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198-201pg q5 8/30/05 11:39 AM Page 198



# The nutrition transition in India

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## Introduction

The World Health Report 2002 introduced the term 'risk transition' to describe the changes in consumption of tobacco, alcohol, nutrition and other lifestyles that promote the development of non-communicable diseases (NCDs).[1] Five patterns of the nutrition transition have generally been described: that of collecting food, a pattern of recurrent famine, receding famine, a phase of degenerative disease and a phase of behavioural change.[2] The phase of degenerative disease is associated with a shift in dietary patterns to more 'Western' diets rich in saturated fat, refined foods and sugar and low in fibre and leads to an increase in NCDs. The degenerative phase of the nutrition transition, characterised in its early phases by an increased prevalence of obesity, has been described in several developing countries across continents.[2] What has become increasingly clear is that this phase of the nutrition transition does not necessarily affect an entire population but rather segments of it, based on, for instance, the environment (e.g. rural v. urban) or socioeconomic circumstances. This paper reflects on the nature of the degenerative phase of the nutrition transition in India using a variety of data in addition to an ongoing study, the Prospective Urban Rural Epidemiology (PURE) study.

## Dietary profiles in India

The existence of diverse dietary profiles in India, linked to religion, ethnicity and geographical region, make assessments about 'national' dietary profiles difficult. This problem is compounded by the methodological issues related to dietary assessments, which have been extensively reviewed. Despite these problems, however, periodic data from the National Nutrition Monitoring Bureau (NNMB) and other sources such as the National Family Health Survey (NFHS) indicate that there are clear differences in diet between urban and rural areas within a region. These data have been reviewed earlier,[3] and suggest that the visible fat in poor rural diets is mainly vegetable-based and that the differences in the dietary fat intake between rural and urban populations are largely due to differences in the intakes of visible fats. Urbanisation may also be associated with a change in dietary n6/n3 ratio because of increases in the consumption of cheap commercial vegetable oil (n6 fatty acids). Fruit and vegetable intake in rural communities are lower than would be expected.

In addition to the rural-urban differences in dietary patterns, there are also important changes that occur with improvements in socioeconomic status.[4] These include:

- An increased intake of legumes, vegetables, milk and, in case of non-vegetarians, foods of animal origin.
- Substitution of coarse grain by the more prestigious and often highly polished cereals such as rice. There is also a reduction in the overall cereal intake, although this continues to be high by Western standards.
- Progressive increases in the intake of edible fat.
- Increased intake of sugar and sweets.
- Increase in energy intake leading to obesity.

## Physical inactivity in Indians

Earlier studies in India using simple, self-reported categorisations of physical activity status had documented the disparate physical activity patterns in urban and rural populations. However, there is clearly a need to document the problem of physical inactivity more comprehensively. A large number of studies, predominantly in developed countries, have linked the risk of a lack of discretionary leisure time activity to the development of NCDs such as diabetes and coronary heart disease. In developing countries, however, lower levels of mechanisation at home, at work and in transport make the documentation of physical activity within these domains particularly important. For instance, in urban areas in India, about a third of the people who exercise approximately 30 minutes 5 days a week are sedentary in terms of their composite physical activity levels when all physical activity domains are taken into account (M Vaz – unpublished data). In contrast, individuals in rural areas with little discretionary leisure time activity may be heavily active owing to the nature of their manual occupations. Yet again, simple categorisations of physical activity status

198-201pg q5 8/30/05 11:39 AM Page 199

on the basis of occupation can lead to erroneous conclusions because of variable contributions to physical activity in the 'non-occupational' domains of physical activity. This suggests that it is important to evaluate physical activity across all physical activity domains, and these data have become available in India only fairly recently. There remains, however, the need to establish the relationship between composite daily physical activity levels and risk of non-communicable disease.

In India, associations between coronary heart disease (CHD) and physical inactivity have been explored using rudimentary questionnaires. These studies have demonstrated the protective effect of physical activity in preventing CHD, although the extent of this effect in rural and urban areas is variable, in part owing to the fairly basic assessment of physical activity. In assessing physical activity patterns, these studies have used key questions to document occupational and leisure time activity. Data from healthy, educated, urban, employed Indians, using more comprehensive physical activity questionnaires, indicate that 61% of males and 51% of females are either sedentary or mildly active.[5] Physical activity patterns in rural Indians have not been evaluated to any large extent. However, small studies in agricultural workers indicate that they have high levels of physical activity[6] and that this may be true both during the harvest season and during the lean season.[7]

## The emerging problem of obesity

The emerging problem of obesity in India coexists with relatively high levels of adult undernutrition, particularly in rural areas. NNMB data between 1975 and 1997 indicate that the prevalence of overweight (using a BMI ≥ 25) increased modestly in rural areas from 2.3% to 4.1% in men and from 3.4% to 6.0% in women. Several more recent studies have added valuable information about the prevalence of overweight and obesity in India. Data from the NFHS study, which is restricted to 'ever-married women', indicate that the problem of overweight is variable across the different states in India and that the prevalence of overweight across the states is positively correlated with the per capita income (correlation coefficient 0.81, $p < 0.001$) and the level of human development (correlation coefficient = 0.687, $p < 0.001$) of the state. Available data also indicate that overweight/obesity is a major problem within the urban environment, with estimates of individuals with BMIs greater than 25 of between 19.2% and 38% in the major metropolises of India,[8,9] and is also an emerging problem in urban slums.[9] In at least one study in the state of Andhra Pradesh,[10] there appears to be a clear relationship between the level of urbanisation and percentage of individuals with a BMI greater than 24.99 (7.6% rural, 22% town, 24.1% small city, 36.6% large city; $p < 0.001$).

There has been considerable debate about the cut-offs for overweight and obesity in Indians. There are data that suggest that Indians have a greater amount of body fat at a given BMI than Caucasians (the 'Indian phenotype'). A recent World Health Organization consultative group recommended a reduction in the cutoff for overweight in Asians to 23 kg/m$^2$. However, more data are required, particularly from prospective studies, to establish clear cutoffs of BMI and other indices of total and central adiposity linked to the risk of NCDs.

## Childhood obesity in India

There is increasing evidence that pathological changes linked to non-communicable chronic diseases appear fairly early in childhood. Childhood obesity and lifestyle behaviours are also important because these track into adulthood. Intervention programmes including health and nutrition education in children are therefore especially important.

The problem of obesity in Indians may be compounded by the potential role of undernutrition *in utero* in increasing the risk of diabetes and CHD in adulthood.[11] South-Central Asian countries, of which India is a part, show the highest rates of intrauterine growth retardation (IUGR)/low birth weight (LBW) in the world.[12] This high prevalence of IUGR/LBW in India has important implications, given the thrifty-phenotype hypothesis. A relatively recent study has demonstrated that despite their lower birth weights, Indian babies at birth preserve their subcutaneous fat, particularly the subscapular skinfolds, when compared with Caucasian babies. This has led to the speculation of the intrauterine origin of adiposity and central adiposity in Indians. These babies also had higher cord insulin levels.[13]

The WHO estimated that India had a preschool child obesity prevalence of about 1% and the estimate of overweight in school-going children for the Asia-Pacific region is approximately 4.1%. There are only a few studies of obesity in children and adolescents on focal groups in India. In summary, these studies suggest that as many as a quarter of children and adolescents between 10 and 16 years in 'affluent schools' may be overweight.[14] The prevalence of overweight among less affluent groups is lower and physical inactivity is associated with the problem of childhood overweight. These data suggest that, as in adults, the problem of overweight in children is disparate in terms of distribution and that in more affluent groups the problem has already achieved levels that are described for more developed regions of the world.

198-201pg q5 8/30/05 11:40 AM Page 200



## The emerging problem of NCDs in India

Secular trends in NCDs in India are difficult to determine precisely because of the lack of prospective studies, differences in study designs and disease definition over time and varied methodology. Nonetheless, a review of studies published over several decades suggests that there is a steady increase in a number of NCDs in India and that this increase is most marked in the urban areas. Thus, for instance, the prevalence of hypertension in 20 - 80-year-olds in the city of Bombay in 1959 was approximately 3% and rose 5-fold to 15.5% by 1980 and to approximately 44% in 1999 (18 - 60 years).[15] Urban hypertension is currently estimated to be more than 2-fold higher than in rural areas. Diabetes has similarly shown dramatic increases in urban areas, where most studies have been done. The prevalence of diabetes in New Delhi, for example, was 2.3% in 1972, 6.7% in 1991[16] and 11.6% in 2000 (as part of the National Urban Diabetes Survey). Current reports indicate that diabetes is between 2- and 10-fold higher in urban areas compared with rural areas in different parts of the country. It is estimated that India accounts for 17% of global cardiovascular mortality,[17] and this is projected to rise to 50% in the future. There is a prominent rural-urban divide in the prevalence of CHD, although the extent of the difference varies in different studies. A comparison of populations between the ages of 35 and 64 years in urban Delhi and rural Haryana, for example, revealed prevalences of CHD (on history) of 4.0% and 0.5%, respectively.[18] In contrast, the prevalence of CHD (based on history and ECG) in urban and rural Rajasthan in a population > 20 years was 6.0% and 3.4% in men and 10.5% and 3.7% in women.[19]

## The PURE (Prospective Urban Rural Epidemiology) study

While urban-rural comparative studies have been done in India, and attest to the large disparity in obesity and NCDs such as diabetes and CHD in these groups, these studies have been limited in scale and depth and to a large extent have been unable to provide deep insights into the specific mechanisms that might account for the difference in prevalence of CHD in urban and rural areas. In particular, diet, physical activity, 'social' variables including social support systems and psychological variables such as depression have been inadequately documented, as have more recent biochemical and genetic markers of diabetes and CHD. Recent strides in the identification of candidate genes for diabetes and CHD are particularly exciting as prospective rural-urban comparisons will allow for the study of gene-environment interactions in two groups which are presumed to be genetically similar, but with very divergent lifestyles. Urban-rural comparisons have an added advantage in that they provide a wide range of data for most lifestyle variables which will allow for adequate ascertainment of risk.

The PURE study is well into the process of establishing a large population cohort in urban and rural areas in five sites in India (two in the North and three in the South), for prospective tracking of changing environments, lifestyles, risk factors and NCD outcomes. The preliminary cross-sectional analyses of the baseline information from this cohort study will explore the relationship between the degree of urbanisation and changes in lifestyle, with risk factors including obesity and dysglycaemia, and CHD. In addition, by following these subjects long term, changes in community level factors such as increasing mechanization, which affects lifestyles and nutritional status, and access to health care can be related to changes in the rates of various diseases and their risk factors.

Preliminary analyses of the baseline PURE data indicate that there are variable differences in urban and rural areas across the sites that have been studied in terms of dietary intakes, physical activity patterns and prevalence of diabetes, hypertension and CHD. There is some evidence of a positive behavioural shift in the higher socioeconomic urban population with regard to the adoption of more physically active lifestyles. In rural areas with a high penetration of urban influences, the degenerative phase of the nutrition transition is well underway.

## The nutrition transition in India – what are the challenges?

The challenge for India, as elsewhere, is clearly to counteract the seeming inevitability of the degenerative phase of the nutrition transition. This must be done while continuing the efforts to address the additional burden of undernutrition. There is much we already know that we can act on. The recently concluded INTERHEART study,[20] for instance, indicated that nine modifiable risk factors including abdominal obesity and diet accounted for most of the risk of myocardial infarction worldwide in both sexes at all ages. Therefore, while there is a need to generate more reliable data on mortality, disease and risk factor prevalence, we can already use existing knowledge to formulate strategies. In order to impact on the nutrition transition at national and individual levels, multilevel strategies will need to be initiated. Considerable headway needs to be made in nutritional knowledge and practice among health professionals as well as the public. In order to facilitate healthy nutritional practices there is a need for initiatives that link enhanced agricultural produce to effective food storage and delivery systems that ensure a more equitable distribution of healthy food at affordable prices. The

198-201pg q5 8/30/05 11:40 AM Page 201

challenges are enormous, but the price to be paid for failing to act is even more so.


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