

HEALTH AND DEMOGRAPHIC SURVEILLANCE SYSTEM PROFILE

Profile: The Chakaria Health and Demographic Surveillance System

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Chakaria Health and Demographic Surveillance System (CHDSS), located on the south-eastern coast of the Bay of Bengal, was established in 1999 and is one of the field sites of International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR). The surveillance covers 118 315 residents living in 19 847 households. Data on socio-demographic and health indicators including birth, death, migration, marriage, maternal health, education and employment are recorded through quarterly household visits. The primary objective of CHDSS is to monitor the changes in socio-demographic indicators, inequalities in health and impact of public health interventions. A demographic change was accompanied by a shift from traditional to modern society during the past decade, but inequality in health still persists. The findings from the surveillance are shared regularly among the local and global communities. Data are also available upon request to ICDDR and INDEPTH for use by researchers and policy makers.

Why was the CHDSS set up?

International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR) started its activities in Chakaria in 1994 with an intervention programme to improve health through promotion of self-help for health among the villagers. The focus of the activities was to facilitate local initiatives for the improvement of health of the community. The activities of the project had been participatory with emphasis on empowering the people by raising awareness about health, inducing promotion of positive preventive behaviour through health education, and providing technical assistance to any health initiatives taken by the village-based indigenous organizations. Initiatives taken by the villagers included assessment of health needs, defining actions for health, implementing them and monitoring their implementation and outputs. Among the health-related activities, identification of volunteers for health education, mobilizing local resources for

the establishment of village health posts and their management, introduction of a pre-paid family health card and establishment of health cooperatives were the major ones. Details of the activities have been reported elsewhere.¹

Cross-sectional surveys were carried out to measure the progress of the projects periodically until 1999. However, in the absence of longitudinal data and usable vital registration data, these surveys were unable to assess whether the health and demographic changes observed were due to secular socio-economic changes or to the intervention programmes. It is this need that resulted in setting up CHDSS in the intervention and comparison areas.

What does it cover now?

The CHDSS covers eight unions (the smallest rural administrative and local government unit in

Bangladesh), namely Baraitali, Kayerbil, Bheola Manik Char, Paschim Boro Bheola, Shaharbil, Kakara, Harbang and Purba Boro Bheola. Of these, the last two unions formed the comparison area and the first six formed the intervention area (Figure 1A). Although CHDSS started in 1999, covering 183 villages of 166 405 individuals living in 27 000 households, data collection was interrupted during 2001–03. Since 2004, quarterly data collection has resumed, and data have been systematically collected from 6816 households, randomly chosen from the total of 26 979 households in the area.

Data have been collected through quarterly visits by a team of surveillance workers (SWs) with supervision from a team of two supervisors. On a typical day, a SW would come to the office and take a list of households assigned by the supervisors, travel to respondents' households, update the events and return the collected data sheets to the office. Using this system, data collection and data management took a significant amount of time and money, involving daily travel to the households by SWs.

The above system of data collection was modified in 2011. The modification involved choosing 49 villages randomly from a total of 183. The 49 villages were divided into 14 work areas and 14 SWs were recruited from the 14 work areas where they resided. Most of the households included in the system prior to this modification were also included in the new system. Some of the households that were included in the earlier system and not included in the new have been visited by SWs as was done before. The modification of the system has resulted in the SWs visiting almost double the number of households in comparison with the previous system, saving time spent on travel in the earlier system. In addition, the modification allowed the possibility of estimating migration as the system includes complete villages. Currently, CHDSS covers 118 315 individuals (19 847 households).

Where is the HDSS area?

CHDSS is located between latitudes $21^{\circ}34'$ and $21^{\circ}55'$ north and longitudes $91^{\circ}54'$ and $92^{\circ}13'$ east in the southeastern coast of the Bay of Bengal. The site belongs to Chakaria Upazila, which is a subdistrict in the Cox's Bazar district of Bangladesh. The total CHDSS area is about 288 km^2 ($12 \times 24 \text{ km}$). The population density is $782 \text{ individuals/km}^2$, considerably lower compared with the national average of $939/\text{km}^2$.² The area is surrounded by river basin. The eastern region of Chakaria is hilly, whereas the western side is the coast to the Bay of Bengal and is low land. Climate is tropical in nature. The average annual temperature is 25°C , which varies between 28°C and 19°C . The average annual rainfall of 355 cm is concentrated in the rainy season. The area often falls victim to cyclones, tidal bore and flash floods. The main economic activities in the area have been agriculture, forestry and sea fishing. A map showing the location of Chakaria is presented in Figure 1A.

The health-care delivery system in the CHDSS area comprises of public, private and non-governmental organizations (NGOs). At present, the Upazila Health Complex of the government and four private hospitals provide health-care services at the headquarters of Chakaria. At the union level, 14 community clinics, 7 Union Health and Family Welfare Centres (UHFWCs) and 1 rural dispensary (RD) of the government provide health-care services in CHDSS area. About 11 midwives have been providing safe motherhood services (antenatal care, post-natal care and delivery services) in seven village health posts that were initiated by the community members. The Family Development Services and Research (FDSR), an NGO, also provides health-care services in this area. Apart from these, the health-care services of 242 village doctors (allopathic and homoeopathic) dominate the health service delivery in this area.

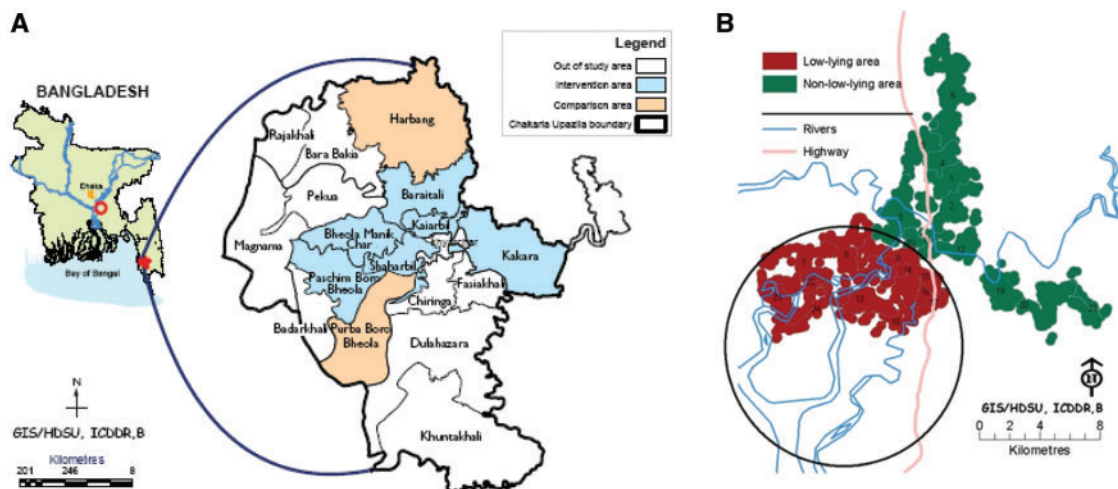


Figure 1 (A) Map of Chakaria showing intervention and comparison areas (B) Low-lying and non-low-lying areas of CHDSS

Who is covered by the HDSS and how often have they been followed up

The population comprises mainly of Muslims (93%) and a small number of Hindus (5%) and Buddhists (2%). 'Bangalees' constitute 97.6% of the households, and the remainder is from an ethnic minority group called 'Mogh' (Rakhain). The surveillance covers all individuals irrespective of age and sex living in the area. Leaf (37%) is the most commonly used material for building roofs of dwellings, followed by tin (34%), straw (27%), cement (1%) and polythene (1%). About 72% of the households are nuclear families and the remaining households are extended/joint families.³ Of the total population, 51% are male and 49% are female. The average household size is 6.2.³

About half of the CHDSS area belongs to low-lying areas and the rest of the area is non-low-lying land (Figure 1B). The low-lying delta lands of the Matamuhuri in the tidal zone of Southern Bengal are flooded with saline water, as well as by direct rainfall. The people residing in the low-lying areas have poorer characteristics as compared with the non-low-lying areas in terms of employment, access to health facilities, educational institutions and markets, exposure to flash floods and presence of development organizations like NGOs.⁴

CHDSS records vital events and use of maternal health services using structured forms, completed through quarterly household visits with the wife of the household. Information on pregnancy is collected from respective pregnant women. The asset list of the household, education and occupation of individuals is updated annually from the household head or his wife.

What has been measured and how have the HDSS databases been constructed

So far, all the important demographic indicators related to fertility, mortality, migration and nuptiality have been measured. Information on causes of deaths and migration are also collected and tabulated. In addition, indicators of special interest such as hunger, water and sanitation, use of family planning, use of safe delivery services, immunization, health-seeking behaviour, use of iodized salt, consumption of tobacco, nutritional anthropometry, ownership of mobile phone and household socio-economic condition have been collected when felt appropriate. Socio-economic inequities for the major health and demographic indicators have always been assessed and published.

In CHDSS, a household is defined as a unit comprising a single individual or a group of related or unrelated individuals who live in the same compound and share food from the same kitchen. Individuals who

live outside the household but spend at least one night every month at the household are also considered as members of the household.

A household member is considered migrated-out if s/he leaves the household and does not return or intend to return within 6 months from the day s/he leaves the household. An individual, previously not included as a household member, is considered migrated-in to household if s/he starts living in the household for at least one night every month for a minimum of 6 months from the day s/he joins the household.

Asset quintiles based on ownership of various assets by any member of the households were used to examine differences in various health and demographic indicators. The list of assets included 'almirah' (wardrobe), table/chair, van/rickshaw, *choki/khat* (bedstead), radio, television, cycle, motorcycle, fridge, sofa, electric fan, sewing machine, telephone and electricity. The principal component analytical technique was used for calculating weights of the assets to derive household asset index scores.⁵

Mid-upper arm circumference (MUAC) of children aged 3 years was measured directly by the interviewer during interview at home. This is used as an indicator of nutritional status: severely malnourished if MUAC ≤ 125 mm and not severely malnourished if MUAC > 125 mm.

Interpreting verbal autopsy (InterVA) software is currently used to ascertain causes of death. SWs collect data on 106 indicators (information about the circumstances of a death, including signs and symptoms leading to death, previous medical history, etc.) during quarterly household visits from the informed household member.⁶

All households were mapped using GPS. Each SW is assigned a work area covering approximately 1500 households. Each SW is provided with a sketch map of their assigned work area to help collect data sequentially. A supervisor guides and monitors their activities and checks the health and demographic events for one in every 20 households of an SW.

For each SW, 5% of their assigned households are chosen randomly to be re-interviewed either over the phone or through a home visit by an external interviewer within 2 days of data collection by the SWs. Data are then compared and checked for inconsistencies and feedback is provided to the SWs in the team. Based on the feedback, necessary corrections are made. For data collection, the survey instrument is printed from the population register listed in Table 1.

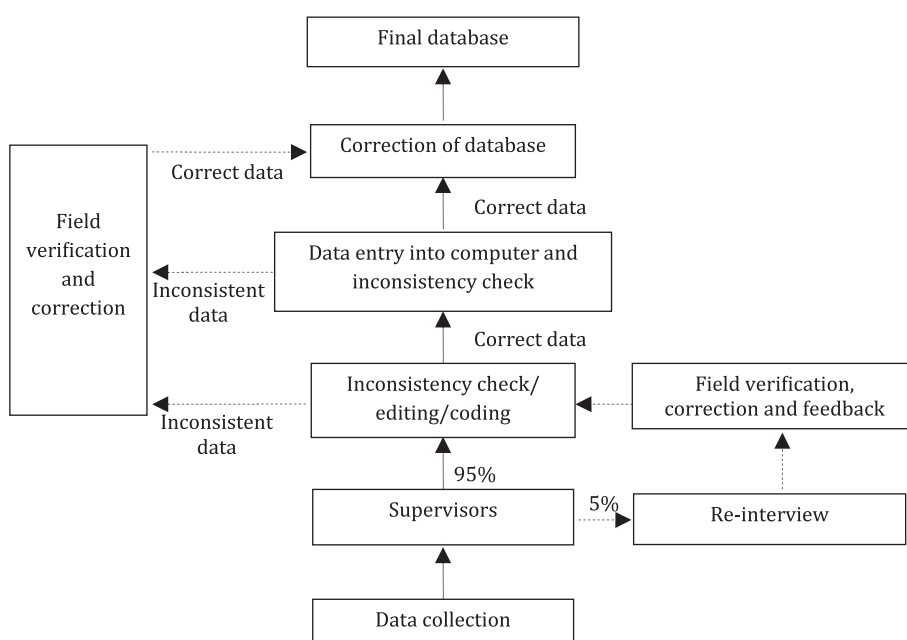
Data are stored in a relational database, developed in Visual FoxPro hosted on Windows XP, maintaining 15 tables for data entry. A flowchart for data collection and management is presented in Figure 2.

Key findings

A demographic change has been observed between 1999 and 2010. The median age of the population

Table 1 Data collected in CHDSS

Health and demographic indicators	Information
Village	List of health facilities, educational institutes, NGOs, clubs, indigenous organizations and health-care providers
Households	Name of household head, household ID, latitude, longitude, low-lying area, water and sanitation, assets owned, use of cellular phone, religion, ethnicity, family type and NGO membership
Household member	Names, sex, date of birth, enrolment in education, occupation, date and history of marital events
Births	Date of birth, place of birth, sex of newborn and antenatal care during pregnancy, feeding immediately after birth and breastfeeding practices
Deaths	Date of death, place of death and causes of death are classified using verbal autopsy
In-migration	Date of in-migration, names, sex, date of birth, education, occupation of migrant, causes of in-migration and origin of in-migrant
Out-migration	Date of out-migration, causes of out-migration and destination of out-migrant
Family planning	Family planning methods used by currently married women aged 15–49 years
Pregnancy	Date of conception, pregnancy order, planned pregnancy, pregnancy outcomes, skilled attendant during delivery, number of babies and methods of delivery
Childhood vaccination	Information on vaccination card, date of vaccination, reasons for not being vaccinated, attending campaign and sources of vaccination data
Child nutrition	Taking measurements of mid-upper arm circumference (MUAC) of children aged <3 years using a measurement tape developed by Teaching Aids at Low Cost (TALC)

**Figure 2** Data flowchart

increased to 19 years in 2010 from 16 years in 1999. The proportion of under-10 population decreased to 24% in 2010 from 32% in 1999. The total fertility rate per woman declined to 2.7 in 2010 from 5.1 in 1999. Declining fertility was also seen in the 0–5 years

cohort for the pyramid–1999 and 0–5 and 5–9 years cohorts for the pyramid–2010 (Figure 3).^{3,7}

The decline in mortality was slower than in fertility. The crude death rate decreased to 6.0 per 1000 population in 2010 from 7.0 in 1999.^{3,7} The infant

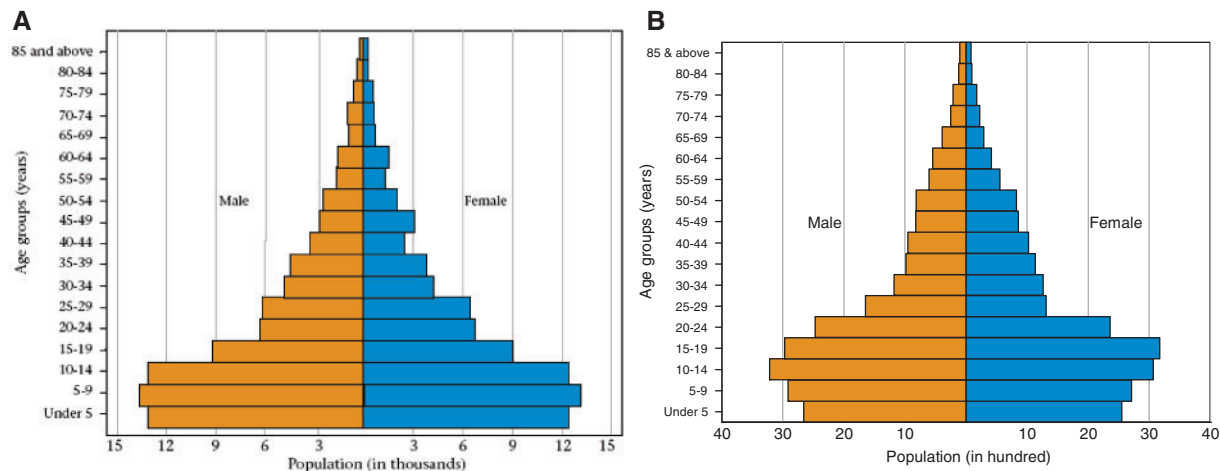


Figure 3 (A) Age structure of population, 1999. (B) Age structure of population, 2010

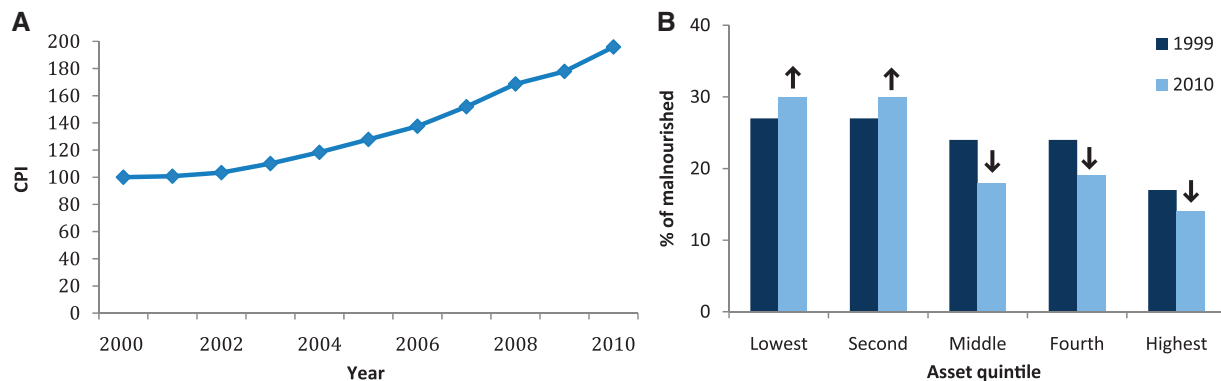


Figure 4 (A) Consumer Price Index for food in Bangladesh, base-year: 2000. (B) Proportion of malnourished children (aged 6–23 months) by asset quintile and year (Chakaria, Bangladesh)

mortality (49/1000 live births) and neonatal mortality (32/1000 live births) remained stable and the under-5 mortality decreased to 67 in 2010 from 69 per 1000 live births in 2005.^{7,8} The under-5 mortality rate of children from the lowest asset quintile was nearly double that of the children from the highest quintile.^{3,7–12} The life expectancy at birth among the lower, middle and upper class were 63, 67 and 71 years, respectively, between 2005–10. The under-5 death rate was higher in the low-lying area than in the non-low-lying area (16.6 vs 11.3/1000 person-years).⁴

The proportion of malnourished children declined slightly between 1999 (23.9%) and 2010 (22.5%). Although the proportion of malnourished children (6–23 months) in better-off households is decreasing, it is increasing in impoverished households (Figure 4B).

Food prices continued to rise in Bangladesh during the period from 2000 to 2010.¹³ The impact of price hike may have disproportionately affected the poor families, increasing the rate of malnourishment

among children (Figure 4A and 4B). Over the past decade, the demographic change has been accompanied by a shift from a traditional to a modern society. During this time, there was noticeable improvement in education, employment, communication, water and sanitation, immunization and health service utilization (Table 2). However, the rising trend of malnourished children in impoverished households still needs attention from researchers and policymakers.

Results from surveys conducted since the 1960s have shown that high levels of iodine deficiency are prevalent in Bangladesh. Only 2% of households used iodized salt in Chakaria compared with the national figure of 77% in 1999.^{14,15} Tubewell is the universal source of drinking water in Chakaria. Tubewell was also the dominant source of water for bathing in 2009. The use of sanitary latrines increased during last decade (Table 2). A variation in using sanitary latrines between the five asset quintiles persists.¹¹ The prevalence of diarrhoea was 6.8% during the 2 weeks preceding the day of interview in 2009. About

Table 2 Socio-economic, demographic, health, and water and sanitation indicators

Indicators	CHDSS		National 2009
	2005	2010	
Socio-economic			
Adult literacy rate of 15–24 years old population (%) (MDG)	56.88	63.97	58.3
Adult literacy rate of 15–24 years old population (Male) (%)	54.82	52.54	NA
Adult literacy rate of 15–24 years old population (Female) (%)	58.69	73.16	NA
Net enrolment in primary education %)(MDG)	77.10	94.90	91.90
Proportion of pupils starting grade one who reach last grade of primary %)(MDG)	38.70	42.90	54.90
Ratios of girls to boys in primary education (MDG)	1.05	1.00	1.01
Ratios of girls to boys in secondary education (MDG)	1.40	1.41	1.20
Ratios of girls to boys in tertiary education (MDG)	0.31	0.34	0.32
Share of women in wage employment in the non-agricultural sector %)(MDG)	11.80	18.10	24.60
Employment to population ratio %)(MDG)	44.20	51.30	59.30
Percentage of households having electricity supply	10.10 ^a	27.70	NA
Percentage of households owning television	3.50 ^a	10.80	NA
Cellular subscriber per 100 population (MDG)	NA	12.50	30.80
Proportion of households owning a cell phone (%)	10.01	61.00	NA
Percentage of households having at least one NGO member	25.50 ^a	43.90	NA
Percentage of landless households	24.76	30.26	11.30
Percentage of households having at least one day-labourer	48.60 ^a	56.40	NA
Percentage of households owning mosquito net	93.30 ^a	99.20	NA
Demographic			
Unplanned pregnancy (%)	30.80	28.10	29.00
Adolescent birth rate per 1000 women (MDG)	102.90	86.80	60.00
Infant mortality rate per 1000 live births (MDG)	48.90	49.60	41.30
Mortality rate per 1000 live births for children aged <5 years (MDG)	69.20	67.10	53.80
Contraception prevalence rate %)(MDG)	51.90	NA	60.00
Crude birth rate per 1000 population	28.70	22.70	26.10
Total fertility rate per woman	4.20	2.70	2.70
Neonatal mortality rate per 1000 live births	31.50	32.10	37.00
Life expectancy at birth, male	68.50	68.90	68.00
Life expectancy at birth, female	70.90	69.60	69.00
Crude death rate per 1000 population	6.10	6.00	6.00
Sex ratio at birth (male:female)	1.03	1.03	1.04
Male emigration rate per 1000 population	5.50	7.50	11.30 ^b
In-migration rate per 1000 population	24.10	28.70	54.10 ^b
Out-migration rate per 1000 population	24.80	42.20	58.00 ^b
Rate of natural increase per 1000 population	22.50	16.80	14.50 ^b
Population growth rate (%)	2.10	0.30	1.10 ^b
Male marriage at age <21 years (%)	24.70	25.00	NA
Female marriage at age <18 years (%)	47.30	36.40	NA
Age dependency ratio	0.88	0.74	0.56
Health			
Births attended by skilled personnel %)(MDG)	10.30	28.10	24.00
Antenatal care coverage (at least one visit) %)(MDG)	58.80	62.20	60.00
Antenatal care coverage (at least four visits) %)(MDG)	13.30	27.30	21.00

(continued)

Table 2 Continued

Indicators	CHDSS		National 2009
	2005	2010	
Proportion of 1-year-old children immunized against measles (%) (MDG)	72.81	89.90	82.30
Prevalence of diarrhoea of children aged <2 years during previous 2 weeks (%)	13.00	8.60	NA
Use of ORS during diarrhoea episode for children aged <2 years (%)	66.90	85.50	NA
Exclusive breastfeeding of children <6 months old, (%)	NA	66.4	NA
Exclusive breastfeeding of children <6 months old, (Male) (%)	NA	60.8	NA
Exclusive breastfeeding of children <6 months old, (Female) (%)	NA	71.6	NA
Percentage of children (6–23 months) severely malnourished	23.90	22.50	NA
Water and sanitation			
Use of sanitary latrine (%) (MDG)	17.50 ^c	49.90	54.00
Population using improved drinking water source (%) (MDG)	100.00 ^c	100.00	97.60

^aFigures are for the year 1999.

^bMatlab HDSS of ICDDR, B.

^cFigures are for the year 1994.

NA, data not available.

86.5% of the people with diarrhoea used ORS (oral rehydration saline). The prevalence of diarrhoea and its management among under-2 children improved during the previous decade (Table 2).

Chakaria have smoking rates that are much higher than the national average. Smoking had declined from 41% in 1994 to 27% in 2008. The decline was lower among the poor and the rate remained the same for the female illiterates. Smoking is inversely associated with the socio-economic status.¹⁶

The cellular subscriber was 24.0% among the people aged ≥ 13 years in 2010. The rate was higher for males (43.5%) than females (17.6%). The rate was 13.4% among teenagers and for this age group was about three times higher for males than for females (20.7% vs 6.5%). The proportion of households owning at least one cell phone increased between 2005 and 2010 (Table 2).

The poor seek health care from the public hospital and the rich from the private.¹² Village doctors are the first line of health-care providers.¹⁷ About 80% of the drugs prescribed by the village doctors are inappropriate or harmful.¹⁸

Most of the rates in Chakaria are similar to those of the national figures of Bangladesh (Table 2).^{19–21} Chakaria has made good progress on 18 Millennium Development Goals (MDGs) indicators during 2005–10 (Table 2).

Future analysis plan

Currently, 19 MDG indicators are being monitored by CHDSS. Additionally, the proportion of children under 5 years sleeping under insecticide-treated bed nets, the death rate associated with malaria, the death rate associated with TB, unmet need for family planning and under-5 malnutrition will be included in the CHDSS module.

Recently, a study conducted in a coastal area of Bangladesh showed that one-fourth of the women had some kind of hypertensive disorder during pregnancy.²² The impact of hypertensive disorder in pregnancy is associated with birthweight, gestational duration and small-for-gestational-age births. Indicators such as the salinity of tubewell water, hypertension and perinatal deaths will be monitored with GPS coordinates in CHDSS low-lying (seaside) and non-low-lying villages to measure their impact. The objective would be to determine relationships between salinity in drinking water and hypertension, along with the impact of hypertension on perinatal deaths. We intend to test the hypothesis that proximity to the coast would result in higher levels of salinity in the drinking water thereby causing hypertensive disorder, which in turn raises likelihood of perinatal deaths.

Education, employment, communication, water and sanitation, immunization and health service utilization improved significantly over the years in Chakaria. But infant mortality has remained stable during the past 5 years. Nutritional status is worse among the children in the poorest quintile and it is worsening over the years. Infectious diseases can be markedly reduced in both the well-nourished and malnourished population by universal application of immunization. The site will be monitored to assess the impact of vaccination on malnourished children to determine whether it improves their nutritional status.

Strengths and weaknesses

The key strength of the surveillance lies in its quality of data. Trained surveillance workers are involved in collecting household data. Data are monitored rigorously

and there are a number of validation checks within the process that further strengthens the quality. Moreover, weekly feedback sessions among data collectors are held to identify inconsistencies in data and problems in data collection. Within 7 days of data collection, data are entered into the system by the data management team. Inconsistencies in data found during data entry are sent back to the field workers for correction. Figure 2 provides a detailed illustration of the data collection and management process.

As CHDSS is located in the coastal area, this site will help in understanding the changes in disease pattern due to climate change in coastal areas. Identifying the additional vulnerabilities of this community due to climate change is significant and universally beneficial. This can help determine pre-emptive strategies to preserve the environment through human interventions. The indicators for measurement would include salinity in drinking water, malaria, hypertension, respiratory disorders, vectorborne diseases, foodborne diseases, waterborne diseases, socio-economic shifts in land use practices, socio-economic shifts in occupation and displacement of people due to floods and other natural disasters including sea-level rise.

Data sharing and collaboration

ICDDR, recognizes the need to provide access to its knowledge data, and is pleased to share such data according to its Data Access Policy. Chakaria HDSS data from the ICDDR Data Centre will be provided to interested researchers for purposes of secondary data analyses upon approval of a Data Licensing Application and Agreement (available at: <http://www.icddr.org/who-we-are/data-policies>). Meta-data are also available in published annual scientific reports (<http://www.icddr.org/what-we-do/publications/catalog/52-publications/10043-icddr-documents/10058-icddr-reports-and-working-papers/10061-scientific-reports>).

Enquiries may be sent to S.M.A. Hanifi: hanifi@icddr.org.

CHDSS is a member of INDEPTH Network. INDEPTH has established iSHARE to achieve its goal of making its data widely and freely available to all researchers and decision-makers upon registration at their website (<http://www.indepth-ishare.org>). Currently, CHDSS is involved in a number of collaborations with both national and international agencies.

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Conflict of interest: None declared.

KEY MESSAGES

- CHDSS has a large population (118 315) under quarterly surveillance.
- Major focus of CHDSS is to monitor the health and demographic indicators in general and MDG indicators in particular with a focus on equity.
- CHDSS provides a unique opportunity for monitoring the effect of climate change, for example, on salinity in drinking water, vector- and waterborne diseases and the displacement of people due to its location in the coastal area of Bangladesh.

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