Nutrition Transition in Mexico and in Other Latin American Countries

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Mexico and other Latin American countries are currently undergoing important demographic, epidemiologic and nutrition transitions. Noncommunicable chronic diseases such as obesity, type 2 diabetes mellitus, and high blood pressure are becoming public health problems as the population experiences an important reduction in physical activity and an increase in energy-dense diets. In contrast, the prevalence of undernutrition is declining in most countries, although several decades will be needed before the prevalence drops to acceptable values. The objective of this article is to discuss the characteristics of the nutrition transition with emphasis in data from Mexico, Brazil, and Chile.

Key words: epidemiologic transition, obesity, noncommunicable chronic disease, food intake, national surveys

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Introduction

Mexico and other Latin American countries are experiencing important health, nutrition, and demographic transitions.1-3 The demographic transition is marked by shifts from high to low fertility and mortality, and by population aging. The epidemiologic transition is characterized by a shift from high infectious disease morbidity and mortality to the preponderance of non-communicable chronic diseases (NCCD). The nutrition transition, a shift from high prevalence of undernutrition to predominance of diet-related NCCD, has been associated with the rapid process of urbanization and economic growth, by technological changes and innovations that lead to reduced physical activity in the working place and leisure, and by changes in food patterns and dietary intake, including increased consumption of energy dense processed foods.4

Different countries and regions in the American continent are experiencing different stages of the nutrition transition. Some of them are experiencing the “receding famine” stage, characterized by starchy, low-variety, low-fat, and high-fiber diets, and by labor-intensive work. In these countries, stunting, underweight, and micronutrient deficiencies are highly prevalent and infant mortality due to infectious diseases, with low birth weight and undernutrition as contributing causes, is high.

Other countries and regions are in the so called “degenerative diseases” stage, with increased fat, sugar and processed foods intake, reduced physical activity due to shifts in technology for work and leisure, and the emergence of obesity, bone density problems and increased risk of NCCD.

The last stage of the nutrition transition, referred to as “behavioral change”, is an ideal stage in which people, after experiencing the devastating effects of the transition from receding famine to degenerative diseases, adopt behavioral changes in diet and lifestyle such as a reduced intake of fat and refined carbohydrates, an increased intake of fruits, vegetables, fiber and complex carbohydrates and replacement of sedentary lifestyle with purposeful changes in recreation and physical activity. As a result, a reduction in body fatness and improvements in bone density occur, with the corresponding reductions in NCCD and a focus on healthy aging.5 No country as a whole can be identified as experiencing this stage of the nutrition transition; however, certain groups of highly educated, informed and motivated people in some countries are experiencing this shift.

In recent years obesity, diabetes, and other NCCD are increasing among the poor.6,7 Moreover, a growing number of studies are finding associations between low birth weight and obesity, diabetes and coronary heart disease in adults,8-12 all of which seem to support the hypothesis of the fetal origins of a number of NCCD.

This paper presents information about the nutrition...
transition in Latin America, with an emphasis on data from Mexico, Brazil and Chile.

**Shifts in Undernutrition**

The prevalence of undernutrition is declining in most countries and regions in the world. Table 1 presents prevalence of stunting in less developed countries (LDC) by world region in 1990 and 2000.\(^\text{13}\) The estimated prevalences are based on nationally representative surveys of countries in each region. A decline in prevalences is observed in all regions; however, reductions are important in Asia, Latin America and the Caribbean, while in Africa the rate of decline has been modest. This small reduction is due to an increase in prevalence observed in Sub-Saharan Africa, the only sub-region in which stunting did not decline.

The prevalence of wasting (weight-for-length \(<−2\) SD of the WHO/NCHS/CDC reference population\(^\text{14}\)) in most Latin American countries is below 2.5%, the proportion expected in a healthy population.\(^\text{13}\) Stunting (length-for-age \(<−2\) SD of the WHO/NCHS/CDC reference population\(^\text{14}\)) declined substantially, despite the fact that the baseline prevalence in 1990 was the lowest of all regions (Table 1).\(^\text{13}\) Examination of the prevalence of stunting in 10 Latin American countries at two points in time between 1986 and 1999 (C Lutter, personal communication, Washington, DC, 2000) shows declining rates occurring in all countries (Table 2), although the rate of decline in some countries is such that several decades will be needed before the prevalences drop to expected values in healthy populations. For example, in Mexico the prevalence of stunting declined from 22.2% in 1988 to 17.1% in 1999, 5.1 percent points in 11 years or 22.4% relative to 1988.\(^\text{13}\) However, the rate of decline is modest, in comparison with the Latin American region as a whole and with other Latin American countries (Tables 1–2). At the current decline rate in Mexico, about 30 years would be needed to reduce the prevalence of stunting to 2.3% or less. This rate of decline is clearly nonsatisfactory.\(^\text{15}\) Although the prevalences are declining in every country, apart from Brazil, Dominican Republic, and Colombia, all other countries in Table 1 have prevalences above 15%; therefore, stunting is a public health problem in these countries. Actions should be taken to achieve faster reductions in the prevalences of stunting.

**Shifts in Dietary Intake**

In contrast to the decline in stunting, dietary intake is shifting to a higher fat and refined carbohydrate intake in countries like Mexico and Brazil\(^\text{16,17}\) and food purchases of total energy and fat are increasing in Chile.\(^\text{18}\) In Mexico, a shift to higher fat and refined carbohydrate intake was observed in the 11-year period between 1988 and 1999.\(^\text{16}\) At the national level, the percentage of total energy from fat went from 23.5% to 30.3% (a 28.9% decrease relative to 1988) during the same period, while the percentage of total energy from carbohydrate intake shifted from 59.7% to 57.5% during the same period (Figure 1). The increase in fat intake occurred not only in the wealthiest regions in Mexico. For example, although the percentage increase in the relative contribution of fat

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**Table 1. Trends in the Prevalence of Stunting in Children under 5 Years of Age in Less Developed Countries (LDC) by World region between 1990 and 2000**

<table>
<thead>
<tr>
<th>Regions</th>
<th>Stunting (%)</th>
<th>Period Change</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1990</td>
<td>2000</td>
<td>% Points</td>
</tr>
<tr>
<td>Africa</td>
<td>37.8</td>
<td>35.2</td>
<td>-2.6</td>
</tr>
<tr>
<td>Asia</td>
<td>43.3</td>
<td>34.4</td>
<td>-8.9</td>
</tr>
<tr>
<td>Latin America and Caribbean</td>
<td>19.1</td>
<td>12.6</td>
<td>-6.5</td>
</tr>
<tr>
<td>All LDC</td>
<td>39.8</td>
<td>32.5</td>
<td>-7.3</td>
</tr>
<tr>
<td>Mexico(^*)</td>
<td>22.8</td>
<td>17.7</td>
<td>-5.1</td>
</tr>
</tbody>
</table>

*From 1988 to 1999.
From references 13 and 16.

**Table 2. Changes in the Prevalence of Stunting in Children under 3 Years of Age in Latin America**

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Prevalence</th>
<th>% Points</th>
<th>% Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolivia</td>
<td>1989</td>
<td>38.0</td>
<td>-10.9</td>
<td>-28.7</td>
</tr>
<tr>
<td></td>
<td>1993</td>
<td>27.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>1986</td>
<td>27.7</td>
<td>-17.4</td>
<td>-62.8</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>10.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>1986</td>
<td>25.5</td>
<td>-13.0</td>
<td>-51.0</td>
</tr>
<tr>
<td></td>
<td>1995</td>
<td>12.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>1991</td>
<td>19.4</td>
<td>-8.7</td>
<td>-44.9</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>10.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecuador</td>
<td>1986</td>
<td>34.0</td>
<td>-7.6</td>
<td>-22.4</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>26.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>El Salvador</td>
<td>1993</td>
<td>22.8</td>
<td>+0.5</td>
<td>+2.2</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>23.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guatemala</td>
<td>1987</td>
<td>68.5</td>
<td>-22.1</td>
<td>-32.3</td>
</tr>
<tr>
<td></td>
<td>1998</td>
<td>46.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Haiti</td>
<td>1978</td>
<td>39.6</td>
<td>-7.7</td>
<td>-19.4</td>
</tr>
<tr>
<td></td>
<td>1994</td>
<td>31.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>1988</td>
<td>22.8</td>
<td>-5.1</td>
<td>-22.4</td>
</tr>
<tr>
<td></td>
<td>1999</td>
<td>17.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peru</td>
<td>1991</td>
<td>36.5</td>
<td>-10.7</td>
<td>-29.3</td>
</tr>
<tr>
<td></td>
<td>1996</td>
<td>25.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From a personal communication (Lutter C, Washington, DC, 2000).
to total energy was larger in the north and in Mexico City, the more urbanized and wealthier regions (between 30% and 32% relative to 1988), the south, which is the poorest region, also experienced an increase of almost 22% relative to 1988. The 1988 data does not distinguish between complex and refined carbohydrates. Therefore, it is not possible to know the relative contribution of refined carbohydrates to total carbohydrates from dietary data. However, mean quantities of food purchased in the households per adult equivalent between 1984 and 1998 do show an increase in refined carbohydrates. In general, food quantities purchased declined during the period in all food groups studied, and in particular the purchases of fruits and vegetables, which decreased approximately 29%. In contrast, purchases of refined carbohydrates and soda increased by 6.3% and 37.2%, respectively, in 1998 relative to 1984 (Figure 2).16

### The Rise of Overweight and Obesity

Parallel to these dietary changes, rises in the prevalence of overweight and obesity were observed. We show these

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**Figure 1.** Relative contribution of the macronutrients to total energy intake in Mexico in 1988 and 1999. From reference 15.

**Figure 2.** Changes in mean food purchases in 1998 relative to 1984 (%) by food group in Mexico. From reference 15.
prevalences in women from the two Mexican National Nutrition Surveys conducted in 1988 and 1999 (Figure 3). The combined prevalences of overweight and obesity in women 18–49 years of age were 33.4% in 1988 and 59.6% in 1999, an increase of 78% relative to 1988. The 11-year increments of overweight and obesity, relative to baseline prevalences, occurred across the whole country. These were about 70% in Mexico City and the north, 81.3% in the south, and 101.4% in the central region. Increments in overweight during this 11-year period were almost 47% at the national level, ranging from 29% in the north to 73% in the center, while obesity increased 160%, ranging from 133% in Mexico City to 174% in the center. The prevalence of obesity in children under 5 years of age increased from 4.2% in 1988 to 5.3% in 1999, a 26% increase. The highest prevalences in 1988 were in the north and center; however, the relative changes in this period were much higher in Mexico City and the south (increases of over 80%) as compared with the north (12.5%) and the center (18.5%).

This phenomenon is also observed in Chile, where the dramatic increase in the prevalence of overweight and obesity is evidenced by the trends in obesity in first-grade school children in the 13-year period from 1987 to 2000. The prevalence of obesity (weight-for-height ≥2 SD of the WHO/NCHS/CDC reference population) increased 2.9 times in boys and 2.2 times in girls during the period. The increases observed both in Mexico and in Chile are striking and call for immediate action to reduce the epidemic of obesity that is taking place in Latin America.

The Rise of Non-communicable Chronic Diseases

Obesity is a known risk factor for morbidity and mortality due to NCCD. For example, the prevalence of hypercholesterolemia (serum cholesterol >200 mg/dL) in two cross-sectional samples of Chilean males and females adults living in Santiago increased from about 34% in 1987 to 42.5% in males and 46.1% in females in only 5 years.

In Mexico, the national prevalences of various NCCD in 20- to 69-year-old urban adults were obtained from the Mexican National Chronic Diseases Survey, a national probabilistic survey conducted in urban areas. The prevalence of hypertension (average systolic pressure ≥140 mmHg and/or diastolic pressure ≥90 mmHg from two measurements) was 28.5% for males and 25.1% for females, with higher prevalences in the north (30.3% males, 26.1% females), followed by the south (31.3% males, 24.6% females), the center (27.2% males, 26.7% females), and Mexico City (25.0% males, 23.0% females). The prevalence of diabetes (concentration of glucose in fasting venous blood serum ≥126 mg/dL or ≥200 mg/dL in casual samples) at the national level was 7.2% for both sexes, with higher prevalences in the north (8.6% males, 9.3% females), followed by the south (7.3% males, 6.1% females), the center (6.0% males, 7.5% females), and Mexico City (6.9% males, 6.1% females). The prevalence of hypercholesterolemia (using a higher cut-off point than the Chilean studies: total serum cholesterol concentration ≥240 mg/dL) at the national level was 10% for males and 8.1% for females, with higher prevalences in the center (12.0% males, 9.7% females), followed by Mexico City (11.9% males,

Figure 3. Changes in the prevalence of overweight and obesity in women 18–49 years of age in Mexico (1988–1999). From reference 15.
9.3% females), by the south (7.7% males, 7.2% females) and the north (8.3% males, 6.3% females). The increases in the prevalences of overweight and obesity are also reflected in the rise of mortality due to diet-related chronic diseases. We conducted an analysis of age-adjusted standardized mortality rates (SMR) for acute myocardial infarction (AMI), diabetes mellitus, and hypertension, from 1980 to 1998 for the national level, and by region. Results are presented in Figure 4 as index SMR relative to 1980. Figure 4 also presents SMR for cirrhosis and vascular cerebral disease as references for comparison with the three diet-related NCCD of interest.

Dramatic increases in SMR between 1980 and 1998 were observed for the three analyzed diet-related causes of death (Figure 4). A sharp increase for AMI is observed in the last 10 years (1988–1998). A steady increase for diabetes is observed over most of the period (1980–1997), with a sharp increase in 1998. The increase in 1998 is mostly due to a change in the classification system that year. Finally, an abrupt increase for hypertension is observed between 1983 and 1985, with a slower slope thereafter. The increases over the period 1980–1998 were 53% for AMI, 62% for diabetes (40% from 1980 to 1997, before the sharp increase) and 55% for hypertension.

Analysis by region showed that the baseline SMR (1980) was higher in Mexico City and the north, relative to the less developed regions (center and south), for the three causes of death. However, the relative increments were substantially larger for the south and center compared with the more developed regions (north and Mexico City). Relative increments in the south and center ranged from 70% to 140% for the different causes; the corresponding figures for the north and Mexico City ranged between −10% and 50%.

One possibility is that the observed increases are partially explained by improvements in the quality of the deaths registry system in Mexico. In 1980, medical doctors certified 86% of total deaths, while in 1998 this figure increased to 96.8%. Ill-defined causes of death decreased from 6.7% in 1980 to 2.0% in 1992. Thus, it is possible that at least part of the sharp increases were due to improvements in the quality of the registry system. However, the relative small magnitude of the increase in certifications by medical doctors and the decrease in ill-defined causes of death relative to the large increases in mortality for the three causes studied suggests that improvements in the registry system do not account for a significant part of the increases in mortality observed. This claim is further substantiated by the decline or by the lack of change in mortality rates for several other causes of death during the study period. For example, mortality rates due to accidents have decreased about half during the period, deaths due to liver disease decreased by 28%, and neonatal mortality remained constant. As shown in Figure 4, SMR for cirrhosis and vascular cerebral disease (stroke) decreased during the study period. Further support for the mortality findings is the morbidity information presented, which shows high prevalences of diabetes, hypertension and hypercholesterolemia.

Epidemiologic studies indicate that the three causes

![Figure 4](image-url)
of death studied are of multiple etiologies and result from a variety of risk factors. Heredity plays a role in all, but the three causes of death share common risk factors, such as obesity, inadequate dietary intakes (high energy, fat, cholesterol and carbohydrates intake with a reduction in consumption of fruits and vegetables), and physical inactivity. Thus, modifiable risk factors such as these, becoming widespread decades before, might account for a considerable proportion of the mortality increase.

Overweight and obesity in women 18–49 years increased dramatically (78%) during the last decade. This increase is consistent with increases in mortality for the three causes considered, for which obesity is a risk factor. Moreover, obesity rates parallel mortality rates in the four regions studied. The highest prevalences of overweight and obesity in 1988 were found in the north and in Mexico City, coincident with the highest SMR during the first half of the 1980s in these regions. The changes in overweight and obesity in women from 1988 to 1999 were larger for the south and center, which is consistent with the largest increases in SMR in the same regions. Comparisons of trends in overweight and obesity for the NCCD suggest that overweight and obesity are playing an important role in the etiology of these NCCD in Mexico. This is probably the case in other Latin American countries, as well.

Obesity and NCCD Among the Poor
A widespread misconception in developing countries is that obesity and NCCD are problems associated with wealthy populations. In the view of some, including decision makers, obesity and NCCD are low priority health problems when compared with undernutrition or diseases that are associated with the poorest population. Epidemiologic data clearly show that this is not the case. For example, we analyzed the data from the National Health Survey conducted by the Mexican National Institute of Public Health on more than 45,000 adult males and females in 2000. Using information about house characteristics and possession of goods, an indicator of housing conditions was derived from a principal components analysis. The first component explained almost 50% of the total variance. The resulting standardized factor scores were divided into quintiles, which were used as housing conditions categories. We then obtained the prevalences of overweight and obesity in males and females for each quintile. The results show that the sum of overweight and obesity declines as socioeconomic conditions increase (Figure 5). Similar evidence has been published from other Latin American countries. For example, data from Chile in 1988 indicate that the prevalence of obesity in women of the lowest of three categories of socioeconomic status was twice the prevalence found in the highest income category. A similar inverse trend between socioeconomic level and prevalence of obesity was found in 1994 in Curacao. Other risk factors for NCCD are also more frequent in low socioeconomic groups. For example, a study in Brazil found that any leisure time physical activity was positively associated with socioeconomic status both in men and women. Over 30% of men from the highest socioeconomic quintile engaged in leisure time physical activity, as compared with about 8% in the lowest quintile; almost a fourfold difference. In women, the difference was even larger (about 14-fold). Other important risk factor for some chronic diseases, notably

Figure 5. Prevalence of overweight and obesity in Mexico by quintile of socioeconomic status in 2000. From reference 22.
cardiovascular diseases and several types of cancer, is smoking. In Brazil, smoking is negatively associated with socioeconomic status in both men and women. Evidence published by Martorell et al. relating obesity with education level in five Latin American countries (Haiti, Guatemala, Peru, Dominican Republic and Mexico) indicates that prevalences of obesity were higher in less-educated women in the three countries with the highest GNP per capita (Mexico, Dominican Republic and Peru) while in the countries with lower GNP (Haiti and Guatemala), obesity was highest among the more educated women (Figure 6). Similar evidence was found by Monteiro et al. in Brazil. These authors analyzed obesity trends in adult women from the 25% lowest and the 25% highest socioeconomic groups in the wealthy area of southeastern Brazil and in the poor northeastern Brazil, in 1975, 1989, and 1997. In northeastern Brazil, the poorest region, they found increasing trends for obesity in both the low and high socioeconomic quintiles. In contrast, in southeastern Brazil the trend in obesity increased from 1975 to 1997 among the lowest quintile, while in the highest quintile, a clear drop in obesity was observed from 1989 to 1997. This suggests that during that period, women from high socioeconomic conditions living in wealthy areas started to reverse the trend, probably as a result of moving to the last phase of the nutrition transition (the behavioral change stage). The results of the analysis by Martorell et al. also suggest that in countries with middle- to high-income, more educated women—who also tend to have better living conditions and more access to high-quality health information—were probably moving towards the behavioral change stage.

If our interpretation is correct, the findings are encouraging because they show that under certain conditions (availability of high-quality health information, high education, certain minimum income level) behavioral changes towards healthy lifestyles can occur in large segments of the population. However, this hypothesis remains to be tested. Even if this is the case, a question arises as to what extent it is possible to achieve behavioral changes leading to healthy lifestyles among the poor, who are experiencing increases in the prevalence of overweight and obesity. Moreover, if the Barker hypothesis holds in Latin American populations, an important question to be answered is to what extent behavioral changes may modify the association between intrauterine growth retardation and the risk of NCCD. Currently, almost 70% of Mexican-American adults are overweight or obese. Relative to other ethnic groups in the United States, Mexican Americans have the highest prevalence of overweight, and the second highest prevalence of obesity (after non-Hispanic blacks). Given the high prevalences of overweight and obesity in Mexican Americans, it is possible that prevalences will continue to increase in Mexico and other Latin American countries from the current combined prevalence of approximately 60% to the 70% observed in the United States or more, unless public health programs are implemented soon (Figure 7).

Conclusions and Recommendations
The increase in the prevalences of overweight, obesity and NCCD in Mexico, Chile, and Brazil suggest that other Latin American populations could experience a similar nutrition transition, unless preventive measures are implemented promptly.

The evidence presented here indicates that undernutrition, particularly stunting, is still a public health problem in Latin America and the Caribbean, even when this problem is declining in most countries. On the other
extreme, the prevalences of overweight and obesity are clearly increasing at a striking rate in several countries. The fact that overweight and obesity are risk factors for a number of NCCD and that the morbidity and mortality from diabetes mellitus, high blood pressure, and myocardial infarction are increasing substantially, indicates the need for immediate actions to prevent and control obesity and NCCD. There are not many successful interventions to prevent and control obesity and NCCD from which we can draw lessons. Clearly, the principal risk factors that can be modified through behavioral changes and price policies are tobacco use, unhealthy diet and physical inactivity.28 Therefore, population-based prevention programs must target those three behaviors. Some examples of integrated programs that seem to be having positive effects include one in Brazil ("Agita Brazil") and one in Chile ("Mirame" project).29

An interesting successful project that can be used as a model was the North Karelia Project in Finland, which was able to reduce the mortality rates of coronary heart disease by about 70% through a combination of promoting good nutrition and physical activity as well as implementing price and food policies aimed at promoting the consumption of healthful diets.28

We presented evidence showing an urgent need to launch regional actions and strategies in Latin America and the Caribbean to reduce the rates of growth of overweight and obesity and diet related non-communicable chronic diseases. Adequate and timely interventions have the potential to significantly reduce morbidity and mortality in Latin American populations.