmitted infections and HIV/AIDS. Emphasis needs to be placed on providing education to people who practice FGM about the implications of FGM to discourage them from the practice.

It is suggested that intensive efforts are needed to substantially explain and prove to people who practice FGM why the practice should cease, because it is natural that they may not easily compromise their practices, because of its socio-cultural sensitivity. In view of the fact that FGM is often at the heart of the community's belief system, the community first needs to acknowledge the practice as detrimental to the health of women and girls before it will begin to change. It is agreeable that people will change their behaviour and accept change once they realize that it is in their best interests and that of their children. It is important that members of the community, particularly the political, religious and opinion leaders, play a role in the design and conduct of the FGM eradication activities, in particular, to advocate ending the practice. This, we believe, will provide a strong basis for developing an appropriate strategy for a successful eradication of FGM in the study community and other communities where the practice is rife.

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Hypertension in Rural Haitians: Its Relation to Weight*

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Abstract

Being overweight is a risk factor for hypertension, but there has been little study of the extent of this risk where obesity is rare. While providing medical services, clinical personnel recorded the ages, weights, blood pressures (BP) and diagnoses of 396 Haitian adults; as well, descriptive and analytical statistics were generated to explain associations among these recorded factors. Elevated BP was found in 39% of men and 45.6% of women. It was noted that 30.1% of men and 12.4% of women were underweight, whereas none of the men and 3.2% of the women were overweight. Regression models showed significant contributions from age and weight in predicting BP, but only accounted for 11–32% of the variation. Although age and weight are useful in predicting BP, there are unmeasured factors that account for most of the variation, which require future research.

Introduction

One of the first interventions that a physician recommends to an overweight hypertensive patient is weight reduction because of the association between obesity and high blood pressure (BP). However, hypertension has been shown to have multifactorial causes, and in some populations, weight gain may be a minor risk factor in comparison to others.

In 1997, a team of American clinicians traveled to Haiti to provide medical care to people living in and around the rural town of Léon in the Grande-Anse province. Many of the clinically malnourished and underweight patients encountered there had elevated BP readings. This observation, plus the rarity of obesity in this community, suggested that weight might play a minor role in the etiology of hypertension in these people. An understanding of the extent to which weight is a risk for BP elevation would be relevant in planning hypertension treatment for Haitian-Americans who have been able to increase their caloric intake. If weight does play a relatively minor role in the etiology of their hypertension, then focusing on this too much could divert attention from other more effective medical interventions.

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* The views presented here are those of the author and do not necessarily represent those of the U.S. Department of Health and Human Services, the U.S. Department of Defense, or any of their components.

Background and Public Health Significance

The published literature on hypertension in Haitians is sparse. Most studies of high BP in Black populations come from the United States and Africa. Preston et al. (1996) published a small study of 88 Haitian patients seen in a multi-specialty clinic in Miami. They found 87.5% to be hypertensive (BP greater than or equal to 140 millimetres mercury (mm Hg) systolic or 90 mm Hg diastolic, or taking antihypertensives), and 52% to be obese (based on weight and height). In a study of African-American men from a county in the southern United States, Curtis et al. (1998) found a positive correlation between baseline obesity and hypertension, and between hypertension and weight gain during the study in men who were not obese at baseline. Rosenberg et al. (1999) used logistic regression to examine the relationship of body mass index (BMI) to hypertension in college-educated African-American women. Overweight women had a 2.7-fold greater risk of hypertension, and severely overweight women (BMI 32.3 or above) had a 4.9-fold greater risk compared to women of normal weight. The regression models showed further that about 25% of the prevalence was explained by the differences in proportions of moderately and severely overweight women.

Lluberas et al. (2000) found a 27% prevalence of hypertension among 233 Haitian adults seen in a rural mission clinic (26% for women, 31% for men). The average BP was 131/79, without a significant gender difference. There was a significant age difference between hypertensive (59 years) and non-hypertensive men (47.1 years). The hypertensive men were said to be leaner, but weights and BMIs were not reported. Shipp (2001) found a 24% prevalence of hypertension among 382 adults who were accompanying sick people to a clinic in Port-au-Prince.

In 826 patients seeking medical care at the Léon dispensary over a one-week period in 1997, malnutrition and high BP were among the top five most frequent problems, exceeded only by nonspecific musculoskeletal complaints, gastroesophageal symptoms and intestinal parasites. Of the 55% of adult patients who had BP recorded, 36% had a systolic BP greater than 140 mm Hg, and 33% had a diastolic BP greater than 90 mm Hg. Fifty-seven per cent of these patients met a case definition for malnutrition based on clinical impression and a weight below the fifth percentile for their gender. However, this was a biased estimate, since weights were not measured on all patients.

A second medical team returned to Haiti in 1998. Based on earlier observations, the team wished to define better the prevalence of high BP and malnutrition in this population in order to guide its community-oriented primary care planning efforts. Thus, a clinical protocol was developed that included taking BP and weight measurements on all patients over 18 years of age. A bilingual (English and French) medical record was created for purposes of clinical care. The data included age, gender, BP, weight, height and up to four diagnoses. This was used to estimate the frequencies of high BP, clinical malnutrition and other medical conditions.

The 1998 data again showed a number of people who had elevated BP (some severely so) despite being underweight. Since weight is associated with elevated BP in other populations (including those of African descent), but had not been studied in Haitians specifically, this study was initiated to determine whether this association holds for Haitians, too. Since this study was done in a primary care clinic setting, it was more representative of the general population than a subspecialty clinic would be. Thus, hypotheses can be generated to clarify risk factors for hypertension, and to provide a basis for estimating the burden of disease and prioritizing the delivery of targeted health services for rural Haitian people.

Materials

The study population consisted of 396 adult patients who came to the Léon dispensary for any medical complaint during a one-week period in March 1998, when a team of American clinicians provided direct primary care. This dispensary served residents of both the town and outlying areas within several days walking distance, and was normally staffed by Haitian nurses.

Methods

This study was a secondary data analysis of medical records. As such, the design was reviewed by

the Institutional Review Board at the Uniformed Services University of Health Sciences, Bethesda, Maryland, and approved as an exempt study.

In this study, the case definition of high BP was the World Health Organization (2003) criterion of greater than or equal to either 140 mm Hg systolic or 90 mm Hg diastolic. The case definition of underweight was a weight below the fifth percentile for male or female 18-year-olds. This reflected the percentile criteria used to define "underweight" on the 2000 growth charts of the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (2000). This percentile had been chosen previously by the team in order to prioritize limited treatment resources to the most severely affected. The case definition of overweight was a weight at or above the 95th percentile, consistent with the Centers for Disease Control and Prevention (CDC) definitions.

Data from the clinical encounters were entered into a Statistical Package for the Social Sciences (SPSS) database. Each adult patient's age, sex, systolic and diastolic BP, weight and diagnoses were entered along with a study identification number. No personal identifiers were included. Data entry was then verified and corrected by manually comparing the database with the original records.

Age was recorded in years. Nurses used aneroid cuffs to take BP readings. Systolic and diastolic BPs were recorded in mm Hg. When more than one BP was in the record, the first one was entered into the study database for consistency. Systolic and diastolic BP were recoded into a single categorical variable for high and normal BP. Nurses recorded weights in kilograms; the weights were recoded into fifth and 95th percentile bands based on NCHS growth charts (Hamill et al. 1979). Diagnoses were transcribed into the database in the order in which they appeared in the records, using the phrasing employed by the clinician as much as possible. When a specific diagnosis was not recorded, the presenting symptoms were substituted. Diagnoses were then converted into codes from the International Classification of Diseases, Ninth Revision (Hart and Hopkins 2004).

Statistical analysis was done by means of SPSS-12 and SAS-9.1 software. Descriptive statistics (means and standard deviations) are presented for the various study factors. Pearson correlation coefficients were calculated for continuous variables. For contingency tables, continuity adjusted chi-squares were used. All analyses were two-sided, with significance defined at the $p < 0.05$ level.

Results

During one week, 396 adult patients were seen, of whom 36.9% were men and 63.1% were women. Ages of 18 or over were recorded for 387 patients (ranges 18–91 for men, 18–87 for women). The other nine patients had no age recorded, but were judged to be adults on the basis of the clinical presentations in their medical records. Mean ages for men and women are found in Table 1.

Table 1. Mean age, BP and weight of patients by gender, with corresponding standard errors: Léon, Haiti, 1998

	Women		Men	
	M	SE	M	SE
Age (years)	45.9	1.0	45.6	1.4
Systolic BP (mm Hg)	138.0	2.1	133.5	2.2
Diastolic BP (mm Hg)	84.7	1.1	82.0	1.1
Weight (kg)	55.3	0.7	58.4	0.7

M Mean
SE Standard error

Systolic BP was obtained for all 146 (100%) of the men and 247 (98.8%) of the women. Diastolic BP was obtained for all as well, save one woman who had only a systolic BP recorded.

Table 1 presents mean systolic and diastolic measurements. Forty-three per cent of the patients had elevated BP, with no significant gender difference (see Table 2).

Table 2. Number and per cent distribution of hypertensive, underweight and overweight patients by gender: Léon, Haiti, 1998

	All Patients		Women		Men		*p*
	Number	%	Number	%	Number	%	
All patients	396	100.0	250	100.0	146	100.0	
Hypertensive	171	43.2	114	45.6	57	39.0	0.20
Not hypertensive							
Normotensive	222	56.1	133	53.2	89	61.0	
Unknown	3	0.8	3	1.2	0	0.0	
Underweight	75	18.9	31	12.4	44	30.1	< 0.0001
Not underweight							
Normal weight	296	74.7	199	79.6	97	66.4	
Overweight	8	2.0	8	3.2	0	0.0	
Unknown	17	4.3	12	4.8	5	3.4	

Weight was recorded for 141 (96.6%) of the men and 238 (95.2%) of the women. Mean weights are in Table 1. The mean weight for men was just above the 10th percentile. The mean weight for women (none of whom were pregnant) was below the 50th percentile. The per cent distributions of underweight, normal weight and overweight patients are in Table 2. About 30% of the men and 12% of the women were underweight – a highly significant gender difference. No men and about 3% of the women were overweight.

Elevated BP was noted in about 41% of the underweight men and 39% of the underweight women. Although the idea for this study came from these patients, no significant positive or negative association between underweight and elevated BP was noted for either gender (Table 3).

Table 3. Association between weight and BP by gender: Léon, Haiti, 1998

	Women			Men		
	Underweight	Not Underweight	*p*	Underweight	Not Underweight	*p*
All patients	100.0	100.0	0.47	100.0	100.0	0.99
High BP	38.7	47.6		40.9	39.2	
Normal BP	61.3	52.5		59.1	60.8	

Age was positively correlated with systolic and diastolic BP in both men and women. Weight was positively correlated with both systolic and diastolic BP in men, but only with systolic BP in women. There was no significant correlation between age and weight (Table 4).

Multiple linear regression models were constructed for each sex using systolic and diastolic BP as dependent variables and age and weight as independent variables, using stepwise selection (probability of F to enter = 0.05; probability of F for removal 0.10). Intercepts, regression coefficients for weight and age, correlation coefficients and coefficients of determination are presented in Table 5. Analysis of variance showed all four models to be highly significant. Frequency plots of standardized residuals and normal P-P plots showed the residuals to be normally distributed.

Table 4. Correlations among age, weight and BP by gender: Léon, Haiti, 1998

	Women		Men	
	R	*p*	*R*	*p*
Age – weight	–0.05	*ns*	–0.03	*ns*
Age – systolic BP	0.54	< 0.001	0.28	0.001
Age – diastolic BP	0.40	< 0.001	0.18	0.03
Weight – systolic BP	0.14	0.03	0.22	0.01
Weight – diastolic BP	0.00	*ns*	0.29	0.001

ns Nonsignificant
R Correlation coefficient

Table 5. Linear regression models for systolic and diastolic BP by gender: Léon, Haiti, 1998

	Women					
	Intercept	Beta (weight)	Beta (age)	*R*	Adjusted R^2	*p*
Systolic BP	57	0.51	1.14	0.57	0.32	< 0.001
Diastolic BP	54	0.44	0.20	0.42	0.17	< 0.001
	Men					
	Intercept	Beta (weight)	Beta (age)	*R*	Adjusted R^2	*p*
Systolic BP	68	0.76	0.47	0.37	0.12	< 0.001
Diastolic BP	47	0.49	0.15	0.35	0.11	< 0.001

R Correlation coefficient
R^2 Coefficient of determination

Discussion

This preliminary work has shown that hypertension is a significant problem for the people of this area of rural Haiti, as it is for many populations of African descent. The prevalence of elevated BP was high for both women (39%) and men (45.6%). This is similar to the prevalences reported by the Centers for Disease Control and Prevention (2005) among American non-Hispanic Black women (40.4%) and men (43.4%) between 1999 and 2002.

The impetus for this study was the observed high prevalence of elevated BP in this adult clinic population, even though obesity was rare, and even in the presence of clinical malnutrition. Thus, the high prevalence of hypertension stood out even more starkly than it does in developed countries where obesity is a significant confounding factor even among ethnic Haitians.

The next question was whether weight was still a risk factor for hypertension in such a population. Since BP is known to rise with age and weight in other populations, bivariate correlations were set up, which showed similar relationships in this Haitian population except for diastolic BP in women.

For those who like to quantify risk factors, linear regression analysis is attractive. In these equations, both age and weight contributed significantly to the prediction of systolic and diastolic BP, even for diastolic BP in women. However, the coefficients of determination were discouraging, ranging from 11–32%. Thus, age and weight accounted for only a small portion of the variability in BP in this population, implying that there are other unmeasured risk factors that would need to be taken into account in constructing a more complete regression model.

While examining the associations between weight and BP is interesting, and certainly more powerful statistically because of the continuous nature of the variables, the real clinical question is whether hypertension itself is associated with weight in Haiti. Because these data show positive correlations between BP and weight, it is reasonable to think that a larger sample size might define better a similar categorical relationship for hypertension. It is impossible to draw conclusions about the relationship of obesity to hypertension in this population, since there were so few overweight women and no overweight men.

Other Possible Causes of Hypertension

There are undoubtedly other factors influencing the prevalence of hypertension (such as renal or cardiac disease, family history, diet, consumption of raw sea salt available in the local market) for which data were not collected. Some possibilities for these factors in African-descended populations come from the literature, albeit not for Haitians specifically.

Fraser (1986) noted that African-Americans do not excrete a sodium load as rapidly as Americans of European descent. He also noted that there may be African subpopulations that are more prone to develop hypertension than others in response to dietary salt. He also cited non-African populations with high prevalences of hypertension, and related that to salt consumption as well. One Solomon Islands tribe stood out from their neighbours in having a higher prevalence of hypertension, associated with a unique custom of boiling their food in seawater. A confederation of Turkish tribes with a high age-related incidence of hypertension also showed higher than usual sodium excretion for both genders, presumably due to high salt consumption. This is of interest in Haiti, since raw sea salt was available in large quantities on market day in the town of Léon where the clinic was located.

Ducorps et al. (1996) found an overall hypertension prevalence of 66.4% among 550 diabetic patients at a hospital in Cameroon. They contrasted this with previous studies in Africa that showed prevalences between 2.5–30% in more general populations. Svetkey et al. (1991) studied hypertensive American patients with clinical features suggesting a renovascular cause. Renal artery stenosis was found in 19% of Black subjects; renovascular hypertension was diagnosed in 9% of these subjects. However, this did not differ significantly from results seen in White patients. Seedat (1996) reported an age-adjusted hypertension prevalence of 25% among urban Zulus in South Africa, but also noted that the mean arterial pressures in this group were lower than those seen in Black populations of the West Indies and United States. He attributed this difference to the "New World" groups having lived "Western lifestyles" over 300 years, and goes on to discuss other etiologic factors such as limitations in intracellular sodium-potassium exchange, slower sodium excretion rates and defects in the renin-aldosterone pathway in Black populations. He noted no differences in daily sodium intake between South African Black populations and Western populations, but suggested a potassium-deficient diet as one causative factor for hypertension.

Limitations

The sample for this current study was not randomly drawn from the population. Self-selection bias is likely in a clinic population, which might yield an overestimate of the real population prevalence of BP or weight abnormalities. Especially in 1998, the local people were aware that the team offered some treatment for both hypertension and malnutrition. Also, some patients who might have come to the clinic due to the novelty of visiting American clinicians might not ordinarily have sought medical care, especially if they lived a great distance from the clinic. The extent of these factors or how they might have affected the composition of the study population is not certain. However, since the majority of patients were presenting with symptoms of musculoskeletal pain and dyspepsia, and had high BP noted incidentally, it is reasonable to assume that these data may approximate the true population prevalence of hypertension. These prevalences are relevant to other volunteer organizations that provide medical care in developing countries, in that their clinic populations are also likely to be self-selected, and therefore to exhibit the same type of bias among the patients they actually treat.

This medical mission was not conceived for research purposes. Therefore, the measurements were

subject to issues of reliability and accuracy inherent to a clinical setting in a developing country. These might have included variations in BP measurement techniques among nurses and the absence of external calibration of the BP cuffs. Standard cuffs were used for all patients, even at the extremes of weight, which could have introduced an unknown degree of systematic error to these measurements. There is diagnostic inaccuracy inherent in using only one BP screening as the basis for diagnosing hypertension. The usually-accepted diagnostic criterion for hypertension is three elevated BP readings taken at different times. Thus, it is recognized that elevated screening BP readings are not strictly equivalent to a diagnosis of hypertension. For this reason, the team's treatment efforts were targeted to the above-160/100 group, in order to best utilize limited medication supplies. Although BMIs calculated from both weight and height would have been better than weight alone, heights were recorded on very few patients because of the large numbers needing to be seen in a short time. Thus, this study was limited to defining underweight in terms of weight percentiles alone. There was a small number of adults (less than 5% of the total) missing either BP or weight.

Adult Haitian norms for BP and weight may differ from US norms. However, no literature exists to validate this as a significant concern. Neither the CDC nor the WHO advocates different norms for specific ethnic groups, nor are such norms available.

Conclusions

In this population of self-selected rural Haitian patients with undifferentiated complaints, age and weight were positively associated with both systolic and diastolic hypertension, but correlations were weak. Linear regression models showed that age and weight account for a significant but small amount of the variability in BP.

Thus, the hypothesis generated by this study is that there are other determinants of BP elevation in rural Haitians that account for the largest part of the etiology. Possibilities for future research include: dietary factors, especially sodium and potassium intake; diabetes mellitus and other diagnoses that might be associated with hypertension; cardiac pathology, such as aortic stenosis or coarctation; renal dysfunction, especially due to tropical diseases; and closer investigation of the renin-angiotensive-aldosterone system. Although there are practical limitations to studying many of these factors in a rural mountain setting in a developing country, some of them can be assessed through anthropological techniques (dietary customs and food availability), dietetic surveys (to estimate sodium and potassium intake), physical examination (cardiac auscultation and differential BP) or systematic recording of target diagnoses using objective case definitions. It may be possible to investigate other factors with some technological investment (e.g., serum/urine electrolytes and glucose screening). Other biochemical studies are possible, but would require collection of body fluid specimens that would need to pass through international barriers to be delivered to a reference laboratory.

Although these findings can only be extrapolated strictly to similar populations of self-selected clinic patients in Haiti, this has practical value to medical non-governmental organizations that serve precisely this type of population. Since most of the hypertensive patients were not presenting with a chief complaint of hypertension, it is reasonable to test hypotheses generated by this study in the general Haitian population. A prospective community outreach approach would be much more effective for drawing inferences about this population.

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Paediatric Health Economic Evaluations: A World View

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Abstract

Objectives: As economic evaluation methods evolve, their applicability to special populations, such as children, has received increased scrutiny. The objective was to review paediatric health economic evaluations published over the last quarter century, comment on trends, discuss gaps between developed and developing nations, and point to future directions for research.

Methods: Data compiled for the Paediatric Economic Database Evaluation (PEDE) project to 2003 were used to describe temporal and geographic trends and evaluate the frequency of intervention categories and conditions studied.

Results: The volume of paediatric health economic evaluations rose rapidly since 1980. Studies of infective/parasitic diseases, congenital anomalies and complications of pregnancy accounted for the majority. Prevention rather than treatment was emphasized. Most evaluations performed since 1998 (78%) were cost-effectiveness analyses. Cost-utility analyses were rare. The US produced half of all publications, with the UK contributing 12%. Economic evaluations from developing countries were uncommon, despite an urgent need for evidence-based decision-making in these regions. The interventions studied reflected local health priorities; HIV and malaria prevention were more commonly studied in developing nations, whereas treatments for asthma and birth malformations were more often evaluated in developed nations.

Conclusions: Despite global initiatives to combat disease, developing nations rely on foreign research to inform implementation of local health programs. There is a need for better methods for data transfer and extrapolation. Future research must focus on paediatric models of costs and consequences and the development of tools to measure long-term effects.

Introduction

The picture of contemporary healthcare systems is one that reflects the tension between increasing investment in new technology on the one hand and the need to curtail spending on the other. As a tool to facilitate budget allocation decision-making, economic evaluations that weigh healthcare costs against health benefits have been documented in the medical literature for over 25 years and paediatric economic evaluations were among the earliest. In recent years, a rapid escalation in healthcare costs around the globe has contributed to the urgency of generating high-quality health economic evaluations to inform decision-making and ensure sustainability of our healthcare systems.

In this paper, the roots of paediatric health economic evaluation will be described. Trends in paediatric health economic evaluation over time and by global region will be presented, and the types of interventions and paediatric conditions studied around the world in recent years will be explored. The paper will reveal the gaps in international research in paediatric health economics by exposing differences between developed and developing countries, and future directions for the conduct of paediatric health economic evaluations will be highlighted.

The Origins of International Paediatric Economic Evaluations

In 1980, eight full paediatric economic evaluations (i.e., ones that included a comparator and measured both costs and consequences) were published in the medical literature. These consisted of studies of an immunization program in Indonesia (Barnum et al. 1980), prevention of dental caries (Klock 1980), prevention of tuberculosis (Koplan and Farer 1980), immunization for measles in Southern Zambia (Ponnighaus 1980), a nutritional intervention in the Philippines (Popkin et al. 1980), an intervention for problem behaviour (Siegert and Yates 1980), a management care-delivery system for children with cancer (Strayer et al. 1980) and vaccination against pneumococcal pneumonia (Willems et al. 1980). These eight studies, published in a wide array of journals that included the *Bulletin of the World Health Organization, JAMA, New England Journal of Medicine, Pediatrics, Social Science & Medicine, Journal of Tropical Medicine & Hygiene and Community Dentistry & Oral Epidemiology*, represent the wide therapeutic areas and geographical disparities that continue to this day to typify child health worldwide. Unlike adult medicine that emphasizes medical treatment of disease, paediatric medicine places much importance on prevention of illness. Child health is holistic in that nutritional status, dental health and school performance are emphasized as important indicators alongside good physical health. Because of the relationship between susceptibility to disease and normal child development, aspects of behaviour and learning are often integrated into the prevention and management of illness. Child health features community, school and public health interventions to a great extent. The international health economic literature reflects these unique characteristics and also reveals the difference in priorities in child health between developed and developing nations.

The benefits of programs that focus on prevention are sometimes fully valued in monetary terms. As such, the emphasis on prevention in paediatric medicine has led to the publication of a number of cost-benefit analyses (CBAs), wherein both costs and benefits are expressed in monetary units. This is in contrast to more conventional analytic techniques such as cost-effectiveness analysis (CEA), which measures outcomes in natural health units. The occurrence of CBAs among paediatric economic evaluations belies the notion that CBAs are rare in the health sector. Among the eight pioneering studies cited above, three were CEAs, three were CBAs and two were cost-minimization analyses (CMAs) that compared costs only, given evidence of equal effectiveness between the interventions.

Not only were paediatric health economic evaluations among the earliest, they have also been among those at the methodological forefront. The 1980 study of a preventive treatment for tuberculosis (Koplan and Farer 1980) featured decision analysis, a sophisticated mathematical modelling technique that integrates data from multiple existing sources to derive the expected utility of comparator interventions (Detsky et al. 1997). In 1983, Boyle et al. published one of the first cost-utility analyses (CUA), calculating the incremental cost per quality-adjusted life year (QALY) gained for neonatal intensive care for very low birth weight babies. A QALY is a unit of health benefit that adjusts

expected survival expressed as life years gained, by decrements in health-related quality of life. This paper, regarded as a classic in the health economics literature, presented the results in both CEA and CUA frameworks. As neonatal intensive care continues to be among the costliest forms of medical care, this paper continues to have relevance for today's decision-makers. Paediatric studies were also at the forefront of the development of utility scores that reflect preferences for diverse health states for the calculation of QALYs. The Health Utilities Index (HUI), an instrument based on a multi-attribute classification system, is among the most common methods for determining utilities (Drummond et al. 2005). The HUI was developed through a systematic survey of parents of children with cancer regarding their preferences for diverse paediatric health states (Drummond et al. 2005).

International Trends in Comparative Paediatric Economic Evaluations

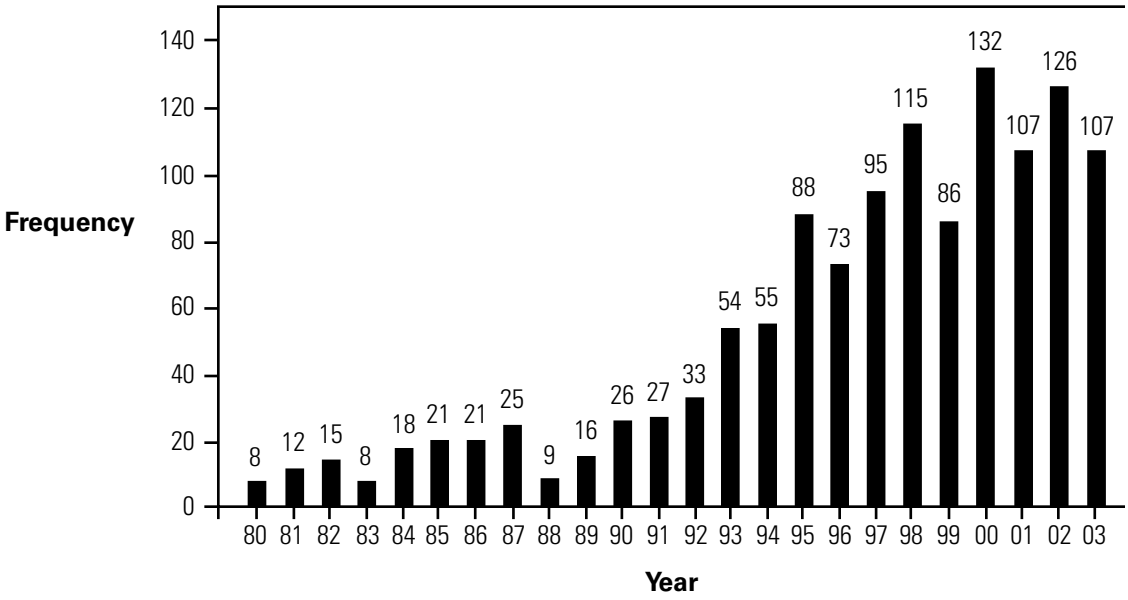
The data compiled for the Paediatric Economic Database Evaluation (PEDE) project were used for all descriptive analyses of trends. The PEDE database is an inventory of full paediatric economic evaluations, where both costs and consequences were measured for two or more comparators, published globally since 1980 (Ungar and Santos 2003). Details of the methods used to build and evaluate the PEDE database have been described elsewhere (Ungar and Santos 2004; Ungar and Santos 2002). Analyses were undertaken to examine trends over time and by region with respect to ICD-10 disease categories (World Health Organization 2003) and types of intervention studied. All experimental interventions described in published papers were classified in one of the following categories: Dental, Detection/Screening, Diagnosis, Educational, Healthcare Delivery, Health Program, Treatment, Prevention or Surgical. The Treatment category included pharmacological agents as well as devices. The great majority of interventions in the Prevention category were immunizations for primary prevention of communicable disease.

Temporal Trends in Paediatric Economic Evaluations

As seen in Figure 1, there has been significant growth in the number of full comparative paediatric economic evaluations published globally over time, particularly since the early 1990s. In 1996, the total volume of all published health economic evaluations, including adults, was estimated at 518 (Elixhauser et al. 1998), thus the paediatric literature accounts for approximately 15% of the total. Between 1980 and 2003, a total of 1,277 paediatric studies have been published with just over half of the papers (673) published since 1998. In latter years, the annual volume has begun to plateau, with an average of 112 papers published per year since 1998. Among the paediatric papers published since 1998, the largest proportion (35%) appeared in medical journals devoted to paediatric or perinatal medicine. Thirty-three per cent were published in other types of sub-specialty journals, 11% in public health journals, 9% in general medicine journals and 8% in health economics, health policy or methods journals.

Of the various types of paediatric interventions studied around the globe in the last few decades, those for prevention were the most common, with medical treatments appearing to grow as a proportion of the total in later years. Over time, the majority (63%) of health prevention interventions were for infectious disease, including hepatitis B, *Hemophilus influenzae* type B, measles, varicella and general vaccination strategies. Economic evaluations of interventions to prevent complications of pregnancy were also common and increased in later years. Among studies of treatments, the largest proportions were for infectious disease and for perinatal conditions. Common pregnancy and perinatal conditions that were treated included cardiac abnormalities, low birth weight, prematurity, respiratory conditions, Down's syndrome and congenital hip dislocation. Detection/diagnostic interventions were focused mostly on congenital anomalies, complications of pregnancy and infectious diseases. Studies of health programs were devoted to general health as well as perinatal conditions and complications of pregnancy. Over one third of assessments of surgical interventions were directed at congenital anomalies. Surgical interventions were also common for digestive and genitourinary conditions in children. By 2003, infective and parasitic diseases, congenital anomalies and complications of pregnancy, childbirth and the puerperium together accounted for 58% of all publications.

Figure 1



Volume of Published Paediatric Economic Evaluations, 1980-2003. Adapted from Ungar and Santos 2003.

With regard to the precise analytic technique employed in the economic evaluation, CEA was the most common technique used overall since 1980. Over time, the proportion of studies using CEA has been increasing, while the prevalence of CBA has been decreasing. This may reflect the increasing emphasis in the literature on treatment rather than prevention of disease. It may also reflect an improved specification of analytic technique, as cost-effectiveness analyses are sometimes mislabelled as CBAs, particularly in publications that pre-date health economic guidelines (Zarnke et al. 1997). CUA, despite being regarded as the gold standard in health economic analytic approaches (Siegel et al. 1996), remains rare in the paediatric health economics literature, accounting for only 15/107 (14%) of papers published in 2003. The scarcity of CUAs may be related to the particular challenges associated with measuring utility as well as obtaining accurate estimates of life years gained for various interventions in children. CEA was the most common technique for all intervention types. CBAs tended to be used to evaluate health prevention and detection/diagnostic strategies. Although rare, CUAs that were conducted were usually applied to evaluations of prevention strategies and treatment interventions.

Overall, the observed temporal trends may be explained by several factors. In the 1980s, many paediatric economic evaluations were sponsored by governmental organizations, including the US Center for Disease Control (CDC), the World Health Organization and governments of developing countries investigating screening and prevention program, and were performed by trained economists. The CDC pioneered the use of cost-effectiveness analysis to assess the economic benefits of health programs. This was consistent with the CDC's public health goals to promote prevention and early intervention in American children. A growth in managed care healthcare systems, whether as for-profit organizations or as government sponsored public plans, came with an increased awareness of the need to manage costs. Many government jurisdictions as well as managed care organizations began to use formularies to control pharmaceutical benefits. Attenuating costs within the healthcare system by restricting access to or limiting use of medications listed on a single budget formulary was relatively easy compared to achieving savings in other healthcare sectors that were funded by more complex mechanisms. Emphasis on assessing the cost-effectiveness of pharmaceuticals began

to grow, and in the early 1990s, a number of guidelines for the conduct of pharmacoeconomic evaluations were published (Siegel et al. 1996; Torrance et al. 1996; Jacobs et al. 1995; Australian Commonwealth Dept of Health, Housing, Community Services 1992). Academic health services researchers, private sector researchers and clinicians joined economists in efforts to produce economic evaluations. Over the years, the increased availability of guidelines in countries and agencies around the world (Hjelmgren et al. 2001) and an increasing demand by payors for evidence of cost-effectiveness of treatments, particularly pharmaceuticals, spurred rapid growth in the conduct of comparative health economic evaluations. This trend is apparent from the large increase in studies devoted to medical treatments for children over the last two decades. The growth in paediatric economic evaluation may also be ascribed to a growth in new technologies related to maternal and foetal health, such as ultrasound screening for foetal abnormalities. Currently, third-party payors, managed care organizations and international agencies that sponsor healthcare programs are increasingly demanding evidence of the cost-effectiveness of not only health treatments and prevention strategies, but also of medical and surgical procedures, services and programs.

Regional Trends in Paediatric Economic Evaluations

As portrayed by the global map in Figure 2, paediatric health economic evaluations are being conducted all over the world. Among the 673 publications that appeared from 1998 to 2003, almost half (49%) were conducted in the US. European countries were studied in 27%, with the largest European contribution delivered by researchers in the UK. Other important locations for the conduct of paediatric health economic research included Canada, Africa and Australia. The scarcity of paediatric economic evaluations in developing countries is striking. Regions such as sub-Saharan Africa and South Asia face a double jeopardy. The limited resources available hamper the production of paediatric health economic evaluations, and it is precisely in countries with limited healthcare resources that the need for high quality health economic evidence to ensure careful and efficient resource allocation is greatest.

Figure 2

Global Distribution of Paediatric Economic Evaluations, 1998-2003. The numbers represent the total number of published paediatric health economic evaluations conducted in the indicated region between 1998 and 2003. Percentage of total in parentheses.

Table 1. Type of Intervention by Region, 1998-2003

Region	Detection/ Screening	%	Health Care Delivery	%	Health Program	%	Health Treatment	%	Prevention	%	Other	%	Total
Africa	3	9%	1	3%	2	6%	4	13%	20	63%	2	6%	32
Central & South America & Mexico	1	8%	2	17%	0	0%	4	33%	4	33%	1	8%	12
South & Southeast Asia	2	8%	1	4%	3	12%	9	36%	10	40%	0	0%	25
Far East	3	21%	0	0%	1	7%	2	14%	5	36%	3	21%	14
Middle East & Turkey	2	17%	1	8%	0	0%	5	42%	1	8%	3	25%	12
Canada	3	9%	5	14%	6	17%	7	20%	11	31%	3	9%	35
US	59	18%	42	13%	41	12%	63	19%	60	18%	64	19%	329
UK	26	33%	0	0%	2	3%	27	35%	12	15%	11	14%	78
Australia & New Zealand	2	8%	0	0%	3	12%	6	23%	11	42%	4	15%	26
Eastern Europe	2	29%	0	0%	0	0%	0	0%	4	57%	1	14%	7
Scandinavia	2	15%	0	0%	0	0%	4	31%	4	31%	3	23%	13
Netherlands & Belgium	7	41%	0	0%	0	0%	2	12%	4	24%	4	24%	17
Western & Central Europe*	14	21%	1	1%	2	3%	16	24%	27	40%	8	12%	68
Other	1	20%	0	0%	0	0%	1	20%	2	40%	1	20%	5

* excluing UK
Percentage represents the proportion of the regional (row) total.

Despite the fact that a few large developed countries produced the majority of studies, it is remarkable to note the wide variety of countries contributing to the literature. In total, over 53 countries around the globe contributed one or more comparative paediatric economic evaluations to the medical literature between 1998 and 2003.

Between 1998 and 2003, the three most common categories of interventions studied worldwide were prevention (26%), treatment (22%) and detection/screening (19%). Most studies of prevention were for infective and parasitic diseases. On a per region proportional basis, evaluations of infective and parasitic diseases were more common in Africa, Eastern Europe and the Far East where they accounted for 75%, 71% and 57% of studies conducted in these regions respectively, compared to 22%, 15% and 20% of studies conducted in the US, UK and Canada respectively. As seen in Table 1, as a proportion of the total number of studies in the region, studies of prevention were more common in Africa (63%), Eastern Europe (57%), Australia/New Zealand (42%), Western/Central Europe excluding the UK (40%) and South/Southeast Asia (40%) compared to the US (18%) and the UK (15%). In contrast, studies of congenital anomalies were more frequent on a per region proportional basis in the US and UK, where they accounted for 11% and 15% of all studies respectively, compared to 0% in Africa and Australia/New Zealand, 6% in Canada and 4% in Western/Central Europe.

Between 1998 and 2003, most preventive interventions studied consisted of immunization strategies against a wide variety of communicable diseases, including hepatitis A, hepatitis B, *Hemophilus*

influenzae type B, measles, meningococcal disease, pneumococcal disease and varicella. While studies of these diseases were distributed across numerous countries and continents, the many studies of interventions to prevent malaria were concentrated in Africa (including sub-Saharan Africa, Gambia, Tanzania and Kenya) and Afghanistan. The US and UK contributed only one study each to the prevention of malaria. Despite the preponderance of studies evaluating immunization strategies for primary prevention of common communicable diseases, the diseases most frequently targeted for prevention were respiratory syncytial virus (RSV) and maternal-fetal transmission of HIV. The RSV studies were all conducted in the US, UK, Spain, Argentina, Australia, Germany or New Zealand. In contrast, the majority of HIV prevention studies were conducted in sub-Saharan Africa and South Africa. Only six studies of HIV prevention were conducted in the US, UK or Canada.

Studies of interventions categorized as treatments included economic evaluations of pharmacotherapy and devices. Of those that were published between 1998 and 2003, the largest proportion examined antibiotic regimens for a variety of infectious diseases. These studies were distributed across many global regions. Also common were treatments for complications of birth. These studies were conducted exclusively in the US, Canada, Sweden and Australia. Numerous economic evaluations of asthma, the most common chronic disease of childhood in developed nations (Akinbami and Schoendorf 2002; Mannino et al. 2002), were published by researchers in the US, UK, Brazil, Canada, Denmark, New Zealand and Sweden. Studies of nutritional interventions, both parenteral and oral supplements, were also common around the globe. Other studies evaluated treatments for attention deficit hyperactivity disorder, cystic fibrosis, deafness, haematological disorders, nausea and vomiting, neutropenia, optimal orthopaedic strategies and optimal anaesthesia regimens.

A majority of interventions labelled as detection/screening were for perinatal detection of birth defects. The interventions evaluated included biomarkers, genetic tests and imaging modalities. Down's syndrome was the disease for which screening interventions were evaluated most often. These studies were conducted in the US, UK, the Netherlands, France, Switzerland, Canada and Denmark. Also common were evaluations of screening for haematological disorders, including sickle-cell anaemia and thalassaemia. These studies were conducted in the UK, US, Hong Kong, Israel and Thailand. Evaluations of screening strategies for hearing and visual disorders were also common. Studies of HIV screening were conducted in the US, UK and New Zealand. Studies of antenatal screening for sexually transmitted diseases were among publications in the US, UK, sub-Saharan Africa, the Netherlands and Slovenia.

The analytic approach used was often related to the type of intervention studied. Table 2 displays how each intervention type was distributed across the four principal analytic techniques for all regions and all publications between 1998 and 2003. CEA was used in a majority of publications of each intervention type. The rate was lowest, however, for prevention interventions, of which 17% used CBA. CBAs were also more common in evaluations of detection/screening strategies compared to other types of interventions. Approximately one third of all CUAs were devoted to studies of health treatments and another third to studies of prevention.

Despite the measurement challenges associated with conducting CUAs in children, they have been conducted by researchers around the world for a range of diseases, including several infectious diseases, haematological disorders and asthma. They have also been applied to the evaluation of medical devices for hearing loss and diabetes management. The largest proportion of CUAs (31%) consisted of studies of infectious diseases compared to other ICD-10 disease categories. These were most frequently studies of hepatitis A and B, HIV, meningococcal and pneumococcal disease. Sixteen CUAs of infectious disease interventions were carried out in the US (four), sub-Saharan Africa (four), India (two), the Netherlands (two), Switzerland (two), Chile (one) and the UK (one).

Regional Disparities in Paediatric Health Economic Evaluations

The above examination of the global regional distribution of published paediatric economic evaluations underscores the wide disparities in healthcare resources between developed and developing

Table 2. Analytic Technique by Type of Intervention, 1998-2003

Intervention Type	CBA	Column %	Row %	CEA	Column %	Row %	CUA	Column %	Row %	CMA	Column %	Row %	Totals
Dental	1	2%	7%	12	2%	86%	0	0%	0%	1	3%	7%	14
Detection/ Screening	15	27%	12%	105	20%	83%	3	6%	2%	4	10%	3%	127
Diagnosis	0	0%	0%	24	5%	83%	4	8%	14%	1	3%	3%	29
Educational	2	4%	10%	14	3%	67%	4	8%	19%	1	3%	5%	21
Health Care Delivery	1	2%	2%	45	9%	85%	1	2%	2%	6	15%	11%	53
Health Program	2	4%	3%	52	10%	87%	1	2%	2%	5	13%	8%	60
Health Treatment	6	11%	4%	113	22%	75%	17	33%	11%	14	35%	9%	150
Prevention	29	52%	17%	127	24%	73%	18	35%	10%	1	3%	1%	175
Surgical	0	0%	0%	33	6%	75%	4	8%	9%	7	18%	16%	44
Total	56			525			52			40			673

Abbreviations: CBA = cost-benefit analysis; CEA = cost-effectiveness analysis; CUA = cost-utility analysis; CMA = cost-minimization analysis
Column and row percentages may not add to 100 due to rounding.

nations. Non-members of the Organisation for Economic Co-operation and Development (OECD) accounted for only 14% of the paediatric health economics literature but exhibit the greatest burden of disease. As a measure of burden of disease, disability adjusted life years (DALY) in children aged 14 years and under were 30,644 per 100,000 population in low- and middle-income countries, compared to 5,911 per 100,000 population in high-income countries (Mathers et al. 2005). The countries of South Asia and sub-Saharan Africa accounted for 69% of the DALY burden in children worldwide (Mathers et al. 2005). Each year, approximately 10 million children die from preventable and curable diseases (Black et al. 2003).

As mentioned above, developing countries face the double jeopardy of possessing limited resources for conducting paediatric health economic evaluations and having the greatest need for high quality health economic evidence to inform allocation of extremely limited healthcare budgets. Efforts to transfer knowledge from economic evaluations conducted in developed countries are hampered by differences in healthcare delivery systems as well as differences in healthcare priorities. Even if findings of a particular study, such as an evaluation of a tuberculosis vaccination program, were generalizeable to other settings, transferability of results is hindered by difficulty identifying appropriate price sources and conversion rates. In developing countries, prices may not reflect the opportunity cost and a shadow foreign exchange rate is often required (Walker and Fox-Rushby 2000). Another concern is that for developing countries, mere evidence of cost-effectiveness of an intervention is not enough. These nations also require an indicator of *affordability* (i.e., the ability of the target payors, such as government or health agencies, to cover the costs of the program). Developing nations may have no choice but to rely on foreign economic evaluation findings when faced with the need for *ex ante* evidence to inform decisions regarding implementation of health programs. This is particularly true for wide-scale prevention programs such as national immunization schedules. A reliance on foreign economic evaluation stresses the need for better methods for transferability and extrapolation of data.

When economic evaluations are conducted in developing regions, they are often funded by international agencies such as the World Health Organization (WHO), UNICEF and the World Bank. The risk in this case is that studies funded by world health agencies, non-governmental organizations or private sector multinational corporations will reflect the priorities of these organizations, which may or may not coincide with those of the local people (Walker and Fox-Rushby 2000). If divergence in priority-setting between international organizations and local governments is present, the funding of programs and services directed toward local child health needs may suffer. Moreover, childhood diseases such as malaria, which are not deemed a worthy investment by multi-national pharmaceutical companies, remain (de Joncheere 2001), thus further limiting access to needed treatments. International funds, such as charitable organizations, can help to ensure that research will be conducted in underserved therapeutic areas (de Joncheere 2001).

Priorities for Future International Paediatric Health Economic Evaluations

In determining future directions for paediatric health economic research, it is essential that researchers who produce economic evaluations and policy decision-makers who utilize them recognize the critical differences between paediatric and adult health economic evaluation, both conceptually and methodologically.

Conceptual differences relate to the way child health is understood. Understanding child health as multi-dimensional, encompassing physical, mental, nutritional, behavioural, educational and sociological components, facilitates the design of integrated programs or interventions (i.e., those that address physical health as well as nutrition, education and family and community supports). In a Canada-Tanzania collaborative pilot project that directed limited available funds at reducing child mortality from several major causes simultaneously, death rates fell by more than 40% in the districts implementing this approach (Nolan 2005). In addition, understanding the relationship between time of exposure to an intervention and the pathway for normal development is essential for the design of appropriate outcome measures. Valid outcome measures relevant to healthy development may include physiological milestones as well as participation rates at school and academic performance. It was recognized in early economic evaluations examining nutritional interventions that chronic malnutrition in the first two years of life permanently impairs cognitive ability, with adverse consequences for productivity and earnings potential throughout life (Behrman 1993). A time horizon that captures costs and benefits into adulthood is thus often necessary. A health intervention that results in better school performance may lead to greater workforce participation in adulthood, higher income and a change in societal determinants of health such as a reduction in poverty. Even less well-recognized is that early childhood interventions may also result in greater workforce participation and increased productivity by parents and caregivers. The potential for cost-effective health interventions delivered during childhood to have far-reaching effects, such as poverty reduction and, ultimately, demographic transition, must be recognized (Belli et al. 2005).

The need to capture lifetime costs and consequences presents a difficult but not insurmountable challenge. While statistical modelling and decision analysis offer some tools for extending time horizons, the best data are empirical. Birth cohort studies that track large cohorts of children longitudinally with repeat assessments through the years of development into adulthood greatly enhance our ability to predict outcomes. Birth cohort studies typically encompass a representative sample of whole populations born in a given year, such as the UK Medical Research Council National Survey of Health and Development (Wadsworth et al. 2004) and the UK National Child Development Study (Blundell et al. 2005). Two recent initiatives, the Norwegian autism birth cohort study (Fink 2004) and the Canadian Allergy, Genetics & Environment birth cohort study (Sears 2005), will include the collection of DNA samples alongside detailed health questionnaires for studying how the relationship between genes and the environment affect the development of disease. Both studies offer opportunities for wide-scale and long-term measurement of costs and health outcomes.

Several researchers have pointed out important differences between adults and children for selecting the appropriate methodology to conduct paediatric health economic evaluations (Ungar

and Santos 2005; Keren et al. 2004; Nujiten 2004; Tilford 2002). In addition, there have been three critical appraisals of the paediatric health economics literature (Griebsch et al. 2005; Ungar and Santos 2005; Walker and Fox-Rushby 2000). Some of the same deficiencies that compromise the quality of adult studies can be seen in the paediatric literature, namely, poor specification of perspective, incomplete costing, omission of productivity costs, reliance on intermediate outcome measures, lack of sensitivity analyses and lack of transparency. A key limitation is the lack of child-specific outcome measures and the inadequacy of adult measures for assessing health outcomes in children. In particular, there does not exist a valid and reliable measure of utility for calculating QALYs in children. To make matters worse, researchers often rely on parent proxies to report preferences and health status in very young children. Numerous studies have demonstrated a lack of agreement between parent and child reports of quality of life (Brunner et al. 2003; Eiser and Morse 2001; Saigal et al. 1998). The use of an adult measure to solicit a parent proxy report of child health status is a flawed approach to measuring outcomes in children. Given the importance attributed to CUAs as the gold standard analytic approach in international health economic guidelines, several researchers have called for the development and validation of child-specific measures of utility (Griebsch et al. 2005; Tilford 2002). Alternatively, it may be sensible to acknowledge the limitations of QALYs and seek better approaches to valuing health outcomes in all age groups. Because of the emphasis on lifetime disease prevention and the need to include family and community in valuing paediatric outcomes, alternative approaches, such as willingness-to-pay, which incorporate externalities and intangible benefits related to improved child school performance and increased productivity in caregivers may be preferred to utility assessment, which focuses on patient preferences alone. By capturing overall improvements in social welfare, a willingness-to-pay approach remains consistent with welfare economic theory and presents a result within the framework of CBA.

While there may be a shortage of high quality paediatric economic evaluations, there is no shortage of general guidelines on conducting health economic evaluations. None of the 25 independent guidelines that have been generated by various jurisdictions and agencies (Hjelmgren et al. 2001) provides insight on the application of health economic methods to the paediatric population. Rather, there is an implicit, if not flawed, assumption that these methods can be applied to all age groups. In addition, many of the guidelines lack a recommendation to include time costs. Failure to do so will bias the results when the inclusion of caregiver productivity gains is significant enough to move an intervention from cost-generating to cost-saving (Hjelmgren et al. 2001). This is illustrated by the example of intravenous immune globulin for the treatment of respiratory syncytial virus. When the newer drug palivizumab, administered by intramuscular injection, was introduced to the market, the use of intravenous immune globulin all but disappeared, despite similar direct costs, due to the much greater caregiver time required for the administration of intravenous immune globulin (Tilford 2002). Similarly, an economic evaluation of a varicella vaccination program in the US revealed that the program actually saved money when parental productivity gains were included in the analysis (Lieu et al. 1994).

In addition to inadequacies in existing guidelines, there is no single set of harmonized international guidelines, despite the need for standardized methods for transferring cost and outcome data across borders. With the maturation of the field of health economics, the time has come for the development of guidelines that focus on the paediatric population and that point out the directions for much needed methodological research.

Conclusion

The volume of publications in the international medical literature devoted to paediatric health economic evaluations has risen rapidly in the last two decades. Publications in the areas of infective and parasitic diseases, congenital anomalies and complications of pregnancy, childbirth and the puerperium accounted for the majority of publications. Disease prevention rather than treatment was the most common category of intervention. The majority of economic evaluations (78%) performed since 1998 were in the form of CEA. CUAs remained rare (less than 8%), despite being

promulgated by guidelines. The US alone produced almost half of all publications, with the UK contributing another 12%. Not surprisingly, economic evaluations from developing countries were rare, despite the urgent need for evidence-based informed decision-making to guide the allocation of limited healthcare budgets in these regions. To a certain degree, the types of interventions studied were reflective of the health priorities of particular regions. On a per country proportional basis, studies of prevention of HIV and malaria were more common in developing nations, whereas studies of treatments for asthma and birth malformations were more common in developed nations. There is evidence that the WHO is beginning to shift its focus to chronic rather than communicable diseases. Recently, emphasis has been placed on containing the burden of illness in developing countries due to chronic disease such as asthma (World Health Organization 2005).

Despite increasing global initiatives to combat disease, developing nations continue to rely on foreign economic evaluations to inform decisions regarding implementation of health programs. There is thus a great need for better methods for transferability and extrapolation of data. Future research must focus on accurate conceptual definitions of paediatric costs and consequences and in developing the tools and methods necessary to conduct high quality studies. In particular, tools that facilitate long-term measurement of cost and consequences are vital. The future of paediatric health economic evaluation would greatly benefit from an international effort to harmonize guidelines and to recognize the special needs of children.

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Editorial Comment on Ungar, "Paediatric Health Economic Evaluations: A World View"

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As specified in our mission statement, the *Journal of World Health and Population* "... provides a forum for researchers and policy makers worldwide...[and]…encourages the conduct and dissemination of applied research and policy analysis from diverse international settings." The review of paediatric healthcare evaluations by Ungar (2006) underscores the validity and potential contribution of this mission.

Ungar provides a brief but excellent worldwide review of paediatric economic evaluations since 1998. She does this in the overall context of economic evaluation of healthcare interventions, as well as by parsing the evaluations by methodology, subject area/focus and country/region of origin. Her reference list is particularly comprehensive and useful for the area of economic evaluations.

Ungar reaches several critical conclusions of interest and importance to the readers of *WHP*. First, she documents that over two-thirds of all paediatric economic evaluations since 1998 have originated from and focus on North American and Western European countries. She comments that "the scarcity of paediatric economic evaluations in developing countries is striking." This is particularly unfortunate, given the "double jeopardy" implicit in the need for efficient allocation of scarce healthcare resources (through economic evaluations) being greatest in places where the burden of disease is the highest, and the necessary studies can be afforded the least.

Second, relying on transferring knowledge from North American and Western European settings and studies is potentially of limited usefulness due to both different healthcare delivery systems and differing healthcare priorities. It is a reasonable hypothesis that studies originating from the in-country context might better reflect the realities and priorities of the country than studies originating from the academic interests or funding priorities of the international (e.g., North America and Western Europe) community. Moreover, locally-originating studies could also possess greater credibility and political attractiveness to local decision-makers.

Finally, Ungar points out the applicability of methods such as cost-benefit analysis (CBA) in addressing problems in lower-income countries where the public and private sector economic investment alternatives can be more starkly drawn between healthcare and other sectors. Evaluations using CBA are becoming less frequent, according to Ungar, although their relevance remains the same (or is increasing) in the countries were paediatric disease impact is the highest. She correctly points out the issue of "affordability" as the follow-up issue for low-income countries. Cost-effectiveness of an intervention is irrelevant if, in the end, it is just not affordable.

In conclusion, I wholeheartedly recommend this paper as a guide, resource and encouragement for the preparation of further, greatly needed, economic evaluations of healthcare interventions originating from low-income and developing countries. Review and publication of such articles will remain a critical part of the mission of *WHP*.

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