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Environmental factors affecting nutritional status in urban areas of developing countries

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SUMMARY. Environmental factors affecting nutritional status in urban areas of developing countries. The demographic and economic transition that many developing countries are undergoing is producing important changes in diet and lifestyle that greatly impact on disease risks. Among the risk behaviors associated with socieconomic transition and urbanization are excessive dietary fat intake, sedentary lifestyle, smoking, and environmental contamination. Combined with a reduced infant mortality and increased life expectancy, those risk factors lead to an increasing prevalence of chronic diseases like non-insulin dependent diabetes and coronary heart disease. This disease profile is a relatively new phenomenon in developing countries, where health programs have traditionally focused on "acute" interventions such as immunization or oral rehydration. A new approach will be needed to address chronic diseases, which frequently demand a life-long and technically complex medical management, and may have significant impact on the quality of life and productivity of the population. Efforts to address this situation should focus on a) expanding the information base on diet, nutritional status and lifestyle changes in populations migrating to urban areas; b) developing and evaluating approaches for improving diet quality in urban populations, including fortification and community-based supplementation programs; c) understanding better the social and behavioral determinants of nutritional status in the urban poor; and d) defining the role of the food industry and of agricultural production for improving the quality of the food supply in urban areas.

INTRODUCTION

The demographic and economic transition that many developing countries are undergoing is also associated with important changes in diet and lifestyle that greatly impact on disease risks. Among the risk behaviors associated with socioeconomic transition and urbanization are excessive dietary fat intake, sedentary lifestyle, smoking, and environmental contamination. Combined with a reduced infant mortality and increased life expectancy, these risk factors lead to an increasing number of adults and elderly affected by chronic diseases like non-insulin dependent diabetes and coronary heart disease (1). This disease profile is a relatively new phenomenon in developing countries, where health programs have traditionally focused on "acute" interventions such as immunization or oral rehydration. A new approach will be needed to address chronic diseases, which frequently demand a life-long and technically complex medical management, and may have a significant impact on the quality of life and productivity of the affected population (2). Although non-communicable chronic diseases are still not the dominant cause of death in the poorest countries, their prevalence is increasing at a much higher rate than in industrialized countries. Worldwide, the two leading causes of death are ischemic heart disease and cerebrovascular disease, and almost 60% of these occur in the developing world (3).

In Latin America, over 80% of the population is considered urban (4). This rapid migration occurred in a relatively short period of time, and did not result from a gradual socio-economic development of rural society, but rather primarily from the pressure of external factors determined by world economic forces (5). A similar process is occurring in several Asian nations, resulting in a shift to the right of the population BMI distribution (Figure 1, ref. (6)).

THE NUTRITIONAL ECOSYSTEM IN RURAL AREAS

The nutritional ecosystem in rural areas is characterized by:

- A predominance of vegetable protein sources, usually with low micronutrient content.
- Seasonality of food availability, which causes important cycling in body weight in adults and in growth velocity in children.

Availability of certain items that may be major sources of micronutrients will also be reflected in fluctuations in nutrient status throughout the year.

- A food market system with minimal influence from marketing and commercialization techniques, but strongly affected by agricultural and food aid programs.
- High energy needs relative to intake. Physical activity patterns include farming, transporting water, and raising animals for consumption. Children may have additional energy demands as they may be incorporated into the workforce at an early age.
- High nutrient losses relative to intake, due to gastrointestinal diseases, particularly parasitoses and acute diarrhea of bacterial or viral etiology.

As a result of these unfavorable nutritional and dietary conditions, a process of adaptation takes place, consisting of reduction of growth rate in children, and a reduction in energy expenditure (reduced productivity and leisure activities). This adaptation leads to functional impairment and eventually to irreversible changes.

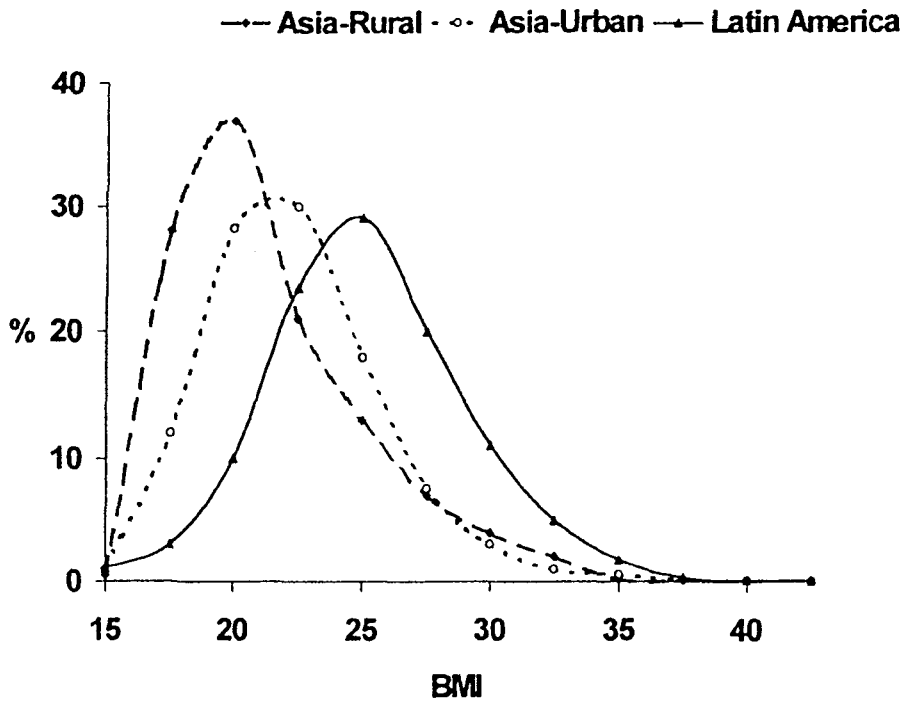
Environmental contaminants are also a factor in determining nutritional status in rural areas. Carbon monoxide is generated by indoor heating through wood fire, and it is also transferred to infants via breast milk. Use of pesticides, particularly those with residual deposition in adipose tissues of animals and humans, may pose an added risk to health and interfere with nutrient utilization or increase requirements for certain essential nutrients (7).

THE NUTRITIONAL IMPACT OF URBAN MIGRATION

Migration to urban areas is usually associated with major changes in dietary and nutritional conditions. Socioeconomic change include changes in the type of employment, and the loss of the survival system

FIGURE 1

Comparison of population distribution of body mass index (BMI) in three regions of different degree of urbanization. Data from International Clinical Epidemiology Network (INCLEN) (6)



developed over many years in the rural environment. The family nucleus is frequently disassembled in the city, with parents living separately because of work, and children spending long hours with no supervision, either locked at home or in the street. The group (clan) approach to survival in rural areas is replaced by the city's focus on the individual and the competitiveness in the street or the workplace. Some of the nutritional consequences of these changes are summarized in Table 1, and include:

- Eating behavior is less centered in the home and family, and more outside the house. Street food vendors become a major source of daily nutrient intake. This usually means cheap, low-quality foods, perhaps providing equal or more calories than rural foods but with no significant improvement in micronutrient content. As the number of meals consumed outside the house increases, the impact of intrahousehold food distribution is substantially reduced, offering little opportunity to prioritize allocation, which in many cultures tend to favor the child.
- The market forces for food commercialization become a significant factor in food availability and eating behavior. The influence of the media in food preferences is well recognized.
- Environmental contaminants of significance include lead, which enhances the risk of nutritional anemia, and several industrial pollutants. Tobacco use may be more common, aided by intense advertising and ready availability. Smoking increases the requirements for antioxidant micronutrients, and increases the risk of intrauterine growth retardation.
- Illegal drug trafficking and drug addiction are eminently urban phenomena. Victims are primarily in lower socioeconomic class, whether they are users or not, because of the intense use of slums for drug traffic operations and the frequently more aggressive involvement of police in low-income neighborhoods.
- Alcoholism is not uncommon in rural areas, but it may be more prevalent in some urban settings.
- Limited surveys tend to indicate that physical activity is reduced in the city relative to rural areas, but with much more variability. Low-energy output work is much more common in the urban workplace, and the energy expenditure required for basic survival tasks (food and water procurement, transportation) is usually much lower in the city than in the rural environment.

HEALTH AND NUTRITION IMPLICATIONS

As noted, one consequence of the changes enumerated above is a trend toward increased BMI in the overall population (6). Although carefully controlled comparisons of rural and urban dietary intake are inherently difficult to perform, a rough estimate of urban-rural differences in dietary nutrient composition can be obtained from some of the reported comparisons. We took the food consumption data published by Alarcon et al. (8) and analyzed it using the U.S. food composition database to compare the nutrient content of diets consumed by low-income families in urban and rural Guatemala. The results show that the urban diet is higher in calories, proteins, carbohydrates and fat content (Table 2). The urban diet, nevertheless, provided similar or less amounts of vitamin A, panthotenic acid, folic acid and ascorbic acid. Although the use of a generic food composition database may not reflect the actual nutrient content of food items, it nevertheless permits a restricted comparison between these two diets. The results suggest that the dietary transition towards an urban pattern of food intake may not necessarily improve

micronutrient deficits found in the rural diet.

The fact that the urban diet provides more calories, along with a reduced energy expenditure in the urban lifestyle, may lead to excessive weight gain and an increased prevalence of obesity. Indeed, there is evidence that the rate of obesity is increasing in most urban areas of the developing world (9, 10). Furthermore, some observational studies suggest that chronic malnutrition (stunting) early in life may constitute an additional risk factor for obesity in older children and adolescents (11, 12).

The etiology and mechanisms of the increased prevalence of obesity in less developed countries are still unclear, but lifestyle and diet are likely to be important factors. The association between poverty, malnutrition and risk of obesity has been a focus of interest. For many years, obesity in developing countries was a problem of the higher socioeconomic levels, but this trend is progressively reversing to a developed country model, where the condition is more common in lower socioeconomic strata. Among the socio-economic and cultural factors explaining this prevalence are less opportunities for recreational physical activities, less ability to purchase low-fat, healthier foods, and less exposure to educational messages about healthy eating practices. The possible contribution of genetic factors has also been explored. One hypothesis is that poverty and its associated food scarcity early in life may cause a

TABLE 1
Dietary and lifestyle difference between urban and rural environments

	Urban	Rural
Energy Sources	Refined grains (rice, wheat) Sugar Fiber: low	Corn, millet Unrefined sugar Complex carbohydrates Fiber: high
Protein Source	Animal	Vegetal
Fat	Higher % of calories Animal fat More saturated	Less % of calories Vegetable oils Less saturated
Processed foods	Common	Uncommon
Eating behavior	Eating out Fast foods	Family/home
Breast feeding	Low	High
Determinant of diet	Food industry State regulations	Food production Food distribution
Role of women	Workforce	Family
Type of work	Capital-intensive (low EE)	Labor-intensive (high EE)
Stress	High	Variable

permanent imprinting of the metabolic system toward a higher efficiency of energy utilization, allowing the individual to adapt to low-calorie intake. When dietary energy becomes plentiful, this higher efficiency will result in more excess calories been deposited as body fat. This theory, named the "thrifty gene" hypothesis, was put forward to explain the extraordinarily high rates of obesity among the Pima Indians of Arizona, in the United States, where almost 80% of the adult population is overweight (13). However, genetic factors are unlikely to explain the rapid rise in obesity rates in developing countries, which occurred in a relatively short time span. In addition, there is evidence that environmental factors play a major role in the rise in obesity among American Indians such as the Pimas (14), and it is likely that the same is true in developing countries.

The prevalence of obesity in children is also increasing in urban areas of the developing world (15). It is possible that children who reach school age with a deficit in longitudinal growth and find an improved availability of dietary calories (from a low-quality diet) do increase their rate of body weight gain, but do not catch-up in longitudinal growth. Such situation would tend to result in an increase in body mass index. It is also likely that these urban diets may be only marginally adequate or even inadequate in growth-related micronutrients such as zinc, which will impair longitudinal growth but may not necessarily inhibit body fat

TABLE 2
Comparison of nutrient content of urban and rural diet (Guatemala)

	URBAN	RURAL
Calories (kcal)	2395	1538
Protein (g)	74.6	51
Carbohydrates (g)	406	309
Dietary fiber (g)	52.2	52.1
Total fat (g)	61.7	26.7
Saturated fat (g)	16.3	6.9
Monosaturated fat (g)	19.9	8.73
Polysaturated fat (g)	18.6	7.96
Cholesterol (mg)	314	136
Vitamin A total (RE)	772	901
Vitamin A carotene (RE)	652	852
Vitamin A preformed (RE)	121	49.1
Vitamin C (mg)	74	69.8
Vitamin E (mg)	21.2	8.82
Panthotenic (mg)	5.12	7.48
Thiamin (mg)	1.82	1.94
Riboflavin (mg)	1.52	1.05
Niacin (mg)	21.3	18.1
Pyridoxine (mg)	1.92	1.88
Cobalamin (mg)	3.69	1.63
Folacin (mcg)	335	465
Calcium (mg)	370	140
Copper (mg)	1.45	0.995
Iron (mg)	17.8	10.2
Magnesium (mg)	528	397
Phosphorus (mg)	1543	1169
Potasium (mg)	2472	2831
Selenium (mg)	1047	38.7
Sodium (mg)	863	294
Zinc (mg)	14.8	8.91

Food intake data from Alarcon et al. (8). Nutrient content calculated from U.S. food composition database.

accumulation.

Ideally, the diagnosis of obesity in children requires an assessment of body fatness, and not only of body weight. Many developing country children with body mass index above the reference cutoff point for obesity may not have a true excess of body fat, but rather an impairment in stature associated with a normal weight. For example, a 9 year-old child with body weight in the 50th 70th percentile and height in the 5th-10th percentile for age, will have a body mass index above the 85th percentile, which is the accepted cutoff point for overweight. It is unclear whether this child has a true excess body fat for his/her age, and if so, whether the risk for chronic diseases associated with that BMI is comparable with those defined for developed country populations.

The growth pattern of urban children shows a slight improvement relative to the rural environment. Comparisons in Venezuelan children by Lopez Blanco et al (16) show that while there is a higher percentage of rural children that are malnourished (below the 10th percentile) there is a higher prevalence of overweight children in the urban area (above the 90th percentile) (Table 3).

The contribution of urban migration to coronary heart diseases can be inferred from the dramatic increase in mortality from heart diseases in still poor countries undergoing rapid urbanization. Statistics from PAHO show that attributed mortality from cardiovascular diseases is increasing at a higher rate in poor countries, compared with developed countries where incidence is stable or decreasing (4).

PROGRAMMATIC IMPLICATIONS

Health and nutrition in urban areas is a relatively new focus of concern, and still few public health programs adequately address the changing needs called for by urbanization. A major contribution of the scientific community would be to provide a solid foundation to define priorities and modify old programs in order to address the needs of the urban poor (10). Some of the key issues to be addressed should include:

1. Patterns of dietary intake in urban populations
   - Content and bioavailability of micronutrients
   - Nutrient interactions: Calcium, iron and lead
   - Oxidative load (from diet and environment)
2. Nutrient balance and output
   - Changes in nutrient requirements: increased demands of some micronutrient due to increased oxidative load, environmental toxins, etc. Impact of changes in energy balance on requirements of micronutrients.
   - Changes in nutrient losses.

In addition, more general programmatic areas would need to be revised or developed. Among these tasks we should include:

1. Improve the database on dietary intake and nutritional status by obtaining longitudinal information on changes in diet, nutritional status and lifestyle on populations migrating to urban areas.
2. Define strategies for improving diet quality in urban populations, including fortification and community-based supplementation programs.
3. Identify the social and behavioral determinants of nutritional status in the urban poor.
4. Define the role of the food industry and of agricultural production on improving the quality of the food supply in urban areas.
5. Document the role of existing programs, particularly food distribution and supplementation programs created to combat malnutrition, on current dietary trends in low-income urban populations. Identify the changes needed in existing nutrition programs to adapt to the nutrition transition, and develop new components to address emerging diet-related conditions.

TABLE 3
Growth of children in rural and urban areas

	WEIGHT/ HEIGHT		**HEIGHT/ AGE**		**WEIGHT/ AGE**	
	URBAN (%)	RURAL (%)	URBAN (%)	RURAL (%)	URBAN (%)	RURAL (%)
$> 90^{TH}$ PCT.	12.01	8.42	6.75	4.83	9.06	5.09
$10^{th} >< 90^{th}$ PCT.	78.27	78.38	76.76	68.14	72.93	67.21
$<10^{th}$ PCT.	9.72	13.19	16.46	27.02	17.99	27.69

Data from Lopez-Blanco et al. (16).

The potential impact of chronic non-communicable diseases on the health and economic progress of developing countries is enormous. Loss of quality of life and productivity, as well as increasing demand for complex medical care will seriously tax the health care system and society at large. Furthermore, the crisis affecting the technology-driven medical care of industrialized countries is sufficient to discourage any attempts to imitate that model to address this problem. Only a prevention-focused health policy may have a positive impact, by reducing the rate of these diseases. Toward this goal, diet and nutrition efforts should clearly play a major role.

REFERENCES

1. Popkin, B. The nutrition transition in low-income countries: an emerging crisis. Nutr Rev, 52:285-298 1994.
2. Murray, CJL & Lopez, AD. The Global Burden of Disease. Cambridge, MA: Harvard University Press, 1996.
3. Editorial. From what will we die in 2020? Lancet, 349:1263, 1997.
4. PAHO. Health Conditions in the Americas. Washington, D.C. Pan American Health Organization, 1996.
5. Albala, C & Vio, F. Epidemiological transition in Latin America: the case of Chile. Pub Health, 109: 431-442, 1995.
6. INCLEN. Body mass index and cardiovascular disease risk factors in seven Asian and five Latin American centers: data from the International Clinical Epidemiology Network (INCLEN). Obesity Res, 4: 221-228, 1996.
7. Caballero, B. Nutritional implications of dietary interactions: a review. Food Nutr Bull, 10: 9-20, 1988.
8. Alarcon, JA & Adrino, FJ. Diferencias urbano-rurales en la inges ta de alimentos de familias pobres de Guatemala. Arch Latinoamer Nutr, 51: 327-335, 1991.
9. Pena, M & Freire, WB. Informe de la reunion tecnica sobre obesi dad en la pobreza: situacion de America Latina, 1996. (abst)
10. WHO. Diet, Nutrition, and the Prevention of Chronic Diseases. Geneva: World Health Organization, 1990.
11. Sawaya, AL; Dallal, G; Solymos, G; de Souza, MH; Ventura, ML & Roberts, SB. Obesity and malnutrition in a shantytown popula tion in the city of Sao Paulo, Brazil. Obesity Res, 3:107S-115S, 1995.
12. Popkin, B; Richards, MK & Monteiro CA. Stunting is associated with overweight in children of four nations that are undergoing the nutrition transition. J Nutr, 126: 3009-3016, 1996.
13. Harrison, GG & Ritenbaugh, CK. Obesity among North American Indians. In: Bjorntorp P, Brodoff B (eds). Philadelphia, Lippincott Co. 1992, p. 610-618.
14. Ravussin, E; Valencia, ME; Esparza, J; Bennett, PH & Schulz, LO. Effects of a traditional lifestyle on obesity in Pima Indians. Diabetes Care, 17:1067-1074. 1994.
15. Arteaga, H; Dos Santos, JE & Dutra de Oliveira, JE. Obesity among schoolchildren of different socioeconomic levels in a devel oping country. Intl J Obesity, 6: 291-297, 1982.
16. Lopez-Blanco, M; Landaeta Jimenez, M & Mendez Castellano, H. Urban-rural differences in the growth status of Venezuelan chil dren. Am J Hum Biol, 4:105-113.1992.