WORLD HEALTH & POPULATION

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VOLUME 11 • NUMBER 1 • 2009

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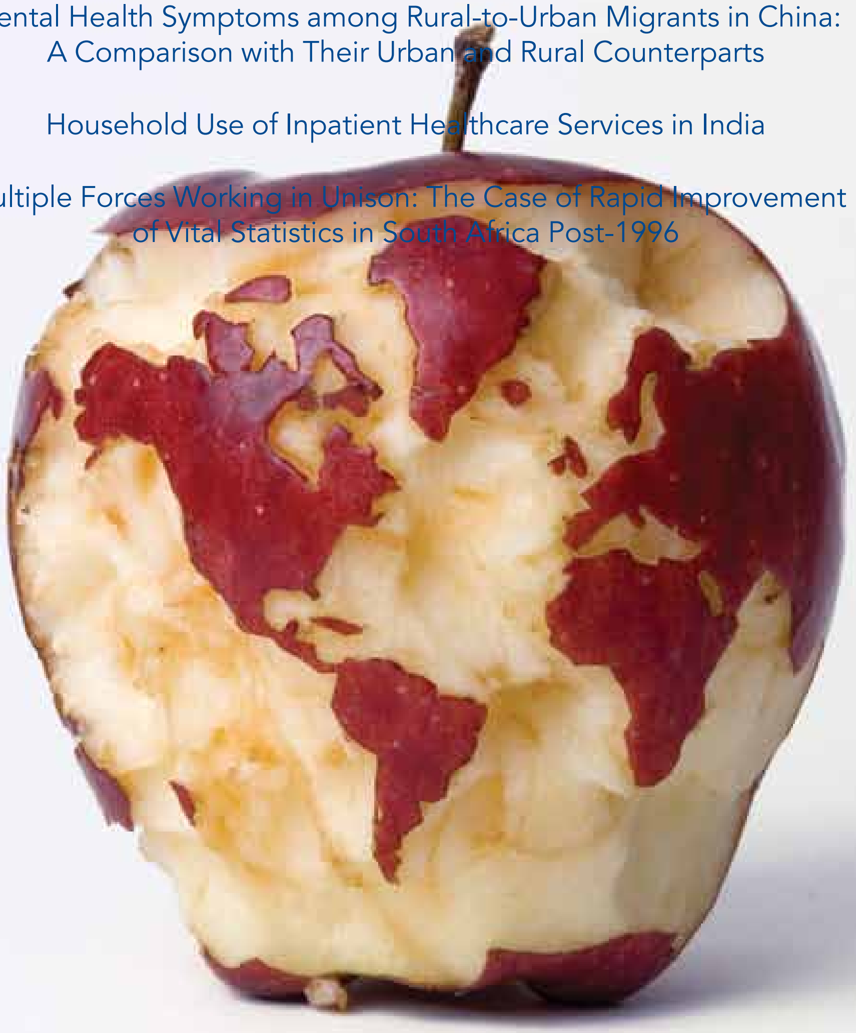

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WORLD HEALTH & POPULATION

IN THIS ISSUE

WORLD HEALTH & POPULATION

Founded and edited by members of the Department of Health Policy and Administration, School of Public Health, University of North Carolina at Chapel Hill.

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Graphic Designer, Design and Production
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ISSN No. 1718-3340

Publications Mail Agreement No. 40069375

© September 2009

From the Editor-in-Chief

This issue of *World Health & Population* presents papers that have been published online by *WHP* and are selected here as representative of recent contributions to the journal. Included are two manuscripts from China, one each from Bangladesh and India, and one reporting on the development of the currently quite strong vital statistics system in South Africa.

Interest in achieving the Millennium Development Goals (MDGs) seems to be picking up the closer we find ourselves to the internationally determined milestone of 2015. We can only hope that the interest isn't "too little too late" for the countries furthest behind to achieve significant progress with regard to many of the MDGs. In the first article in this issue, Subir Saha and M. Kabir present results on survival of newborns in Bangladesh. In the Bangladeshi context, MDG 4 focuses on reducing mortality of children under five by two thirds from 1990 levels. Bangladesh is making significant progress in this area, as revealed through analysis of data from the Bangladesh Demographic and Health Survey (BDHS) reported by Saha and Kabir. Progress has been achieved mostly through reducing mortality among the 1- to 4-year-olds, through focusing on pneumonia, diarrhea, malnutrition and vaccine-preventable disease. Progress toward meeting MDG 4 through reduction in neonatal mortality has been harder to achieve, however, with the proportion of under-five deaths represented by neonates in this population increasing from 39% to 50% between the two BDHS reporting periods. Saha and Kabir recommend a more coordinated strategy integrating newborn health interventions with existing (and quite successful) safe motherhood and child survival programs. Perhaps coordinating ongoing efforts addressing maternal health (contained in MDG 5) and childhood mortality (MDG 4) would provide a way of doing this.

Xiaoming Sun and colleagues at the University of Toronto, Harvard, and Fudan and Jiaotong Universities in Shanghai report on the successful development of a hearing disabilities screening program for newborns in Shanghai. Although "universal newborn hearing screening programs" have been recommended in many countries for years, their implementation is far from universal. Sun et al. cite a 2003 study reporting that only 58% of US hospitals regularly employed the recommended two-stage hearing screening process. This study, however, demonstrates the feasibility of this important public health screening program and produced results and coverage exceeding those of many clinical programs in North America and Western Europe. The authors' pilot and feasibility studies, conducted between 2001 and 2007, involved all 105 hospitals engaged in deliveries in Shanghai. Remarkably, over 560,000 infants were screened, representing more than 90% of all births during that period in those hospitals. The rate of severe and permanent hearing impairment detected (0.146%) was in line with that typically found in other countries (0.1% to 0.3%). The authors also discuss treatment follow-up and the difficulties of serving the "floating populations," which is the focus of the second article on Chinese health in this issue.

Xiaoming Li, Bonita Stanton and colleagues have published a number of interesting research articles in *WHP* in the last 3 years concerned with the issues around rural-to-urban migrant health and healthcare in China. This article compares results on mental health symptoms for a population of rural-to-urban migrants with comparison groups of rural residents (those who have not migrated) and urban residents. Having two comparison groups is interesting for triangulating the results and providing robustness for the conclusion of a negative impact on mental health relating to migration. The differences remained significant even after multivariate analysis to control for various demographic factors and perceived health status. Problems of assimilation, discrimination and stigma among the migrant population identified by Li et al. in their research certainly contribute to the lower follow-up rates noted for these groups in the Sun study described above. Li et al. recommend further investigation of the critical issues around rural–urban health in China. It is encouraging that this research group will likely remain at the forefront of research in this area.

In the fourth article in this issue, Chungkham Singh and Laishram Ladusingh present a study of household characteristics, infrastructure characteristics at the state level, and use of inpatient healthcare in India. Based on the 2004 Indian National Sample Survey, the authors apply multivariate techniques to look at the impact of various household, infrastructure and expenditure variables on use of inpatient healthcare services. Interestingly, household factors dominated over state-level factors, with the education level of the head of household being the most important explanatory factor. Substantial variation in proportion of the population hospitalized (by nearly a factor of two) was found across Indian states.

The final article in this issue describes the advances in statistical reporting in South Africa and the resulting contribution for monitoring progress on the MDGs, as well as for planning and implementation of healthcare programs in that country. Sulaiman Bah from King Faisal University describes the process that South Africa went through in the post-apartheid period to develop the robust death reporting system that exists today, and the excellent examples of international cooperation and support that brought the transformation about.

In summary, we hope that you find the articles in this issue of interest and value, and that you will also consult other papers recently released online at www.worldhealthandpopulation.com. *WHP* remains committed to its mission to provide a forum for researchers and policy makers worldwide to publish and disseminate health- and population-related research, and to encourage applied research and policy analysis from diverse global settings. Note also that *WHP* is indexed on MEDLINE and accessible through PubMed. We look forward to continued enthusiastic submission of manuscripts for consideration, peer-review and publishing. Finally, the editors and publishers of *WHP* are always interested in any comments or suggestions you might have on the articles or journal. Please feel free to write or email us.

John E. Paul, PhD
Editor-in-Chief, *World Health & Population*
paulj@email.unc.edu

Survival of Newborns: Implications for Achieving the Millennium Development Goal in Bangladesh

Subir Saha, Research, Monitoring and Evaluation Specialist, Freelance Consultant,
New York, USA

M. Kabir, Professor, Department of Statistics, Jahangirnagar University, Bangladesh

Subir Saha, Research, Monitoring and Evaluation Specialist, 99-42,
41 Avenue, Apt. # 4B, Corona, New York, NY 11368, USA, Email: subir_03@yahoo.com

Abstract

The global burden of neonatal deaths is around 37% of all under-five deaths (UNICEF 2008). In Bangladesh, neonatal deaths account for almost half of all under-five mortality. Most newborn deaths in Bangladesh take place at home and in the absence of a skilled hand. The target of Millennium Development Goal 4 for Bangladesh is to reduce under-five mortality by two thirds by 2015 from 1990 levels. The objectives of this article are to give an overview of newborn health in Bangladesh and provide a strategy for further reducing under-five mortality to achieve MDG 4.

Data for this study were obtained from the Bangladesh Demographic and Health Survey (BDHS) 2004 data set (National Institute of Population and Training [NIPORT] et al. 2005). According to the BDHS, under-five mortality in Bangladesh declined from 133 per 1000 live births in 1991 to 88 per 1000 in 2001, about 4.1% per year. However, the decline was faster between 1991 and 1997 than from 1997 to 2001. The BDHS shows that while neonatal deaths were 39% of all under-five deaths in 1991, they constituted almost half in 2001. The highest concentration of newborn deaths occurred during delivery and within the first 24 hours of birth. Reducing newborn deaths will be an important strategy to achieve MDG 4.

Introduction

The objectives of this paper are to provide an overview of newborn health in Bangladesh and to describe a strategy to further reduce under-five mortality in order to achieve Millennium Development Goal (MDG) 4. We use data from the Bangladesh Demographic and Health Survey

(BDHS) 2004 (NIPORT et al. 2005), which is a nationally representative sample survey.

The child mortality rate is a reflection of the care, health and nutritional status of children below the age of five years and also indicates the social, cultural and economic progress in the country. A comparison of 2004 data with earlier BDHS results shows a substantial (20%) improvement in child (1–4 years of age) survival, but there is no evidence of change in infant (<1 year) survival in recent (up to 2004) years. Despite improvement in child survival, neonatal mortality remained high in Bangladesh. The decline in child mortality can be attributed to improvement in the management of diarrhea and acute respiratory infection – especially pneumonia – and improved immunization coverage and vitamin A supplementation.

Every year, approximately 4 million babies are born in Bangladesh and approximately 120,000 die in the first 28 days of life. Neonatal death accounts for about two thirds of infant deaths. The high number of newborn deaths is a major concern, both for the reduction of under-five mortality and to achieve MDG 4.

Materials and Methods

Data Sources

This paper utilized the birth history data of the 2004 BDHS, the fourth survey of its type conducted in Bangladesh. BDHS followed a two-stage cluster sampling design with samples from rural and urban areas. The data were also representative for each of the six divisions: Barisal, Chittagong, Dhaka, Khulna, Rajshahi and Sylhet. Details of the survey have been reported elsewhere (NIPORT et al. 2005). The 2004 BDHS is a nationally representative survey of 11,440 ever-married women aged 10 to 49 and includes detailed information of the birth and death of each child. For each live birth, the date of birth, sex and survivorship status was collected. For living children, the age of each child at his or her last birthday was recorded. For children who had died, the respondent was asked to provide the age at death. The number of children in the 10-year reference period preceding the survey for whom survival status and basic information were known is 14,209, 9886 and 4323 for national, rural and urban areas, respectively.

The BDHS focused mostly on quantity. So to understand the particular problems, issues, norms, associated factors and community perceptions related to newborn death, in addition to BDHS data, qualitative data were collected through focus group discussions (FGDs) with mothers, family members and traditional birth attendants (TBAs). The FGDs took place in rural and peri-urban settings of Parbatipur Upazila under Dinajpur district. An FGD was conducted separately with each group, following the guidelines of participatory rapid assessment (PRA). Each FGD was conducted with 10 to 12 participants so that everyone could participate actively and get equal attention.

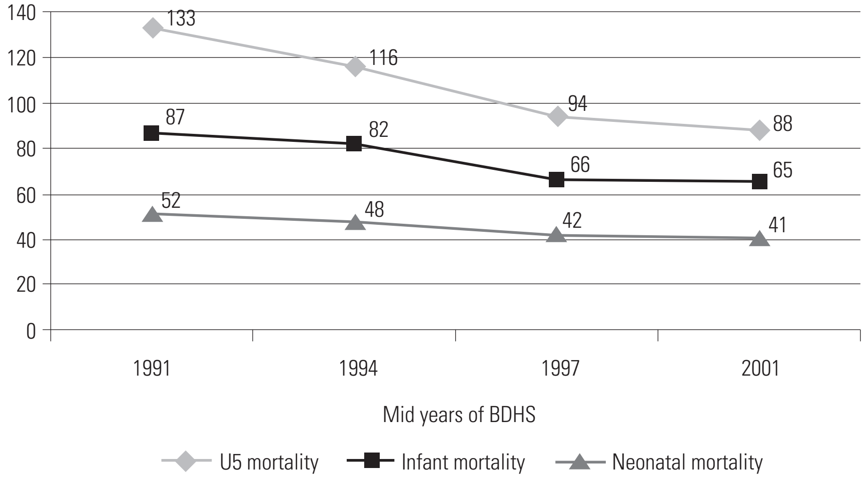
To understand the poor–rich inequality in mortality, households were classified into five quintiles (ranging from poorest to richest), each representing 20% of the total population based on ownership of selected household assets, source of drinking water, type of latrine used and the construction materials of different parts of the dwelling (Filmer and Pritchett 1998; Gwatkin et al. 2000). A separate index was constructed for urban and rural households, following the principal component analysis method. The first and fifth quintiles were considered as the poorest and richest, respectively, and used for comparison and measuring poor–rich inequality by using quintile ratios, concentration curves and indices. Mortality rate was calculated using the life table technique and BDHS birth history data.

Results

Trends in Childhood Mortality

According to 2004 BDHS data the neonatal mortality rate (NMR) in Bangladesh is relatively high (41 per 1000 live births) compared with that of other developing countries. NMR has shown an extremely slow decline over the years. Between 1989 and 1993 it was 52 per 1000 live births; from 1992 to 1996, 48 per 1000, and from 1995 to 1999, 42 per 1000. Neonatal mortality fell by about 21% over the 10-year period. In the same period, under-five mortality declined by 34% and infant mortality by 25%. Figure 1 shows the trends of neonatal, infant and under-five mortality in Bangladesh since 1991.

Figure 1. Trends in childhood mortality in Bangladesh



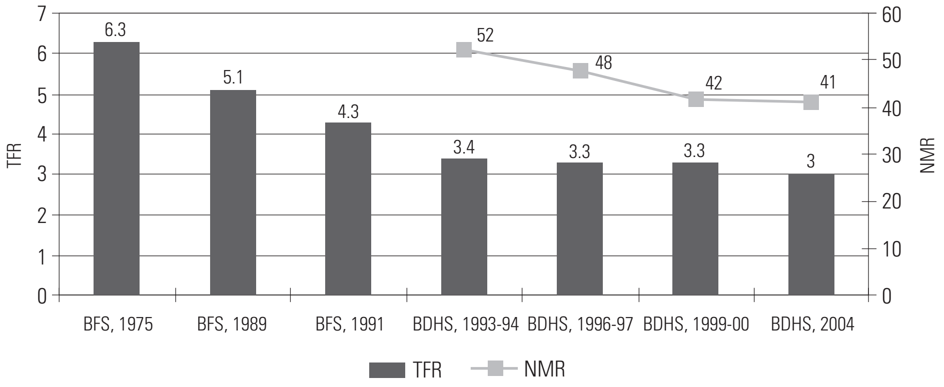
BDHS = Bangladesh Demographic and Health Survey.

While neonatal deaths were 39% of all under-five deaths in 1991, they constituted almost half of all under-five deaths in 2001. Neonatal mortality constitutes the majority of infant deaths: 60% in 2004.

Total Fertility Rate and Newborns Survival

The empirical data from Bangladesh give no clear indication of neonatal mortality decreasing along with fertility decline. According to the BDHS, the total fertility rate in Bangladesh declined from 6.3 in 1975 to 3 in 2004. This is largely due to the impressive increase in the contraceptive prevalence rate, from 8% in 1975 to 58% in 2004 (NIPORT et al. 2005). Despite this significant fertility decline, neonatal mortality remained nearly stagnant and relatively high (Figure 2).

Figure 2. Trends in total fertility rates (TFR) and neonatal mortality rates (NMR)

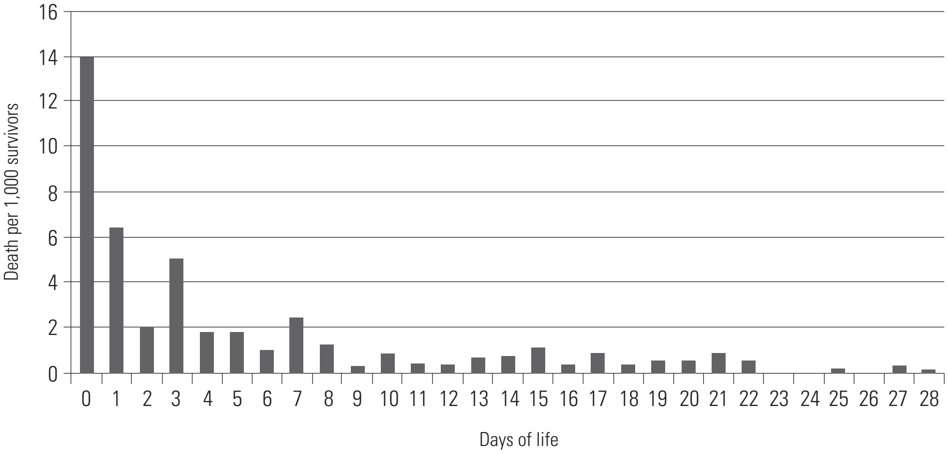


Note. NMR was not available for BFS 1975–1991.
BFS = Bangladesh Fertility Survey; BDHS = Bangladesh Demographic and Health Survey.

Neonatal Mortality by Days

While the neonatal period is only 28 days, almost half of all under-five deaths take place during that time in Bangladesh. About a quarter of deaths occur during the post-neonatal period, and another quarter between ages 1 and 4 years. Within the neonatal period there are considerable variations in the daily risk of death (Figure 3).

Figure 3. Daily risk of death in neonatal period in Bangladesh



As in other developing countries, mortality of newborns in Bangladesh is also very high in the first 24 hours after birth. More than 30% of neonatal deaths included in this analysis occurred within 24 hours of birth. Around 75% of neonatal deaths occurred in the first week after birth. These findings support the global statistics on newborn deaths. Globally, 25% to 45% of all newborn deaths occur in the first 24 hours after birth, and some three quarters of newborn deaths occurs in the first week (Lawn et al. 2005).

Trends in Early Neonatal Death

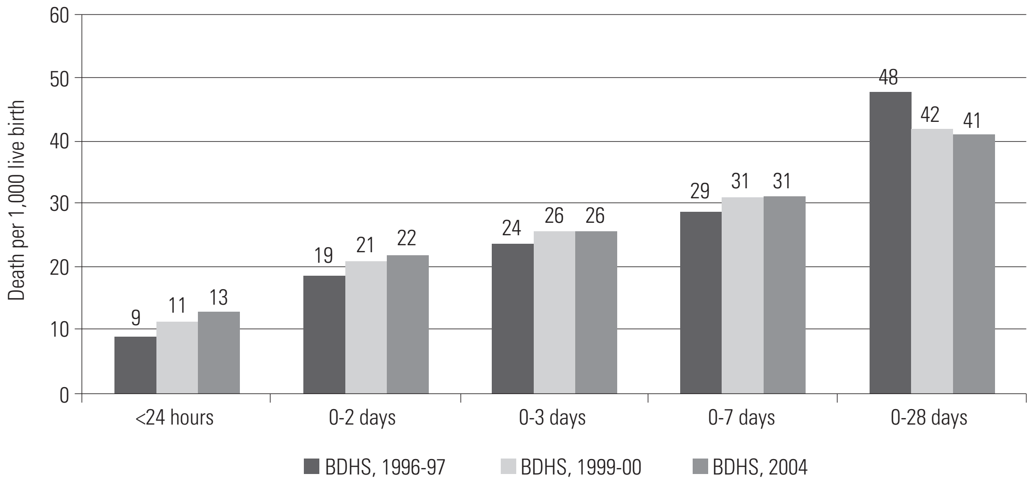
In comparing the three recent BDHS data sets (BDHS 1996–1997, 1999–2000 and 2004), it is evident that the neonatal mortality (death between 0 and 28 days) rate has shown an extremely slow decline over the years; however, deaths in the early neonatal period (between 0 and 7 days) are gradually increasing (Figure 4).

Globally, death during the neonatal period accounts for almost two thirds of all deaths in the first year of life. About two thirds of neonates die in the first week of life and, of those, two thirds die in the first 24 hours (Lawn et al. 2005). Investigation of the two-thirds rule in the Bangladesh context demonstrates that roughly two thirds of deaths occurred in the first month of life. Among the neonatal deaths, about three quarters occur within first week. Similarly, of deaths within one week, about one third occur within first the 24 hours. There may be some errors in recording the time of death for newborns between the first 24 hours and the second day, and so on. As a result, the ratio of within-24-hours deaths to within-first-week deaths is low.

Causes of Neonatal Death

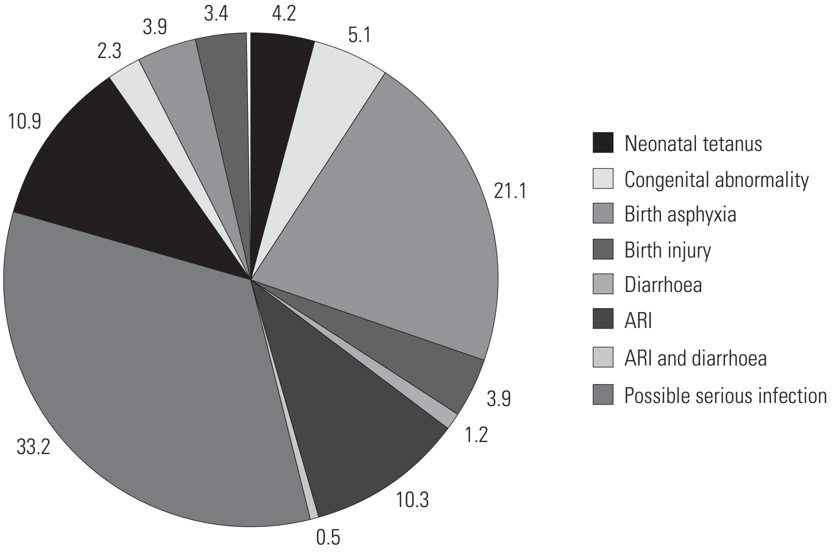
According to the 2004 BDHS, possible serious infection is the most important cause of death among neonates (33%), followed by birth asphyxia (21%), pre-maturity/low birth weight (11%) and acute respiratory infection (10%). Figure 5 shows the causes of neonatal deaths as reported in BDHS 2004.

Figure 4. Trends in neonatal mortality in Bangladesh, BDHS 1996–2004



BDHS = Bangladesh Demographic and Health Survey.

Figure 5. Causes of neonatal death, BDHS

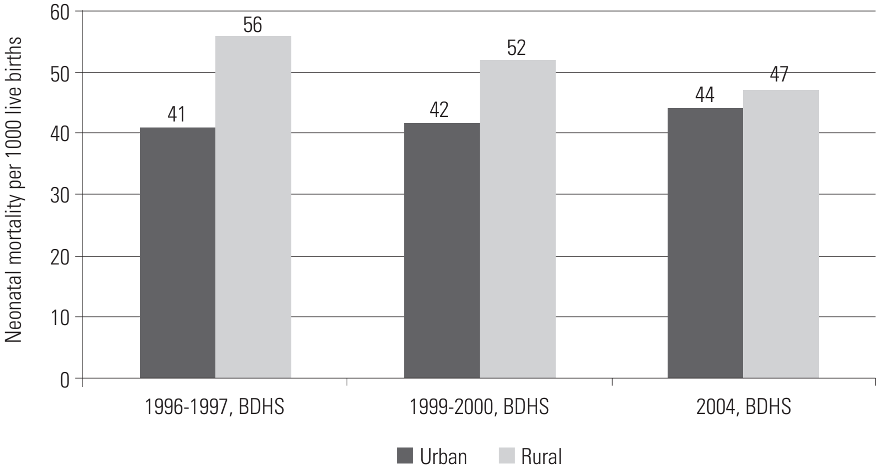


ARI = acute respiratory infection; BDHS = Bangladesh Demographic and Health Survey.

Trends in the Urban–Rural Neonatal Mortality Rate

Place of residence – usually in the rural–urban dichotomy – has generally been regarded as an important area where meaningful differentials in neonatal mortality can be observed (World Health Organization 1991). Although NMR is consistently lower in urban areas (47 vs. 44 per 1000 live births for rural and urban, respectively), the urban–rural difference in neonatal mortality in Bangladesh has narrowed in recent years. In urban areas neonatal mortality has been increasing, while in rural areas it has been decreasing (Figure 6).

Figure 6. Trend of urban–rural neonatal mortality rate

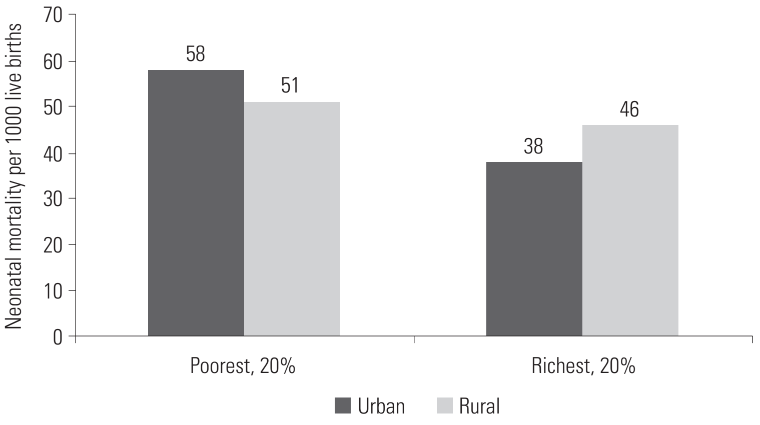


BDHS = Bangladesh Demographic and Health Survey.

Poor–Rich Gap in Neonatal Mortality Rate

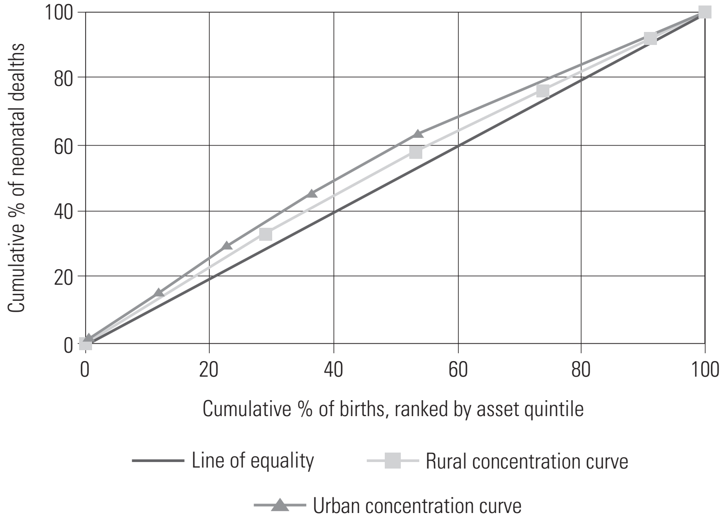
The NMR is consistently high for those living in a poor family (first quintile). For example, a poor–rich ratio of 1.6 for urban children implies that NMR in the poorest quintile is about 1.6 times higher than in the richest quintile. In rural areas, the poorest-to-richest ratio of NMR is 1.1, indicating that in rural areas the NMR is also higher among the poorest quintile. This also indicates that there is much difference in NMR between the rural and urban poor. Among the urban poor, the NMR is 58 per 1000 live births, whereas for rural poor the rate is 51 per 1000 (Figure 7). At the national level, the NMR is 41 per 1000 live births. This information suggests that child survival for urban poor children would be worse in future. Rapid urbanization and urban poverty is likely to increase, particularly in the urban slums where the quality of life is extremely poor.

Figure 7. Urban–rural gap in neonatal mortality



The negative value of the concentration index, -0.0361 and -0.0765 for rural and urban areas, respectively, showed that both rural and urban neonatal mortality is concentrated within poorest families. However, Figure 8 illustrates that although in both urban and rural areas NMR is higher in poor families, poor–rich inequality is higher in urban than in rural areas.

Figure 8. Rural and urban concentration curve for neonatal mortality rate



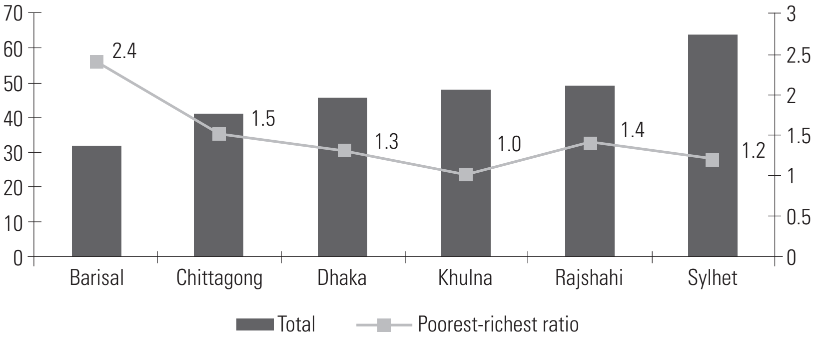
This paper also identified a sharp difference in newborn mortality between rural-to-urban migrants and non-migrants in Bangladesh. Neonatal mortality is 1.5 times higher among urban migrants than among urban natives (48 and 32 per 1000 live births, respectively). Rapid growth of the urban population in recent years, due to migration, is considered one of the major explanations for such urban–rural differentials in childhood mortality in Bangladesh. Due to unmet basic needs and environmental hazards, the health risk for urban children of poor families is much higher than those for rural children, but in Bangladesh, the government's primary healthcare system is focused mainly on rural areas. The disadvantaged condition of urban migrants is also evident in the relatively poor rate of healthcare utilization among mothers of migrant children compared with that of urban natives. For example, among migrants 40% of mothers received at least three antenatal care visits, compared with 61% of urban natives. Similarly, institutional delivery is almost two times higher for urban natives than for migrants (34% and 18%, respectively).

The data also indicated wide variations in neonatal mortality across geographic divisions. Among the six divisions, Sylhet had the highest NMR (64 per 1000 live births), and the division's lifetime risk of neonatal mortality was also high. In Barisal division, there is a huge difference in NMR between the poorest and richest quintiles: the NMR in the poorest quintile is more than two times that in the richest (Figure 9).

Discussion

Qualitative findings suggest that limited access to information, insufficient skilled care providers, the perceived value of women, women's illiteracy, cultural beliefs, gender discrimination, absence of emergency preparedness at the family level and absence of ready transport and cash create obstacles for community-based newborn and maternal healthcare. Although the government has established health infrastructures and intensified health services all over the countryside to improve the health of the people, women often do not receive appropriate institution-based care in emergencies. Women who do receive facility-based care often confront service providers who are not gender sensitive and who may not ensure privacy or confidentiality, which further discourages women from using these services. Despite efforts to increase access to institutional care and promote institutional delivery, home delivery is still common in Bangladesh. About 89% of mothers in Bangladesh deliver their babies at home, and TBAs conduct the large majority (87%) of home deliveries. Poverty and the inability to pay for services also confound the problem. Analysis of the data indicates that the "invisibility" of maternal, fetal and neonatal deaths is largely due to socio-cultural practices.

Figure 9. NMR and inequality by division



To address urban–rural inequality, as well as to improve the survival status of newborns in the country as a whole, there is a crucial need to strengthen the urban primary healthcare system, which is almost ignored, especially at the sub-district level of municipalities in Bangladesh. Responsibility for primary healthcare services for urban dwellers belongs to the Ministry of Local Government Rural Development and Cooperative. But this ministry has limited technical expertise, resources and skills. Primary healthcare services in rural areas are provided by the Ministry of Health and Family Welfare (MOHFW). The MOHFW is responsible for the country's overall health policy formulation, planning and decision making. Recently, local government, with financial support from the Asian Development Bank, Department for International Development, Swedish International Development Co-operation Agency, United Nations Population Fund and Orbis Bangladesh, is offering primary healthcare services targeted to the poor. But these services are limited to six city corporations (i.e., six major cities of six divisions) and only five district-level municipalities, whereas there are 300 municipalities in Bangladesh. The project is a public–private partnership. If replicated in other districts, the project can benefit many more of the poor.

One of our most important findings is that about 30% of all neonatal deaths happen on a child's first day. Almost 75% of newborns die in their first week. But 0 to 3 days is the peak period of newborn deaths, as almost 63% of neonatal deaths occur during this period. Hence it is a very critical period for newborns.

Complications of childbirth can have a significant impact on newborns. Over 30% of neonatal deaths are the result of injuries or infections sustained during delivery. Asphyxia, for example, occurs when the newborn receives an inadequate supply of oxygen immediately before, during or just after delivery. But research suggests that most birth asphyxia cases can be managed at the community level without sophisticated equipment. Babies need to be kept warm by being dried and wrapped. The airway must be cleared by correctly positioning the baby's head, by clearing mucus and, if necessary, by giving artificial respiration by mouth to mask or by tube and mask. Breastfeeding must also be supported (State of the World's Newborns 2001). But the reality is that mothers' as well as family members' knowledge on this issue is very poor. The Bangladesh government is promoting the skilled birth attendant (SBA) instead of the TBA, but, practically, SBAs are not readily available and it will take longer to expand their services to the whole country.

To improve its survival, a newborn baby should be dried, kept clean and warm and put to the mother's breast immediately after birth. But the reality is that in rural and even peri-urban areas, after birth the newborn is left on the floor soaked in amniotic fluid until the expulsion of the placenta. Lack of awareness of hypothermia contributes to this harmful practice. Most babies are cleaned immediately by bathing and wiping off the vernix to make them holy and acceptable to be touched by others. Immediate breastfeeding is also delayed until expulsion of the placenta, as well as bathing rituals. The rate of early initiation of breastfeeding (within the first hour of delivery) is only 24% in Bangladesh, but findings suggest that immediate breastfeeding, within one hour of birth, can avert 31% of newborn deaths, or about 37,000 deaths per year.

Conclusion and Recommendations

It is evident that existing child survival strategies have concentrated mainly on children older than 1 month through focusing on pneumonia, diarrhea, malnutrition and vaccine-preventable diseases. Safe motherhood programs have focused primarily on mothers, through promotion of antenatal and postnatal care and safe delivery. Prevention of newborn death has not been addressed as expected because the two interventions are being implemented independently. The health of newborns must be considered with that of their mothers, who also face significant risks during and in the days following delivery. Causes related to pregnancy, delivery and infections each account for about one third of newborn deaths, so interventions need to address both mothers and newborns. Preventing newborn deaths as well as improving newborn health and survival go hand in hand with promoting safe motherhood. Decision makers can work to ensure healthier futures for mothers and their newborns by supporting programs that provide essential maternal and newborn care, as well as broader policies that enhance women's health and socio-economic opportunities during the life cycle.

Results of this study show important areas for program planners and policy makers to improve newborn survival in Bangladesh. First is the need to integrate newborn health interventions into existing safe motherhood and child-survival programs to bring many of the desired changes. Secondly, the urban primary healthcare system should be strengthened and integrated with the Ministry of Health and Family Welfare. We also recommend establishment of a well-functioning referral system and quality obstetric services to treat women in the event of complications, ensuring there is an appropriate number of qualified staff and making them available in healthcare facilities. It is also essential to ensure access to and quality of maternal and child healthcare services in public healthcare facilities for the poorest people. If these recommendations can be implemented effectively, the newborn's chances of survival will increase, and the consequent reduction in infant mortality will help us to achieve MDG 4.

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Development of an Effective Public Health Screening Program to Assess Hearing Disabilities among Newborns in Shanghai: A Prospective Cohort Study

Xiaoming Sun, MD PhD, Shanghai Municipal Health Bureau, Shanghai, China; School of Public Health, Harvard University, Boston, MA,USA

Xiaoming Shen, MD PhD, Xinhua Hospital, Jiaotong University, Shanghai, China

David Zakus, PhD, Dalla Lana School of Public Health and Department of Health Policy, Management and Evaluation, Faculty of Medicine, University of Toronto, Canada

Jun Lv, PhD, School of Public Health, Fudan University, Shanghai, China

Zhengmin Xu, MD PhD, Pediatric Hospital, Fudan University. Shanghai, China

Hao Wu, MD PhD, Xinhua Hospital, Jiaotong University, Shanghai, China

William Hsiao, PhD, School of Public Health, Harvard University, Boston, MA, USA

Xiaoming Sun, Shanghai Municipal Health Bureau, 1477 Beijing West Road, Shanghai, China 200040, Email: xm_sun2003@yahoo.com.cn

Abstract

Background

An effective, systematic program of screening, diagnosis and intervention against hearing loss in infants could help them avoid developmental impediments and could help society stem preventable healthcare burdens. We assessed the feasibility and outcomes of a new public health universal newborn hearing screening program (UNHSP) for neonates born in Shanghai.

Methods

From March 2002 to June 2007, we conducted a two-stage hearing loss screening program for neonates born at all 105 delivery hospitals in Shanghai. Institutional participants in the program followed standardized testing criteria and procedures. The first stage of screening occurred in the hospital during the third day post-birth; positive infants underwent a second-stage outpatient screening on Day 42. Positive infants were examined at clinical diagnosis centres, and interventions were conducted at rehabilitation centres. In 2003, a random sample of parents were interviewed about the program, and their level of stress over learning their child screened positive were recorded and analyzed.

Findings

Overall, our program screened 72.98% of eligible infants and provided effective interventions within six months to 86.31% of those with hearing loss. During the 5-year study, first-stage screenings assessed 90.85% of 616,880 eligible infants and found 12.16% positive. Day 42 screenings had a 65.68% participation rate and a positive rate of 14.75%. Of these, 0.146% were deemed permanently hearing impaired within three months of birth. Parental satisfaction measures exceeded 90%.

Interpretation

A government-sponsored public health program to screen, diagnose, treat and provide interventions for all newborns with permanently hearing impairment can be effectively implemented and can achieve outcomes that surpass comparable clinical initiatives.

Introduction

Worldwide, significant bilateral hearing loss is found in one to three of every 1000 newborns in well-baby populations and in 2% to 4% of infants in neonatal intensive care units (American Academy of Pediatrics 1999; Green et al. 1999; Zhao 2001). Failure to detect hearing loss in a timely manner, and to intervene as soon as possible, can lead to activity limitations in linguistic and language functioning and cognitive development, and to difficulties in social participation. Research indicates that diagnosing hearing loss in newborns within three months of birth and implementing appropriate treatment and interventions within six months of birth normalizes cognitive and language development, thereby allowing hearing-impaired infants to develop at a pace similar to that of infants without hearing loss. Such studies also show that the long-term quality of life for infants who receive interventions surpasses what would have been possible had treatment been delayed or absent (American Academy of Pediatrics and Joint Committee on Infant Hearing 1995; Shen 2001).

Research also shows more traditional detection efforts are inadequate: only about 50% of neonates with congenital hearing loss are detected using the high-risk registry that screens for, among other items, a family history of deafness. In addition, physician examinations and parental observations only occasionally succeed in identifying congenital hearing loss in infants under the age of one. To improve the early detection of infant hearing loss, in the past 15 years many countries and cities have instituted universal newborn hearing screening programs (UNHSPs) or have set up a series of screening measures (American Academy of Pediatrics 1999; American Academy of Pediatrics and Joint Committee on Infant Hearing 1995; Kanne et al. 1999; Wessex Universal Neonatal Hearing Screening Trial Group 1998; Grandori 1999).

In the United States and elsewhere (White and Behrens 1993), UNHSPs have spread gradually (White 2003; Morton and Nance 2006; Wu 2000), spurred by the endorsements of the 1993 National Institutes of Health Consensus Development Conference and, in 1994, by the American Academy of Pediatrics (AAP). The AAP's findings set a goal of universal detection of hearing loss in infants before 3 months of age, coupled with appropriate intervention no later than 6 months of age. Both groups advocated hearing loss screening for all newborns before hospital discharge (American Academy of Pediatrics 1999; American Academy of Pediatrics and Joint Committee on Infant Hearing 1995; National Institutes of Health 1993; Centers for Disease Control and Prevention 2003).

In 2003, an analysis of UNHSPs in the United States showed 58% of hospitals employed a two-stage process: initial inpatient screening after birth in the hospital, followed by outpatient screening before three months of age. This achieved a first-stage screening rate of 70% among eligible newborns. After the second screening, 56% of the infants were referred for diagnosis (by three months of age), and 53% of the infants diagnosed with hearing loss had received an appropriate intervention by six months of age (White 2003).

Most clinical UNHSPs in developed countries use otoacoustic emission (OAE) screening protocols, which include some combination of transient-evoked otoacoustic emission (TEOAE), distortion products otoacoustic emission (DPOAE) and automated auditory brainstem response (AABR) (Xu et al. 2003; Li et al. 2004; Shen 2002). Approximately 53% of US screening programs use TEOAE and 67% use AABR, with some employing both methods (White 2003). In general, these programs start with an initial screening test 24 to 48 hours following birth and either undertake a second inpatient or outpatient screening for newborns who test positive in the first stage or refer newborns with positive results directly to a diagnosis centre (US Preventive Services Task Force 2001 and 2002; Uus and Bamford 2006; Lin et al. 2002).

According to an epidemiological survey undertaken in Shanghai, between 600 and 700 of the 78,762 infants born in 1999 had some congenital impairment. Furthermore, the rate of disability for children under seven years of age was 0.968%, with 16% of that group experiencing hearing loss (Zhao et al. 1999).

In 2000, Shanghai's government health bureau initiated a strategy for developing effective monitoring and intervention techniques that might limit or prevent disabilities in newborns. The strategy concentrates on three areas of public health importance: genetic testing and counselling before pregnancy, prenatal screening for congenital impairments (such as Down's syndrome) and newborn screening for hearing loss. To address the strategy's hearing loss screening component, we developed a public health universal hearing loss screening procedure that was systematically designed to ensure cross-program consistency in all key aspects: instrumentation, diagnosis and screening procedures, interventions, administration and organization, personnel training and quality control of methods and outcomes. Overall, we sought to ensure our program would meet the needs of Shanghai's population and meet, or even exceed, world standards.

Methods

Network Infrastructure

All 105 of Shanghai's delivery hospitals, both obstetrics and gynecology hospitals and obstetrics and gynecology departments in general hospitals, participated in the study. Diagnostic centres were set up in three institutions: Shanghai Children's Medical Centre and Xinhua Hospital, both affiliated with Jiaotong University; and Fudan Pediatric Hospital, affiliated with Fudan University. Rehabilitation centres were set up at Xinhua Hospital, the EENT hospital affiliated with Fudan University, and Shanghai Municipal Federation of Disabled People, a rehabilitation centre that assists those with disabilities. The 19 district-level women and children healthcare networks assisted in managing this stage of the process. Administration was centralized at the Shanghai Institute for Women and Children Healthcare, an institute organized and supported by the Shanghai Municipal Health Bureau.

In order to standardize screening results, in 2001 we purchased 130 units of the GSI 60 TEOAE system (Grasen-Stadler GSI 60, Grasen-Stadler, Inc., A Welch Allyn Co., Milford, NJ, USA). This instrument was selected after an analysis of its technical performance and cost, a review that used reports on its ease of use and clinical performance from experts in hearing screening systems. We adopted the World Health Organization's criteria for hearing screening (see Table 2). Regular training sessions were arranged for the hospital personnel who would be conducting the screenings, and participants were granted work permits (or licenses) upon passing a proficiency examination. Nominal testing fees of 20 RMB (US 2.50 dollars) for one ear and 40 RMB (US 5·00 dollars) for both ears were set. Standardized processes were established for information collection and quality control.

Pilot Study

We carried out a 1-year pilot study (September 2000 to August 2001) to determine participation rates for screenings on an outpatient basis alone (Day 42) and for inpatient screenings conducted on either the first, second or third day following birth. In addition, we conducted an internal comparison of the inpatient results, including images of the outer surfaces of the infants' tympanums and results from tests using high-frequency acoustic impedance technology, to determine the status of eardrum effusion in neonates assessed on each of the three days. A total of 5000 infants were screened in the pilot study: 2000 during outpatient checkups at birth hospitals on Day 42 and 1000 on each of the first, second and third days following birth prior to hospital discharge.

Timing for inpatient screenings was chosen according to the hospitalization period after spontaneous delivery, which is usually three days in Shanghai. Follow-up screening took place on the 42nd day following birth, the fixed time for the first return checkup of newborns and their mothers in the birth hospital. The days of hospitalization duration and return checkup are settled by regulations of Shanghai Municipality on Mother and Infant Health Care. The timing was very critical to effectively conduct the program.

Based on the results of the pilot studies we produced two documents: *The Strategy of Launching Universal Newborn Hearing Screening Program in Shanghai* and *The Plan for Universal Newborn Hearing Screening, Diagnosis and Intervention in Shanghai.* These documents detailed the objectives, methods and requirements necessary for an effective screening program, the screening procedure (Figure 1) and the diagnosis and intervention processes (Figure 2) that such a program should follow, as well as the quality controls, administrative responsibilities and costs to both families and program. The documents and their recommendations were adopted by the Shanghai Municipal Health Bureau in early 2002 and used as the blueprint for implementing our city-wide UNHSP feasibility study that would address the public health needs of Shanghai infants who are born with hearing loss. To emphasize its powerful support for our large feasibility study of the hearing loss screening program, the Shanghai Municipal Health Bureau officially launched the program on March 3, 2002, in conjunction with World Hearing Day.

Screening Feasibility Study

From March 2002 through June 2007, 560,432 infants born in any of the study's 105 delivery hospitals were screened for hearing loss. Infants receiving positive reports received a second screening on Day 42 following birth, conducted on an outpatient basis at the infant's birth hospital. All screenings were performed by hospital personnel trained in the use of the equipment. Infants receiving a second positive report were referred to one of the three diagnostic centres in the study, where they were given an otoscopic exam, checked for the presence of tympanic effusion, and given DPOAE, AABR and hearing behaviour assessments (Figure 2).

Interventions included the use of hearing aids within six months of diagnosis for infants with slight to moderate hearing loss as well as for some with severe hearing loss. Interventions for infants with severe and extremely severe hearing loss consisted of the surgical implantation of artificial cochlear devices within 1 year of birth. Implantations were performed at two hospitals, and all infants who needed implants received them. In addition, all infants who received interventions had aural and language training at one of the three rehabilitation centres participating in the study.

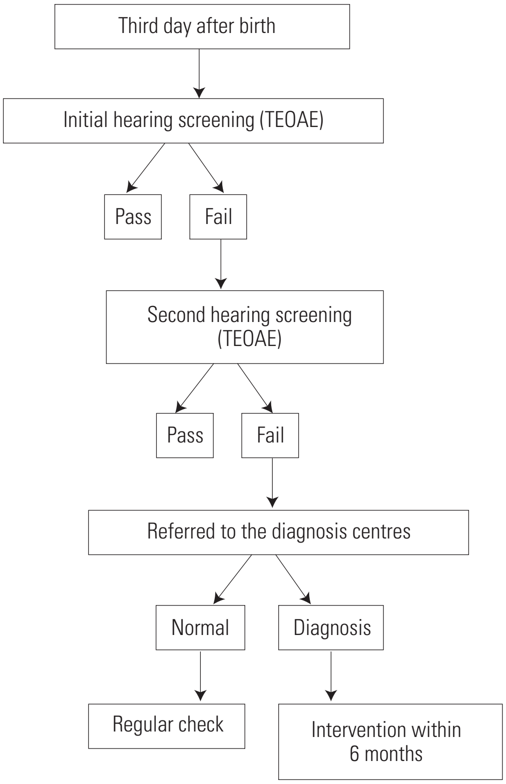
Sociological Measures

In 2003, at six of the participating hospitals, 400 parents, either the father or mother of infants who had received positive results in first-stage screening, were randomly selected for face-to-face interviews. Interview questions were designed to assess parental satisfaction with the screening process. In addition, 110 of the 400 parents responded to questions that would help assess the level of anxiety or stress they felt upon learning their infants had initially screened positive for hearing loss.

Results

A comparison of data from the pilot study indicated first-stage inpatient screenings would be most effective, that is, less likely to result in false-positive reports, if conducted on the third day following birth. Imaging of the outer surface of the tympanum and acoustic checks using high-frequency impedance detection technology showed tympanic effusion rates decreased dramatically in the 3-day period following birth. According to our data, an effusion rate of up to 70% was found in the 1000 infants screened on the first day post-birth. This rate dropped to 30% in infants screened the second day and approached zero in the 1000 infants screened on the third day post-birth. Since the presence of amniotic fluid interfered with acoustic transmissions, we determined that TEOAE screenings would yield the fewest false-positive results if conducted on the third day following birth.

Figure 1. Administrative process for universal newborn hearing screening program in Shanghai



Our preliminary assessment also supported the two-stage screening process begun on the third day following birth and repeated if needed on Day 42. We found that initial inpatient screening achieved high participation but also produced a high number of false positives. Families receiving a positive diagnosis were motivated to attend the second screening; the majority of Chinese families have one child, so learning that the child may be hearing impaired caused parents great anxiety. The second screening, with its promise of further defining, perhaps even nullifying, the initial diagnosis, spurred compliance. In addition, by ensuring diagnosis by three months of age and intervention by six months, families were encouraged to pursue the timely potential benefits of participation in the program.

By lessening the number of false positives, the two-stage screening also greatly reduced the number of infants referred for diagnosis. If the 13.14% of infants who screened positive in the initial stage had all been referred for diagnosis, we estimate we would have needed 12 diagnosis centres to handle the referral load. With the two-stage testing, referrals totalled fewer than 2000 per year, a number that could be handled by three centres efficiently and well.

During the study period, 616,880 infants were born in delivery hospitals in Shanghai. Of that group of eligible infants, 90.85% (560,432) received an initial hearing screening test on the third day after birth, with 12.16% (68,152) testing positive for hearing loss. A second-stage screening, conducted on an outpatient basis 42 days following birth, had a participation rate of 65.68% (44,763 infants). Positive results were reported in 14.75% (6601) of the infants. Overall, the two-stage screening process achieved a 72.98% screening rate among eligible infants (Figure 3, Table 1).

Figure 2. Process for diagnosing hearing loss in newborns

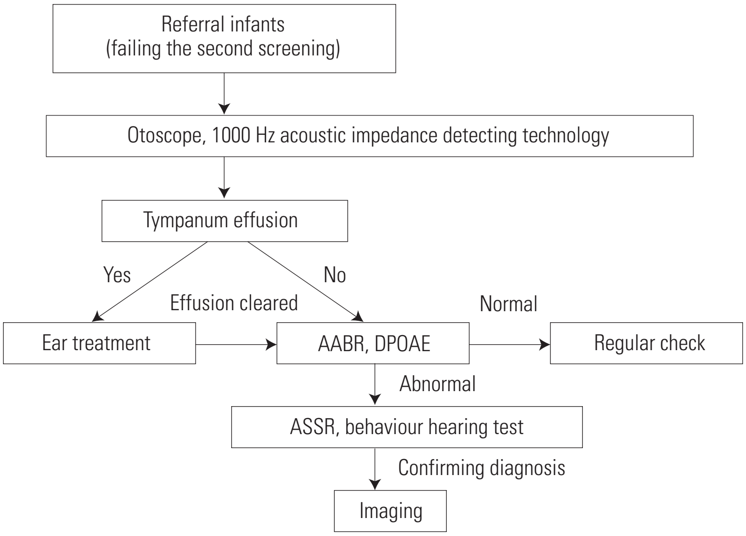
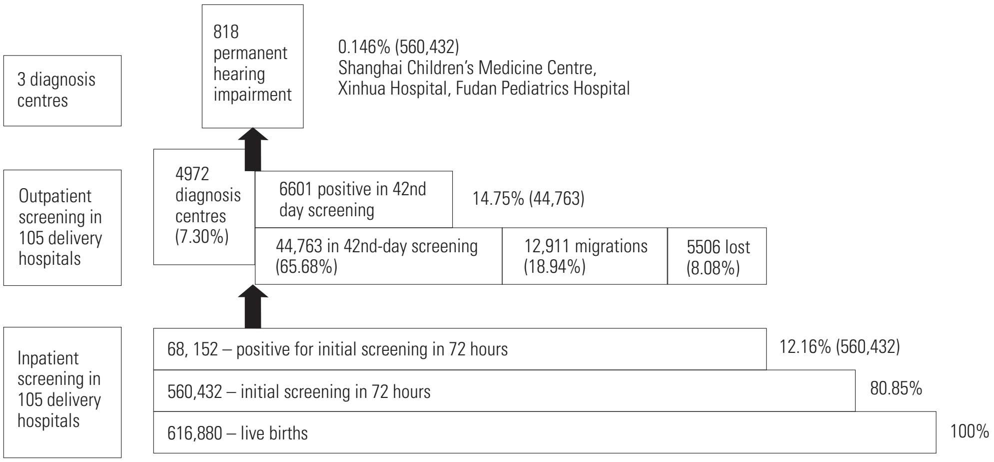


Figure 3. Statistics of universal newborn hearing screening program in Shanghai, 2002–2007



An accounting of the 34.32% (23,389) of neonates who failed to participate in the second screening despite receiving positive results in the first screening revealed 7.30% (4972) were taken directly to diagnosis centres after their first screenings, 8.08% (5506) were lost to contact, and 18.94% (12,911) were infants of temporary workers who had moved back their original residential provinces following their child's birth (Figure 3).

To help understand the success of our high rate of participation in both stages of screening, it is useful to know that annually 51% of the 100,000 infants born in Shanghai are children of parents who have moved to the city to take temporary work. These parents usually return to their home province after childbirth. If they then return to Shanghai after recuperating from delivery, their newborns are generally left with the grandparents in the home province. Ninety percent of the infants born to these temporary workers, known as the "floating population," are not taken to their birth hospital for a return visit on Day 42.

Among Shanghai residents, failure to return for a second screening on Day 42 (by the 15% of the remaining 49% of infants and families who did not follow up) was attributed to economic concern, lack of faith in the process, fear of getting in trouble because of a negative diagnosis, and the like.

Of the infants referred to diagnostic centres, 1.46 per 1000 of those from the first-stage screening (a total of 818) received a diagnosis of permanent hearing impairment within three months of birth. The majority of diagnoses, however, showed slight to moderate hearing loss in referred infants (33.98%, or 278 infants, and 55.37% or 453 infants, respectively) with only 3.42% (28 infants) found to have extremely severe hearing loss. Bilateral deafness was diagnosed in 82.40% of the referred newborns (674) and unilateral deafness in 17.60% (144) of the infants (Table 2).

Table 1. Number of newborns screened in program, 2002–2007

		March – December 2002	2003	2004	2005	2006	January – June 2007	Total
Live births		67,418	83,817	114,072	125,130	144,994	81,449	616,880
3rd day screening	Number	56,191	78,595	105,873	117,371	129,738	72,664	560,432
	Positive	7040	8771	12,147	13,812	16,836	9546	68,152
3rd day screening rate (%)		83.35	93.88	92.81	93.80	89.48	89.19	90.85
3rd day screening positive rate %		12.53	11.16	11.47	11.77	12.98	13.14	12.16
42nd day screening	Number	4500	5534	8264	9545	10,651	6269	44,763
	Positive	468	751	1359	1444	1638	941	6601
42nd day screening rate (%)		63.92	63.09	68.03	69.11	63.26	65.67	65.68
42nd day screening positive rate (%)		10.40	13.57	16.44	15.13	15.38	15.01	14.75
Diagnosis in 3rd month		94	118	153	157	189	107	818
Diagnosis rate (%) in 3rd month		1.67	1.50	1.45	1.34	1.46	1.47	1.46
Intervention in 6th month		80	89	141	139	158	99	706
Intervention rate (%) in 6th month		85.11	75.42	92.16	88.54	83.60	92.52	86.31

Among the infants with permanent hearing impairment receiving interventions, 86.31% (706) had effective interventions within 6 months (Table 1). All bilateral hearing aids, internal ear moulds and batteries were provided free of charge by Shanghai's Municipal Federation of Disabled People. Cochlear implants were provided free of charge by two Shanghai-based nongovernmental organizations: the Inpatient Health Insurance Foundation for Children and the Charity Foundation.

Interviews with 400 randomly selected parents revealed 90% were satisfied with the screening process and their knowledge of it. At the same time, 110 parents indicated they had gone through a high degree of mental stress upon learning their child had tested positive for hearing loss.

Table 2. Degree of hearing loss among newborns in Shanghai, 2002–2007

	Criteria	Congenital deafness	Proportion (%)
Degree	Voice frequency (500, 1000, 2000 Hz Pure-tone threshold average (PTA)		
Slight	26–40 dbHL	278	33.98
Moderate	41–60 dbHL	453	55.37
Severe	61–90 dbHL	59	7.21
Extremely severe	>90 dbHL	28	3.42
Total		818	100
Unilateral or bilateral			
Unilateral		144	17.60
Bilateral		674	82.40
Total		818	100

dbHL = decibels hearing level.

Discussion

Our study shows that a government-sponsored public health universal newborn hearing screening program can be effectively developed and implemented in a large, complex city like Shanghai. This is one of the successful models of a public health UNHSP.

The integrated design of our study, following a pilot implementation to determine key study variables, included an initial soon-after-birth inpatient screening, a second screening on an outpatient basis six weeks later, and coordinated diagnosis and intervention services (including free hearing aids, surgical implantation of cochlear devices and aural and language training). It resulted in high rates of participation for both the initial and the second screenings, reduced false-positive rates at second screening, widespread access to participating centres and prompt and effective interventions that placed no economic burden on the infants' parents.

In addition, we believe our study shows that implementing a well-organized program that adheres to uniform screening, training and intervention standards can achieve high compliance rates and high rates of satisfaction from families involved in the program. Our outcomes, such as high participation at first- and second-stage screenings and high percentages of infants receiving diagnoses and interventions in a timely manner as suggested by international guidelines, exceed those of clinical programs conducted in many developed countries. Furthermore, the success of our program spurred the central government of China in 2005 to add the program to its list of legislated screening programs. Our UNHSP model has since been launched in 27 provinces, municipalities and autonomous regions (of a total of 31 in mainland China).

The study's outcomes are not without shortfalls and limitations, however. Why did 9% of eligible infants not take part in the initial inpatient screening? Although we had a high rate of participation in the third-day screening, we had no mechanism in place to follow up on groups that failed to show up for the second screening, such as the 26.24% who were the children of "floating population" workers who temporarily move to Shanghai from other provinces. Subsequent efforts will need to investigate whether these infants received diagnoses and, when necessary, appropriate interventions at their local hospitals. We also need to reconcile the reasons and outcomes of the 8.08% lost to contact following their initial positive screening, and we need to determine ways to improve the intervention phase so that all infants who receive diagnoses of permanent hearing impairment are treated within 6 months. Our study intervened in 706 of the 818 cases diagnosed; 112 who had been diagnosed with permanent hearing impairment were left without proper treatment within the appropriate time period. In addition to addressing these questions, we hope to further analyze data from this study to determine the overall cost-effectiveness of the program.

Contributors

X. Sun was the main author, principal investigator, project manager and developer of the project's systematic design. X. Shen designed the study methodology and assisted in managing the project. D. Zakus assisted with the analysis and write-up. J. Lv oversaw the sociological assessment and the statistical analysis of the study. Z. Xu managed the diagnostic centres and training program, and H. Wu managed operations in the clinical and rehabilitation centres. W. Hsiao gave instructions on the draft.

Acknowledgements

The authors wish to thank Zhu Liping, Director of the Shanghai Institute for Women and Children's Health Care; Yu Huijun, Director of the Department of Rehabilitation, Shanghai Municipal Federation of Disabled People; and all hospitals, nongovernmental organizations, colleagues and participants who supported or took part in the study. In addition, they wish to thank William Hsiao, K.T. Li Professor of Economics at the School of Public Health, Harvard University in Boston, Massachusetts, for his advice and guidance, and A.M. Menting for assistance in the preparation of the manuscript.

Source of support: Shanghai Municipal Health Bureau

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Mental Health Symptoms among Rural-to-Urban Migrants in China: A Comparison with Their Urban and Rural Counterparts

Xiaoming Li, Pediatric Prevention Research Center, Wayne State University School of Medicine, United States

Bonita Stanton, Pediatric Prevention Research Center, Wayne State University School of Medicine, United States

Xiaoyi Fang, Beijing Normal University Institute of Developmental Psychology, China

Qing Xiong, Beijing Normal University Institute of Developmental Psychology and Jiangxi University of Finance and Economics School of Humanities Sciences, China

Shuli Yu, Pediatric Prevention Research Center, Wayne State University School of Medicine, United States

Danhua Lin, Beijing Normal University Institute of Developmental Psychology, China

Yan Hong, Texas A & M Health Science Center Department of Social and Behavioral Health, United States

Liying Zhang, Pediatric Prevention Research Center, Wayne State University School of Medicine, United States

Xinguang Chen, Pediatric Prevention Research Center, Wayne State University School of Medicine, United States

Bo Wang, Pediatric Prevention Research Center, Wayne State University School of Medicine, United States

Xiaoming Li, PhD, Prevention Research Center, Carmen and Ann Adams Department of Pediatrics, Wayne State University School of Medicine, Hutzel Building 5th Floor W534, 4707 Saint Antoine St., Detroit, MI 48201 Tel: 313-745-8663, Fax: 313-745-4993, Email: xiaoli@med.wayne.edu

Abstract

Objective: To examine the mental health symptoms among rural-to-urban migrants in China, in comparison with representative samples of their counterparts in the rural areas from where they emigrated and urban communities to which they immigrated.

Methods: A cross-sectional survey conducted in 2004–2005 in China. Both rural-to-urban migrants (n = 1006) and urban residents (n = 1000) were recruited in Beijing; the rural resident sample (n = 1020) was recruited from the eight provinces of origin for 75% of the migrant sample. Mental health symptoms were measured using the Symptom Checklist-90 (SCL-90).

Results: Both rural-to-urban migrants and rural residents scored higher than urban residents in all the SCL-90 global indices and subscales. The rural-to-urban migrants scored higher than rural residents on the SCL-90 Positive Symptom Distress Index and two subscales (depression and psychoticism). The difference remained significant after controlling for a number of key individual characteristics (age, gender, marital status, education, income and perceived general health) in the multivariate model.

Conclusions: The data in the current study demonstrate that rural-to-urban migrants suffer from lower mental health status than both urban residents in the immigrating communities and their rural counterparts in the emigrating communities. The data suggest a possible deteriorative effect of migratory experience on mental health status among rural-to-urban migrants in China and suggest an urgent need for etiological studies and for mental health promotion and prevention efforts among this growing population.

Introduction

The relationship between migration and health has been extensively explored in the global literature, but the data have been inconclusive. Some researchers have suggested that migration, particularly rural-to-urban migration, might result in improved physical and mental health because of increases in both income and healthcare access (De Jong et al. 2002). Previous studies also suggested that migrants might be healthier than non-migrants because of a selection process by which more healthy individuals tend to migrate (e.g., "healthy migrant syndrome") (Fuentes-Afflick et al. 1999; Muening and Fahs 2002; Razum et al. 2000; Signh and Siahpush 2001; Swerdlow 1991). In contrast, a substantial amount of global literature suggests that migration is associated with increased risk for poor mental and physical health (McKay et al. 2003). This increased risk may be related to contextual and psychosocial factors associated with migration experience or migratory lifestyle such as adjustment to the new socio-cultural environment, changes in traditions and lifestyles, economic transitions or barriers to access to local community services, including healthcare delivery. Previous research has also documented that the stigmatization encountered by migrants in their new destination causes anxiety that may contribute to mental and physical illnesses (Darmon and Khlat 2001; Li et al. 2006b; Pudaric et al. 2000).

In addition, the existing literature on the relationship between migration and health has largely been limited to migrants within North American and European countries and those seeking permanent resettlements, such as trans-culture or trans-country immigrants and war refugees (Darmon and Khlat 2001; Diaz et al. 2001; Pernice and Brook 1996; Pudaric et al. 2000). During the past decades, there have been massive internal migrations in many developing countries, including China. These internal migrations provide an excellent opportunity to study the relationship between migration and mental health. However, data are limited regarding the relationship between migration and health status among temporary, rural-to-urban migrants in many developing countries, including China, which is home to one fifth of the world's population.

Migration from rural to urban areas in China was restricted through the official household registration (*hukou*) system for almost a quarter century until economic reform took place in the late 1970s (Li et al. 2006a). Under the hukou system, each individual is officially registered as either a rural or an urban resident. Rural residents could not freely move to or settle in urban areas in order to become urban residents. With the introduction in 1979 of the Rural Household Contract Responsibility System, a form of rural economic reform, China experienced rapid growth in agricultural productivity (e.g., agricultural GDP increased from 2.7% in 1970–1978 to 7.1% in 1979–1984) and a subsequent surplus of rural labour (e.g., agriculture labourers as a percentage of the working population decreased from 81% in 1970 to 49% in 2000) (Anderson et al. 2003). Concurrently, rapid economic growth in urban China widened the income gap between the urban and rural areas to a historically high level in the 1990s (Anderson et al. 2003). Both the surplus of rural labour and the increasing urban–rural income disparity have provided strong motivation and incentives for rural residents to migrate to urban areas in search of employment opportunities and better lives. Consequently, millions of Chinese farmers have left their villages for cities, giving impetus to rural-to-urban migration, which has now become one of the largest internal migrations in China's recent history (Zhang 2001).

According to Chinese governmental statistics, there are approximately 114 million rural-to-urban migrants in China, accounting for 23.2% of total rural labour and 9% of the total population in China (China National Bureau of Statistics 2004). Rural-to-urban migrants are defined as individuals who moved from rural to urban areas for jobs (Li et al. 2006b). These migrants work or live in urban areas without official urban household registration. Because of legal restrictions on household registration, approximately 80% of the migrants do not permanently relocate (i.e., obtain official urban hukou) (Zhang 2001).

Limited data are available at present on the mental health status of rural-to-urban migrants in China. Shen and colleagues examined the mental health symptoms among 371 (166 men and 205 women) migrant workers in Shenzhen, China (Shen et al. 1998). They found that young migrant workers (mean age 22.90 ± 2.67 years) had poorer mental health status than their urban counterparts. Using data from qualitative interviews, Li and colleagues found that rural-to-urban migrants in cities demonstrated hostile behaviour and poor social adjustment (Li et al. 2006b). A cross-sectional survey among more than 4000 rural-to-urban migrants in China also revealed that increases in mobility were associated with elevated levels of substance use and increased depressive symptoms (Li et al. 2006b). While these few studies suggest that rural-to-urban migrants experience increased mental health symptoms in their urban destinations, the lack of appropriate comparison groups from non-migrant residents in either the emigrating or immigrating communities makes it difficult to draw decisive conclusions on the complex relationship between rural-to-urban migration and mental health symptoms.

Several recent studies among migrant workers in China with comparison groups from non-migrant urban and rural residents yielded a different result. By comparing 4,453 migrant workers, 1,957 urban workers and 1,909 rural residents in western Zhejiang province in China, Hesketh and colleagues found that individuals in their migrant sample were not especially vulnerable to poorer mental health and other health risks (e.g., HIV and syphilis) than their urban and rural counterparts (Hesketh et al. 2008; Li et al. 2007). While these findings were inconsistent with previous studies that suggested a higher risk for mental health problems among migrants, the authors did warn that poor living condition and inadequate healthcare access might make migrants vulnerable to poor long-term health (Hesketh et al. 2006).

Given the rapid increase of the rural migrant population in China and the inconclusive findings in the literature on the relationship between rural migration and mental health, more research is needed to assess the impact of rural-to-urban migration on mental health symptoms in China and other developing countries. Therefore, the current study was designed to examine the mental health symptoms among rural-to-urban migrants, in comparison with representative samples of their counterparts in the rural emigrating and urban immigrating communities.

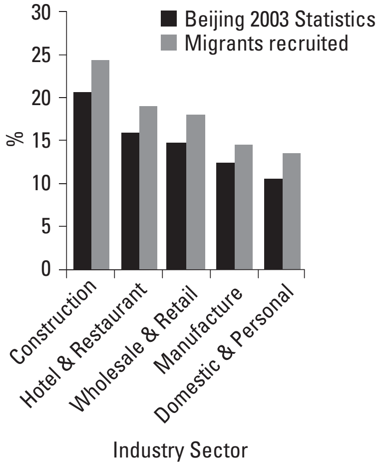
Methods

Sampling Procedures

Rural-to-urban migrant sample. The rural-to-urban migrant sample was recruited in Beijing, China. Beijing, the capital city of China, covers 16,808 square kilometres with a permanent population of 13 million. The Beijing municipal government has jurisdiction over four central urban districts, four near-suburban districts, eight outer-suburban districts and two counties. There were more than three million rural-to-urban migrants (69% men and 31% women) in Beijing in 2003 (Beijing Bureau of Statistics 2004). It was estimated that the majority (80%) were between 18 and 40 years of age (Beijing Bureau of Statistics 2004). Given the absence of other relevant sampling frames for the migrant population (e.g., household census data on migrants), we employed the occupational cluster-based "quota-sampling" scheme to ensure the representative nature of the migrant sample (Li et al. 2004; 2006a).

Based on 2003 government statistics of migrant employment, five occupational clusters employed 81.9% of the rural-to-urban migrants in Beijing (i.e., 22.8% in construction, 17.7% in hotel and restaurant, 16.2% in wholesale and retail, 13.6% in manufacturing and 11.6% in domestic service and other service sectors) (Beijing Bureau of Statistics 2004). These five occupational clusters were selected as the sampling frame for rural-to-urban migrants in the current study. The number of participants recruited in each cluster was approximately proportionate to the overall estimated distribution of migrants in the cluster (Figure 1). In addition to occupational clusters, the sampling was also stratified by gender to match the overall gender distribution of the migrant population in Beijing (i.e., 69% men and 31% women).

Figure 1. Proportion of rural-to-urban migrants recruited from each occupational sector

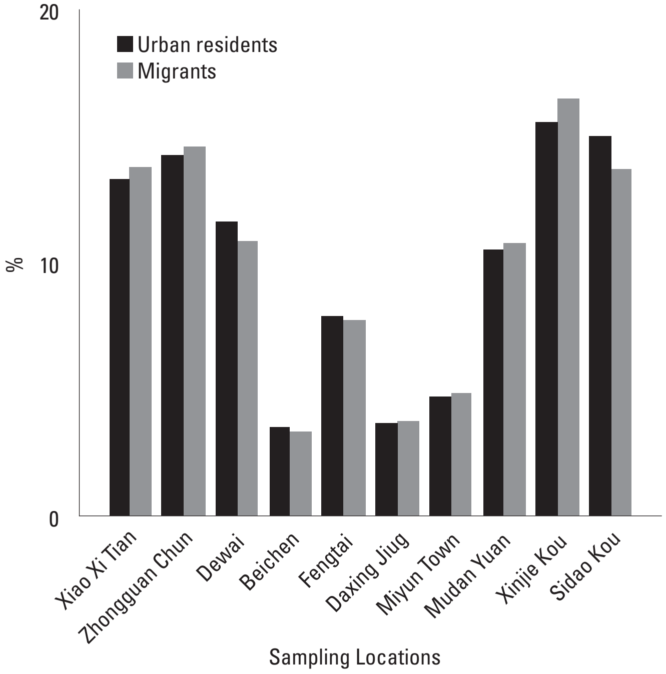


Migrants were eligible for participation in the study if they (1) came from rural areas; (2) worked in Beijing without obtaining a permanent Beijing residency; (3) had been in Beijing for at least one month; and (4) were between 18 and 40 years of age. The local research teams used workplaces (store, shop, club, office, factory and construction site) as the sampling units. Streets were used as the sampling units for migrants who did not have fixed workplaces (such as repairmen, street vendors). Because of the lack of relevant sampling frames for the migrant population, we employed several outreach strategies to identify the sampling units for the migrant sample. These strategies included direct contact (53% of the sampling units) and referral by local community or business leaders (47% of the sampling units).

Once a sampling unit was identified and selected according to the pre-established sampling scheme, employers (or managers) at the sampling unit were contacted for permission to conduct the survey on their premises. Upon receiving permission, the interviewers randomly approached available rural-to-urban migrants at the sampling unit and verified their eligibility for participation. This process was repeated until target numbers of sampling units or numbers of participants in each sampling stratum were reached. To prevent over-sampling of migrants from any single sampling unit, the number of migrants recruited from any unit was limited to 50 individuals. The final sample of 1006 rural-to-urban migrant workers was recruited from 34 sampling units. These sampling units, stratified by occupational cluster, were spread across ten large geographic locations (e.g., metropolitan areas, business districts, major streets and suburban townships) in two central urban districts, two near-suburban districts and two outer-suburban districts/counties in Beijing.

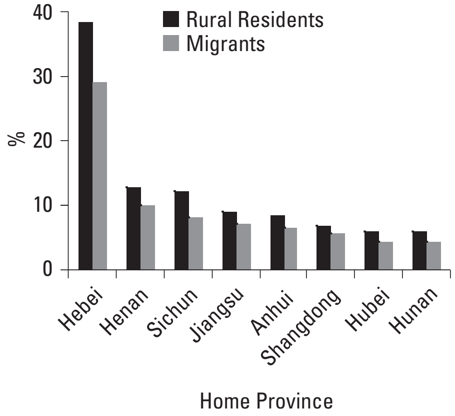
Urban resident sample. The urban resident sample was recruited from the same geographic areas as the migrant sample. Urban residents were eligible to participate if they (1) were between 18 and 40 years of age and (2) lived in Beijing with permanent Beijing residence status. We recruited eligible urban residents from the same sampling units as rural-to-urban migrants if the sampling units employed both migrants and urban residents. For migrants recruited from some migrant-dominated occupational sectors (e.g., men in construction and women in domestic service and entertainment establishments), we recruited "matching" urban residents from other occupations that required similar levels of skills or education, at the same geographic locations. Similar proportions of urban residents and migrants were recruited from each of the ten geographic locations in Beijing (Figure 2).

Figure 2. Proportion of urban resident sample and migrant sample by sampling locations in Beijing



Rural resident sample. Rural residents were recruited using multiple-stage cluster sampling. Once individuals had been recruited for the migrant sample, their provinces of origin were tallied. While the migrant sample in the current study originated from 25 provinces across mainland China, 75% of the sample came from eight provinces (Hebei, Henan, Sichuan, Jiangsu, Anhui, Shangdong, Hubei and Hunan). These eight provinces were selected as the first sampling stratum for the rural residents. The proportion of rural residents recruited from each province was set to be approximately equal to that of the migrant sample that originated from the same province (Figure 3). The county within each province served as the second sampling stratum. A total of 34 counties were selected from these eight provinces (range from one to 11 counties per province, with an average of 4.25 counties per province). The rural village within each county served as the third sampling stratum. A total of 63 villages were selected from the 34 counties (range from one to four villages, with an average of 1.85 villages per county). Outreach strategies employed to identify counties/villages included referrals from local government or direct personal contacts with village leaders. Once permission was granted by the village leaders to conduct the survey in their areas, the research team randomly approached available residents in villages and verified their eligibility for participation. Rural residents were eligible to participate if they (1) lived in a rural area and had permanent rural residency; (2) had stayed in their home town for at least 1 month; and (3) were between 18 and 40 years of age. To prevent over-sampling of rural residents from any village, the number of rural residents recruited from any village was capped at 30.

Figure 3. Proportion of rural resident sample and migrant sample by home province of origin



Survey procedures

Once an eligible individual was identified in a sampling unit, trained interviewers (psychology graduate students and faculty members at a local university in Beijing) provided the individual with a detailed description of the study design and the consenting procedure and invited her or him to participate in the survey. Eligible individuals who declined to participate were enumerated and their gender was noted. Eligible individuals who agreed to participate and provided informed consents were asked to complete a self-administered questionnaire developed through the joint efforts of investigators in both China and the United States. Similar questionnaires, with some sample-specific modifications (e.g., migration-related measures for the migrant sample), were developed for each of the three study samples (i.e., urban residents, rural-to-urban migrants and rural residents). Questionnaires were pilot-tested for comprehension among migrants in Beijing and typically took about 45 minutes to complete. Participants completed the survey individually or in a small group (three to five people) at workplaces, homes or other locations preferred by the participants. Trained interviewers provided assistance to a small number of rural-to-urban migrants and rural residents with limited literacy by reading survey items to them. Respondents were provided with a small monetary compensation for their participation. The study protocol was approved by the Institutional Review Boards at Wayne State University in the United States and Beijing Normal University in China.

Measures

Individual characteristics. All participants were asked to provide their age, ethnicity (Han versus non-Han), level of formal schooling and marital status. For the purpose of data analysis in the current study, the response to schooling question was grouped into three categories: no more than middle school (i.e., 9 years of compulsory education in China), high school (10–12 years of schooling) and post-secondary education (more than 12 years of schooling). Marital status was grouped into "never married" or "married." The latter category included 1.7% of the participants who were currently either divorced or widowed. Participants were asked to self-rate their overall health status on a 5-point scale: very good, good, fair, poor and very poor. For the purpose of data analysis in the current study, the response was grouped into three categories: good, fair and poor. All participants were asked about their average monthly income (in Chinese currency, yuan). The rural sample and some migrants who did not receive salary or payment on a monthly basis were instructed to divide their total annual income by 12 as an approximation of their monthly income.

Mental health symptoms. Participants' mental health symptoms during the most recent seven days were measured with the Symptom Checklist-90 (SCL-90) (Derogatis et al. 1973). The SCL-90 is a multidimensional self-report inventory designed to screen for a broad range of psychological problems and symptoms of psychopathology. The SCL-90 has nine primary symptom dimensions (somatization, obsessive–compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism) and three global indices, including the global severity index (the measure of overall psychological distress), positive symptom distress index (the measure of intensity of symptoms) and positive symptom total (the number of self-reported symptoms). The scale, originally developed for assessing the symptomatic behaviour of psychiatric outpatients, has been used with a variety of populations, from the non-patient "normal" population to medical patients or individuals with psychiatric disorders, and has been translated into numerous languages including Chinese (Derogatis et al. 1973; Wang 1993). Within the Chinese population, the SCL-90 has been used to assess mental health symptoms or trauma symptoms among community samples, nurses, women undergoing an early abortion, adolescents, patients with functional dyspepsia, unemployed workers and migrant workers (Hu et al. 1997; Jiang et al. 2000; Luo et al. 1996; Shen et al. 1998; Wang et al. 2000; Wu et al. 2001; Xia and Qian 2001). Based on results of our pilot testing (e.g., infrequency of "extreme" response), the response option of SCL-90 was modified from the original 5 points (0 to 4) to 4 points (0 to 3). The internal consistency estimates (Cronbach alpha) of the 10 subscales ranged from .74 to .88 for the entire sample, .75 to .88 for the urban sample, .70 to .87 for the migrant sample and .75 to .89 for the rural sample (Table 1).

Table 1. Estimates of internal consistency (*Cronbach alpha*) of SCL-90 scales among three Chinese samples

		Sample			
		Overall	Urban	Migrant	Rural
Somatization	12	.88	.88	.86	.89
Obsessive-Compulsive	10	.82	.84	.81	.81
Interpersonal sensitivity	9	.81	.83	.79	.79
Depression	13	.88	.88	.87	.88
Anxiety	10	.85	.86	.83	.85
Hostility	6	.79	.80	.78	.80
Phobic anxiety	7	.79	.82	.78	.78
Paranoid ideation	6	.75	.79	.70	.75
Psychsticism	10	.83	.86	.79	.83
Additional items	7	.74	.75	.71	.75
Full scale	90	.98	.98	.97	.98

As shown in Table 2, the internal consistency estimates were consistent between gender (ranging from .76 to .88 for female and .72 to .88 for male) and across different levels of educational attainment (ranging from .72 to .88 for ≤ middle school, .74 to .88 for high school and .77 to .89 for post-secondary education).

Table 2. Individual characteristics of study sample

	Sample			
	Overall	**Urban**	**Migrant**	**Rural**
N (%)	3026 (100%)	1000 (33%)	1006 (34%)	1020 (33%)
Mean age in years (SD)	27.24 (6.44)	27.52 (6.28)	25.39 (6.21)	28.79 (6.38)*
Mean monthly income (SD)[a]	1079 (972)	1664 (1255)	980 (703)	604 (450)*
Gender[b]				
Woman	1204 (40%)	479 (48%)	332 (33%)	393 (39%)
Man	1808 (60%)	515 (52%)	670 (67%)	623 (61%)
Han ethnicity	2832 (94%)	896 (90%)	968 (96%)	968 (95%)*
Education[b]				
≤ Middle school	1528 (51%)	74 (7%)	721 (72%)	733 (72%)
High school	858 (29%)	412 (41%)	223 (22%)	223 (22%)
Post-secondary education	627 (21%)	512 (51%)	57 (6%)	58 (6%)
Martial status[b]				
Single	1502 (50%)	587 (59%)	612 (61%)	303 (30%)
Ever married	1506 (50%)	409 (41%)	386 (39%)	711 (70%)
Perceived health[b]				
Good	2007 (67%)	589 (59%)	716 (72%)	702 (69%)
Fair	869 (29%)	352 (35%)	243 (24%)	274 (27%)
Poor	135 (5%)	57 (6%)	41 (4%)	37 (4%)

[a] Measured in Chinese currency, yuan (8 yuan ≈ 1 US dollar at the time of survey).
[b] Difference among groups was significant ($p < .0001$) * $p < .0001$.

Analysis

First, Chi-square (for categorical variables) or ANOVA (for continuous variables) was employed to examine the difference of individual characteristics among the three groups. Second, one-way ANOVA was performed to compare the group differences in the three SCL-90 global indices and 10 SCL-90 subscales. Post-hoc comparison was conducted using the least significance difference (LSD) criterion. Third, ANOVA or Pearson product moment correlation coefficients were employed to assess the association of mental health symptoms with key individual characteristics. Finally, the general linear model (GLM) was employed to simultaneously assess the group difference in all 10 SCL-90 subscales, controlling for key individual characteristics of the samples. Individual characteristics in the GLM model included gender, marital status, age, level of education, monthly income and perceived general health status. All statistical analyses were performed using SPSS for Windows Version 11.5.

Results

Individual Characteristics of Study Samples

Approximately, 1025 eligible participants were approached in each of the three target groups. Total participation rates were 97.6%, 98.4% and 99.3% for urban residents, rural-to-urban migrants and rural residents, respectively. Approximately equal numbers of men and women in each group refused to participate (i.e., 11 women and 14 men in the urban sample, six women and eight men in the migrant sample, and three women and four men in the rural sample). The final database contained 1,000 urban residents, 1,006 rural-to-urban migrants and 1,020 rural residents.

As shown in Table 3, these three groups differed in a number of individual characteristics. The mean age was 25.39 years for the migrant sample, younger than either the urban (27.52 years) or rural samples (28.79 years). There were more women in the urban sample (48%) than either the migrant (33%) or rural samples (39%). The proportion of Han ethnicity was lower in the urban sample (90%) than either the migrant (96%) or rural samples (95%). The urban sample had more participants who had completed post-secondary education (51%) than the migrant (6%) or rural samples (6%). The proportion of participants who were never married was similar between the urban sample (59%) and the migrant sample (61%), but lower in the rural sample (30%). About 70% of the migrant and rural samples perceived that they had very good or good health, compared with 49% of the urban sample. The average monthly income was 1664 yuan (~ US 208 dollars at the time of survey), 980 yuan (~ US 122 dollars) and 604 yuan (~ US 75 dollars) for the urban, migrant and rural samples, respectively.

Table 3. Group difference of mental health symptoms as measured by SCL-90

	Sample				Post-Hoc Comparison (Significant Pairs)
	Overall	Urban (1)	Migrant (2)	Rural (3)	
SCL-90 Global Indices					
GSI	.55 (.41)	.49 (.41)	.59 (.41)	.57 (.41)**	(1,2) (1,3)
PST	36.82 (22.56)	34.21 (24.16)	37.92 (21.14)	38.30 (22.09)**	(1,2) (1,3)
PSDI	1.27 (.29)	1.22 (.25)	1.33 (.34)	1.26 (.27)**	(1,2) (1,3) (2,3)
SCL-90 Subscales					
Somatization	.46 (.45)	.42 (.43)	.48 (.45)	.48 (.47)*	(1,2) (1,3)
Obsessive–compulsive	.72 (.49)	.63 (.48)	.78 (.51)	.75 (.48)**	(1,2) (1,3)
Interpersonal sensitivity	.65 (.48)	.55 (.46)	.69 (.50)	.69 (.46)**	(1,2) (1,3)
Depression	.57 (.48)	.51 (.46)	.63 (.50)	.57 (.48)**	(1,2) (1,3) (2,3)
Anxiety	.49 (.45)	.45 (.44)	.52 (.45)	.51 (.46)**	(1,2) (1,3)
Hostility	.61 (.53)	.56 (.52)	.62 (.54)	.64 (.54)*	(1,2) (1,3)
Phobic anxiety	.39 (.47)	.34 (.45)	.43 (.48)	.40 (.47)**	(1,2) (1,3)

Paranoid ideation	.59 (.50)	.54 (.50)	.63 (.49)	.61 (.50)**	(1,2) (1,3)
Psychoticism	.47 (.44)	.42 (.44)	.53 (.45)	.48 (.43)**	(1,2) (1,3) (2,3)
Additional items	.58 (.47)	.53 (.46)	.62 (.49)	.58 (.46)**	(1,2) (1,3)

GSI = Global Severity Index, the average score of the 90 items of SCL-90; PST = Positive Symptoms Total, the number of items scored above zero; PSDI = Positive Symptom Distress Index, the average score of the items scored above zero.
* p < .01. ** p < .0001.

Mental Health Symptoms

As shown in Table 4, there were significant differences in the three SCL-90 global indices, with both migrants and rural residents scoring higher on these indices than urban residents. Migrants and rural residents differed only in the positive symptom distress index (PSDI), with migrants scoring higher than rural residents for intensity of the symptoms. The three groups differed significantly in all 10 SCL-90 subscales (i.e., nine primary subscales and the scale with additional items). The post-hoc pair-wise comparison revealed that both migrants and rural residents scored higher than urban residents on each of the subscales. Migrants scored higher than rural residents on the depression scale and the psychoticism scale.

Table 4. Association of SCL-90 scales with individual characteristics

	Gender		Marital status		Correlations			
	Woman	Man	Single	Married	Age	Education	Income	Perceived health
Global indices								
GSI	.57 (.41)	.54 (.41)	.57 (.43)	.53 (.40)***	-.06***	-.13****	-.11****	-.21****
PST	38.23 (22.20)	35.97 (22.76)**	37.83 (23.12)	35.82 (21.92)*	-.05*	-.10****	-.11****	-.21****
PSDI	1.25 (.29)	1.28 (.30)***	1.29 (.30)	1.25 (.29)****	-.06***	-.15****	-.10****	-.10****
Subscales								
Somatization	.47 (.45)	.46 (.45)	.45 (.45)	.47 (.45)	.05**	-.12****	-.06****	-.27****
Obsessive-compulsive	.73 (.49)	.71 (.49)	.74 (.50)	.70 (.48)	-.04*	-.13****	-.12****	-.16****
Interpersonal sensitivity	.66 (.48)	.64 (.47)	.68 (.49)	.62 (.46)****	-.08****	-.15****	-.13****	-.16****
Depression	.61 (.50)	.55 (.47)****	.60 (.50)	.54 (.46)***	-.06**	-.10****	-.11****	-.21****
Anxiety	.53 (.47)	.47 (.44)****	.52 (.47)	.46 (.44)****	-.07****	-.10****	-.09****	-.17****
Hostility	.63 (.53)	.60 (.54)	.64 (.56)	.58 (.51)**	-.08****	-.08****	-.08****	-.16****
Phobic anxiety	.44 (.48)	.36 (.45)****	.44 (.50)	.34 (.43)****	-.14****	-.11****	-.09****	-.13****
Paranoid ideation	.56 (.49)	.61 (.51)**	.63 (.52)	.55 (.47)****	-.08****	-.10****	-.07****	-.14****
Psychoticism	.45 (.42)	.49 (.45)*	.51 (.46)	.44 (.42)****	-.08****	-.11****	-.08****	-.17****
Additional items	.58 (.47)	.58 (.47)	.59 (.48)	.56 (.46)	-.02	-.12****	-.09****	-.20****

GSI = Global Severity Index, the average score of the 90 items of SCL-90; PST = Positive Symptoms Total, the number of items scored above zero; PSDI = Positive Symptom Distress Index, the average score of the items scored above zero.
* p < .05. ** p < .01. *** p < .001. **** p < .0001

Both SCL-90 global indices and subscales were associated with a number of individual characteristics (Table 5). Compared with women, men reported fewer positive symptoms but higher levels of intensity of these symptoms. Women reported more symptoms for depression, anxiety and phobic anxiety than men, while men reported more symptoms for paranoid ideation and psychoticism. Participants who had never married reported more symptoms and higher intensity of the symptoms than married participants. Specifically, singles reported more symptoms in all nine SCL-90 primary subscales except for somatization and obsessive-compulsive scales. Age was negatively associated with all nine SCL-90 primary subscales except for somatization, which was positively associated with age. Likewise, education, income and perceived health were all negatively associated with both global indices and all subscales of SCL-90.

Table 5. General linear model analysis of SCL-90 subscales

	Main effect[a]			Interaction[b]	Covariates			
	Group	Gender	Marital status	Group × gender	Age	Education	Perceived health	Income
Multivariate test	3.99****	16.92****	2.53**	2.16**	7.80****	3.12***	27.14****	2.50**
Somatization	2.10	<1	3.49	<1	2.05	15.29****	239.11****	1.93
Obsessive–compulsive	9.67****	<1	8.07*	2.60	<1	5.14*	107.95****	9.47**
Interpersonal sensitivity	7.98****	<1	14.00****	<1	2.41	15.96****	120.55****	5.90*
Depression	8.64****	6.64**	14.58****	<1	<1	5.97*	162.95****	12.45****
Anxiety	2.43	7.15**	11.37***	<1	2.53	9.98**	120.81****	3.32
Hostility	1.60	<1	3.19	<1	8.96**	6.66**	104.97****	2.18
Phobic anxiety	2.98	19.72****	8.66**	1.60	19.03****	15.37****	81.81****	1.31
Paranoid ideation	1.45	8.18**	9.64**	1.29	4.82*	11.64***	89.76****	<1
Psychoticism	4.35*	6.38*	13.33****	1.41	3.01	11.44***	132.44****	2.25
Additional items	2.94	<1	13.36****	<1	<1	13.20****	145.52****	4.85*

[a] F-statistics for Pillai's trace were presented for the multivariate tests, and conventional F-statistics were presented for test at level of individual subscale.

[b] The table omitted other 2-way and 3-way interaction terms, none of which was statistically significant for either multivariate test or individual scales.

*p < .05.** p < .01. *** p < .001. **** p < .0001

Multivariate Analysis

The General Linear Model analysis of 10 SCL-90 subscales, controlling for key individual characteristics (age, gender, marital statue, education, income and perceived status of general health) revealed significant omnibus difference among the three groups for mental health status (Table 6). Gender, marital status, age, education, income and perceived health were also associated with mental health status in the multivariate test. Residency status (i.e., urban residents, migrants and rural residents) also showed a main effect on four of the SCL-90 subscales (obsessive–compulsive, interpersonal sensitivity, depression and psychoticism) after controlling for the key individual characteristics. As shown in Table 6, gender was significantly associated with depression, anxiety, phobic anxiety, paranoid ideation and psychoticism in the GLM model. Marital status was significantly associated with all SCL-90 subscales except somatization and hostility.

There was a significant group-by-gender interaction term in the multivariate test. However, the interaction term was not significant for any of the SCL-90 subscales. Other two-way or three-way interaction terms among group, gender and marital status were not significant for multivariate tests or for individual scales. The strongest covariates for mental health status were the level of education and perceived status of general health, as they were significantly associated with all SCL-90 subscales. Age was associated with hostility, phobic anxiety and paranoid ideation. Monthly income was associated with four SCL-90 subscales (obsessive–compulsive, interpersonal sensitivity, depression and the scale of additional items).

Discussion

Rural-to-urban migrants in the present study had inferior mental health status compared with urban residents in the communities to which they had immigrated. The difference remained significant even after controlling for age, gender, marital status, education, income and perceived general health. The data in the current study also suggest that migrants did not enjoy a more positive mental health status than their rural counterparts. Migrants reported more symptoms of depression and psychoticism than their rural counterparts in the emigrating communities. The data did not provide support for a "healthy migrant syndrome," but instead suggested a possible deteriorative effect of the migratory experience or migratory lifestyle on mental health status among rural-to-urban migrants in China.

One of the strengths in this study is the inclusion of three comparison groups: rural-to-urban migrants, urban residents in the communities to which the migrants had immigrated, and rural residents in the communities from which the migrants had emigrated. Our objective of sampling was to recruit a representative sample of the migrant population in Beijing and also to select the urban and rural samples to match the migrant sample. One of the major challenges in this study was the recruitment of urban and rural samples that were not only comparable to the migrant sample, but were also representative of the target populations. Several steps were taken to ensure both the comparability and the representative nature of the samples. We matched the samples by geographic location either at the urban destination or at the home province of origin, as well as by age range and other factors. Within those matched sampling frames, we tried to recruit participants who were representative of the study population.

Because of the existing differences between these study populations in terms of their demographic characteristics (e.g., age and gender composition), as well as income and level of education, our representative samples inherited these differences. For example, differences in age, education and marital status among the three groups in our study were consistent with the China 2000 Census Data (the most current national database with demographic characteristics), which indicated that migrants were younger than either urban permanent residents or rural permanent residents, that the migratory population was less educated than urban residents and that there were more singles among migrants (Beijing Bureau of Statistics 2003; China National Bureau of Statistics 2001). The fact that there were substantially fewer women in the migrant sample is consistent with the demographics of migrants (China National Bureau of Statistics 2001). We are less certain of the explanation for the low proportion of women in the rural population and conjecture that it results at least in part from the cultural tradition in rural China that men (rather than women) in the household communicate with outsiders (Dai 1991).

Nevertheless, the fact that both the migrant and urban resident samples were recruited from a single major metropolitan area using convenience sampling limits our ability to generalize our findings to migrants and their urban counterparts from other areas of China. The second limitation was the potential sample selection bias due to the non-random identification of the sampling units and participants (in both urban and rural areas). The third limitation is the potential overestimation of income for rural residents. While the difference in income among the three samples was consistent with the urban–rural income disparity in China (China National Bureau of Statistics 2006), the measures of monthly income among rural residents might not be comparable to that of the other two samples (urban residents and migrants). Rural residents were instructed to estimate their average monthly income by dividing their estimated annual income by 12. Because it is difficult to allocate farming incomes to individual family members, it is most likely that their calculation was based on their annual household income, while the other two groups (migrants and urban residents) might report their individual-level income.

The fourth potential limitation was the modification of the response option of SCL-90 items (i.e., reducing the range of response options from 0–4 to 0–3). Although the intention of a change of this nature was to reduce the response burden by simplifying the response options, such an alteration could cause an underestimation of the intensity of the symptoms and make it difficult to compare the findings with other studies using different response options. The fifth limitation was that the data analysis in the current study did not take into account the multistage and cluster sampling methods of the design; this could potentially inflate some of the differences in outcome measures based on residential status. Finally, because of the lack of normed data or criterion score on SCL-90 measures for the Chinese population, we were unable to assess the clinical significance of the differences in SCL-90 scores among various study samples.

Despite these methodological limitations, the current study is one of the first efforts to compare the mental health symptoms among migrants and their urban and rural counterparts. The findings in this study underscore the importance of mental health promotion and prevention efforts among rural-to-urban migrants. While a detailed examination of possible causes or determinants of elevated mental health symptoms among rural-to-urban migrants is beyond the scope of the current study, previous studies have documented a wide spectrum of possible reasons that could result in increased mental health symptoms among this population. These possibilities include separation from their families and community at origin, social isolation and social stigmatization in the urban destination, unstable living arrangements, substandard employment conditions and inadequate health-seeking behaviours (Hong et al. 2006; Li et al. 2006b, 2006a; Yang 2004). Future mental health promotion or intervention efforts should take these factors into consideration in order to improve the psychological well-being of rural-to-urban migrants in China and other developing countries. The findings in the current study also suggest a need for etiological studies and mental health promotion and prevention efforts among Chinese rural residents who suffer from more mental health problems than urban residents, an issue that has largely been overlooked in the literature.

Acknowledgement

This research was supported by NIH Research Grant #R21TW006375 funded by the Fogarty International Center and the National Institute of Mental Health. The authors wish to thank dedicated students and faculty members from Beijing Normal University for their assistance in field data collection. The authors also want to thank Dr. Ambika Mathur and Ms. Joanne Zwemer for assistance in manuscript preparation.

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Household Use of Inpatient Healthcare Services in India

Chungkham Holendro Singh, Lecturer, Department of Statistics, North-Eastern Hill University, Umshing Mawkynroh, Meghalaya, Shillong, India

Laishram Ladusingh, Professor, Department of Mathematical Demography & Statistics, International Institute for Population Sciences, Mumbai, India

Chungkham Holendro Singh, Department of Statistics, North-Eastern Hill University,
Umshing Mawkynroh, Meghalaya, Shillong-793022, India, Tel. +91-0364-2722901,
email. holendrosingh@gmail.com; holendro@iips.net

Abstract

Improving household use of healthcare facilities is a vital public health strategy to reduce burden of disease in India. Our study set out to understand the importance of the interplay of household characteristics and state-level public health covariates in accessing inpatient healthcare services. The study is based on morbidity and healthcare data from the 60th round of the Indian National Sample Survey Organisation, 2004. We used multilevel logistic regression to disentangle dependence among the observations. We observed that the education level of household heads and the household's economic well-being had a significant positive influence on accessing inpatient healthcare services. Distance from the household to the health facility showed a significant inverse association with use of health facilities for inpatient treatment. Further, we found a significant variation across the states. Variability in accessing inpatient services at the household and state levels are 1.7% and 21% respectively.

Introduction

Household use of healthcare facilities can go a long way in reducing the burden of disease in developing countries. In India, accessibility of healthcare remains a major challenge. At the macro level social, administrative, geographical and cultural factors all converge to influence health-seeking behaviour and access to health services. At the household level, cost is a major deterrent for poor people. This includes also so-called hidden costs such as transportation, loss of working time, and the cost of pathological or clinical tests or drugs that are not provided by health facilities.

Cultural perceptions and health practices of peers also determine health seeking behaviour. The poor in particular are more likely to first ignore ailments, and then turn to traditional practitioners before seeking formal healthcare. Within the household, social and economic conditions are key factors in determining use of healthcare services. Health behaviour is a dynamic process that depends on knowledge, resources, information and availability of health services locally. Lack of knowledge, cultural reasons and gender discrimination in particular prevent individuals from using basic healthcare services. In addition to gender, disparities in access are accentuated by old age and poor economic status of the household.

A number of studies have noted large inequities in healthcare accessibility for low-income and minority populations without health insurance coverage, lack of access to a regular source of care, gaps in preventive care, postponement of healthcare, and higher rates of morbidity, hospitalization, and mortality that could have been avoided with appropriate access to care (Brown 2000).

Access to healthcare services is the outcome of interactions of two broad sets of characteristics – one at the household or individual level and the other involving the healthcare delivery system. Many researchers have argued that access can best be evaluated through outcomes of the individual's passage through the system, looking at indicators such as utilization rates or satisfaction scores. These measures, they argue, permit "external validation" of the importance of the system and individual characteristics. Most often, accessibility is considered synonymous with the availability of financial and health system resources in an area (Aday and Anderson 1974).

Studies on access tend to focus on comparing utilization with health system infrastructure (supply factors) rather than a patient's health-seeking behaviour (demand factors). There are a number of theoretical models for describing access (Aday and Anderson 1974; Andersen et al. 1983; Penchansky and Thomas 1981; Donabedian 1973), many of which viewed access as a matching between predisposing factors on one side and enabling and health system factors on the other (Aday and Anderson 1974). Predisposing factors include an individual's perception of an illness, as well as population-specific cultural, social and epidemiological factors. Enabling factors include the means available to individuals for using health services. Health system factors include resources, infrastructures, institutions, procedures and regulations through which health services are delivered. Despite numerous studies measuring access, the literature about the approach for quantifying the contribution of various household characteristics and health system factors is scarce. Such an understanding could prove extremely useful in identifying specific constraints in health service delivery and could guide policy direction to provide effective stewardship.

Although empirical studies have often found that use of healthcare services depends as much on their availability and accessibility as on users' socio-economic characteristics, studies of the determinants of use of health services have focused on individual-level factors, with little attention given to the health infrastructure (Stephenson and Tsui 2002). This is partly due to the lack of adequate data. However, there is a growing interest in the ways in which healthcare services influence care-seeking behaviour. In the case of maternal care, for instance, Thaddeus and Maine (1994) pointed out the importance of community differences in accessing health facilities, the availability of healthcare providers and the adequacy of transport systems in timely care-seeking for obstetric complications. A handful of studies have indicated that distance to healthcare services is inversely associated with use (Gregory et al. 2000; Jones and Bentham 1997; Sexton and Sexton 2000). Important deterrents to accessing health services include geographic isolation, poor transport links, shortage of healthcare providers and an overall lower socio-economic status (Jong et al. 2004). Some studies have also pointed out that intense use of health services is evident if a health facility is located in the community or neighbourhood. In India, it was found that increasing the number of doctors in the community significantly increased use of health services related to delivery of care (Stephenson and Tsui 2002).

Research findings consistently support the finding that low income and high cost of services are the main constraints on service utilization and that socio-economic factors such as income, household wealth, education and working status are stronger predictors of service use than measures of the availability and accessibility of health services (Celik and Hotchkiss 2000; Valdivia 2002;

Falkingham 2003; Kandel et al. 2004). In general, studies have found that people in the poorest neighbourhoods are least likely to access services adequate to meet basic healthcare needs (Pearl et al. 2001; Collins and Schulte 2003; Magadi et al. 2003). Other studies indicate that healthcare facilities are grossly inadequate and their uneven distribution depicts serious inequalities in accessibility across households and regions (Ajala et al. 2005). These studies concluded that there is an urgent need for government intervention in provision of healthcare facilities that are focused on equitable distribution and accessibility to enhance sustainable rural development.

Our study is designed to fill the gap in the literature on household access of inpatient healthcare in India, considering the factors of the number of doctors in the population, distance to facilities and public health expenditure.

Data and Methods

The unit-level data on morbidity and healthcare for this study is from the 60th round (January–June 2004) survey of the National Sample Survey Organisation (2006). The survey covers a nationally representative sample of 73,868 individuals from 58,967 households. The sample design adopted is a two-stage stratified design, with census villages and urban blocks as the first-stage units for rural and urban areas respectively, and households as the second stage-units in both the cases. The survey also collected information on hospitalized status for each person in the household during the 365 days prior to the survey date. At the household level, survey data includes residence (urban or rural), educational level of the household head, and the household's monthly expenditure. The unit of analysis for our study is households selected to represent the states. The other data sources at the state level are distance to government hospital (International Institute for Population Sciences [IIPS] 2000), percentage living in urban areas (Ministry of Health and Family Welfare [MoHFW] 2001), health expenditure as a percentage of net state domestic product at factor cost (MoHFW 2005; Central Statistical Organisation 2007) and doctor–population ratio (MoHFW 2003).

Our study attempts to understand the relationship of household characteristics and health infrastructure/resources at the state level and household use of inpatient healthcare services. The unit of analysis is the household, and the outcome variable for our analysis is the proportion of hospitalized persons in each household. It is calculated as the ratio of number of persons in a household hospitalized in the last 365 days to the number of individuals in the same household. In India, healthcare is primary the responsibility of the states and is expected to vary substantially from state to state. Inpatient healthcare accessibility to households within states would, by and large, depend on knowledge and affordability, which may also differ across states. We used multilevel logistic regression to estimate the effects of state-level public health variables and household characteristics on the outcome variable of accessibility of inpatient healthcare. Multilevel logistic regression is appropriates to capture hierarchical data structure (Subramanian et al. 2000, 2001), and the approach facilitates understanding the effects of several state- and household-level covariates on household use of health facilities for inpatients care.

The logit of proportion of hospitalized individuals in the household is modelled as

$$logit(\pi_{ij}) = \beta_0 + \beta_1 h_{ij} + \beta_2 s_j + \mu_j \qquad (1)$$

where i and j are the level 1 (household) and level 2 (state) units, respectively; π_{ij} is the probability of the outcome for the ith household in the jth state; βs are the fixed coefficients; $\mu_j \sim N(0, \sigma_j^2)$ indicates the random effects for the jth state; and h and s refer to household and state characteristics, respectively. Estimates are based on a second-order penalized quasi-likelihood (PQL) procedure under the standard assumption that the outcome y_{ij} has a binomial distribution, where the n_{ij} observations are all equal to 1. Hence, $y_{ij} \sim Binomial(1, \pi_{ij})$, which has a binomial variance of $\pi_{ij}(1-\pi_{ij})$. The binomial variation assumption was tested by fitting extra-binomial variations, and found that most parameters are close to 1.0, suggesting that the Bernoulli distribution is an adequate assumption for the data (Goldstein 1995).

The analytical strategy consists of fitting five different models. The first is an empty model without any covariates. The second includes only household-level covariates in order to understand the effects of household characteristics on household accessibility to inpatient healthcare services. The state-level variables are included in third model, and the fourth model considers, in addition to household characteristics, state-level characteristics that facilitate understanding the mediating effects of state-level factors. In the last model we have included interaction terms of residence with household head's education and monthly per capita consumption expenditure (MPCE) to capture the confounding effects of education and consumption expenditure. All models were fitted with a state-level random intercept term, which represents the extent to which the outcome varies between states after controlling for the independent variables and factors that were omitted from the model or that could not be readily quantified in a large-scale survey, such as state variations in attitudes about service utilization. Regression results are presented in terms of odds ratios. Descriptive and bivariate analyses were derived using STATA Version 9.0 (StataCorp 2003), and all models were fitted in MLwIN 2.02 (MLwiN 2003). The proportion of variation explained by variables at level 1 and level 2 is measured by the formulas given by Snijders and Bösker (1999) as

$$R_1^2 = 1 - \frac{(\hat{\sigma}_u^2 + \hat{\sigma}_e^2)\ \textit{for fitted model}}{(\hat{\sigma}_u^2 + \hat{\sigma}_e^2)\ \textit{for empty model}} \tag{2}$$

$$R_2^2 = 1 - \frac{(\hat{\sigma}_u^2 + \hat{\sigma}_e^2/n)\ \textit{for fitted model}}{(\hat{\sigma}_u^2 + \hat{\sigma}_e^2/n)\ \textit{for empty model}} \tag{3}$$

where $\hat{\sigma}_u^2, \hat{\sigma}_e^2$ and n are the estimated errors of level 2, level 1 and average number of households in each state.

Results

Characteristics of the Sample

Descriptive statistics of the outcome variable, household characteristics and state healthcare infrastructures and resources for each state are shown in Table 1. In most of the states, households were predominantly in rural areas, except in Maharashtra and Tamil Nadu. Looking at the outcome variable, the highest mean proportion of inpatient hospitalization of household members was in Kerala, at 0.114; the lowest was in Bihar, at 0.064. The overall mean proportion of household members hospitalized for inpatient treatment was 0.083. Punjab had the highest economic status, with a monthly per capita expenditure of Rs. 942 (approximately US$25); Orissa had the lowest, at Rs. 457. Healthcare need at the household level is integrated into the analysis as the percentage of household members who had reported an ailment in the 1-year period preceding the survey. As most ailments are age-related, the calculation for "mean percentage ailing" took into account the average age of household members. To understand awareness of healthcare services, the study included the household head's education, categorized into three levels. Most household heads were educated at most to the middle level,that is eight years of complete schooling under the Indian system of education. As many as half of household heads in Andhra Pradesh were not literate, while Haryana had the highest number of households headed by a person educated to at least the secondary level, at 32.6%.

The most important variable affecting accessibility of healthcare facilities was the distance from the hospital, and our study attempts to capture this influence. Mean distance to a government hospital was found to be greatest in the state of Rajasthan, at 23 km, and least in Tamil Nadu, at 7 km.

Another variable with direct bearing on accessibility is the doctor–population ratio, measured as the number of doctors per 1000 population. The overall average was 65/1000; Jammu and Kashmir had the most doctors, at 253/1000, whereas Haryana had the least, at 9/1000. The lowest level of

Table 1. Description of characteristics for state units

State units	% household		No of household	Mean proportion hospitalized	MPCE	Mean percentage ailing	Mean household age	% household with head education			Distance to govt. hospital (km)	% urban	HE % NSDP	Doctor density[a]
	Rural	Urban						Illiterate	At most middle	Secondary +				
Andhra Pradesh	64.0	36.0	5016	0.098	700	20.0	31	50.3	30.9	18.8	17.1	27.1	9.9	74
Assam	81.8	18.2	2624	0.067	629	14.0	27	22.1	61.0	16.8	21.9	12.8	9.3	82
Bihar	84.7	15.3	4162	0.064	468	11.7	28	47.9	31.4	20.7	17.5	10.5	23.2	29
Gujarat	53.4	46.6	2777	0.086	832	15.4	31	29.9	46.7	23.4	11.8	37.4	6.1	51
Haryana	60.8	39.2	1392	0.077	899	15.9	29	30.6	36.8	32.6	11.2	29.0	11.0	9
Jammu and Kashmir	68.5	31.5	1196	0.073	812	13.9	29	43.9	34.5	21.7	17.5	24.9	14.0	253
Karnataka	54.9	45.1	3330	0.087	696	14.4	30	42.8	34.1	23.1	14.1	34.0	6.0	83
Kerala	65.0	35.0	2800	0.114	882	32.2	34	14.8	63.4	21.9	19.0	26.0	17.3	107
Madhya Pradesh	64.0	36.0	3537	0.073	564	13.7	29	39.8	39.9	20.3	15.2	26.7	11.2	22
Maharashtra	49.9	50.1	5262	0.091	832	19.1	31	25.7	45.3	29.0	20.9	42.4	6.9	50
Orissa	79.0	21.0	2643	0.081	457	14.7	30	42.0	44.0	13.9	19.2	15.0	10.1	127
Punjab	54.8	45.2	1489	0.079	942	19.1	30	39.3	33.2	27.5	9.6	34.0	10.1	132
Rajasthan	68.2	31.8	3366	0.071	686	13.1	28	43.0	36.1	20.9	23.0	23.4	6.8	84
Tamil Nadu	49.3	50.7	5083	0.106	782	19.1	33	31.0	45.5	23.5	7.1	43.9	6.9	46
Uttar Pradesh	71.8	28.2	9272	0.065	604	17.1	28	43.7	34.3	22.0	17.7	20.8	20.0	42
West Bengal	62.9	37.1	5018	0.088	702	20.5	30	32.3	47.8	19.9	15.4	28.0	7.5	70
All state units	64.6	45.4	58967	0.083	692	17.4	30	37.1	41.0	22.0	16.4	27.4	11.6	65

HE % NSDP = health expenditure as % of net state domestic product (2001–02); MPCE = monthly per capita expenditure.

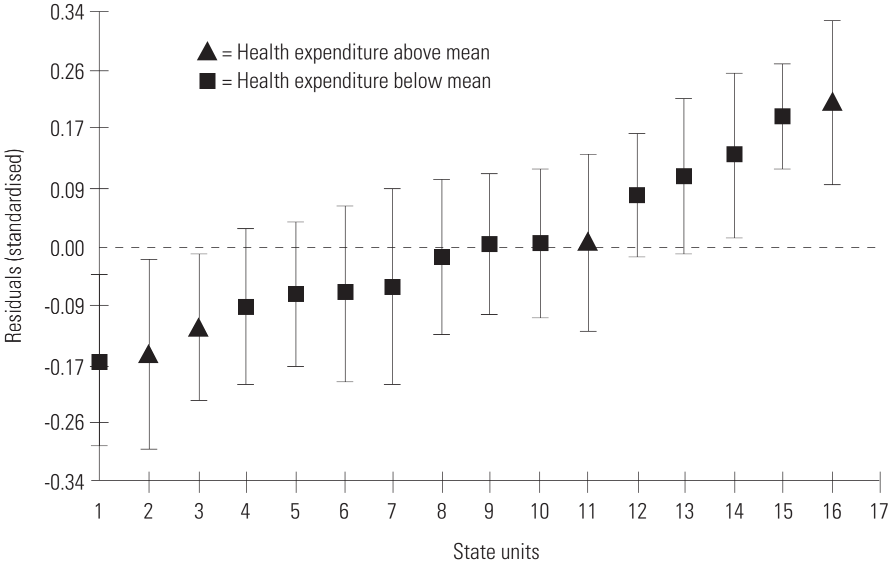
[a] number of doctors per 1000 population.

spending on healthcare (health expenditure as a percentage of net state domestic product) was in Karnataka, at 6%; Bihar had the highest, at 23%, against the overall average of 12%.

Multilevel Analysis

In this study, five competing versions of multilevel logistic regression are discussed in order to understand the interplay of household- and state-level factors in explaining accessibility of healthcare facilities. The significance of the state-level variance at a 5% level of significance in all the models indicates a considerable unexplained variation in accessibility of inpatient healthcare services at the state level that cannot be captured by the observed covariates. Relative importance of household-level and state-level variables in accounting for variation in the accessibility outcome is obtained by considering Model-I, which is a null model with no explanatory variables as a base model for comparison. For assessing the fitness of alternative models, a summary statistic is also included in the form of deviance measuring the extent to which the fitted model deviates from the saturated model. The approach for assessing model fit is to find the difference in the deviances for the alternative models, noting that the difference in deviance follows an exact Chi-square distribution, with degrees of freedom equal to the difference in the number of parameters in the competing models. First of all, it is found from the multilevel modelling that there exists a significant variation in accessibility of inpatient services between state units, at $p < .05$. The dispersion of residuals in Figure 1 depict this variability in accessibility across the state units. States with low health expenditures measured as percentage share of domestic product are concentrated in state units having lower levels of hospitalization.

Figure 1. Standardized residuals' departure from the mean hospitalization across state units (ranked)



From Model-II, which includes only household characteristics, it is found that the odds of urban households using inpatient care services are lowered by 0.13 compared with rural households (Table 2). This may reflect exposure of rural households to adverse work conditions, making them prone to accidents and injuries that required hospitalization. Patel (2009) found that incidence of disability due to burns, accidents and injury is higher in rural areas. The key to developing equitable health systems and reducing social exclusion for the poor is in removing barriers on access to healthcare services (Feachem 2000). Even among the poor, high utilization of services was found in the case of

Kerala , the state known for high literacy level, well informed citizen and good governance (Krishnan 2000; Mahal et al. 2001).

Table 2. Parameter estimates and standard errors for household–state model of inpatient healthcare accessibility

Fixed effects	Model-I	Model-II	Model-III	Model-IV	Model-V
Intercept	0.089 (0.047)*	0.071 (0.064)*	0.039 (0.436)*	0.053 (0.448)*	0.053 (0.451)*
Household-level variables					
Place of residence					
Rural^R					
Urban		0.872 (0.035)*		0.785 (0.108)*	0.874 (0.139)
Monthly per capita expenditure					
Lowest^R					
Medium		1.223 (0.040)*		1.217 (0.040)*	1.257 (0.044)*
Highest		1.554 (0.043)*		1.539 (0.043)**	1.581 (0.052)*
Household head education					
Illiterate^R					
At most middle		1.065 (0.035)**		1.065 (0.035)**	1.041 (0.044)
Secondary and above		1.146 (0.040)*		1.143 (0.040)*	1.111 (0.051)*
Mean age of household member		0.996 (0.001)*		0.996 (0.001)*	0.996 (0.001)*
Percentage of ailing members		1.005 (0.001)*		1.005 (0.001)*	1.005 (0.001)*
State-level variables					
Distance to govt. hospital			0.998 (0.001)*	0.996 (0.004)	0.996 (0.004)
Percentage urban			1.014 (0.005)*	1.009 (0.005)**	1.009 (0.005)**
Log$_{10}$ HE % NSDP			1.150 (0.246)	1.000 (0.247)	1.000 (0.248)
Log$_{10}$ doctor density			1.194 (0.112)	1.125 (0.112)	1.123 (0.112)
Interaction					
Urban* At most middle					0.930 (0.072)
Urban* Secondary and above					0.950 (0.083)
Urban* Medium quintile					0.710 (0.104)**
Urban* Highest quintile					0.740 (0.099)**
State-level variance	0.030 (0.012)*	0.023 (0.010)*	0.013 (0.006)*	0.013 (0.006)*	0.014 (0.006)*
-2 log likelihood	33340	33324	33297	32340	32317

^{R} Reference category; *p<.05, **p<.01.

This study also showed that higher economic status is likely to increase healthcare accessibility. The odds of receiving inpatient healthcare services by households in the medium quintile income group in terms of MPCE were higher by 0.22 compared to households in the lowest quintile income group, and they were higher by 0.55 for households in the highest quintile income group after controlling other household characteristics. Both effects were significant at $p< .05$. This clearly indicates that households with greater economic well-being had a higher probability of accessing services for inpatients care.

Educational attainment is the key to awareness of healthcare needs and use of healthcare facilities. Our study supports this notion and revealed that the odds of accessing inpatient facilities were higher by 0.07 and 0.15 for households headed by someone educated at most to the middle level and secondary and above, compared with households headed by a non-literate person, respectively, after controlling the effects of other covariates. These results are significant at $p < .05$. The proxy for household healthcare need – the percentage of household members with reported ailments in the 1-year period leading up to the survey – was a significant association at 1% of significance with household access of inpatient healthcare facilities. In regard to the importance of age on use of inpatient care, we found that the higher the mean age of household members, the lower the likelihood of a household having accessed inpatient healthcare. This inverse association, after controlling other household and state confounders, was statistically significant at $p < .01$. The result is a reflection of aging on morbidity and ailments.

From Model-III, which includes only the state-level variables, we found that distance to government hospital was inversely association with the odds of using inpatient care facilities; it was statistically significant at $p < .01$. This finding is aligned with results of other studies, which found that having health facilities in the neighbourhood resulted in higher odds of making four or more antenatal care visits (Anastasia and Calixte 2006). Level of urbanization at the state level is considered as a proxy for availability of healthcare infrastructure and health facilities. Level of urbanization is measured as the percentage of the population that lives in urban areas. The better the healthcare infrastructure, the greater household use of healthcare facilities. If we assume a one-to-one correspondence between percentage urban population and healthcare infrastructure, we can conclude that the odds of household use of healthcare facilities for inpatient treatment becomes higher by 0.01, corresponding to 1% improvement in health infrastructure. This association is significant at $p < .05$. There is no doubt that each state's investment in public health also plays a major role in accessing health facilities. Though the association between health expenditure as percentage of state domestic product and household access of inpatient care, controlling for other confounders, was found to be positive, it was not statistically significant. Further, the influence of the doctor–population ratio on inpatient healthcare facilities, though positive in the sense that the higher the ratio the greater the accessibility, was again found to be statistically insignificant.

Model-IV integrates both household-level and state-level characteristics in describing use of inpatient care facilities. Most of the preceding findings remain intact. With the integration of state-level covariates, there is a reduction of 38% in the variance initially observed between state units, compared to the result of Model-II, which includes only household-level covariates. The magnitudes of healthcare access differential explained by household- and state-level covariates included in Model-IV are 1.7% and 21% respectively. This indicates the importance of state-level covariates in explaining variability of outcome, as in other studies (Ladusingh and Singh 2006).

Now to explore the relationship between residence and accessibility of services, where it is important to know whether place variability is determined by the household head's level of education or by the economic well-being of the household. To arrive at a comprehensive interpretation, two sets of interacting terms are included in Model-V – residence and education, and residence and MPCE quintile. In this model it should be noted that the influences of residence and education on use of inpatient services lose their statistical significance, though the nature of their relationships still holds up. The introduction of interactions between residence and household head's education, residence and MPCE quintile, facilitates a comparative assessment of the likelihood of using the services by each level of education within each level of economic status. The interaction results show that household access to inpatient healthcare facilities across place of residence do not significantly vary by the education level of the household head, that is, there is no significant contribution of interaction between residence and education. However, the contribution of interaction between residence and household economic well-being on household use of services is significant at $p < .01$. This proportion of variation in access by household- and state-level factors remains unchanged, as in Model-IV. Nonetheless, significant state-level variances in the last two models suggest unexplained variations remaining in the data at the state level. The test of difference in deviance statistics indicates that results drawn from Model-V are preferable over that of Model-IV.

Conclusion

The analysis presented here has highlighted the importance of household characteristics and state-level health infrastructure in explaining healthcare accessibility for inpatient care in India. It indicates that the education level of the head of the household plays a major role in explaining accessibility at the household level. Our study confirms the results of other studies, that household economic well-being measured in terms of monthly per capita expenditure has a significant direct influence on use of healthcare services. From the findings of our study, it seems that rural households are more prone to ailments that required inpatient treatment, as in a study in Vietnam probably related to accidents and injuries indicated in Patel (2009). The finding that inpatient healthcare services decrease with mean age of household is also aligned with findings from other studies. Most of the results of our study related to education level of the household head, household economic well-being and rural location conform to the findings of Sepehri et al. (2008) and Lin et al. (2004). For state-level factors, distance to government hospitals had a significant inverse association with accessibility of services. This aligns with other studies by Gregory et al. (2000), Jones and Bentham (1997) and Sexton and Sexton (2000). The availability of health infrastructure, measured in terms of level of urbanization, was found to have a significant association with household use of inpatient healthcare facilities. The number of doctors in the population had a positive effect on the use of inpatient services, though it is not pronounced enough to be significant. One of the most valuable findings is that household factors dominated over state-level healthcare infrastructure and expenditure. This study also indicates that a sizeable proportion of the variability in access is explained by state-level factors.

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Multiple Forces Working in Unison: The Case of Rapid Improvement of Vital Statistics in South Africa Post-1996

Prof Sulaiman Bah, College of Applied Medical Sciences, King Faisal University, Dammam, Saudi Arabia

Prof Sulaiman Bah, P.O. Box 2435, Dammam 31441, Saudi Arabia, Tel: +966-3-857-7000, ext. 2751, Email: sbah@kfu.edu.sa.

Abstract

In a period of about five years, from 1997 to 2002, South Africa remarkably improved the coverage and production of its vital statistics. This period witnessed the entrance of South Africa into the select league of countries that publish statistics on multiple causes of death and that make use automatic coding of causes of death. These achievements were accomplished through multiple forces working in unison. Some of the important factors contributing to the achievement were lessons learned from study tours to Australia, Sweden and the USA. The paper describes these lessons and how they were adapted to suit the South African reality. Comparison is made between the status of demographic statistics by the end of apartheid and in the post-apartheid era. Stakeholder relationships that shaped the transformation of demographic statistics in the new South Africa are also discussed.

Introduction

Out of the eight Millennium Development Goals, three are directly health-related. These are; goal 4 on reducing child mortality, goal 5 on improving maternal health and goal 6 on combating HIV/AIDS, malaria and other diseases. The indicators needed for monitoring progress towards achieving these goals come from health information systems. Globally, health information systems need to be strengthened in order to produce realistic indicators and meaningful progress reports. In many countries, some of the data feeding into the health information system are obtained from the civil registration/vital statistics system (CR/VS system) and South Africa is one of such countries.

Prior to the 1990s, national coverage of vital statistics was very low in South Africa (Bah 1999a). But during the late 1990s, Statistics South Africa (Stats SA), the Department of Health (DoH) and the Department of Home Affairs (DHA) made concerted efforts to improve coverage of birth and death registration. These efforts saw the raising of awareness of the importance of vital registration, introduction of new death registration forms, inclusion of nurses and village headmen in the registration process and conversion from ICD-9 to ICD-10 coding. This has paid off well, and South Africa is now producing timely statistics on causes of death. In addition, it is publishing statistics on multiple causes of death and has automated the selection of underlying cause of death. National completeness of death registration is now very high, estimated at 90% or higher. Through these remarkable efforts, South Africa has shown that it is possible, within a decade, to turn the tables around from defective vital statistics to commendable ones of high standard. These positive results have been widely acclaimed in the literature (Groenewald and Pieterse 2007; Lopez et al. 2007; Setel et al. 2007).

The first premise in this paper is that during the late 1990s multiple forces were at work to improve the CR/VS system in South Africa. The second is that the interventions or measures put in place in the late 1990s worked. Therefore, the first aim of the paper is to identify those interventions or measures and link them to specific improvements. The second is to place the interventions/measures in the wider context of the literature on improving CR/VS systems. While all aspects of vital statistics were improved during the study period, the paper concentrates mostly on mortality and cause of death. The paper draws on the experience of the author, who was heading the section dealing with vital statistics from 1997 to 2003. In that sense, a lot of the material presented here is based on primary, first-hand information.

The following section gives a brief overview of the evolution of the CR/VS system in South Africa to the end of apartheid. Following that, each aspect involved in the improvement of the system is analyzed. The paper concludes with a synthesis of these aspects and contextualizes them in light of the literature on the improvement of the CR/VS system.

Summary of the Evolution of Collecting Demographic Statistics in South Africa to the End of the Apartheid Era

The Union of South Africa was formed in 1910, and the modern history of the CR/VS system started with the formation of the national statistics office in the war year of 1914. The significant dates in the history of the development of CR/VS in post-Union South Africa are 1924, 1950, 1991 and 1992. A description of the relevant pieces of legislation enacted during these years and their main features is shown in Table 1.

Table 1. Sentinel events in the evolution of collecting demographic statistics in South Africa up to the end of the apartheid era

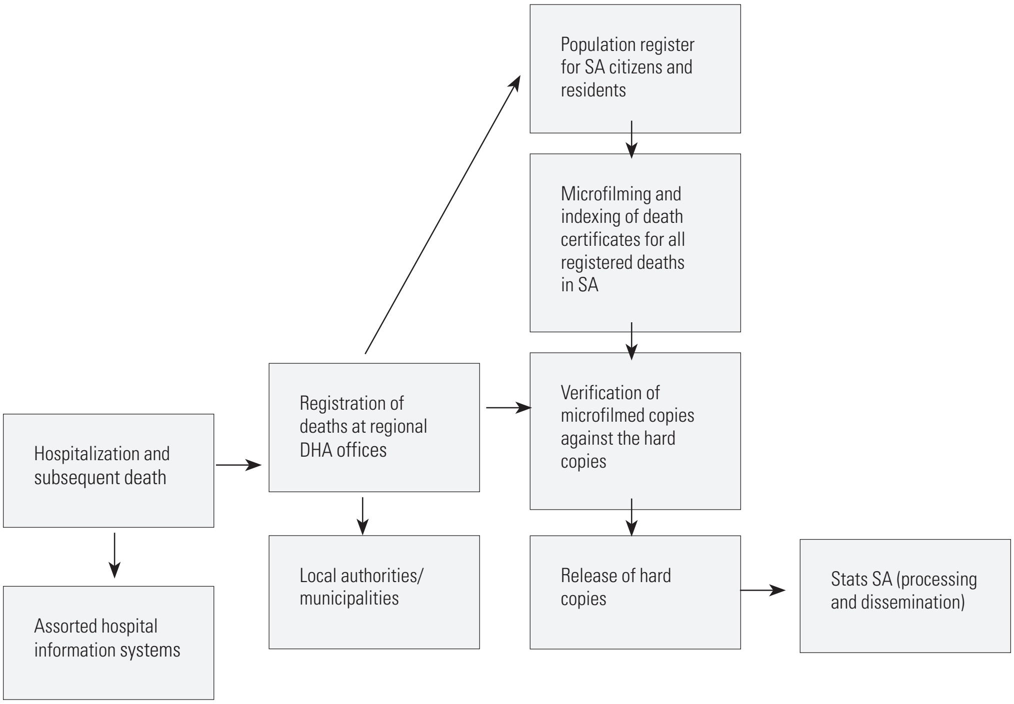
Year	Legislation enacted	Main features
1924	Births and Deaths Registration Act (Act 17 of 1923)	Uniformity in vital registration throughout the Union of South Africa
1950	Population Registration Act of 1950	The introduction of the race identifier into the population register and the provision of the legal basis for apartheid
1991	Population Register Repeal Act of 1991	The dropping of the race identifier from the population register
1992	Births and Deaths Registration Act of 1992 (Act 51 of 1992)	The act that resembled the previously comprehensive Act 17 of 1923

Act 17 of 1923 paved the way for uniformity in vital registration throughout the union. This act, which became effective in 1924, laid the foundation for the CR/VS system and remained in place for the next six decades. It was replaced by a similarly comprehensive act, the Births and Deaths Registration Act of 1992 (Act 51 of 1992) (Khalfani et al. 2005). In the period between 1924 and 1992, the CR/VS system experienced highs and lows through the "making," "unmaking" and "new making" phases (Bah 1999a). In 1950, the Population Registration Act was enacted and this led to the introduction of the race identifier into the population register This law remained in place for the next 40 years and was only revoked by the Population Register Repeal Act of 1991, which saw the dropping of the race identifier from the population register.

During apartheid, the population register information system was used mostly for producing race-based identity documents and other legal documents such as birth, death and marriage certificates. However, in spite of its name, it played a marginal role in the production of vital statistics. Birth statistics were obtained from the births register that fed into the population register, while death statistics were obtained through processing the actual death notification forms. Vital statistics produced during this era came from the other registers that fed into the population register. These registers captured current events, whereas the population register cumulatively captured vital events.

In the case of deaths, production of vital statistics during the apartheid era was stalled by the legal requirements of the population register. The process of compiling vital statistics is shown in Figure 1. Minimal information was extracted from death registration forms and entered in the population register. The forms were then sent for microfilming and subsequently for verification. After verification, the civil registration system had no further use for the forms and they were sent to the national statistics office for processing. However, the verification stage could be long, resulting in substantial delays in the production of death statistics. This was unsatisfactory for both users and policy makers. The situation continued till the mid-1990s.

Figure 1. Institutional arrangements for producing death statistics in South Africa prior to the intervention



DHA = Department of Home Affairs.

By the end of apartheid in the mid-1990s, producing demographic statistics faced several challenges. The first was to make national statistics geographically and racially inclusive, covering previously excluded population groups and geographic areas. The second was to improve the relevance of the data for policy making. This partly involved improving the lag time between the year of collection and the year of publication, as well as the professionalism in the analysis and reporting of vital statistics. The third challenge was to exploit the population register to meet demographic data needs.

Prioritization by Government

The new South Africa that emerged at the end of apartheid was faced with the challenging task of transforming all major government institutions, including Stats SA. During the post-apartheid era, the main driver for the transformation of vital statistics was the Government of National Unity (GNU), through the Reconstruction and Development Programme (RDP). The RDP outlined a framework in which goals to be achieved within the period 1995 to 2000 were spelled out. One of the cornerstones of the RDP framework was redistribution of resources and services to redress the inequalities of previous regimes. Subsequent to this, a number of departments, including the DoH, contextualized the RDP goals by issuing their own RDP white papers. The DoH was quick to constitute the National Health Information System for South Africa (NHIS/SA) committee in 1994. The committee's broad objective was to develop a National Health Information System for South Africa that began at the local level and fed into district, provincial and national levels, and included the private and public sectors. In a discussion paper titled *Towards a National Policy and Strategy for a National Information System for South Africa* (NHIS/SA), one of the problem statements dealt with births and deaths legislation. It stated that the then-existing births and deaths legislation governing vital records needed revisions to support the revised health information system. Revisions should be done in such a way that they could be used for producing health indicators that allowed monitoring of apartheid-generated disparity in access to healthcare and health status. For example, specific levels of disaggregation would include race, sex, age, geographic location and socio-economic status.

Prioritization by Donors

With the end of apartheid, the international community opened up to South Africa. Many donor organisations offered various forms of assistance to the government to help support the massive transformation that was underway. As with other government organizations, Stats SA was a beneficiary of donor assistance from international organisations such as AUSAID (Australia) and SIDA (Sweden) among others. With sponsorship from these organizations and in some cases from other donors such as UNICEF, several staff members working in vital statistics were sent overseas for study tours, visits or short-term training. One study tour was made to Australia in 1997, another to Sweden in 1999, and multiple visits were made to the US in 2001, 2002 and 2003. Details are given in Appendix I (Australia), Appendix II (Sweden) and Appendix III (US). Lessons learned from the tours guided and informed most of the planning and decision making in the VS component of the CR/VS system.

Training, Seminars and Workshops

Training needs for improving the CR/VS system were diverse. On the VS side, some needs were satisfied internally (within South Africa) while others were satisfied externally (out of South Africa). Stats SA provided generic training to staff members to improve their computer and statistical skills. In the VS section, other specific training was given to staff members as required. Senior coders were sent for internal training in coding using ICD-10. These coders were later responsible for training newly recruited coders. Programmers were sent for internal training on Visual Basic to equip them to develop new systems. A statistician, a programmer and coders were sent for external training on multiple causes of death and for automation in processing causes of death data.

On the CR side, Stats SA, the DoH and the DHA made concerted efforts to improve coverage of death registration. These efforts saw the raising of awareness of the importance of vital registration, introduction of new death registration forms and inclusion of nurses and village headmen in the registration process. Several seminars were organized at different times. The DoH and DHA organized training workshops on the completion of the new death registration forms. At the end of these workshops, Stats SA organized a national workshop on the vital statistics system. This workshop involved the DoH, DHA, provincial Stats SA offices and major users of vital statistics data.

Involvement of users and stakeholders

Major stakeholders during the post-apartheid period (and prior to it) included the DoH, the DHA and a broad group of national researchers. The DHA, DoH and Stats SA were partners in the CR/VS system and were interested in its improvement for different reasons. For the DHA, fulfillment of legal requirements and completeness of the population register were the primary goals, while for Stats SA, computing accurate demographic indicators for use by planners and policy makers were primary. For the DoH, primary goals were obtaining indicators to monitor health status and health disparities, and health policies to improve health outcomes. The broad group of national researchers had an ongoing interest in seeing improved and timely vital statistics. These statistics would be used for conducting research that would feed into government policy making.

At the policy level, the DoH and DHA formed a committee to oversee the transformation of the CR system. At the pragmatic level, Stats SA, the DoH and the DHA formed another committee to handle practical issues encountered in the CR/VS system. Stats SA consulted frequently with the broad group of national researchers to seek advice on any major moves it planned to make. Internally, the national Stats SA office involved the provincial Stats SA offices in field efforts for the improvement of the CR/VS system. There was generally a good working relationship between the different stakeholders as they all shared the common vision for the improvement of the CR/VS in South Africa.

Results of the Combined Efforts

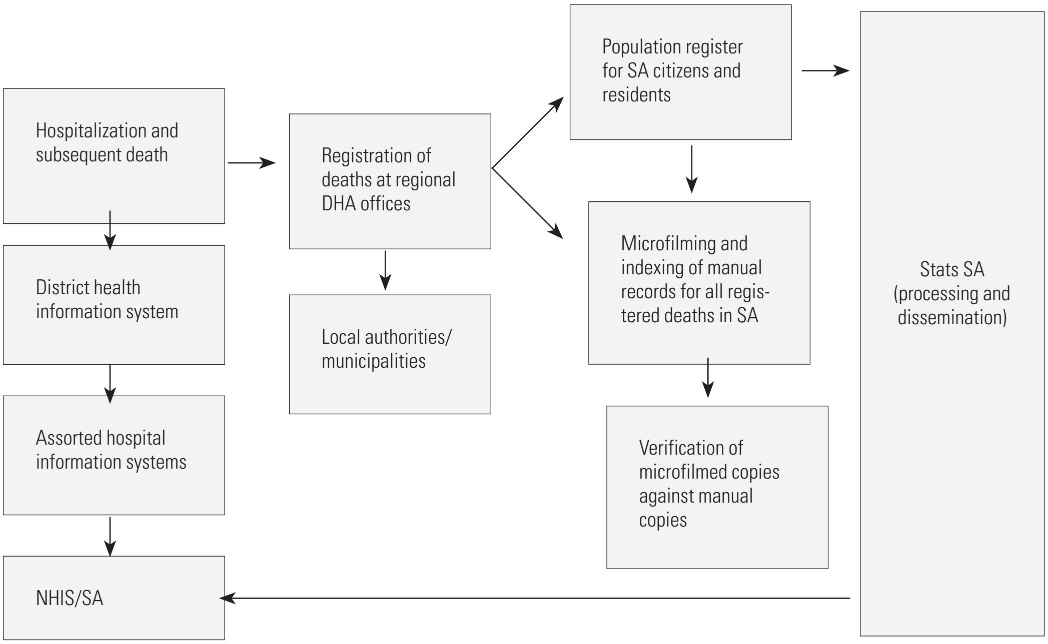
The need for timely mortality data and access to the medical certificate of death for coding causes of death necessitated a change in the CR/VS system. Three solutions were settled on. The first was to use the minimal information on deaths found in the population register (gender, birth date, and date and place of death) and publish an "advance release" of death statistics. The second was to laser print the microfilmed images of the death certificates prior to validation instead of waiting for hard copies that would be available years later. The third was to train a large group of nurses in coding and retain the best-performing ones as coders. With co-operation from the DHA, the new arrangement was put in place and the laser printing of the death certificates was outsourced to an external service provider. This new process for producing statistics on mortality and causes of death is shown in Figure 2. The project cost over a million US dollars for processing five years of data (1997–2001). It brought an end to the delay in producing causes-of-death statistics in South Africa. This approach was later terminated in 2003. The next phase is cutting production costs. The national statistics agency has already started using some forms automation for causes of death, and it is hoped that as this automation improves production costs will decrease.

A comparison of the sources of vital statistics and the uses they were put to during the apartheid and post-apartheid eras is shown in Table 2. During the former era, the population register had been used mostly for maintaining race-based identity documents, even though it had great potential for other uses that were realized only in the post-apartheid era.

Discussion

In South Africa, multiple forces were working in unison to achieve the goal of an improved CR/VS system in the late 1990s. It has been argued that the two core ingredients for the improvement were the commitment of the government and the importance that donors gave to the system (Mahapatra et al. 2007). Both factors were present in the post-apartheid South Africa. The Government of

Figure 2. Institutional arrangements for producing death statistics in South Africa after the intervention



DHA = Department of Home Affairs; NHIS/SA = National Health Information System for South Africa.

Table 2. Different sources of vital statistics and the uses to which they were put during the apartheid and post-apartheid eras

Source	Apartheid era	Post-apartheid era
Births register	Occurrence-based births statistics	
Marriage register	Occurrence-based marriage statistics	
Death notification form	Death statistics (after lengthy period of microfilming and verification)	Death statistics (speedily printed from micro-filmed images- later terminated in 2003)
Population register (for the production of legal documents)	Identity document with race identifier Birth certificate Death certificate Marriage certificate Certificate of citizenship	Identity document without race identifier Birth certificate Death certificate Marriage certificate Certificate of citizenship
Population register (for the production of vital statistics)	None	Cumulative statistics on births Advance release of deaths statistics (later terminated)

National Unity that was formed at the end of apartheid was fully committed to improving the health status of all South Africans. Major transformations were made to the healthcare delivery system and the health information system (Ntsaluba and Pillay 1997). The commitment to improving the health information system continued during the 2000s and was further strengthened by the call for improving the quality of sources of data needed for meeting the Millennium Development Goals (Tshabala-Msimamg 2005). In the aftermath of apartheid, donors were keen on helping South

Africa improve its governance and for that purpose supported initiatives to improve the statistical basis for decision making and monitoring. The two core ingredients described above are necessary but not sufficient for the improvement of the vital statistics system, however. Another ingredient is needed, namely the driving process within the national statistics system. This driving process deals with the motivation of the producers of vital statistics, the learning curve they undertake, the expert help they get through field trips and co-operation with experienced stakeholders, and implementation of lessons learned and experience gained.

The paper has shown that a lot of experience was gained from the study tours and visits to Australia, Sweden and the US. The task faced was to implement the doable recommendations while taking into account the South African reality. Prior to the study tours, Stats SA had defined its priorities in the transformation of vital statistics. The first of these priorities involved improving the coverage of vital statistics. Stats SA had decided that it was going to play a proactive rather than passive role in the collection of vital statistics data. For that reason, Stats SA had started networking with stakeholders in the production of vital statistics. The study tours helped strengthen that resolve and provided ideas on how to do it more effectively. The tours helped Stats SA in exposing it to multiple-cause coding, in looking for innovative ways to expedite publication of vital statistics and in harnessing the potential of the population register.

Conclusion

One of the principles of official statistics is that "bilateral and multilateral cooperation in statistics contributes to the improvement of systems of official statistics in all countries" (United Nations 2008). This proved true in the case of South Africa. By the end of apartheid in the mid-1990s, demographic statistics in South Africa were in disarray and badly in need of transformation. Multiple forces were at play to help correct the shortcomings in the CR/VS system. On the VS side, the route followed was to learn from best practices in other countries and tailor the lessons learned to the South African context.

Given that a high level of coverage of vital events has been achieved, the short-term priority for Stats SA, the DoH and other stakeholders is to improve the quality of the data, especially that of death certification. Several researchers have called attention to this in the past and have made recommendations in this regard (Bah 2003; Bah 2005; Groenewald and Pieterse 2007). While Stats SA coding staff have been trained in coding at the four-digit level of ICD-10, a plan for moving to that level has had to be shelved until the quality of death certification data has improved. Different innovative approaches have to be put in place for improving the quality of certification of causes of death. In addition to implementing training programs on certification and a query system for badly completed death certificates, a system of rewarding/shaming could be introduced. Hospitals whose staff are thorough in completing death certificates (above a pre-specified percentage) would be included in the list of Stats SA "statistics-friendly hospitals," while those who do not take certification seriously would be listed as "statistics-unfriendly hospitals." If such lists were published every year and drew sufficient notice, hospitals would take them seriously and give more attention to the quality of certification of their staff.

Another short-term measure that Stats SA could put in place is to provide "South–South" training to officials from national statistics offices from other developing countries, beginning with some of its neighbouring countries in Southern Africa. Funding could be short-term and training could easily be shared between Stats SA and the statistics office of the neighbouring sending country or countries. In imparting training to other countries, South Africa would be helping them to improve the statistical basis of their decision-making processes and their monitoring of progress toward achieving their Millennium Development Goals.

In the long term, Stats SA could use its decades-old database of deaths to develop a Death Index and use such an index for record linkage and other studies. Once Stats SA has used the index for research, it could organize workshops to train researchers on the index's potential and utility.

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Appendix I: The Study Tour to Australia and Lessons Learned

The aim of the trip was to learn from the Australian Bureau of Statistics (ABS) about their system of collection, analysis and dissemination of statistics. We visited the ABS Brisbane office and the Canberra head office. Among the topics covered were vital statistics, Aboriginal demographic statistics and population projections. For each of these topics, one or more of the following issues were looked at: relationships with users and stakeholders, data flow and capture, computer systems used, issues of coverage and quality of data, confidentiality, documentation and publications, research, logistical and administrative matters and human resources development. The main topics of interest learned from the visit to Australia can be grouped under the following points:

1. Effective use of query programs to improve coverage and quality
2. Use of automation to save time and costs and improve on quality
   - Use of "front end" computer programs
   - Use of computer-assisted coding
3. Effective networking with stakeholders
4. Giving serious attention to user requests
5. Size of publications – trimmed but detailed
6. Range of publications – diverse thematic issues in addition to the standard releases
7. Forum for discussing new ideas – issue papers, discussion papers

In Australia, the production of demographic statistics also faced a few problems. They included legislative bottlenecks, coverage problems, incomplete documentation in a few areas, lack of national identity numbers, non-standardized births and deaths data coming in from the states and the centralization/decentralization dilemma. One troublesome legislative bottleneck is the requirement that administrative forms used for processing demographic statistics be returned to the source (the so-called return-to-source clause). Against these odds, the ABS have achieved excellent levels of coverage of vital events.

The trip to Australia was very helpful in putting into perspective the ingredients for improving the coverage and quality of vital statistics. The trip brought home the following points: key to the improvement of coverage is, first, linking the actors/institutions involved in the vital events with the registration centres through legislation; second, having effective networking between the official statistical organization, the registrars and the actor/institution involved with the vital events; and third, instituting an effective query program involving Stats SA provincial offices, which would be critical in improving both quality and coverage.

In terms of administrative legalities, there were far fewer bottlenecks in South Africa than in Australia and, in some instances, South Africa enjoyed a relative advantage. In South Africa, ID numbers are present and, as a bonus, there is a population register, a national standard birth and death certificate and no return-to-source clause. This puts South Africa in a good position to catch up on coverage of vital statistics in a relatively short time. The main problem in South Africa in the mid-1990s was the incompleteness in coverage of vital events in rural areas and informal settlements, as well as differential coverage among the different population groups. In order to correct this shortcoming, there was discussion about making the hospitals registration centres for births and deaths. It was envisaged that since most of these events occurred in hospitals, their becoming registration centres would improve coverage. Even if this proved true, though, the trip to Australia has shown that coverage of vital events can still be improved when registration centres are separate from hospitals.

Appendix II: The Study Tour to Sweden and Lessons Learned

The trip to Sweden took place in June 1999 with the primary aim of studying population registration and applying the knowledge gained to South Africa. The ultimate aim was to widen the role of the South African population register in general, and improve the production of demographic statistics in particular. Staff from Stats SA and the DHA (the custodian of the population register) went on the trip. They studied the Swedish population registration system in depth and subsequently wrote a report that included 21 recommendations relevant to the South African population registration system and/or improving the CR/VS system in general (Bah 1999b). As some of the recommendations dealt with the improvement of the South African population register, and this lay in the DHA's jurisdiction, Status SA could have little effect on enforcement and implementation. The following recommendations were directly relevant to coding and processing of causes of death:

6. After gaining more experience in coding with ICD-10, Stats SA should explore the feasibility of moving over to the 4-digit level of coding. This has to be done in consultation with the major users of causes of death data.
7. Stats SA should seek to become part of the network of coders and to make proposal for South Africa to become a WHO collaborating centre for causes of death coding. Such a move would be of benefit to SADC. For this to become a reality, Stats SA needs to be exposed to the international discourse regarding current and emerging practices of coding and their automation.
8. Stats SA should continue its own route of using interactive computer assisted coding but incorporate the rules used in the ACME-TRANSAX-MICAR-SuperMICAR system, within its programs. This development should be shared with the international coding community" (Bah 1999b: 4).

As would be discussed later, Stats SA did act on the last two recommendations. In a follow-up to the visit, Statistics Sweden sent coding staff to Stats SA to help in their multiple-cause coding.

Appendix III: Multiple Visits to the US and Lessons Learned

Stats SA staff visited the US several times for different purposes. One staff member visited the National Center for Health Statistics (NCHS) to study the US vital statistics system and the processing and analysis of mortality statistics. One lesson learned was that co-operation among states formed the basis for producing good and timely statistics. Another important lesson involved the development of the mortality index and its use for wide-ranging research. The NCHS also conducted a "followback" survey on the deceased to enrich the data available from death certificates. The trip provided an opportunity for networking and the basis for other staff visits. Staff members were subsequently sent to the NCHS for training on multiple-cause coding and automatic coding (with funding provided by Statistics Sweden). Some of the recommendations from that visit are given below:

6.1 Stats SA are currently coding causes of death at the three-digit level. The training at the NCHS was conducted at the 4-digit level. The officials that are currently coding have all been trained to code at the 4-digit level. Stats SA should move to that level of coding as it provides more specific information on the cause of death. This move would be implemented in consultation with the major users of causes of death data

6.4 Stats SA's move towards automated coding should be gradually implemented in focused phases. The phasing of implementation would allow the officials enough time to become familiar with current changes before moving on to the next set of changes. The current move to semi-automated coding is in line with the proposed strategy.

6.5 The second set of priorities includes customising the existing programs to incorporate the changes on the new birth and death registration forms. These changes can run concurrently with preparations for full automation such as the compilation of the dictionary of medical terms that links the US English with South African English, Afrikaans and medical abbreviations used by local medical doctors (Mavimbela and Mentz 2001: 11).

Other staff members participated in the International Collaborative Efforts (ICE) meetings on automatic coding of causes of death, shared their work with colleagues and joined the network of coders.

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