

## Review Article

**Nutrition-related health patterns in the Middle East\***

Osman Galal MD, PhD

*Secretary General, International Union of Nutritional Sciences*

Nutritionally-related health patterns in the Middle East have changed significantly during the last two decades. The main forces that have contributed to these changes are the rapid changes in the demographic characteristics of the region, speedy urbanization, and social development in the absence of steady and significant economic growth. Within these changes, the Middle East has the highest dietary energy surplus of the developing countries. The population in the region has a low poverty prevalence, at 4%. The region's child malnutrition rate is 19%, suggesting that nutrition insecurity remains a problem due mainly to poor health care and not due to inadequate dietary energy supply or poverty. The one extreme country, Afghanistan, has an extremely high dietary energy deficit of 490 kilocalories and a 40% malnutrition rate. Iran and Egypt have relatively high child malnutrition rates of 39 and 16% respectively, but belong to the dietary energy surplus group. Morocco and the United Emirates have the lowest child malnutrition rates of 6 and 8% respectively. In the Middle East, as in other parts of the world, large shifts have occurred in dietary and physical activity patterns. These changes are reflected in nutritional and health outcomes. Rising obesity rates and high levels of chronic and degenerative diseases are observed. These pressing factors that include the nature and changes in the food consumption pattern, globalization of food supply, and the inequity in health care will be discussed.

**Key Words:** Middle East, food security, nutrition transition, health, Middle East, Egypt**Introduction**

The present paper will address nutritional-related health patterns in today's Middle East. It will focus mainly on selected aspects of this broad area, somewhat broader than just North Africa, itself. The general approach taken here is to conceptualise health patterns in the Middle East in terms of major changes in political, social and economic happening during the last three decades. The 16 nations listed in Table 1 represent the extension of the region as defined for this paper.

The Middle East region is known as a highly diversified region in the world in terms of ecology (green valleys and dry yellow deserts), political structures (republics, monarchies) and stability (conflicts, civil wars and unrest), and economic diversity (including countries that classify as among the world's richest and poorest). Health and nutritional status of this region are determined by all these factors. Resource issues that impact on the quality of daily life for people in the region are primarily centred in food supply and education, and the availability and utilization of effective preventive and curative health services, sanitation, and safe clean water. Topping the list are those which manifest themselves as problems of food security, mainly agricultural and water resources, and economic policy resources. These two areas - food security and public health - not only overlap, but are often the centre of political life in the countries of the area, and sometimes instrumental in its shaping.

Rapid urbanization is another characteristic in the most populous countries in the region (Human Development Report 2002).<sup>1</sup> Kuwait and Qatar are 100% urban countries, whereas Yemen is still only 25% urban. The

rate of urbanization in the Middle East is proceeding very fast in most of the countries in the region. Figure 1 shows the percentage of urbanization in the different countries in the region. Urbanization is having a major impact on health and nutrition in several countries especially, in their biggest cities. The Middle East includes at least two megacities, Cairo and Tehran, three largest if we include Istanbul, and a large number of medium-sized urban cities.<sup>2</sup> The cities have grown at a faster rate than the surrounding countryside due to in-migration, and this trend tends to be accentuated during recessionary economic times. The population of Cairo now stands at 15 million, and we know of the serious plans for controlling growth; hence growth is unstoppable.

The demographic of the region are characterized by high crude birth rates and as a consequence, have a broad-based age pyramid.<sup>3</sup> The populations of the Middle East are young populations, typically with about half of them under the age of 15 years. The proportion of elderly is small, but expected to double in most countries in the area over the next decade. Population growth rates vary from somewhat over replacement to more than 3.5% per year, and the region includes some populations with among the

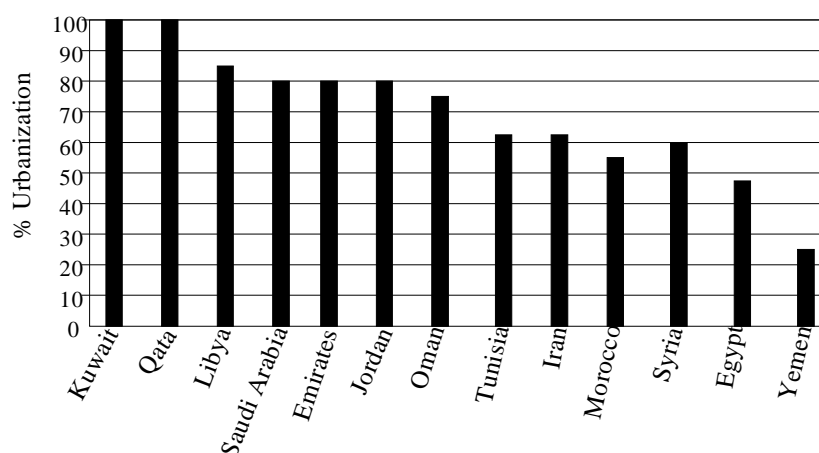
**Correspondence address:** Dr Osman Galal, Public Health, Department of Community Health Sciences, 650 Charles E. Young Drive South, Room 36-081CHS, Los Angeles, CA 90095-1772, USA

Tel: + 1 310-206-9639; Fax: + 1 310-794-1805

Email: ogalal@ucla.edu

Accepted 30 June 2003

\*Presented at Symposium on "North & West African Foods and Health" February 8<sup>th</sup> 2003, Marrakech, Morocco



**Figure 1.** Percent of urban population

shortest doubling times in history (for example, the occupied Palestinian territories are currently estimated to have a population doubling time of 16 years).<sup>4</sup> Population density varies from sparse in desert populations to among the highest in the world. Even within the relatively small population of the occupied Palestinian territories, there is a stark contrast in living environment with a population density of 200/km<sup>2</sup> in the West Bank and 2100/km<sup>2</sup> in the Gaza Strip. This crowding is seen also in some other areas of the region; for example, some neighbourhoods in Cairo have population densities that exceed 3000/km<sup>2</sup>.

Life expectancy at birth has increased dramatically in the region during the last twenty five years but still varies widely, from about 59.2 years in Yemen to more than 75 years in Kuwait (Table 1). Life expectancy increased in

**Table 1.** Life expectancy rate at birth in the Middle East (1975 and 2000)

Country	Life expectancy in 1975 (years)	Life expectancy in 2000 (years)
Algeria	54.5	70.5
Bahrain	63.5	72.9
Egypt	52.1	69.3
Emirates	62.5	71.6
Iran	53.9	69.0
Jordan	56.6	70.0
Kuwait	67.3	76.5
Lebanon	65.0	71.3
Libya	52.9	66.5
Morocco	52.9	69.5
Oman	49.0	73.5
Qatar	62.6	74.4
Saudi Arabia	53.9	71.4
Syria	57.0	69.9
Tunisia	55.6	17.9
Yemen	42.1	59.2

the region by more than 10 years in all countries in the region within 25 years.<sup>5</sup> This is an increase of half a year approximately every calendar year. During that period life expectancy in Libya, for example, increased by approximately more than 15 years. In Oman, the increase of life expectancy was one year every calendar year. This dramatic increase in life expectancy demonstrates the general improvement in quality of life in the region. Oman is an example of the revolutionary changes in health services and great improvement in health indicators.

Environmental deterioration and pollution are not imposing very serious constraints to population growth in the region's cities, serious as problems are in the long run of increasing environmental burdens of lead poison, air pollution, noise and water pollution. Urban slums, which typically provide inadequate housing, services and infrastructure, grow at much faster rates than cities as a whole.<sup>6</sup> While urbanization usually is associated with better health and better food supply, there is some evidence that being a poor urban dweller in the Middle East's major cities is worse for quality of life than being a rural citizen.

In an analysis of morbidity and mortality rates in children in several countries including Bolivia, Swaziland, Egypt and Cameroon, only Egypt showed average rates of malnutrition, diarrhoea, fever, and other illnesses to be higher for urban than rural children. Exactly the opposite differential is shown for other less-developed countries. Availability of safe water to the population and the progress of sanitary technologies in countries of the region are major determinants of health. Table 2 shows that safe water availability in the region varies among countries. Kuwait, Lebanon and Tunisia are the only countries in the region that covers all the population with access to safe water and access to waste disposal sanitation.<sup>3</sup> In 1982-85, Egypt provided 60% of its population with safe water and in 1990-96 it covered only 64% of its population with safe water and 11% with sanitation.<sup>5</sup> This is due to the rapid population growth

**Table 2.** Safe water and sanitation

	Access to safe water sources (% of population)		Access to sanitation (% of population)	
	1982-85	1996-99	1982-85	1996-99
Egypt	60	77	--	70
Iran	71	92	65	86
Jordan	89	97	91	60
Kuwait	100	100	100	100
Lebanon	92	86	75	79
Saudi Arabia	91	93	86	86
Syria	71	82	45	72
Tunisia	89	89	52	80

during that period with which expansion of services could not compete.

Table 3 shows the sharp decline in infant mortality rate among countries in the region between the years 1970 and 1999. In Bahrain, for example, the decline was from 55/1000 live births in 1970 to 7.7/1000 live births in 1999. Egypt infant mortality rate went down from 157/1000 to 27.2/1000 during the same period. Yemen retains the highest infant mortality rate in the region.<sup>5</sup>

Political and socioeconomic changes in the Middle East have brought about changes in lifestyle including major changes in dietary pattern, the results of which are evident from the health indicators. The health and nutrition transition is taking place in the context of rapid demographic change, urbanization and social development, but it is happening in the absence of steady and significant economic growth. Health dynamics in the Middle East, as in other parts of the world, have shifted in an accelerated manner, from a high mortality spectrum to one of lowered mortality rates, longer life expectancy, and high morbidity. The single greatest achievement of the modern world has been the major reduction in death rates nearly everywhere and with it a very substantial increase in life expectancy.<sup>7</sup> The Middle East is no exception.

**Table 4.** Agriculture indicators

	Percent land under permanent cultivation		Percent of land under irrigation		Food production index (1989-1991=100)	
	1980	1997	1979-81	1995-97	1979-81	1996-98
Algeria	0.3	0.2	3.4	6.9	67.6	129.4
Egypt	0.2	0.5	100.0	99.8	68.0	139.7
Iran	0.5	1.0	35.5	37.7	61.1	144.7
Jordan	0.4	1.5	11.0	19.5	57.3	152.5
Kuwait	--	0.1	--	75.4	93.2	161.2
Lebanon	8.9	12.5	28.3	36.0	59.2	138.2
Saudi Arabia	0.0	0.1	28.9	42.3	26.7	78.8
Syria	2.5	4.1	9.6	20.5	94.2	148.7
Tunisia	9.7	12.9	4.9	7.6	67.6	121.4
Yemen	0.2	0.2	19.9	31.3	75.0	120.7

**Table 3.** Infant mortality rate (IMR) in the Middle East (1970 and 1999)

Country	IMR 1970 (out of 1000 births)	IMR 1999 (out of 1000 births)
Algeria	123.0	36.0
Bahrain	55.0	7.7
Egypt	157.0	27.2
Emirates	61.0	8.6
Iran	122.0	26.0
Jordan	77.0	31.0
Kuwait	49.0	9.4
Lebanon	45.0	26.0
Libya	105.0	24.4
Morocco	119.0	36.6
Oman	126.0	16.7
Qatar	45.0	11.7
Saudi Arabia	118.0	21.0
Syria	90.0	24.0
Tunisia	135.0	28.9
Yemen	194.0	75.3

The dietary components come into play and both during childhood and adulthood, major roles in predisposing individuals to illness and premature death. Poor dietary habits can within a relatively short time lead to various types of morbidity. Good dietary habits and a diet that is safe and balanced can enhance the growth of children, improve immunological competence to overcome infections, sustain optimal cognitive function and contribute to a healthy reproductive system. Very simply, good health is in large part a reflection of a viable safe food supply and good nutritional status.<sup>8</sup>

#### Availability of food in the Middle East

Problems of undernutrition and micronutrient deficiencies still dominate the public health nutrition agenda in the Middle East. In some countries in the region inadequate food consumption and malnutrition are partially responsible for much innocent suffering.<sup>9</sup> This is due to insufficient supplies of food at a national level in one or two countries in the region and partly due to the nature of the land in countries that are mostly arid and desert.<sup>10</sup>

Governments are investing efforts to increase agricultural productivity and to reclaim new land for agricultural production. Table 4 shows the vast efforts in Lebanon and Tunisia to increase their land under permanent cultivation. Syria also exerted similar efforts and increased its land under permanent crop production from 2.5% to 4.1%. Rest of the countries in the Middle East exerted some efforts in the same direction. All countries in the region increased dramatically the irrigated lands. Most of countries introduced programs for land reclamation, which did increase food productivity. Table 4 shows that the food production index increased in all countries in the Middle East during the period from 1978-81 to 1996-98. Projects of land reclamation in the area are progressing in a satisfactory manner.<sup>11</sup>

At a more micro-level, food insecurity in parts of the region often results from social conditions including political instability, war and civil strife, macroeconomic imbalances and trade dislocations, environmental degradation, poverty, population growth, gender inequality, inadequate education and poor health. By and large, these are the root causes of food insecurity in the region today. It is the inability of people to gain access to food due to the cited causes.<sup>12</sup> The problems of insufficient access of food by households, individuals or both are generally not due to lack of national food availability, as the food balance sheets of Middle East countries show the adequacy and even surplus of availability of food. Food production programs in the region were very successful in increasing the food in the area.<sup>13</sup>

Three indicators are often used to locate food insecurity and identify its causes. The first, the daily per capita dietary energy balance (DEB), is used as a measure of national food availability and gives the sufficiency of countries' dietary energy supplies (DES) for meeting the energy requirements (DER) of their populations if such dietary energy were distributed among people according to their requirements.<sup>14</sup> The Middle East region has the highest dietary energy surplus of all developing-country regions, estimated to be at 810 kcal/capita/day, although

there is large variability across countries ranging from substantial deficit to major surplus (Table 5).

The second indicator is a measure of income-based absolute poverty, a proxy for people's ability to access food.<sup>15</sup> A country's absolute poverty rate is the proportion of people whose income is less than the equivalent of one dollar per day. Such people are unlikely to be able to meet their sustainable food needs even if food is available in the country. Income calculations in the Middle East as a region show a low poverty prevalence, at four percent if compared with other regions in the world, suggesting that food insecurity due to poverty is not a major problem in the majority of population with the four percent exception.

The third indicator, child malnutrition, is a measure of Middle East region's child malnutrition rate which is nineteen percent, suggesting that nutrition insecurity remains a problem.<sup>16</sup> If poverty and food national availability are not strong causes for food insecurity among children, it is reasonable to believe that malnutrition is due to poor health or inadequate health care. Within the region, Afghanistan has an extremely high dietary energy deficit of 490 kcals and a forty percent child malnutrition rate. Iran also has a relatively high child malnutrition rate of thirty-nine percent (Table 5).<sup>17</sup>

Employing these three food security indicators, child malnutrition, absolute poverty, and dietary energy availability data, it is possible to construct a chart of food insecurity and to identify its basic causes in the Middle East Region. Data suggests that lack of health services for children is a stronger contributing factor for malnutrition than either poverty or unavailability of food.

#### Identifying food-insecure households

Recent experience from Egypt in identifying and monitoring household-level of food insecurity was based on a large food consumption survey implemented in 1994, covering a sample of more than 6000 households in five of the developed to incorporate several questions designed to identify country's twenty-four governorates.<sup>18</sup>

**Table 5.** Percentage of child malnutrition and dietary energy supply (1990-1992)

Country	Predicted prevalence of child malnutrition (underweight)	Dietary energy supply	Dietary energy balance
	%	per capita kcals/day	per capita kcals/day)
Afghanistan	40.3	1,660	-490
Algeria	9.2	2,900	750
Egypt	10.4	3,340	1,190
Iran	39.0	2,760	610
Iraq	11.9	2,270	120
Jordan	6.4	2,900	750
Kuwait	5.0	2,460	310
Lebanon	8.9	3,260	1,110
Libya	4.0	3,290	1,140
Morocco	12.0	2,730	850
Saudi Arabia	12.6	2,730	580
Syria	12.5	3,220	1,070
Tunisia	8.9	3,260	1,110
Turkey	10.5	3,510	1,360
United Arab Emirates	7.0	3,370	1,220
Yemen	30.0	2,160	10

The questionnaire was household-level food insecurity. The majority of sample households (60.1%) responded positively to a question "Has your household changed the foods you eat in the last year due to rising prices of food?" Thirty-five percent of households in greater Cairo reported having changed their food intake due to rising prices, almost half (49.7%) in Dakahlia, and much higher numbers in the other governorates (73.9% in Ismailia, 86.3% in Aswan, and 87.8% in New Valley). Almost half of households (47.8%) indicated that they spent more than three-quarters of their household cash income on food. The survey also incorporated a question about how additional income would be spent: "If additional income were available to your household, what would it be used for?" Twenty-one percent of household gave a response which included food items (Table 6).

Household food security variables were linked to socio-economic status as measured by adult education. Table 7 and 8 show the percentage of positive responses to two such questions by educational status of the female survey respondent. Similar correlations exist with education of the household head.

The survey also asked several other questions designed to access coping behaviours for food shortage, namely the number of meals eaten yesterday by the household and the disposition of leftovers (both bread specifically and others). None of these questions served to identify households suffering from food insecurity by the more basic measures mentioned above.

The survey results created a "food security" variable as follows: food insecure households are defined as those that reported both spending more than three-quarters of their income on food and said they would use additional income for food. Food-secure households are defined as those that both reported spending less than one-half of

**Table 6.** Percent of households responding to food security questionnaire

Food security class	Percent of households
Food secure (spend less than 50% of household income on food, and would use additional income on nonfood items)	5%
Potentially at risk of food insecurity (have changed food consumption in the last year due to rising food prices)	60%
At risk of food insecurity (spend more than 3/4 of household income on food)	48%
Self-perceived poor dietary quality (would spend additional income on meat or on more fruits and vegetables)	21%
Food insecure (spend more than 3/4 of household income on food and would spend additional income on meat or on more fruits and vegetables)	11%

their income on food and did not include food in their responses to the hypothetical increased-income question. This analytical approach identifies a household on the extreme ends of the food-security continuum, in a population in which most households are at some risk of food insecurity based on the proportion of income spent on food. The definition we have used is tied to currently accepted definitions for food security<sup>19</sup> which include sustained access in socially acceptable ways to gain both enough food and an adequate quality of food for health; thus it includes those households who indicated that they would improve the quality of their diets (e.g., by purchasing more meat, or more fruits and vegetables) if they had additional income.

Using the aforementioned definitions, the proportion of food-insecure households ranged from 4.7% in Ismailia to 21.6% in Dakahlia (Table 9). The very high prevalence of food insecurity in the Delta and in Aswan are particularly noteworthy; the lower prevalence in New Valley may be related to greater home-based production of food in that governorate. Of considerable importance is the very low proportion of households defined as "food secure" (ranging from 2% in Aswan to 6.6% in Cairo).

#### Diet related health problems

In general by most projections, both food and nutrition insecurity are on the decline in most of the Middle Eastern countries. Surplus of energy availability is rising. Child malnutrition in the Middle East is falling rapidly, at around one percentage point per year. It is declining more slowly in areas where land is arid and where political unrest is sustained. At the same time, however, diet-related chronic diseases of adulthood are on the rapid ascending prevalence. Most policy makers in the region are not yet aware of that fact. Much needs to be done to draw the attention of policy makers.

**Table 7.** Proportion of household income spent on food by educational status of female survey respondent

Educational status of female survey respondent	Percent reporting that >3/4 of household income is spent on food
Illiterate	52.7
Reads and writes	51.3
Primary or secondary education	41.7
Higher education	33.4

**Table 8.** Educational status of female survey respondent by response that hypothetical additional income would be spent on food

Educational status of female survey respondent	Percent reporting that >3/4 of household income is spent on food
Illiterate	26.3
Reads and Writes	19.9
Primary or Secondary Education	16.9
Higher Education	12.0

**Table 9.** Prevalence of food security and of food insecurity of sample households by governorate in Egypt

Governorate	Percent of food insecure†	Percent of food secure‡
Cairo	7.3	6.6
Ismailia	4.7	3.8
Dakahlia	21.6	2.9
Aswan	18.6	2.0
New Valley	8.0	4.0

† Households reporting spending more than 3/4 of cash income on food and including food in the response to a question about what uses would be made of any additional income.

‡ Households reporting spending less than 50% of cash income on food and omitting food in the response to a question about what uses would be made of any additional income.

Dietary risk factors, in general, are starting to be the major concern of nutritionists nowadays in the Middle East. The nutrition transition in the Middle East has occurred in the context of abundant dietary energy availability, urbanization and moderate fat intakes on average (22% of dietary energy in rural areas and 27% in urban). In some countries in the Middle East, examples being Egypt,<sup>20</sup> Iran,<sup>21</sup> and Morocco,<sup>22</sup> "nutrition transition" is in its early phase (Table 10). Obesity and obesity-related chronic diseases are emerging, particularly in urban areas. Urbanization is proceeding in the region that might reach approximately 80% of the population in another 20 years. The prevalence of obesity among adults is very high, particularly among women. The prevalence of diabetes mellitus and of hypertension parallel that of obesity and both are very high. Little information is available on physical activity, but it is likely that a large proportion of the population is quite sedentary, particularly in the cities. At the same time, rates of childhood malnutrition remain stubbornly stable and relatively high. The 'double burden' of obesity and malnutrition is clearly evident.

Public awareness of the increasing prevalence of obesity and of diet-related chronic disease is increasing, and attention has turned to documenting the problem(s). Today policy-level awareness in the health sector is disease-specific with little attention to unified underlying

causes. However, there is growing recognition in the agricultural and education sectors of the necessity for better nutrition 'awareness' and guidance toward healthful dietary choices and physical activity in the population. The fact that greatly increased food production over several decades has not eliminated malnutrition has turned attention to the general influence of diet on the health of the population, and there is some progress, in the very recent past, to a comprehensive approach to dietary guidance and health promotion.

### Discussion

Urbanization, population growth, major shifts in diets and, in all probability, reduced physical activity have put an accelerated nutrition transition into motion during the 1980s and predictable health effects have emerged during the 1990s. The dietary profile over the last two decades has been influenced on the one hand by untargeted subsidies for dietary energy and on the other by continuously rising food prices. The important results are access to adequate dietary energy by 80% of households, but a dietary pattern characterized by over-consumption at higher income levels and low nutrient density across the board. A recent analysis showed that two to three times as much from food subsidies compared with households in the bottom third of the income distribution. A 1995 study in Tehran showed that among households in the upper 50% of income, where income is in no constraint to diet, satisfaction of needs for key nutrients in the diet was only possible at energy levels of 3000 kcal day.<sup>1</sup> In other words, low nutrient density is not entirely an income-driven issue.

The question arises as to the reasons behind the rising and high prevalence of obesity among Middle Easterners and particularly women. Although overweight and obesity are apparently still increasing in prevalence, the phenomenon has been evident for at least 20 years. The 1981 Egyptian National Food Consumption survey included measurements of the mothers and fathers of sampled children and reported 63.1% of mothers and 14.5% of fathers to be overweight or obese (i.e. >110% of the standard weight) at that time. The combination of urban living and an abundant food supply does not, by itself, provide the entire explanation. It is very likely that the

**Table 10.** Prevalence of stunting, underweight, wasting, and overweight in Egypt, Iran, and Morocco

Condition		Iran			Egypt		Morocco		
		Urban %	Rural %		Urban %	Rural %	Urban %	Rural %	
Stunted	Boys	20.00	29.30	Children	28.00	36.40			
	Girls	17.00	29.20						
Underweight	Boys	14.00	22.90	Children	9.60	16.00	Women	7.90	10.50
	Girls	17.00	14.20				Men	10.60	10.90
Wasted	Boys	9.50	12.30	Children	3.00	5.20			
	Girls	11.30	12.00						
Overweight	Boys	11.00	6.90	Women	30.08	26.90	Women	31.10	25.80
	Girls	9.00	7.30		Men	26.72	24.28	Men	24.10

cultural preference for female plumpness (only recently beginning to change) coupled with physical and cultural barriers to physical activity make the difference. For example, the recent predominance of apartment buildings higher than six floors (the threshold requiring the installation of elevators) means that fewer families live in buildings requiring or even permitting stair climbing. Organized 'sporting clubs' are confined to the higher socio-economic classes, and in any case seldom encourage much activity on the part of women; there is a lack of physical education in schools; and there is an absence of women's participation in sports in general. Similar cultural barriers to physical activity have been noted in relation to the very high prevalences of obesity among adult women in Saudi Arabia. An active lifestyle for both men and women is not so easy to promote in the Middle East, particularly in the context of its health benefits, but so far there has been little attention to this particular problem.

#### References

- Human Development Report 2002, United Nations Development Programme, New York: Oxford University Press, 2002.
- Galal O, Harrison G. The crowded metropolis: health and nutrition in Cairo. In: Bonim M, ed. Population, poverty, and politics in Middle East cities. Florida: Florida University Press, 1997.
- Barlow R. Health trends in the Middle East, 1950-95. In: Brown J, Barlow R, eds. Studies in Middle Eastern health. The University of Michigan, Centre for Middle Eastern and North African Studies. Michigan Series on the Middle East. University of Michigan Press, 1999, Number 3; 1-28.
- Giacaman R. Married women, family size, and fertility behavior. Palestinian Conference on Population and Family Planning, 1-3 April, 1994, Cairo.
- The Works of WHO in the Eastern Mediterranean Region Annual Report. Regional Director, 1 January-31 December 2000. WHO EMRO-600, 2001.
- Gopalan HNB, Saksena A. Domestic environment and health of women and children. United Nations Environment Program (UNEP), 1999.
- Caballero B, Popkin B. Introduction. In: Caballero B, Popkin B, eds. The nutrition transition. Food and Science and Technology Series. Academic Press, Elsevier, 2002; 1-6.
- Sherman A. Alteration in immunity related to nutritional status. *Nutr Today* 1996; July-August: 7-13.
- Maxwell DG. Food security: a post-modern perspective. *Food Policy* 1996; 21(2): 155-70.
- Frankenberger T, Oshaug A, Smith L. A definition of nutrition security. CARE memo. Atlanta: GA, 1997.
- FAO Report 2000. Food and Agricultural Organization of the United Nations (FAO), 1996. The Sixth World Food Survey. Rome: FAO, 1996.
- Dasgupta P. The population problem: Theory and evidence. *Journal of Economic Literature* 1995; 33 (December): 1879-1902.
- Pinstrup-Andersen P. World food trends and future food security. In: Food Policy Report (March), International Food Policy Research Institute, Washington, D.C. 1994.
- Smith L, Obeid A, Jensen H, Johnson SR. In: Food security: New solutions for the twenty-first century. eds; Obeid A, Johnson S, Jensen H, Smith L, eds. Iowa State University Press/AMES, 1999; 73-105.
- World Bank. World development indicator. Washington D.C.: The World Bank, 1997.
- Casey, P. H, Szeto, K., Lensing, S., Bogle, M., and Weber, J., Children in food-insufficient, low-income, families: prevalence, health and nutrition status. *Archives of Pediatrics & Adolescent Medicine* 2001; 155 (4): 508-514.
- Nutrition throughout the life cycle. In: 4th Report of the World Nutrition Situation. Sub-committee on Nutrition. ACC/SCN, 2000.
- Khorshid A, Ibrahim N, Galal OM, Harrison GG. Development of food consumption system in Egypt. *Adv Agric Res Egypt* 1998; 1(3); 163-217.
- Life Science Research Organization (LSRO), 1990.
- Galal OM. The nutrition transition in Egypt: Obesity, undernutrition, and the food consumption context. *Public Health Nutrition* 2002; 5(1A): 141-148.
- Gassemi H, Harrison G, Mohammad K. An accelerated nutrition transition in Iran. *Public Health Nutrition* 2002; 5 (1A): 149-155.
- Bengellom S. Nutrition transition in Morocco. *Public Health Nutrition* 2002; 5(1A): 135-140.