

Is Bangladesh Going through an Epidemiological and Nutritional Transition?

Nicholas Mascie-Taylor

Division of Biological Anthropology, Department of Archaeology and Anthropology, University of Cambridge, Cambridge, UK

ABSTRACT

Bangladesh is going through an epidemiological transition with large reductions in mortality due to acute, infectious, and parasitic diseases and increases in non-communicable, degenerative, and chronic diseases over the last 20 years. There is also evidence of an adult nutritional transition with increases in pre-obesity and obesity particularly in urban areas. However a high percentage of the population of Bangladesh remain undernourished and economically poor and ultra-poor development programmes indicate that improving their nutritional status might not be achievable as a bi-product of the development programme. Bangladesh like many developing countries has many burdens of under and over-nutrition, high levels of infectious diseases as well as growing levels of non-communicable diseases.

Key words: Bangladesh, epidemiological transition, nutrition transition

Introduction

The theory of the epidemiological transition focuses on the complex changes in patterns of nutrition, health and disease and on the interactions between these patterns and their demographical, economical and sociological determinants and consequences. The theory was first put forward by Abdel R Omran¹ based on his analyses and comparisons of mortality patterns. He put forward 5 propositions.

Proposition One. *The theory of epidemiologic transition begins with the major premise that mortality is a fundamental factor in population dynamics.*

As Omran noted the cyclical rises and falls in population size that have been observed in animal and pre-modern human populations reflect sequential phases of population growth and decline and must be accounted for by variation in fertility and mortality.

Proposition Two. *During the transition, a long-term shift occurs in mortality and disease patterns whereby pandemics of infection are gradually displaced by degenerative and man-made diseases as the chief form of morbidity and primary cause of death.*

Omran argued that mortality patterns distinguish three major successive stages of the epidemiologic transition:

1. *The Age of Pestilence and Famine* when mortality is high and fluctuating, thus precluding sustained population growth. In this stage the average life expectancy at birth is low and variable, varying between 20 and 40 years.

In this stage the major determinants of death are the Malthusian »positive checks«, namely, epidemics, famines and wars. John Graunt's study of the London Bills of Mortality in the mid-seventeenth century showed, for example, that nearly three-fourths of all deaths were attributed to infectious diseases, malnutrition and maternity complications whereas cardiovascular disease and cancer were responsible for less than 6%.

2. *The Age of Receding Pandemics* when mortality declines progressively and the rate of decline accelerates as epidemic peaks become less frequent or disappear. The average life expectancy at birth increases steadily from about 30 to about 50 years. Population growth is sustained and begins to describe an exponential curve.

The second phase involves advances in medicine and the development of a healthcare system. One treatment breakthrough of note was the discovery of penicillin in the mid 20th century which led to widespread and dramatic declines in death rates from previously serious dis-

eases such as syphilis. Population growth rates surged in the 1950s, 1960s and 1970s, to 1.8% per year and higher, with the world gaining 2 billion people between 1950 and the 1980s alone.

3. *The Age of Degenerative and Man-Made Diseases* when mortality continues to decline and eventually approaches stability at a relatively low level. The average life expectancy at birth rises gradually until it exceeds 50 years. It is during this stage that fertility becomes the crucial factor in population growth.

Omran's third phase occurs when human birth rates drastically decline from highly positive replacement numbers to stable replacement rates. In several European nations replacement rates have even become negative. As this transition generally represents the net effect of individual choices on family size (and the ability to implement those choices), it is more complicated.

Proposition Three. *During the epidemiologic transition the most profound changes in health and disease patterns obtain among children and young women.*

Childhood survival is significantly and progressively improved as pandemics recede in response to better living standards, advances in nutrition and early sanitation measures and is further enhanced as modern public health measures become available.

Proposition Four. *The shifts in health and disease patterns that characterize the epidemiologic transition are closely associated with the demographic and socioeconomic transitions that constitute the modernization complex.*

Omran suggested that the tendency of improved infant and childhood survival to depress fertility in the middle and subsequent stages of the transition could be attributed largely to the following factors:

1. *Biophysiological factors*, associated with reduced infant mortality and the expectation of longer life in parents,
2. *Socioeconomic factors*, associated with childhood survival and the economic perceptions of large family size, and
3. *Psychological or emotional factors*, where society as a whole changes its rationale and opinion on family size and parental energies are redirected to qualitative aspects of child-raising.

Proposition Five. *Peculiar variations in the pattern, the pace, the determinants and the consequences of population change differentiate three basic models of the epidemiologic transition: the classical or western model, the accelerated model and the contemporary or delayed model.*

The Classical Model of Epidemiological Transition (*England, most Western European countries*)

The mortality pattern follows three stages. A pre-industrial age of pestilence and famine generates a cyclical

population growth with frequent peaks in mortality is followed by an intermediate stage of receding pandemics in the middle or later part of the 19th Century giving way to a gradual mortality decline. A stage of degenerative and man-made diseases in the 20th Century corresponds to more precipitous declines. Economic factors (improvements in standards of living and in nutrition in the 19th Century) were the primary determinants of the classical transition, but were later augmented in the 20th Century by sanitary improvements, followed by medical and public health progress. The Epidemiological Transition closely parallels the demographic transition and Industrial Revolution and is therefore followed by a population explosion and by sustained economic growth. In the model of this paper, the classical transition corresponds to the endogenous epidemiological transition during the neoclassical growth regime.

The Accelerated Model (*Japan*)

The transition follows a similar pattern as the Classical Model, but the changes in mortality occurred at a later stage of development and were more rapid. This corresponds to the endogenous transition taking place during the modern growth regime. Four when counting the transitional variant of the delayed model.

The Delayed Epidemiological Transition (*most countries in Africa, Latin America, and Asia*)

The substantial decreases in mortality in these economies are very recent. Public health measures have been a major component of a generally imported medical package that reduced mortality while keeping fertility high, thus generating a population explosion. This pattern corresponds to a transition triggered by changes in health technology.

Criticisms of the Epidemiological Transition

The epidemiological model has been criticised for a number of reasons:

1. The model does not include mortality trends that result from accidents, suicides, murders and other injuries, or captures the complex multi-factorial interplay in the causes of death and diseases.
2. New diseases are emerging and since 1973, the Centers for Disease Control and Prevention have identified 29 new pathogens such as HIV, the Rotavirus and Ebola virus.
3. The discovery and widespread use of antibiotics and other drugs resulted in drug-resistant pathogens, adding to the rise of 're-emerging' diseases such as Tuberculosis and Methicillin-resistant *Staphylococcus aureus* (MRSA).
4. Olshansky and Ault², followed by Rogers and Hakenberg³, introduced the notion of a »4th stage« during which life expectancies would increase due to

achievements in the treatment of cardiovascular diseases. Olshansky et al.⁴ set this new maximum at 85 years, the same as that chosen by the United Nations at the end of the 1980s for all countries. Others have argued for a 5th stage which takes into account HIV/AIDS.

Nutrition Transition

The Epidemiological Transition is obviously linked to demographic and nutrition transitions. As far as nutrition is concerned changes in dietary and physical activity patterns are partly responsible for the secular trend in average stature and alterations in body composition. However many modern societies have a diet high in saturated fat, sugar, and refined foods and low in fibre (this diet is often referred to as the »Western diet«) and this diet is associated with high levels of pre-obesity and obesity as well as increased risk of chronic and degenerative diseases e.g. diabetes.

Is Bangladesh going through Epidemiological and Nutritional Transitions?

Epidemiological Transition

There is good evidence of a marked change in the mortality profile from acute, infectious, and parasitic diseases to non-communicable, degenerative, and chronic diseases during the last 20 years in rural Bangladesh⁵.

ICDDR,B has maintained a health and demographic surveillance system (HDSS) since 1966 in Matlab a rural area located 55 km to the southwest of the capital city Dhaka. Since the late 1970s Matlab was divided into two halves one half receiving government health services like any other rural area of Bangladesh (called the government services area) and the other half receiving high-quality ICDDR,B primary health care services in addition to the government health services. In order to examine the epidemiological transition over the last two decades only the area receiving government services was studied.

HDSS used a one-page death form for all age groups, with particular emphasis on child and maternal deaths. Experienced field research assistants were trained to record the precise timing, duration, and gradation of each of the symptoms preceding death, particularly of children and women of reproductive age. The interview took place on average 22 days after the death. The cause of death was ascertained by a fully trained medical officer from a list of 97 possible causes based on the WHO International Statistical Classification of Disease (ICD-9), Injuries and Causes of Death. A total of 18,917 deaths and their causes in the government services area between 1986–2006 were analysed.

The results demonstrated that Matlab has experienced a massive change in the mortality profile from acute, infectious, and parasitic diseases to non-communicable, degenerative, and chronic diseases over the last 20 years. Age-standardised mortality rate (for both sexes) due to diarrhoea and dysentery reduced by 86%, respira-

tory infections by 79%, except for tuberculosis which increased by 173%.

On the other hand, during the same period, mortality due to cardiovascular and cerebrovascular diseases increased by a massive 3,527% and malignant neoplasms by 495% (Figure 3) whereas mortality due to chronic obstructive pulmonary disease and injury remained at a similar level (12–13% increase).

Nutrition Transition

Between 2001 and 2003 a cross-sectional nutritional and tobacco usage surveys on a total of 35,446 adult individuals of whom 54.3% were females in Mirpur, an urban area in Dhaka and in Kaliganj, a rural area about 42 km from the capital was conducted⁶. Four different nutritional measures namely Waist Circumference (WC), Body Mass Index (BMI), Waist-to Height-Ratio (WhtR) and Conicity Index (Cindex) of which the latter three were constructed using the following formulae:

$$\text{BMI} = \text{Body weight (kg)} / \text{Height}^2 \text{ (m)}$$

$$\text{WhtR} = \text{Waist Circumference (m)} / \text{Height (m)}$$

$$\text{Cindex} = \text{Waist Circumference (m)} / [0.109 \times \sqrt{(\text{Body weight (kg)} / \text{Height (m)})}]$$

The value of 0.109 is a constant which results from the conversion of units of volume and mass into units of length

The results are in the same direction using all four measures and here only BMI is presented. There were very marked differences between rural and urban areas; the percentage with Chronic Energy Deficiency (Body Mass Index, <18.5) was nearly twice as much in the rural than urban area (34% *versus* 18.5%). Based on the WHO classification the percentage of pre-obesity and obesity (BMI ≥ 25) was more than three times higher in urban than rural areas (17.6% *versus* 5.6%). Using Asian cut-offs of 18.5–22.9 for normal BMI and ≥ 23 as pre-obese, 1 in 7 of the rural adult sample was pre-obese or obese compared with over 1 in 3 in the urban adult sample.

The highly significant increase in BMI in urban areas is indicative of a nutrition transition. In addition 37.5% of the sample at the time of the survey used at least one form of tobacco (smoking 20.5%, chewing tobacco 20.6% and gul usage 1.8%) and a further 12.5% were past smokers. So in the total sample using the WHO 59% of the sample were at some risk from either underweight, overweight and smoking which increased to 66% for any tobacco usage. When the Asian cut-offs were used there were substantial increases to 77% for underweight, overweight and smoking which increased to 81% for any tobacco usage. Rural females were more likely to be underweight and urban females overweight without a history of smoking or tobacco use, while males more commonly smoked or used tobacco irrespective of their nutritional status or locality.

Other evidence for nutritional transition comes from the Bangladesh Demographic Health Surveys. Maternal BMI changes over the last 4 surveys – 1996 to 2007

($n=16,278$) were studied. Using the WHO cut-offs pre-obese and obese increase from 2.8% in 1996 to 9.3% in 2007 with a concomitant fall in CED from 49.7% to 31.6%, using the Asian cut-offs pre-obese and obese increased from 6.7% to 17.7%.

The changes in under 5 year old children's nutritional status were also examined by determining the extent of stunting, underweight and wasting. Stunting (height-for-age) is a measure of chronic undernutrition, wasting (weight-for-height) signifies acute undernutrition and underweight (weight-for-age) is a mixture of the two.

The trends of the three measures were very different. There was evidence that stunting fell by about 11% between 1996 and 2000, from 56.0% to 45.5%, remained more or less the same in 2004 and then fell by a further 5% to 40.5% in 2007.

The percentage of children who were underweight fell from 50% to about 40% between 1996 and 2000 and remained at that prevalence up to 2007. Wasting fell by 9% between 1996 and 2000, but then the prevalence increased in the subsequent two surveys to reach 17.7%. So the child nutritional trends are encouraging for chronic undernutrition but the high level of wasting (above the 15% WHO action level) is a cause of considerable concern

Poverty in Bangladesh

Although there has been an epidemiological and nutritional transition in Bangladesh about 40% or more of the population live below the national poverty line and an even higher percentage live below the international threshold of \$1.25. For them there has been little or no transition.

DFID are currently working with two projects in Bangladesh aiming to move 1,000,000 ultra poor people out of poverty by 2015 through various asset transfer programmes (e.g. provision of a cow, or goats in rural areas and sewing machine or rickshaw in urban areas).

As part of the programme surveys on the same random sample of households have been undertaken three times a year (panel) and at one of these surveys we also measure nutritional status (anthropometry) and haemoglobin concentration. The surveys have shown that the percentage of households with some cash savings have increased from 36% in the first survey (with average savings of \$2.00) to over 80% 2 years later with average savings of \$36. The total value of assets has also increased substantially from about \$35 to \$153.

We also ascertained whether food diversity has changed. Households were asked how often family members had eaten 13 food items in the 7 days prior to the study. Rice was eaten by nearly all households in all surveys. Over the 2 year period egg consumption rose from 30% to 65%, poultry from 4% to 20% and fruit from 8% to 30%.

The households were also asked about the coping strategies they used as a result of financial hardship in the seven days prior to the survey with a pre-coded list of 10 food strategies. There were significant improvements

in all 10 strategies between survey 1 and 7. For example the percentage of households reporting eating smaller portions of food fell between March 2010 and March 2012 from 84.2% to 12.2%; eating less than 3 meals a day (down from 69.3% to 3.0%), eating food of less quality (down from 63.0% to 10.9%). Borrowing money to buy food fell from 19.5% to 2.0% and buying food on credit fell from 29.4% to 5.3%. There was significant improvement (reduction) in food coping strategies with a fall in mean from 3.4 in survey 1 to 0.4 in survey 7.

The nutritional status of adult males and females was measured in March 2010, 2011 and 2012 and the results were more encouraging for males than females. The percentage with BMI < 18.5 fell in both sexes by about 5% over the two year period but was still over 50% in adult females.

A finger prick of blood was taken and haemoglobin concentration determined using a portable Hemocue. Adult males showed a significant fall in anaemia by about 8% but in adult females the percentage who were anaemic increased to nearly 60%.

The nutritional status of the children was also measured. There was a significant improvement in chronic undernutrition with a reduction in stunting by nearly 10% but underweight worsened and weight-for-height (wasting) showed no change between March 2010 and 2012.

There was also a very marked improvement in children's haemoglobin concentration and the percentage of children with anaemia fell by 24% from about 60 to 36%.

Discussion

There is very clear evidence from the ICDDR,B's twenty year study of a rural area in Bangladesh of a considerable change in mortality. In the past Matlab was a cholera endemic area and a substantial number of deaths were due to diarrhoeal diseases and acute respiratory infections especially in infants and young children. The large reductions in deaths due to diarrhoea and dysentery (86% and 79%, respectively) are probably due to a combination of improvement in primary health care services, water and sanitation, use of oral rehydration solution and high EPI coverage.

The very high increase in mortality due to non-communicable diseases particularly coronary heart disease is in keeping with changes in diet and lifestyle in the rural areas and a recent study⁷ in Bangladesh found that intakes of protein, carbohydrates and smoking all positively associated with prevalence of general hypertension after controlling for Body Mass Index and other nutrients.

It is widely known that undernutrition is caused by poor quality and quantity of food as well as disease, but the underlying determinant is poverty⁸. Asset transfer programmes are one way of improving the income of ultra poor households and in the DFID funded projects described here rapid improvements in income and cash sav-

ings occurred as well as food coping strategies. However it remains unclear whether or not there will be a concomitant improvement in nutritional status and the early results are not consistent in children and adults.

Bangladesh is moving from a double burden of under-nutrition and high prevalence of infectious diseases to a quadruple burden with growing levels of non-communicable diseases and over-nutrition.

REFERENCES

1. OMRAN RA, The Milbank Memorial Fund Quarterly, 49 (1971) 509. — 2. OLSHANSKY SJ, AULT AB, The Milbank Memorial Fund Quarterly, 64 (1986) 355. — 3. ROGERS RR, HACKENBERG, Soc Biol, 34 (1987) 234. — 4. OLSHANSKY SJ, CARNES BA, CASSEL C, Science, 250 (1990), 634. — 5. KARAR A, ALAM N, STREATFIELD K. Glob Health Action, 19(2) (2009). DOI: 10.3402/gha.v2i0.1904. — 6. FLORA MS, MASCIE-TAYLOR CGN, RAHMAN M, WHO South-East Asia Journal of Public Health, 1 (2012) 169. — 7. CHEN Y, FACTOR-LITVAK P, HOWE GR, PARVEZ F, AHSAN H, Am J Clin Nutr, 84 (2006) 1224. — 8. VICTORA CG, ADAIR L, FALL C, HALLAL PC, MARTORELL R, RICHTER L, SACHDEV HS, Lancet, 371 (2008) 340.

N. Mascie-Taylor

*University of Cambridge, Department of Archaeology and Anthropology, Division of Biological Anthropology, Pembroke Street, Cambridge CB2 2QG, UK
e-mail: nmt1@cam.ac.uk*

PROLAZI LI BANGLADEŠ KROZ EPIDEMIOLOŠKU I PREHRAMBENU TRANZICIJU?

SAŽETAK

Bangladeš prolazi kroz epidemiološku tranziciju zbog trenda opadanja smrtnosti uslijed akutnih, zaraznih i parazitskih bolesti, a rasta zbog nezaraznih, degenerativnih i kroničnih bolesti u posljednjih 20 godina. Također, postoje i znakovi prehrambene tranzicije u prehrani odraslih osoba s povećanom prevalencijom debljine i pretilosti, osobito u urbanim područjima. No većina stanovništva Bangladeša još je uvijek pothranjena i ekonomski siromašna i razvojni programi za izrazito siromašne upućuju na zaključak da se poboljšanje prehrambenog statusa neće dogoditi kao nuspojava samog razvojnog programa. Kao i druge zemlje u razvoju, Bangladeš ima problem pothranjenosti i preuhranjenosti, visok stupanj zaraznih bolesti, ali i sve viši stupanj oboljenja od nezaraznih bolesti.