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**Nutrition, lifestyle, obesity
and chronic disease**

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United Nations, New York, 2011

NOTE

The views expressed in the paper do not imply the expression of any opinion on the part of the United Nations Secretariat.

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PREFACE

In November 2009, the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat convened an *Expert Group Meeting on Health, Mortality and Development* at the United Nations Headquarters in New York. The purpose of the meeting was twofold. First, in preparation for the forty-third session of the Commission on Population and Development, the meeting brought together experts and officials of inter-governmental organizations to discuss the challenges in combating the major causes of death and improving health, including consideration of how to strengthen health systems. Second, building upon earlier United Nations Coordination Meetings on the Estimation of Adult Mortality held in 2006 and 2008, the meeting focused on methodological issues in the estimation of adult mortality and initiated a comparison and review of adult mortality estimates for selected countries as produced by different institutions.

The meeting took place from 10 to 12 November 2009. Its agenda and list of participants can be found at <http://www.un.org/esa/population/meetings/EGM-healthmortality/agenda-participantslist.pdf>. A selection of the papers prepared by experts participating in the first part of the meeting is being issued under the Expert Paper Series published on the website of the Population Division (www.unpopulation.org).

Overweight and obesity have grown in prevalence among industrial, developing and transition economies around the world, giving rise to what is increasingly recognized as a global epidemic. Overweight and obesity are associated with increased risks of co-morbidities including type II diabetes, gall bladder disease, insulin resistance, coronary heart disease, hypertension and osteoarthritis. With life expectancy increasing in developing countries and the consequent changes in the demographic profile of the population, the prevalence of obesity and concurrent morbidity associated to concurrent chronic disease is likely to increase in the future. Preventive strategies are essential to reduce such increases and need to incorporate an understanding of the complex factors that drive trends in overweight and obesity. The Population Division is grateful to Mr. Prakash Shetty, Professor of Public Health Nutrition, Institute of Human Nutrition, University of Southampton, for having participated in the meeting and prepared this paper on the relationship between nutrition, lifestyles, obesity and chronic diseases.

The *Expert Paper Series* aims at providing access to government officials, the research community, non-governmental organizations, international organizations and the general public to overviews by experts on key demographic issues. The papers included in the series will mainly be those presented at Expert Group Meetings organized by the Population Division on the different areas of its competence, including fertility, mortality, migration, urbanization and population distribution, population estimates and projections, population and development, and population policy. The views and opinions expressed in the papers that are part of the series are those of their authors and do not necessarily reflect those of the United Nations. The papers in the series are released without undergoing formal editing.

For further information concerning the papers in this series, please contact the office of Hania Zlotnik, Director, Population Division, Department of Economic and Social Affairs, United Nations, New York, 10017, USA, telephone (212) 963-3179, fax (212) 963-2147.

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INTRODUCTION

A critical examination of the principal causes of mortality and morbidity worldwide indicates that malnutrition and infectious diseases continue to be significant contributors to the burden of ill-health in the developing world. Although reductions in the prevalence of undernutrition are evident in most parts of the developing world, the numbers of individuals affected remain much the same or have even increased, largely as a result of population growth in these countries. What is striking, however, is that the burden of overnutrition, such as overweight and obesity, which is associated with other co-morbid non-communicable diseases (NCDs) like heart disease, diabetes, chronic respiratory infections and cancers, is increasing dramatically in many developing countries with modest per capita incomes. This is particularly the case for those developing countries undergoing rapid economic and developmental transitions. Indeed, even modest increases in prosperity that accompany economic development seem to be associated with marked increases in mortality and morbidity attributable to diet- and lifestyle-related diseases. Transitions in the disease burden of the population are mediated by changes in nutritional status, dietary and physical activity patterns and lifestyles, which typify the acquisition of urbanized modern lifestyles.

Most developing countries, particularly those undergoing a rapid developmental transition, are in the midst of demographic and epidemiologic transitions as well. Economic development, industrialization and globalization are accompanied by rapid urbanization. These developmental forces bring about changes in the social capital of societies, increase the availability of food, and change working patterns and lifestyles. Changes in food and nutrition are both quantitative and qualitative; there is not only access to more than adequate food among some sections of the population, but also a qualitative change in the habitual diet. Lifestyle changes contribute to a reduction in physical activity levels (during both occupational and leisure time), which then promotes overnutrition characterized by overweight and obesity. The essence of these changes is captured by the term ‘nutrition transition’ (Popkin, 1994), which accompanies the demographic and epidemiologic transitions. Weak consumer resistance and inadequate regulation compromises food safety and increases contaminants in the food chain, while the deterioration of the physical environment, particularly increasing environmental pollution, further contributes to the burden of ill-health. Developing societies thus suffer a ‘double burden’ – an unfinished agenda of pre-existing widespread undernutrition combined with the emerging burden of obesity and chronic diseases.

A. DETERMINANTS OF EMERGING NUTRITIONAL PROBLEMS IN DEVELOPING COUNTRIES

The major determinants of the emerging nutritional situation in developing countries, which are home to the majority of the world’s population, are summarized in table 1. These include the various components of the developmental transition that accompany the economic development of societies, the rapid urbanization and internal migration that takes place, the changes in the macro-economic environment and the globalization of markets and food systems, as well as the links between poor nutrition, poverty and inequalities, and the increasing risk of obesity and chronic disease.

TABLE 1. DETERMINANTS OF THE NUTRITIONAL PROBLEMS IN DEVELOPING COUNTRIES

Developmental transition: <ul style="list-style-type: none">• Demographic transition.• Epidemiological transition.• Nutrition transition Urbanization and internal migration. Adult-onset effects of low birth weight and the effects of early life programming. Inequalities and social exclusion; effects of malnutrition, nutrient deficiencies and infections Deleterious effects of environmental degradation and impact of globalization.
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1. *Developmental transition*

Economic development of societies is characterized by several attributes that appear common to the developmental process anywhere in the world. These characteristics are referred to as the developmental transition. Economic growth of societies is reflected in changes in mortality (i.e. a dramatic reduction in infant and child mortality rates and improvements in life expectancy), thus changing the demographics of the populations. The demographic transition is hence the changes in population structure following a shift from high fertility and high mortality seen in poorer societies to one of low fertility and low mortality typical of modern, industrialised, affluent countries consequent to economic growth. An inevitable consequence of increasing life expectancy and decreasing birth rate is the shift in the demographic profile of the population, with a progressive change in the age structure characterised by population ageing.

The usual consequence of the demographic transition is a shift in the disease profile from one dominated by mortality largely attributable to infectious and communicable diseases, mostly in infancy and childhood, to a scenario characterized by adult morbidity and mortality due to chronic and non-communicable diseases. This epidemiologic transition that ensues following economic development focuses on the complex changes in patterns of health, disease and mortality that result from the demographic changes, and the associated economic and sociological changes. This health and mortality transition entails substitution of chronic non-communicable diseases (NCDs) for infectious and communicable diseases as the primary causes of morbidity and mortality (Omran, 1971). This transition from a cause of death pattern dominated by infectious diseases with very high mortality at younger ages, to a pattern dominated by chronic diseases and injuries with high morbidity and lower mortality, mostly peaking in adulthood or at older ages, is evident in the increase in life expectancy seen in developing countries concomitant with economic development.

Other changes include dramatic alterations in habitual diets and food consumption patterns in tandem with changes in lifestyles and physical activity patterns that follow the economic development process. These changes have been referred to as the nutrition transition (Popkin, 1994; Caballero and Popkin, 2003). They include both changes in dietary consumption patterns, both quantitative and qualitative, and alterations in levels of physical activity and lifestyles.

2. Urbanization and internal migration

Studies of migrants from developing countries to industrialized societies have highlighted the significance of ethnic or genetic susceptibilities to chronic disease risk. International migration is an important ecological experiment, since comparisons of the health of migrants with the native or indigenous population provides insights into ethnic or genetic variations in the predisposition to disease risk. Migrant studies enable the identification of the role of environment in unmasking genetic susceptibility to diet-related diseases like diabetes, cardiovascular disease and some cancers (Kolonel and others, 1980) On the one hand, studies of migrants demonstrate that the adoption of diet, lifestyle patterns and socio-cultural practices of the indigenous population results in the acquisition of disease patterns similar to that of the native population. On the other hand, migrant studies provide evidence for a probable genetic predisposition to the risk of NCDs consequent to the change in environment (McKeigue, 1997). These types of studies highlight the importance of environmental factors in NCD risk.

A major feature of the developmental transition with implications for changes in diet, lifestyles and health is the increasing rate of urbanization. Variations in NCD risk similar to that following international migration are also evident within a country or region following internal migration from rural to urban areas. Rural-urban variations in NCD incidence within a region or a country suggest that internal migration, urbanization and exposure to changed diet and lifestyles increase the risk of chronic disease. The rapid acquisition of urban lifestyles in much of the developing world, consequent to economic development, is a major determinant of the increase in obesity and NCDs (Chadha and others 1995; Shetty, 2000).

3. Impact of globalization on food systems

Globalization is a complex, multi-dimensional and pervasive process that has as much to do with trade liberalization as with technological, legal, economic, political, social and cultural change. The defining feature of these changes is a convergence, though at differing speeds, across different countries.

Through capital flow and foreign direct investment, global influences are increasingly being exerted on the food systems of developing countries, resulting in changes in food consumption patterns and their consequent impact on disease risk. The attainment of food adequacy is accompanied by changes in the pattern and practices of food consumption toward that which is demand-driven and mechanized, and sedentary lifestyles. This is most evident in the proliferation and popularity of the fast food culture worldwide. Globalization and economic liberalization has fuelled much of this change in the food culture, resulting in the inculcation of qualitatively imbalanced and calorically excessive diets. Capital market liberalization and enormous capital flows in the form of foreign direct investment (FDI) into agribusiness in the areas of retail marketing, food services and food processing has not only resulted in the phenomenal growth of supermarkets, but also revolutionized processed food products both for domestic consumption and for export and trade (Reardon and Berdegue, 2002).

4. Poor nutrition, poverty and social inequalities

The positive relationship between health and GNP of a population in inter-country comparisons (Berrebi and Silber, 1981) mask the large disparities that occur in populations, even in developed countries whereby people in the lower socio-economic classes have a greater risk of ill-health, including that due to NCDs. Disparities in income influence health: the larger the

degree of inequality (i.e. relative poverty), the lower the life expectancy of the population (Wilkinson, 1998). For example, the increases in obesity and hypertension among the lower social classes in Brazil (Monteiro and others, 1995) where obesity and undernutrition co-exist within the same household reflect social inequalities in the country.

Socio-economic differentials in health have introduced an important role for various non-biological factors in risk of disease. Psychological factors may play an important role: occupation-related lack of control, effort-reward relationship and stress are all now recognized as contributing to increased risk (Siegrist and Marmot, 2004). The Roseto effect describes the important role of cultural factors related to a stable family structure, social cohesion, and the supportive nature of the community to protect against risk of disease, despite the presence of similar dietary and lifestyle risk factors (Egolf and others, 1992). Loosening of family ties and loss of community cohesion predisposes individuals to increased risk. Each of these are socio-cultural changes that occur with the economic development process and with increasing inequalities (Egolf and others, 1992).

The developmental origins of the adult disease hypothesis (Barker, 1994) drew attention to the important influences on chronic disease risk that are determined prenatally or during infancy. This hypothesis, which has been confirmed by numerous studies (Barker, 2000), has drawn attention to the importance of inter-generational and prenatal determinants of adult NCD risk and the need to focus on women and maternal nutrition. The high incidence of low birth weights in developing countries is likely to contribute to increased risk of obesity and NCD later in adulthood.

Evidence is also emerging to suggest that stunting as a result of childhood malnutrition is associated with overweight in countries that are experiencing economic and nutrition transitions (Popkin and others, 1996). Nutritional rehabilitation of malnourished children is accompanied by increases in body weight, which is comprised largely of adipose tissue and tends to be deposited intra-abdominally (Shetty, 1999). Intra-abdominal adipose tissue is a known risk factor for diabetes and cardiovascular disease in some populations.

B. THE EPIDEMIC OF OBESITY AND CHRONIC DISEASES

Obesity and chronic non-communicable diseases take an enormous toll on lives and health worldwide. NCDs account for nearly 60 per cent of deaths globally, mostly due to heart disease, stroke, diabetes, cancer and lung diseases. The World Health Organization estimates that about 80 per cent of global deaths due to NCDs occur in low- and middle-income countries (WHO, 2008). Of the 35 million people who died from chronic diseases in 2005, half were under 70 years of age and half were women. The increasing trend in NCD burden is seen more prominently in developing countries and the greatest increase will be seen in the African region, followed by the Eastern Mediterranean region, where it is estimated there will be a 25 per cent increase in incidence by the year 2015.

NCDs contribute to poverty, and their risk factors and determinants occur at a higher rate among poor and marginalized people, reflecting socio-economic inequities in societies. Since the burden of premature NCDs is borne by the economically productive young adult population group, the consequent cost of the morbidity and mortality is a burden on the family with the loss of the wage earner, thus contributing to poverty. By contributing to the socioeconomic and health burden of the population, NCDs undermine economic development. Hence NCD prevention needs to be an integral component of sustainable development. The rapid rise in NCDs represents

one of the major health challenges to global development in the 21st century and threatens the economic and social development of countries as well as the lives and the health of millions of their residents.

The main NCDs responsible for the overwhelming proportion of disease burden and mortality can be grouped into four classifications of chronic diseases: 1) cardiovascular diseases; 2) cancers; 3) chronic respiratory diseases; and 4) maturity onset or type 2 diabetes mellitus. These four groups of diseases are largely caused by four shared preventable risk factors: tobacco use, unhealthy diet, physical inactivity, and the harmful use of alcohol. Their intermediate risks factors include high blood pressure, high blood cholesterol and obesity.

1. Overweight and Obesity

Overweight and obesity are important risk factors that underlie the emergence of chronic diseases. The other intermediate risk factors of chronic diseases (i.e. high blood pressure and high blood cholesterol levels) are intimately linked to and determined by the body weight of an individual (WHO, 2000). Obesity itself is directly associated with increased risk of a range of health problems like osteoarthritis, but also increases the risk of NCDs like cardiovascular disease and type 2 diabetes. Obesity thus affects the morbidity and mortality of population groups and imposes huge health burdens on countries.

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Body mass index (BMI) is a simple index of weight-for-height that is commonly used in classifying overweight and obesity in adult populations and individuals. BMI provides a useful population-level measure of overweight and obesity. It is the same for both sexes and for all adult age groups. While BMI provides a measure of the excessive fat in an individual, it is important to note that it may not correspond to the same degree of fatness in different individuals and in different population groups.

a. Definition of obesity

The practical and clinical definition of obesity is based on BMI. BMI is defined as weight in kilograms divided by the square of height in meters (kg/m^2). A BMI greater than 30 is associated with elevated blood pressure and increased risks of diabetes and coronary heart disease (WHO, 2000). The WHO Expert Committee Report (1995) identified BMIs ranging from 18.5 to 24.9 as normal and classified BMIs above 25 into three grades of obesity. A subsequent report of the WHO Consultation on Obesity (WHO, 2000) modified this BMI classification by categorizing a BMI between 25.0 and 29.9 as overweight (pre-obese) and considering grades of obesity beginning with BMI over 30. It is thus generally agreed that a BMI of greater than 30 is indicative of clinical obesity while a BMI between 25.0 and 29.9 is indicative of overweight. BMIs greater than 30.0 are further categorized into three grades of obesity: BMIs between 30.0 and 34.9 are considered as Grade I obesity; BMIs between 35.0 and 39.9 as Grade II obesity; and BMIs greater than 40.0 are categorized as Grade III obesity or designated as gross obesity. These WHO recommended cut-offs are appropriate for the identification of the extent of overweight or the grades of obesity in individuals and population groups. On this basis it is now estimated that worldwide there are more overweight and obese individuals than there are undernourished and underweight individuals (WHO, 2006).

BMI has emerged not only as the diagnostic criteria for overweight and obesity, but also as the principal anthropometric measure used to assess chronic disease risks related to body size and composition. This measure of relative weight to stature is easy to obtain both in clinical practice and from population surveys, as it requires only measurement of weights and heights of individuals. BMI classifications are hence the preferred practical indicators that may be used as an acceptable proxy for thinness and fatness, and have been directly related to health risks and death rates in many populations worldwide. BMI enables the diagnosis of both degrees of underweight (WHO, 1995) and the gradations of excess weight (i.e., overweight and of obesity) (WHO, 2000).

b. Epidemiology of obesity

According to the WHO (2006), indicate that in 2005 approximately 1.6 billion adults (aged 15+ years) were overweight globally and at least 400 million adults were obese. The WHO further projects that by 2015, approximately 2.3 billion adults will be overweight and more than 700 million will be obese. At least 20 million children under the age of 5 years were also overweight globally in 2005. Once considered a problem only in high-income countries, overweight and obesity are now dramatically on the rise in low- and middle-income countries. This is particularly the case in urban settings.

Obesity is relatively common in Northern America, in much of Europe, as well as in Australia and New Zealand. The prevalence of obesity in the two sexes are similar in these countries with some exceptions; the proportion of obese women is higher in the Netherlands, New Zealand, the Russian Federation and the United States, while it is lower in Canada and Ireland, for example (IOTF, 2009).

Table 2 outlines the prevalence of obesity in many countries of the developed, industrialized world (SCN, 2004). The prevalence of obesity is high (>15 per cent – > 30 per cent) in Australia, Canada, Germany, Hungary, Ireland, the United Kingdom and the United States, while it is low (3 per cent or less) in the developed countries of Asia, such as Japan and the Republic of Korea. These latter countries have comparable standards of living and life expectancy, but show much lower prevalence of obesity than the countries of Northern America and Europe. Many of the other developed European countries have prevalence of obesity between 5 per cent and 10 per cent.

Overweight and obesity prevalence estimates were updated by the International Obesity Taskforce (IOTF; 2009) to indicate that in 2005 the global prevalence of obesity for men and women was 19.3 per cent and 22.2 per cent, respectively. Based on surveys conducted from 2002 to 2003, 31.1 per cent of men and 33.2 per cent of women in the United States were obese. The prevalence of overweight and obesity is also high among the 27 countries of the European Union (EU). According to IOTF (2009), 42.8 per cent and 16.2 per cent of males and 29.5 per cent and 18.1 per cent of females in the European Union were overweight or obese, respectively. In the EU 27 the adult prevalence of overweight and obesity, for both sexes combined, was estimated at 35.9 per cent and 17.2 per cent, respectively. These data imply that over 53 per cent of the EU population was either overweight or obese, amounting to more than 211 million people (113 million male adults and over 98 million female adults). In the EU, more men than women were overweight and more women than men were obese. There is little doubt that the problem of obesity is growing in the developed world.

TABLE 2. PREVALENCE OF OBESITY (BMI >30) AMONG MALES AND FEMALES OF INDUSTRIALISED AND DEVELOPED COUNTRIES

<i>Countries</i>	<i>Survey year(s)</i>	<i>Males (percentage)</i>	<i>Females (percentage)</i>
Australia	1995	18.7	18.4
Canada	2000/2001	16.0	14.0
Denmark	1994	8.2	7.0
Finland	1999	9.7	10.5
France	1991/1992	6.4	7.8
Germany	1998	19.2	22.3
Hungary	1992/1994	21.0	21.2
Ireland	1997/1999	20.1	15.9
Italy	1994	6.5	6.3
Japan	2001	2.9	3.3
Netherlands	1996/1998	6.5	9.1
New Zealand	1996/1997	12.6	16.7
Norway	1994	5.0	5.9
Republic of Korea	1998	1.7	3.0
Russian Federation	1996	10.8	27.9
Spain	1995/1997	12.3	12.1
Sweden	1996/1997	6.8	7.2
United Kingdom	2000	21.0	21.4
United States of America	1999/2000	27.7	34.0

Source: Data compiled for the 5th Report on the World Nutrition Situation, United Nations System Standing Committee on Nutrition, 2004.

Table 3 summarizes the prevalence of overweight and obesity in several developing countries in the African, Asian and Latin American and Caribbean regions. Countries in Asia have probably the lowest prevalence of obesity, although some countries like China, Malaysia and the Philippines have a high proportion of overweight individuals. Some countries in the African region, such as South Africa and Tunisia, also show high prevalence of both overweight and obesity in their populations. However, the worst scenario is observed in Latin America and the Caribbean, with a prevalence of overweight between 30 per cent and >50 per cent and with the proportion obese in countries like Peru and Uruguay comparable to many countries in Europe. Incidentally, this region is also the most urbanized, with the percentage of the population living in urban environments reaching 78 per cent in 2005, which is higher even than Europe (72 per cent urban in 2005) (United Nations, Department of Economic and Social Affairs, Population Division, 2008).

TABLE 3. PREVALENCE OF OVERWEIGHT (BMI >25) AND OBESITY (BMI >30) FOR BOTH SEXES COMBINED IN SOME DEVELOPING COUNTRIES

<i>Countries</i>	<i>Survey year(s)</i>	<i>Percentage Overweight</i>	<i>Percentage Obese</i>
Africa			
Eritrea	2004	13.7	3.3
Gambia	1995	10.4	2.3
Ghana	1987/1989	11.2	3.1
Morocco	1998/1999	34.7	10.0
South Africa	1998	45.1	21.6
Tunisia	1996/1997	43.8	17.2
Zimbabwe	2005	21.6	15.7
Asia			
China	1997	15.4	--
India	1998	4.8	0.5
Laos	1994	9.3	1.1
Malaysia	1996	26.2	5.5
Pakistan	1990/1994	13.8	3.4
Philippines	1998	20.2	3.3
Thailand	1997*	22.0	21.5
Latin America			
Argentina	2003*	17.4	18.5
Brazil	2003*	29.5	11.3
Chile	2003*	37.8	24.4
Cuba	1982	36.4	--
Peru	2000	53.4	15.3
Uruguay	1998	52.4	18.1
Venezuela	2001*		21.2

Source: Data compiled for the 5th Report on the World Nutrition Situation, SCN, 2004 and *subsequently updated from IOTF, 2009.

Table 4 summarizes the serious obesity situation in the Middle East and Gulf countries where prevalence is higher than in most industrialized countries, particularly among women. Obesity is prevalent in Egypt and Palestine, which continue to struggle with undernutrition at the same time.

TABLE 4. PREVALENCE OF OBESITY (BMI >30) AMONG MALES AND FEMALES IN MIDDLE EASTERN COUNTRIES

<i>Countries</i>	<i>Survey year(s)</i>	<i>Males (percentage)</i>	<i>Females (percentage)</i>
Bahrain	1998/1999*	23.3	34.1
Egypt	1998/1999	12.9	32.9
	2005*		46.6
Iran	1999	5.2	13.5
	2005	9.1	19.2
Kuwait	1998/2000*	27.5	29.9
Lebanon	1998/2002*	36.3	38.3
Oman	2000*	16.7	23.8
Palestine	N/A*	23.9	42.5
Qatar	2003*	34.6	45.3
Saudi Arabia	1995	13.1	20.3
	2000*	26.4	44.0

Source: Data compiled for the 5th Report on the World Nutrition Situation, SCN, 2004 and *updated from IOTF, 2009.

The obesity problem is possibly worst in the small island developing states (SIDS), particularly among those in the Oceania and the Pacific region, such as the Cook Islands, Nauru and French Polynesia (Table 5).

TABLE 5. PREVALENCE OF OBESITY (BMI >30) AMONG MALES AND FEMALES IN POLYNESIAN COUNTRIES OF OCEANIA AND OTHER SMALL ISLAND DEVELOPING STATES (SIDS) OF THE WORLD

<i>Countries</i>	<i>Survey year(s)</i>	<i>Males (percentage)</i>	<i>Females (percentage)</i>
Cook Islands	1998	40.6	50.0
Fiji	1993	7.3	20.5
French Polynesia	1995	36.3	44.3
Nauru	1994	80.2	78.6
	2004*	55.7	60.5
Mauritius	1998	8.0	20.0
Seychelles	1994	8.5	28.2
	2004*	14.7	34.2
Tonga	1998/2000*	46.6	70.3
Vanuatu	1998/1999	12.2	19.6

Source: Data compiled for the 5th Report on the World Nutrition Situation, SCN, 2004 and *updated from IOTF, 2009.

2. Obesity and chronic diseases

Although obesity needs to be considered as a disease in itself, it has even greater importance as a key risk factor for a number of non-communicable chronic diseases (WHO, 2000) (see table 6). A large body of epidemiological evidence has linked obesity to increased mortality and increased risk of chronic diseases such as cardiovascular disease, diabetes, hypertension, certain cancers, gall bladder disease, osteoarthritis and osteoporosis (Royal College of Physicians, 1983; US National Research Council, 1989).

TABLE 6. HEALTH CONSEQUENCES OF OBESITY AND THE LINKS BETWEEN OBESITY AND NON-COMMUNICABLE DISEASES

<i>Serious risk</i>	<i>Moderate risk</i>	<i>Mild risk</i>
Insulin Resistance and Type 2 diabetes mellitus	Hypertension and Cardiovascular disease	Some cancers like breast cancer in postmenopausal women; Cancers of esophagus, pancreas, kidney and colon
Gall bladder disease	Osteoarthritis	Impaired fertility
Dyslipidaemia	Gout	Low back pain
Sleep apnoea and breathing difficulties		Increased risk of anaesthetic complications.

Source: Adapted from WHO (2000) and WCRF (2007).

a. *Obesity and Cardiovascular disease:*

Along with smoking, high blood pressure and high blood cholesterol levels, obesity is an intermediate risk factor for cardiovascular diseases (CVD) like coronary heart disease and strokes. Overall, obesity contributes up to 40 per cent of the risk of hypertension and between 20 per cent and 30 per cent of the risk of CVD and stroke (James and others, 2004). Obesity is also a risk factor for other cardiovascular events such as cardiac failure, arrhythmias, peripheral vascular disease and pulmonary hypertension (Ma, Ko and Chan, 2008). The risk of heart disease and stroke increases continuously with BMI (Field and others, 2001). Obesity thus has a similar relationship with mortality as hypertension and hypercholesterolemia—the risk of mortality rises with the degree of obesity.

b. *Type 2 Diabetes Mellitus and obesity*

Obesity is a major risk factor for non-insulin dependant diabetes mellitus (NIDDM), also known as type 2 diabetes, and the risk appears to be related both to the duration and degree of obesity. Type 2 diabetes, in turn, is a major risk factor for CVD, as are hypertension and dyslipidemia. The association between obesity and the risk of developing type 2 diabetes has been confirmed by several long-term studies (Qiao and Nyamdorj, 2009). Long term follow-up has demonstrated that the additional risk of developing diabetes may increase 40 fold in women who are obese as compared to women within the normal range of weight-for-height. The risk increases continuously with BMI and decreases with weight loss.

It appears that the relationship between BMI and diabetes risk is very consistent across populations, despite variations in the degree of fatness across populations for the same BMI. More importantly, the links between obesity and diabetes seem to be determined by the extent of fat accumulation in the abdominal region. The increased risk of diabetes with abdominal obesity places some population groups, like those from the Asian region, at increased risk of type 2 diabetes, even at BMI levels considered to be within the normal range (WHO, 2004). This crucial observation may account for the emergence of high levels of adult-onset diabetes in countries like India.

c. *Metabolic and other disorders linked to obesity*

Obesity is linked to insulin resistance and dyslipidaemia. Dyslipidaemia is characterised by an increase in levels of plasma triglycerides and an unhealthy pattern of plasma cholesterol with LDL cholesterol (“bad” cholesterol) levels raised and HDL (“good” cholesterol) levels lowered, features that have been shown consistently to be related to an increase in the risk of cardiovascular disease (WHO, 2000). Moderate obesity in women is frequently associated with polycystic ovary syndrome, a common endocrine disorder of reproduction (Magnotti and Futterweit, 2007).

d. *Obesity and cancers*

The World Cancer Research Fund (WCRF) Report (2007) concluded that the evidence that overweight and obesity increase the risk of some cancers is convincing. The cancers include that of the esophagus, pancreas, kidney, bowel and probably that of the gallbladder. In women, high BMI is linked to breast cancer in post menopausal women and to cancer of the endometrium (womb).

e. Obesity and other health consequences

Obesity is also linked with other conditions, such as gallbladder disease. Obesity is a risk factor for the occurrence of gallstones. Osteoarthritis and gout are also common problems among people who are overweight or obese. Obesity also impairs respiratory function and sleep apnoea occurs in more than 10 per cent of people who have a BMI greater than 30.0. Between 65 per cent and 75 per cent of individuals with obstructive sleep apnoea are obese (WHO, 2000).

Obesity is also linked to psychological problems, social bias, prejudice and discrimination. Eating disorders, which are categorized as psychological conditions, occur more frequently among obese individuals (WHO, 2000).

f. Obesity and premature mortality

Studies have confirmed a linear and continuous relationship between BMI and premature mortality (WHO, 2000). This conclusion is consistent with the linear and continuous relationships observed between BMI and cardiovascular disease, hypertension and type 2 diabetes, all of which contribute to premature mortality.

3. Chronic Non-Communicable Diseases

Scientific evidence highlights the roles of diet, lifestyles and physical activity in the development of the most common causes of premature morbidity and mortality. These are mostly due to the four classifications of non-communicable diseases. All of these diseases are linked to obesity, which is now a recognized intermediate risk factor. Diet- and lifestyle-related diseases are not only a burden of ill-health among industrialized, affluent, developed countries, but are increasing at an alarming rate among those in developing countries presently undergoing the developmental transition. With the persistence of the huge public health problems associated with poverty and undernutrition, the appearance of chronic diseases in epidemic proportions in the developing world signals the presence of a dual burden of ill-health and malnutrition (FAO, 2006).

a. Epidemiology of chronic diseases

The burden of chronic diseases is not merely one of premature and avoidable morbidity and mortality. It also imposes major adverse effects on the quality of life of affected individuals and creates large adverse and underappreciated economic effects on families, communities and societies in general. Chronic diseases thus affect both the health and economies of countries.

Since premature mortality is not the only outcome of chronic diseases, the burden has to measure also the morbidity and disability they impose. Disability adjusted life years (DALYs) provide an estimate of the time lived with disability and the time lost because of premature mortality. Globally, the DALYs lost due to communicable diseases have been declining, while the DALYs lost due to chronic diseases and injuries have been rising. Table 7 summarizes the DALYs lost from communicable and non-communicable diseases and injuries estimated by the WHO (2004).

The contribution of non-communicable diseases to DALYs lost is high and rising. Many of the countries in various regions bear the dual burden of communicable and non-communicable diseases.

TABLE 7. PERCENT OF DALYs LOST FROM COMMUNICABLE AND NON-COMMUNICABLE DISEASES AND INJURIES, 2002

	<i>World</i>	<i>Africa</i>	<i>Americas</i>	<i>Southeast Asia</i>	<i>Eastern Mediterranean</i>	<i>Western Pacific</i>
Communicable diseases	41.0	74.8	20.0	45.6	52.1	21.5
Tuberculosis	2.3	2.7	0.62	3.0	2.5	2.4
HIV/AIDS	5.7	24.5	2.0	2.9	1.2	0.92
Diarrhoeal diseases	4.2	5.8	1.8	5.2	7.0	2.7
Malaria	3.1	10.3	0.11	0.62	1.9	0.18
Respiratory infections	6.3	8.3	2.3	8.6	8.9	3.3
Nutritional deficiencies	2.3	2.6	1.3	2.9	3.4	1.7
Non-communicable diseases	46.8	17.3	63.5	41.4	36.8	64.3
Cancer	5.1	1.3	5.6	2.9	2.5	8.9
Diabetes mellitus	1.1	0.29	2.2	0.98	0.73	1.2
Cardiovascular disease	4.4	0.94	4.01	5.21	3.96	3.59
Strokes	3.3	0.95	3.1	2.4	1.7	6.5
Injuries	12.2	7.9	16.4	13.0	11.1	14.2

Source: WHO. *World Health Report 2004*. Geneva.

NOTE: Data estimates from 2002. Africa: high child/very high adult mortality stratum; Americas: low child/low adult mortality stratum; Southeast Asia: high child/high adult mortality stratum; Eastern Mediterranean: high child/high adult mortality stratum; Western Pacific: low child/low adult mortality stratum.

C. DRIVERS OF THE GLOBAL EPIDEMIC OF OBESITY AND CHRONIC NON-COMMUNICABLE DISEASES

The emerging global problems of obesity and NCDs are driven both by the macro-economic forces that operate during economic growth (macro-level drivers) as well as the changes that occur at the levels of the community and the individual (micro-level drivers). Obesity is intimately linked to both to the macro-level changes resulting in the ready availability and access to good and safe food, which is affordable and increasingly cheap, as well as the dietary and lifestyle responses to rapid economic growth and development that occurs alongside urbanization.

Obesity is the result of energy intake that is chronically in excess of energy expenditure, resulting in a positive energy balance and weight gain. At the individual level, two critical factors have caused weight gain in both adults and children: changes in dietary intake and changes in the levels of physical activity. In industrialized societies, despite steady decline in per capita energy intake over the last three to four decades, disproportionate reductions in levels of physical activity as a result of increasingly sedentary modern lifestyle patterns have contributed to positive energy balance and weight gain. In developing societies, which are industrializing and have economies in rapid transition, sedentary lifestyles have accompanied periods when per capita intakes were also increasing. Thus changes in dietary intake, food consumption patterns and physical activity levels all contribute to the problem of increasing obesity and co-morbid conditions of chronic diseases.

1. Macro-level drivers

Macro-level drivers operate at levels beyond the ability of the individual or household to influence or alter easily. Recognition of the important role that macro-level drivers play in causing obesity and chronic diseases will help to reduce victimhood among individuals or households when they are held responsible for their conditions. In the debate about whether prevention of obesity and chronic diseases is the responsibility of the individual or that which society as whole collectively needs to address, understanding the roles of these uncontrollable forces that are driving the global epidemic becomes crucial. Policy makers and planners need to address these macro-level drivers because individuals, households and communities are unable to comprehend these forces, let alone influence them. Preventive strategies at the individual level will not succeed unless the macro-level drivers are collectively addressed.

a. Improvements in food availability and reductions in food prices

Although changes at the individual level have dominated the debate on the emerging global epidemic of obesity and NCDs in driving this epidemic, it is important to recognize that many complex and macro-level forces operate to ensure a conducive environment to enable and sustain the micro-level determinants. Advances in agriculture resulting from mechanization, genetic improvements and the extensive use of fertilizers and pesticides have contributed to phenomenal increase in global food production. Growth in food production has exceeded growth in demand for food and provided the rapidly growing population with more and better food at declining real prices. The benefit of this agro-industrial revolution, however, has reached developing countries later than the developed world (Shetty, 2006).

Consumers in developing countries are now benefiting from advances and growth in agricultural productivity. Food prices have declined in real terms to low levels, which combined with gains in economic growth, have enabled populations to eat better while spending less of their family budget on food. Although these developments have not been universal, in many developing countries the progress in access to better and cheaper food has been impressive. The rapid decline in real food prices has allowed consumers in developing countries to embark on food consumption patterns that mimic those of consumers in industrialized countries at much higher levels of GDP (Schmidhuber, 2004).

Rapid improvement in the ability to purchase food calories has probably contributed most to shifts in food consumption patterns. Popkin (1993) identified several other factors such as urbanization and the role of women in the workforce in determining the form and pace of these nutritional transitions. Growing international trade and globalization of tastes should be considered contributing factors as well (Smil, 2000).

b. Urbanization of societies concurrent to economic development

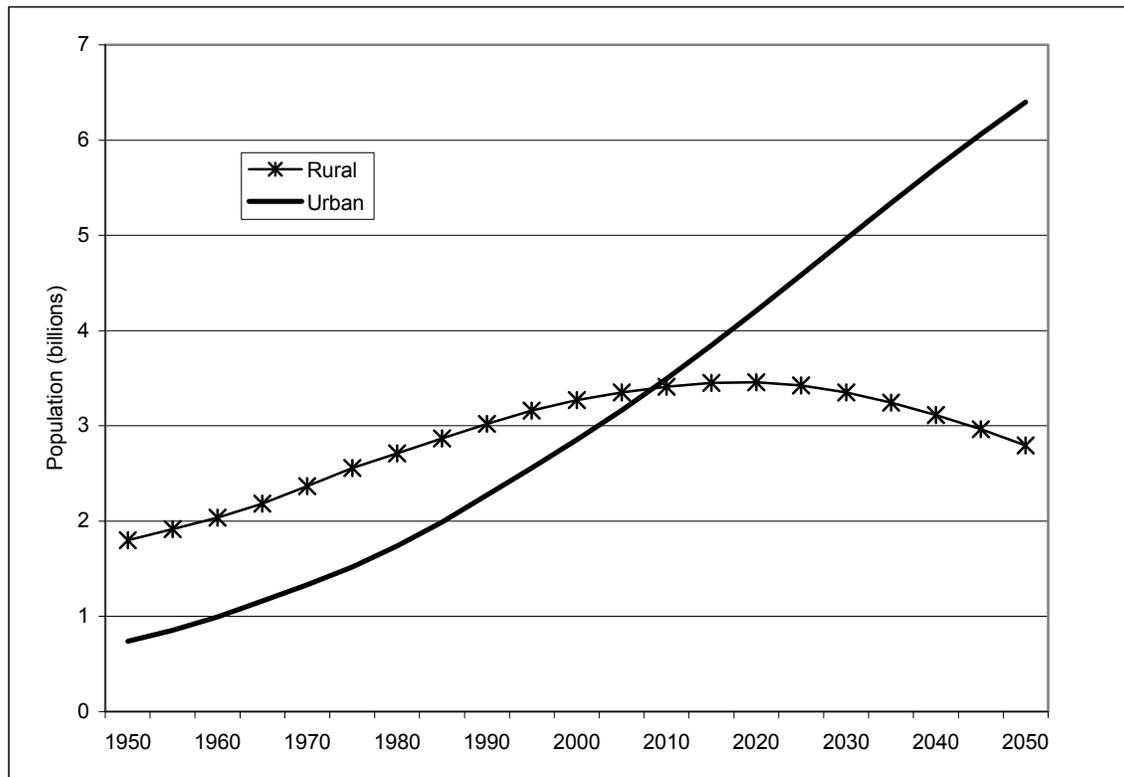
As global population growth slows, an increasing proportion of population change will be in the form of geographic shifts in the population from rural to urban areas. Virtually all population growth in developing countries between 2000 and 2030 is expected to be urban (United Nations Population Division, 2008). The world's urban population, estimated at about 2.9 billion people in 2000, is projected to surpass 4.9 billion by 2030 and exceed 6.0 billion by 2050 (Figure 1). Most of the increase will occur in the cities of developing countries.

The urban population in developing countries is projected to increase from 2.0 billion people in 2000 to almost 4.0 billion people by 2030, thus accounting for almost the entire increment in developing countries' population growth. A part of the increase is due to increased migration from rural to urban areas, while reclassification of rural settlements as urban areas and natural increase of the urban population will also be important contributors.

The effect of moving from a rural area to an urban area on food consumption patterns emerges very soon after the migration. Rural populations tend to be more self-reliant in obtaining food and tend to eat traditional diets that are high in grains, fruits and vegetables, and low in fat (Popkin, 1993). Upon migration to urban areas, people tend to rely more on external forces for sustenance, resulting in a shift away from production of their own food toward the purchase of processed foods. Together with these changes in food consumption patterns, groups moving from rural to urban areas are reported to increase their intake of energy, sugar, refined grains and fat (Monteiro and others, 1992).

Figure I. The global trends and outlook on urbanization

Urbanization to accelerate over the next 40 years
Urban-Rural Population, World 1950-2050



Source: United Nations, Department of Economic and Social Affairs, Population Division (2008), *World Urbanization Prospects: The 2007 Revision*.

Urbanization is also accompanied by higher female participation in the workforce and, with that, a shift away from traditional time-intensive food preparations towards precooked, convenience food at home or fast food and snacks for outside meals. Particularly for the urban poor, the shift towards fast and convenience foods is also a shift away from fresh fruits and vegetables, pulses, potatoes and other roots and tubers, towards a much more sugary, salty and fatty

diet. It is also often a shift away from a diet rich in fibre, minerals and vitamins towards one rich in energy, including from sugar, saturated fats and cholesterol (Schmidhuber and Shetty, 2005).

Urbanization not only affects changes in dietary patterns within a country, it also promotes changes and convergence across borders. Urbanization provides infrastructure, transportation facilities, ports and roads, trains and airports, thereby facilitating trade both within and across countries. It affords international suppliers the advantages of proximity to locally-concentrated masses of consumers, allowing their foreign distribution channels (e.g., international supply chains, supermarkets, fast food chains) to operate efficiently and profitably. Foreign distribution channels bring foreign diets, meaning more processed, sugary, fatty foods that are energy-rich in general.

The United Nations Food and Agriculture Organization (FAO) outlook to 2030 (Bruinsma, 2003) suggests that foreign food will account for a rising share of overall supplies over the next 30 years. Net imports of food by developing countries as a whole will increase by a factor of five, from about US\$ 11 billion in 1997-1999 to about US\$ 50 billion in 2030 in real terms. In fact, in many metropolitan areas it may be easier to feed whole populations with imported food rather than with supplies from the domestic hinterland, particularly where infrastructure deficiencies and difficulties in meeting food standards make the supply from domestic sources cumbersome and expensive.

In addition to changes in food consumption patterns, migration from rural to urban areas also entails changes in lifestyles. People living in lower socio-economic situations who have recently moved to large cities tend to find work primarily as day labourers or factory workers. They leave behind continuous, physical labour and adopt sedentary, sporadic work (Popkin, 1998). While some people are able to carry out work that may actually increase their daily physical activity (e.g., construction workers), generally this is not the case. Physical activity levels, which are an important component of total energy expenditure, account for 15 per cent to 30 per cent of daily energy expenditure. A person experiencing a change in labour practices may see a reduction in physical activity of as much as 50 per cent. This decline in total energy expenditure, if not accompanied by a reduction in energy intake, may result in weight gain and eventually in obesity (Hoffman, 2001).

During the process of economic development, communities often evolve from rural societies where physical activity is needed for agricultural production into urbanized, industrialized communities where the demand for physical labour and activity declines. There is little, if any, information on secular trends in patterns of physical activity in developing countries. The exception is China, where changes in diet and the prevalence of obesity have been shown to be associated with marked changes in physical activity patterns. Data from China show that urban residents in all income groups demonstrated a trend towards increased levels of sedentary activities between 1989 and 1991 (Popkin, 1994). In contrast, rural Chinese show a significant increase from low- and moderate-activity patterns to high-activity patterns. Corresponding data on activity patterns of urban or rural residents of most developing countries are not currently available and need to be collected.

c. Lifestyle changes imposed by the built urban environment

Changes in the built environment in urban areas are now recognized as important macro-level drivers of the epidemics of obesity and chronic diseases (Booth and others, 2005). These have drastically reduced levels of daily activities by increasing demand for mechanized

transportation. They have limited the available space for physical activity pursuits for children at school and adults and have changed the nature of leisure time activity. Concerns regarding safety and security also have restricted the physical activities of children and adults, thus sustaining energy imbalance and promoting weight gain.

2. Micro-level drivers

Micro-level drivers operate at the individual, household or community levels. At the individual level overweight and obesity are functions of energy balance. When the habitual energy intake is greater than the daily energy expenditure, a positive energy balance results in the excess energy laid down in the body, mostly as fat. Energy imbalance (i.e., increased energy intake without compensatory increases in physical activity) and changes in the quality of the diet such as excess fat, salt, etc. can contribute to the incidence of non-communicable diseases like cardiovascular disease, hypertension, stroke and even some cancers. Hence the drivers of this epidemic of obesity and NCDs at the micro-level are both (i) changes in dietary intake and food consumption patterns and (ii) reductions in levels of physical activity.

a. Changes in dietary intakes and food consumption patterns

The availability of good quality food at reasonable prices has contributed to increased availability of dietary energy, thus contributing to changing dietary consumption. In the United Kingdom for instance, although there has been a steady decline in per capita energy intake from the 1950s to the present, over the same 50 years there has been an increase in the proportion of fat in the diet and a consequent decrease in the carbohydrate content of the diet (Prentice and Jebb, 1995). The energy density and fat content of the diet appear to have important effects on the overall intake of food energy, as reducing the energy density of the diet by reducing fat has repeatedly been shown to lower energy intakes (Lissner and others, 1987). Increasing the fat energy of a diet has been shown to increase food intake and, at the same time, interact quite strongly with the level of physical activity (Stubbs and Prentice, 1993).

In developing countries, rapid changes in dietary intake are indicative of an increase in per capita availability of food. While the changes in energy intake have been small, there have been large changes in consumption of animal products, sugars and fats. In China the per capita total cereal and vegetable consumption increased and stabilised by 1984, while the consumption of meat, edible oils, sugar, eggs and fish increased throughout this period (Chen, 1991). The net effect has been a marked shift in the diet with energy from fat (both animal and vegetable) increasing. Countries like China have thus not only changed their overall dietary adequacy, but also have seen a marked change in dietary composition, with increasing proportions of the population consuming more than 30 per cent of their energy from fat. Data from India also show that higher income groups consumed a diet with 32 per cent energy from fat while in the lower income groups only 17 per cent of energy intake was from fat (Padmavathi, 1962). More recent dietary surveys in Delhi confirm that higher income groups in urban India consume higher levels of energy and fat as compared to the urban poor or rural populations (Chadha and others, 1996).

Thus it appears that in most developing countries, the change in energy intake has been dominated by large changes in consumption of livestock and animal products, sugars and fats (World Agriculture Report 2015/2030). In each case, the quantitative change in food intake is small, but there have been large changes in the quality of the diet. In particular, the consumption of animal products, sugar and fats has increased. The net effect has been a marked shift in the diet with energy from fat (both animal and vegetable) increasing year on year. Whereas high fat diets

and diets rich in animal products were once restricted to rich industrialized countries, evidence is emerging to indicate that this dietary change is now occurring in countries with much lower levels of GNP. Nowhere is this change better illustrated than in China, while many other developing countries in transition, such as India and Brazil, show similar trends.

The effect of changes in per capita income with economic growth is reflected in a shift in consumer diets mainly away from staples and increasingly towards livestock and dairy products, fats and oils. A shift also occurs in the habitual diet with increasing consumption of processed foods and an increased occurrence of eating outside the household with more reliance on pre-prepared snack or fast foods. This is partly the result of changes in work patterns and increasing participation of women in the workforce. Easy access to convenience food, fast food outlets and ready-to-eat food also contributes by changing the social milieu. In urbanized market economies, availability and accessibility of foods, together with societal determinants of food choice, modulate the habitual diet along with prices and incomes (Pingali, 2004).

b. Secular trends in physical activities of individuals.

In the industrialised world, physical activity has declined as a result of the increasing mechanization of life. Time in a day or week dedicated to employment or paid work has declined in several industrialized countries since the early 1960s (Gortmaker and others, 1990; Gershuny, 1995) and is the result of shorter work shifts, shorter work weeks and longer vacations. This is compounded by the fact that the decline in time dedicated to productive work has been accompanied by a reduction in energy spent at work as a result of increased mechanization of occupational work (Ferro-Luzzi and Martino, 1996).

Concurrent with the decrease in energy expenditure during occupational activities, increased urbanization, universal use of motor cars, mechanization of most manual jobs outside the occupational sphere and increasing leisure time has aggravated this trend. Increased leisure time is more often than not dedicated to television viewing, thus altering the structure of leisure time and encroaching on time previously allocated to other activities, including weekday sleep (Niemi, 1995).

In the United States, television viewing has increased, leading to a steady decline in regular physical activity and undesirable levels of sedentariness (Schlicker and others, 1994). In the United Kingdom, increasing hours of television viewing have been shown to have a strong social class effect with the lower social classes showing more hours of television viewing per week, which is associated with a higher prevalence of obesity (Prentice and Jebb, 1995). Computer games and videos further contribute to inactivity in children and, together with television watching, have been identified as important determinants of childhood and adolescent obesity (Dietz and Gortmaker, 1985).

The decrease in physical activity in individuals who have access to adequate diets has contributed to an increase in the prevalence of obesity in these societies. The large body of epidemiological evidence links obesity, as well as reductions in physical activity, to heightened risk for several chronic diseases. In developing societies, which are industrializing and have economies in rapid transition, sedentary lifestyles accompany periods in which per capita energy intakes are also increasing. Thus changes in dietary intake, food consumption patterns and physical activity levels, which are crucial elements of the nutrition transition, will lead to changes in body weight and body composition, thus contributing to increasing risk of NCDs in developing societies.

D. INTERVENTIONS TO ADDRESS THE PROBLEM OF OBESITY AND CHRONIC DISEASES

Obesity and chronic non-communicable diseases are preventable diseases and there is good scientific evidence that prevention is a viable option to avoid costly treatments, thus saving lives while reducing the economic burden on the already overstretched health budgets of developing countries. While an individual's diet and lifestyle and perhaps genes may dictate the risk of chronic diseases, preventive strategies operate both at the individual and the population levels. Interventions designed to address the challenges posed by the global problem of obesity and chronic diseases need to be considered from the two levels, just as the drivers of the epidemic were considered earlier. A critical examination and evaluation at both levels is important to consider strategies to tackle the emerging problem of obesity and chronic diseases in developing countries, which are likely to impose huge health and economic burdens.

1. Macro level interventions at national and regional level

The food and agriculture sectors operate at the population level on the distal socio-economic causes within the causal chain linking exposures to disease outcomes. These causes function mainly by primordial prevention, preventing the risk factors from emerging. Hence food and agricultural policies contribute to primary prevention of disease by reducing known risk factors. They promote and contribute to an enabling environment that favours a healthy food system that promotes healthy dietary habits and lifestyles and reduces the risk of disease and ill-health.

a. Food and Agricultural policies

Relevant and appropriate food and agricultural policies at the national level can help address this issue, as evidenced by the fact that inappropriate agricultural and food policies in some parts of the world have actually contributed to this problem. Food and agricultural policies are mainly driven by political, social, economic and other considerations with health often taking a backseat or ignored completely. There are innumerable examples of the health sector having been neglected and not included among the important stakeholders in determining food and agricultural policies. Recent attempts to explore this situation by economists and policy analysts have highlighted the United States food policies and agricultural subsidies as one classic example (Institute of Agriculture and Trade Policy, 2007). Attention is drawn to the fact that while public policies that help shape food and physical activity environments for people are addressed, the impacts of agricultural policy have thus far been absent from public discussion (Muller, Schoonover and Wallinga, 2007). In addition to summarizing trends in the supply and consumption of certain foods produced in the United States and examining the federal agricultural policies that impact child health and nutrition, these authors correlated negative trends in individual health with the nutritional value of foods produced, the price of those foods, and the United States agricultural policies that encouraged their production. They even raised the important issue of how ironic it is that the food assistance and nutrition programs for children—in itself a form of agricultural policy—are needed in large part to fix the problems that other aspects of the United States agriculture policy have created.

Muller, Schoonover and Wallinga (2007) argue that United States agricultural policies have resulted in increasing crop specialization (with 85 per cent of 'Farm belt' acreage dedicated solely to two crops: corn and soya). They note the crucial role of farm payments for these 'programme crops' in contributing to overproduction and low prices, which consequently promote agribusiness investment in the use of High Fructose Corn Syrup (HFCS) and soya bean oil.

Underproduction of healthier crops, such as fruits and vegetables, has resulted in higher prices for these healthy components of the diet. Emerging agribusinesses policies favouring chronic overproduction and oversupply, eroding real market prices and promoting cheap foods have driven the obesity epidemic in the United States (Muller, Schoonover and Wallinga, 2007). The authors conclude that United States agricultural policies discourage local, diversified and healthy food systems. They argue that public health professionals can support a healthier food system not only by championing nutrition programmes at the individual and population levels, but also by collaborating with other organizations to shift the overall direction of farm policy toward a healthier and more sustainable food and farming system (Institute of Agriculture and Trade Policy, 2007).

However, Schmidhuber and Shetty (2009) have shown that the European Union Common Agricultural Policy (CAP), despite its inherent subsidies and market distortions, may have delivered a healthier diet from a nutritional point of view. They conclude that CAP significantly raised primary food prices and hence is unlikely to have been a key driver of the increasing energy intake observed in the EU-15 countries since the 1960s or to have contributed to overweight and obesity. More importantly, CAP raised the prices of foods that are generally associated with adverse health effects, notably sugar, milk and dairy products (butter) as well as meat, particularly beef. In terms of nutrients, CAP appears to have placed a particularly strong tax on saturated fats, cholesterol and sugar (i.e. those nutrients that are generally associated with adverse health consequences) (WHO/FAO, 2003).

b. Integrated national level food and nutrition policies that promote better health outcomes

There are two outstanding country-level examples of integrated, multi-sectoral food and nutrition policies that have been formulated with population health at their core. The experiences of Norway and Finland should be held up as examples of how food and agricultural policies can help to prevent obesity and chronic diseases while promoting healthy diets and eating habits. The success of the approaches of these countries from 1970 onwards may be difficult to reproduce in the twenty-first century, given the remarkable changes that have occurred in food systems. Thus more aggressive and complex approaches may be required to achieve health objectives in the globalized world. Nevertheless, these country examples illustrate the importance of a macro-level strategy and the need for national and regional approaches involving the cooperation of all major stakeholders to attain better health and nutrition of the population and reduce the risks of obesity and chronic diseases.

Norwegian nutrition and food policy: Following the World Food Conference in Rome in 1974, the Norwegian government produced a white paper on *Norwegian nutrition and food policy* (Norum, 1997). While aware of the concern of the agricultural sector that the policies may result in reduced consumption of meat and dairy products, the central question addressed the means to influence production and consumption of food products to encourage healthy dietary habits. A wide range of stakeholders collaborated and a range of policy measures were used. These approaches complemented a National Health Screening Service and encouraged farmers to increase production of food grains, potatoes, vegetables and low-fat milk. Measures were also introduced to stabilise milk and meat production and to avoid overproduction. Subsequent follow-up showed that knowledge of diet and health increased, resulting in positive attitudes concerning healthy dietary habits. Dietary surveys showed that while energy intakes did not change, the contribution of fat to the diet declined and total carbohydrate intakes increased with no change in the consumption of free sugars. There was a dramatic reduction in mortality attributed to coronary heart disease over a 20-year period, thus establishing the role of the Norwegian food and

nutrition policy in reducing the prevalence of obesity and diet-related diseases and in improving the health of the population.

Experience from Finland – The North Karelia Project: Prevalence of high cholesterol levels and extremely high mortality rates due to cardiovascular disease were a feature of population health in Finland in the 1960s and early 1970s. *The North Karelia Project* was a response initiated in 1972 to growing public concern about this situation (Puska and others, 1995). The intervention, which entailed several public policy measures, began in North Karelia province and five years later was extended to cover the whole of Finland. Community organization was key to its success. The framework emphasized an intervention that was flexible, based on continuous monitoring and feedback, and taking advantage of naturally occurring possibilities. The intervention used multiple strategies: innovative media and communication activities, systematic involvement of primary health care, environmental changes, collaboration with the food industry and policy changes. The project worked in close collaboration with national health authorities; its activities benefited from and contributed to national health policy and long-term sustainability was based on strong leadership and an appropriate institutional basis. The reduction in cholesterol levels and a dramatic drop in CVD mortality demonstrated the success of the intervention.

2. *Micro-level interventions at the community and household levels*

Diet-, nutrition- and physical activity-centred strategies have been attempted, not always with success, to target the individual or household to reduce the risks of obesity and chronic diseases. These generally aim to achieve international (WHO/FAO, 2003) or national recommendations made by expert scientific bodies to promote healthier diets and lifestyles. Some important and relevant interventions at this level are reviewed briefly here.

a. *Promoting increased consumption of fruits and vegetables*

International bodies such as WHO/FAO (2003) and WCRF (2007) have recommended a daily intake of 400 gm of fruits and vegetables per person, a message conveyed in the popular ‘5-a-day’ programmes. Interventions to increase consumption of fruits and vegetables have been subjected to systematic reviews in studies of both children (Knai and others, 2006) and adults (Pomerleau and others, 2005). While many studies did show some benefit to interventions that aim to increase consumption of fruits and vegetables, more research is needed in this area. The European Union agriculture policy for fruits and vegetables in schools was shown to be an effective approach, yielding both public health and agricultural benefits. Aiming to increase fruit and vegetable intake amongst a new generation of consumers will support a range of European Union policies targeting obesity and health inequalities (de Sa and Lock, 2008).

b. *Reducing salt intake*

Reducing salt consumption in the daily diet is another community-level intervention to reduce the burden of cardiovascular disease in the population. Evidence has consistently shown a direct relationship between salt intake and cardiovascular risk, and a reduction in population salt intake is associated with a reduction in cardiovascular mortality. Thus the evidence for universal salt reduction is strong, and reducing salt from the current average intake of 10-12 g/day to the recommended level of 5-6 g/day is likely to have a major effect on blood pressure and cardiovascular disease mortality. Since 2003, the United Kingdom Food Standards Agency (FSA) has pursued a programme to reduce consumers’ consumption of salt. Since about 75 per cent of the

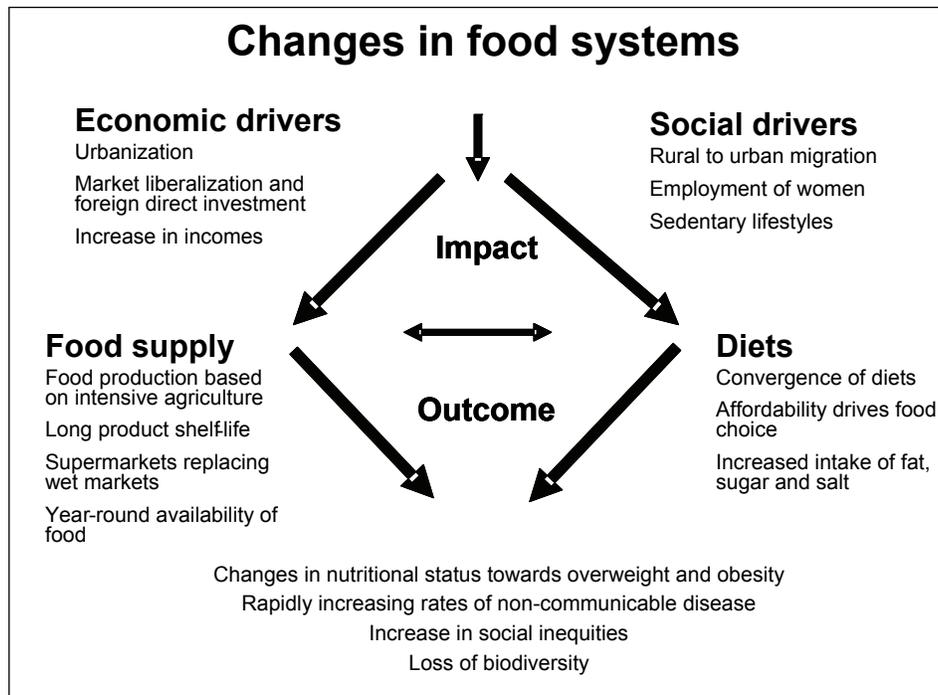
salt consumed is already in the processed foods purchased by consumers, FSA has worked with the food industry to encourage reductions in the levels of salt added to processed foods. The benefits of this programme have not yet been evaluated. Systematic reviews of this type of intervention indicate that it is not suitable for primary care or population prevention programmes, and provides only minimal reductions in blood pressure during long-term trials (Hooper and others, 2004).

CONCLUSION

Obesity and chronic non-communicable diseases are global nutritional problems. They are not confined to the industrialized, developed world nor are they seen in adults only. Indeed, the problems are emerging in epidemic proportions in the developing world, particularly in regions undergoing rapid economic growth and urbanization. Obesity in childhood is increasing in prevalence and is a matter of grave concern in that the co-morbidities associated with obesity in adulthood will impose enormous health and economic burdens on countries.

Although nutrition in terms of access to and consumption of the quantity and quality of food and the level and pattern of physical activity defined by lifestyles is fundamental, the process that leads to obesity and its co-morbid NCDs is complex. It is determined by a range of factors and in modern urbanized societies is driven both by macro-level drivers and by drivers that operate at the micro-levels of individuals and households. Figure II summarizes some of the changes in food systems that are contributing to this burden of ill-health in societies. These changes reflect increasing availability of food at low prices and shifts in the quality of diets.

Figure II



The current prevalence of obesity and chronic diseases is highly variable between developing countries and within populations of a country. In general, the prevalence of obesity is higher in women, as compared to men in developing societies. With life expectancy increasing in developing countries and the consequent changes in the demographic profile of the population, obesity and concurrent morbidity due to other chronic diseases are likely to increase further. Preventive strategies are essential and need to operate with an understanding of the complex factors that drive this global epidemic. Preventive intervention strategies need to operate both at primordial and primary prevention levels, which means that they need to be considered at both the macro- and micro-levels, targeting both the population and individual levels. More importantly, their success will depend on holistic and multi-sectoral approaches that involve the health and agriculture sectors as well as all stakeholders in the public and private sectors.

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