

Original Article

Nutrition transition in the Republic of Korea

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Accelerating epidemiological transition and concurrent shifts in diet, activity and body composition are universal trends, especially in middle- and lower-income countries. A unique nutrition transition has occurred in the Republic of Korea, a country that modernized earlier than most Asian countries. This analysis attempts to describe the nutrition transition in the Republic of Korea, focusing on specific features that other countries may follow to retain the healthy elements of their traditional diets. The analysis uses secondary data on economics, dietary intake, anthropometry and causes of death, including a series of comparable nationally representative dietary surveys (the National Nutrition Survey). The structure of the economy of the Republic of Korea, along with dietary and disease patterns, began an accelerated shift in the 1970s. Major dietary change included a large increase in the consumption of animal food products and a fall in total cereal intake. Uniquely, the amount and the rate of increase in fat intake have remained very low. The Republic of Korea also has a relatively low prevalence of obesity compared with other Asian countries with similar or much lower incomes. The nutrition transition in the Republic of Korea is unique. National efforts to retain elements of the traditional diet are thought to have shaped this unique transition in the Republic of Korea in the midst of rapid economic growth and introduction of western culture.

Key words: anthropometry, causes of death, diet, economic growth, fat intake, National Nutrition Survey, nutrition transition, obesity, Republic of Korea.

Introduction

The epidemiological transition, particularly the rapid shift in morbidity and mortality patterns towards much higher non-communicable disease rates, is dominating the health profile of an increasingly large number of people in middle- and lower-income countries. Concurrent shifts in diet, activity and body composition also appear to be accelerating in many regions of the world.¹ This analysis provides an understanding of the multidimensional phenomenon of the nutrition transition, a sequence of characteristic dietary and nutritional patterns resulting from large shifts in the overall structure of diet, related to changing economic, social, demographic and health factors² in the Republic of Korea, a country that modernized earlier than most Asian countries but kept its unique features. While others have discussed aspects of the transition in the Republic of Korea,^{2–6} this study broadly reviews the transition to provide a thorough understanding of the transition and insights into directions other countries may follow in order to retain more of the healthy elements of their traditional diets.

Unlike the gradual transition that occurred in the US and most European countries, the rate of nutrition transition in many lower-income countries has been rapid. Information from Asian countries such as Japan, China and Thailand, as well as from South Africa and the Caribbean, shows a very accelerated change in the structure of diet once these countries attain dietary sufficiency at the national level.^{1,2,7} In Asia, the impact of economic factors on nutrition transition has been particularly apparent.^{1,8} Japan experienced a rapid shift in its dietary structure during the period of accelerated

economic growth from 1950 to 1970.² China is experiencing an even more rapid shift in diet, especially among its urban residents.^{9,10} Concurrent with these transitions, obesity is increasing in most Asian nations.¹¹

The Republic of Korea experienced earlier economic change than most Asian countries. Its economy grew at an impressive rate during the past three decades, following recovery from the Korean War (1950–1953). Concurrent changes in lifestyle included the rapid introduction of elements of what may be termed a western lifestyle. Fast-food restaurants were introduced and became popular, especially among the younger generation. Other elements in the Republic of Korea were, however, fighting to retain traditional forms. Movements arose to keep traditional dietary patterns and staples. This combination of the rapid introduction of western culture and technology and the fight to retain many traditional elements, which resulted in the unique shape of the nutrition transition in the Republic of Korea, may provide insights important for many other countries. A series of comparable nationally representative dietary surveys was used to provide a more coherent picture of the nutrition transition in the Republic of Korea than we can find for most countries.

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Methods

This analysis synthesized secondary economic, dietary intake, anthropometry and cause-of-death data from published reports and papers.

Economic data

Data on workforce structure were obtained from the National Statistical Office.¹² For economic trends, we used national income data from the official estimates of gross national product per capita (GNP; Atlas method) from 1962 to 1996 as established by the World Bank.¹³ The GNP per capita was expressed in 1996 US dollars adjusted for inflation based on consumer price indices¹⁴ to allow for an easier comparison across the years. Urbanization data also came from the World Bank.¹³

Dietary data

Nutrition data were obtained from the most recent published report of the National Nutrition Survey,¹⁵ which has been conducted annually by the Ministry of Health and Welfare since 1969.¹⁶ All surveys were conducted nationwide among independent persons who were not institutionalized. Surveys were undertaken during a 1 month period between August and November each year. Sample households were selected to be representative of the nation since 1975, using either multi-stage stratified sampling or multi-stage cluster sampling or sampling with probability proportional to size, the method depending on the year. The number of households surveyed ranged from 543 to 2000 before 1988. The sample size was kept at 2000 households nationwide after that time. For dietary intake data, a trained interviewer weighed everything the surveyed household members ate at home for 2 consecutive days. Nutrient values were calculated using food composition tables from the Rural Development Administration and Rural Nutrition Institute^{17,18} that was the most recent available for the survey in question.

As with any nutritional survey, the National Nutrition Survey has limitations.¹⁶ It is almost impossible to measure usual diet by a weighed method in a free-living population. Even though weighing eliminates the main problems inherent in dietary assessment methods, such as inaccuracy of recall and under- or over-reporting, it is invasive enough to alter people's usual intake. In addition, estimation methods are inaccurate. Skipped meals or meals taken away from home were not included in the measure of total household consumption. Because adult males are the major group who eat out, while children, the elderly and housewives tend to eat at home, per capita intakes do not reflect the intake of household members equally and may underestimate the true intake. In addition, because all household members in urban areas tend to have breakfast, the lightest meal of the day, at home, assigning the same weight to each meal probably caused underestimation of the intakes. Flaws in the food composition table, including an incomplete list of newly introduced processed foods and specific varieties, as well as out-dated methods of nutrient analysis, were also weaknesses. In addition, as with even the best household weighing data, some foods were not measured, especially alcohol and herbal foods often used for health-related purposes. These omissions may result in underestimating dietary intake.

The most recent report of the National Nutrition Survey,¹⁵ which summarizes survey data from 1969 to 1995, reported dietary intake data only in per capita terms. This limitation does not allow us to adjust for the fact that the population of the Republic of Korea has aged. This inability to adjust for age composition means that we will underemphasize trends related to decreased intake and overemphasize trends related to increased intake.

Other published papers describing nationally representative nutritional intake in earlier periods were also used to examine dietary trends.^{19–23} To compare the fat intake in the Republic of Korea with that in other Asian countries, we also included comparable national household food consumption survey data from China²⁴ and Japan.^{25,26}

Anthropometric data

A number of studies that presented the mean height and weight of adults were available.²⁷ We focused on the shift towards greater obesity and reported the body mass index (BMI; in kg/m²) distribution from the National Nutrition Survey Report. Unfortunately, information on the distribution of BMI was not included in the National Nutrition Survey Report until 1990. Data that incorporated international standards for measuring obesity were available only for 1995, in the form of BMI distribution data for adults aged 20 years and older. Therefore, we chose to present only 1995 BMI data for adults of the Republic of Korea and included comparable obesity data from other Asian countries to compare the prevalence of obesity. We used the following cut-off points to delineate obesity: 25.0–29.99 kg/m² for overweight (pre-obesity); and ≥ 30.0 kg/m² for obesity.²⁸ In lieu of published BMI data for children, we crudely approximated the mean BMI for 8- and 17-year-olds using average weight and height data.²⁹

Cause of death data

We present cause-of-death trends as percentages of total deaths for four disease categories that showed a noticeable change in the Republic of Korea over the past several decades.^{30,31} Diseases were classified according to the Korean Standard Classification of Causes of Death, which was based on the World Health Organization (WHO) International Statistical Classification of Diseases, Injuries and Causes of Death (ICD). The four categories chosen to illustrate major shifts in disease patterns from infectious to chronic diseases were: (i) infectious and parasitic diseases (including tuberculosis); (ii) diseases of the respiratory system (e.g. pneumonia and bronchitis); (iii) malignant neoplasms (e.g. cancers of the stomach, liver, bronchus and lung); and (iv) diseases of the circulatory system (e.g. rheumatic heart disease, hypertensive disease, ischaemic heart disease, cerebrovascular disease and diseases of pulmonary circulation).

Results

Economy of the Republic of Korea

Remarkable changes have occurred in the economy and structure of the workforce in the Republic of Korea over the past 35 years. The GNP per capita increased dramatically from the early 1960s to the 1990s (Fig. 1), with the rate of increase accelerating in the late 1980s. Indeed, GNP increased more than 17-fold between 1962 and 1996. Such

rapid economic growth increased national food availability and enhanced the purchasing power of the people, which accelerated the nutrition transition.

Associated with this rapid shift in income, population and occupation distributions changed. The Republic of Korea was only 27.7% urban in 1960; by 1996 it was 82.3% urban. A shift from energy intensive occupations in the rural primary product sectors of agriculture, forestry and fisheries to those in services and manufacturing came with the growth in GNP (Fig. 1). The occupational structure of the Republic of Korea today is similar to that of most Western countries. As we have noted elsewhere, this transition is linked to a major reduction in energy expenditure at work.^{1,11}

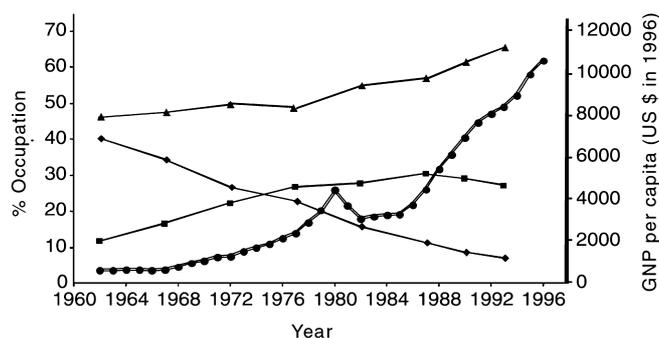


Figure 1. Trends in gross national product (GNP; ●) and the distribution of occupations in the Republic of Korea from 1962 to 1996.^{12,13} (◆), agriculture, forestry and fisheries; (■), manufacturing; (▲), service industry.

Diet

The dietary transition in the Republic of Korea was accelerated by a need to import wheat from the US to make up for food shortages that emerged after 1969.³ Many processed foods made from wheat flour, such as breads and noodles (including Ramen), entered the food supply. The government encouraged the consumption of these foods and other grains. The exposure to the new foods altered people's preferences. The government also assisted in the promotion of the farming industry in the 1960s. In the early 1970s, a new improved variety of rice was successfully developed to increase rice production. In 1979, fast food restaurants first appeared.³² In the 1980s, new technologies were widely introduced from advanced countries and there was a noticeable expansion in the food processing industry. More recently, the removal of trade restrictions in relation to the Uruguay Round of the General Agreement on Tariffs and Trade (GATT) has been important in opening up the importation of meat. This series of changes in the food supply, brought about by industrial development and policy changes, is thought to be a direct cause of the shift in food intake in the Republic of Korea. The following two sections describe trends in food intake in terms of food groups and nutrients.

Food groups

The total amount of food intake per capita per day calculated from household food intake fluctuated around 1000 g between 1969 and 1995 (Table 1). The fluctuation seems random, even though the trend since the late 1980s was a gradual

Table 1. Changes in intake by food group in the Republic of Korea from 1969 to 1995

	1969	1970	1975	1980	1985	1990	1995
Plant food (g)							
Cereals and grain products	558.8	516.8	473.8	495.3	383.7	344.0	308.9
Legumes and their products	24.9	53.1	31.1	46.9	74.2	58.1	34.7
Potatoes and starches	75.6	49.8	54.6	35.8	39.8	43.1	21.2
Vegetables							
Fresh	190.6	143.9	164.0	165.8	147.9	142.0	*
Processed	80.4	151.1	81.7	135.3	125.0	139.0	*
Combined	271.0	295.0	245.7	301.1	272.9	281.0	286.2
Fruits	48.1	18.9	22.4	41.3	64.1	68.8	146.0
Seaweeds	0.8	2.4	1.9	1.5	3.2	6.0	6.6
Seasonings, beverages	41.0	16.9	17.7	36.6	21.7	34.7	47.6
Oils and fats (vegetable)	3.5	-	3.1	4.4	6.9	5.6	7.5
Others	-	0	0.1	0	0	9.4	11.9
Subtotal	1023.7	952.9	850.4	962.9	866.6	850.7	870.6
Animal food (g)							
Meat, poultry and their products	6.6	19.8	14.3	13.6	38.9	47.3	67.0
Eggs	4.2	8.8	5.1	8.3	20.6	19.5	21.8
Fish and shellfish							
Fresh	12.1	32.0	38.8	57.3	52.5	51.9	*
Processed	6.1	12.5	9.0	8.4	28.1	26.7	*
Combined	18.2	44.5	47.8	65.7	80.6	78.6	75.1
Milk and dairy products	2.4	4.9	4.7	9.9	42.8	52.2	65.6
Oils and fats (animal)	0.3	-	0.1	0.1	0.1	0.4	0.1
Others	0.3	4.2	0	0	0	0	-
Subtotal	32.0	82.2	72.0	97.6	183.0	198.0	229.6
Total (g)	1055.7	1035.1	922.4	1060.5	1049.6	1048.7	1100.2
Proportion of animal food (%)	3.0	7.9	7.8	9.2	17.4	18.9	20.9

Data are presented as g nationwide intake per capita per day, except for the proportion of animal food.

*Data no longer provided; -, data not available.

increase in total food intake. A shift did occur in the sources of food; food intake from animal sources increased. This shift became especially apparent after the 1970s. In terms of grams of food, the proportion of plant food intake decreased consistently, from 97% in 1969 to 79% in 1995. In contrast, the proportion of animal food intake increased seven-fold during that period.

This shift can be clearly seen by examining the trends in intake of each food group. Consumption of cereals and grain products, the major contributors to food intake for people in the Republic of Korea, decreased significantly. In 1969, per capita intake of cereals provided 53% of the total amount of food intake. In contrast, it comprised only 28% of the total intake in 1995. However, the consumption of rice did not change much throughout the period. The intake of legumes increased until the mid-1980s, but decreased thereafter. The intake of potatoes and other starchy tubers decreased. Intake of vegetables fluctuated over the whole period, but overall consumption changed little. An important shift did occur towards the consumption of more processed vegetables than fresh ones. This trend resulted from the shifts that occurred in both lifestyle and the agribusiness sector. Increased residence in urban areas and a rapid increase in the number of apartments reduced home gardening remarkably. The increased proportion of women in the labour force (17.8% in 1961, 31.9% in 1980 and 40.6% in 1997)³³ reduced the time available to prepare food. Intake of fruits increased gradually until the late 1980s, but more rapidly after 1990. Seaweed consumption increased gradually.

Intake of all animal food products has increased significantly over the past 35 years. Meat and poultry consumption increased tremendously: 10-fold since 1969. The rate of increase was highest starting in the early 1980s. The consumption of milk and dairy products increased even more rapidly, rising more than four-fold during the period between 1980 and 1985. This increase is attributable to an increase in the importation of milk cows and the growth of the animal feed industry. The consumption of fish and shellfish, particularly processed items, also increased rapidly during this period, but at a slower rate compared with the increases in meat, poultry and milk. In 1995, the intake of fish, meat and milk products was balanced, each comprising approximately one-third of animal food products consumed. Although the rate of increase in fish and shellfish consumption was not as fast as that of meat, poultry and milk, fish and shellfish still represented the most significant source of animal food products for people in the Republic of Korea. The intake of eggs

increased until 1985, but stayed almost steady after that. During the transition, mass production of animal feed led to an expansion of the poultry industry and a subsequent reduction in egg prices. Cheaper egg prices enhanced the role of eggs as a source of higher quality protein in the 1980s. Consumption of added fats and oils doubled between 1969 and 1995. As with the rest of Asia, this increase was predominantly from vegetable oil consumption, but the level of increase was very small relative to other Asian countries.⁸

Figure 2 shows the trends in intake for major food groups between 1969 and 1995. It illustrates the dramatic fall in total cereal intake and the significant rise in total animal food product intake. The transition coincided with the rapid increase in GNP in the early 1980s (Fig. 1).

Nutrients

Nutrient intake data can be used to capture the nutrition transition in the Republic of Korea. Total energy intake decreased gradually after 1940, when nutrient data were first available in published form (Table 2). It was as high as 10.2 MJ (2446 kcal) per capita per day in 1940 and fluctuated between 8 and 9 MJ up to the beginning of the 1980s. It fell below 8 MJ in the mid-1980s and continued to decrease thereafter, as expected with the rapid industrialization and mechanization that was occurring in the country.

For individual nutrients, carbohydrates showed the same pattern as total energy intake. The change in the proportion

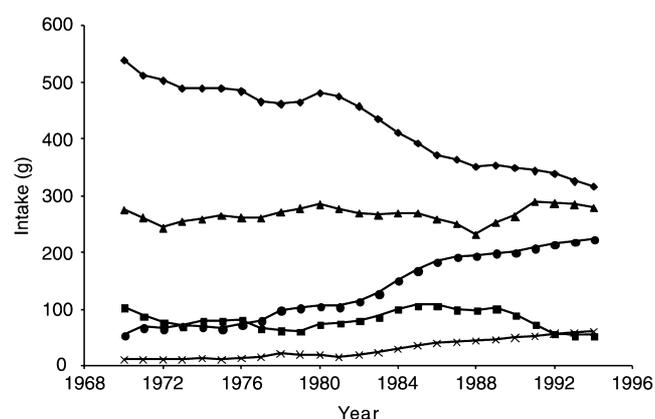


Figure 2. Trends in daily intake per capita by food group in the Republic of Korea; a 3 year moving average for 1969–1995. (◆), total cereal; (▲), total vegetables; (●), total animal food products; (■), legumes and tubers; (×), meat and poultry. Data from the Republic of Korea, Ministry of Health and Welfare.

Table 2. Changes in macronutrient and energy intakes in the Republic of Korea from 1940 to 1995

	1940	1948	1950	1960	1969	1970	1975	1980	1985	1990	1995
Carbohydrate (g)	494	484.4	486	482	422.5	434	398.5	396.1	341.5	316	295
Fat (g)	16.8	18.2	15.5	17.1	16.9	17.2	19	21.8	29.5	28.9	38.5
Protein (g)	79.7	83.6	83	73.9	65.6	64.6	63.6	67.2	74.5	78.9	73.3
Proportion of animal protein (%)	–	8.9	–	–	10.4	14.7	20.6	28.7	41.7	39.8	47.3
Energy											
MJ	10.2	10.2	10.1	9.9	8.8	9.0	8.3	8.6	8.1	7.8	7.7
kcal	2446	2438	2416	2378	2105	2150	1992	2052	1936	1868	1839

Data are from the Republic of Korea, Ministry of Health and Welfare,¹⁵ Chai¹⁸ and Moon.²¹ –, data not available.

of energy derived from each nutrient demonstrates the shift in nutrient intake (Fig. 3). Carbohydrate intake decreased gradually after 1940, from more than 80% of total energy intake to 64% in 1995. The total amount of protein intake was relatively constant throughout the period (Table 2). However, the source of the intake changed significantly. In the past, people in the Republic of Korea obtained protein mainly from rice, with frequent consumption of soy products enhancing overall protein quality. Now, animal sources contribute significantly to protein intake. Less than 10% of the protein intake per capita per day came from animal sources in 1948. In 1995, almost 50% came from animal sources. These increases parallel the significant increases in the intake of meat, poultry, fish, and dairy food during this period, as described in the previous section. Protein-derived energy increased until 1989 and has remained relatively constant since then.

Fat-derived energy intake increased gradually throughout the whole period, from approximately 6 to 18.8%. However, this is still a very low level compared with many other Asian countries, let alone most Western countries.⁸ Figure 4 presents trends in total dietary fat intake for China, Japan and the Republic of Korea from comparable national household food consumption surveys. The level of fat intake in the Republic of Korea is even lower than in China, although

China's GNP was less than 1/14 of the GNP in the Republic of Korea in 1996.¹³ Starting in the 1990s, people in China obtained more than 20% of energy from fat. In 1995, people in the Republic of Korea still consumed less than 20% of energy from fat.

The change in the ratio of energy from carbohydrate, protein and fat gives a broad picture of the transition. The ratio was 81 : 13 : 6 in 1940, indicating that energy intake was mainly from carbohydrate; fat did not contribute much. After 55 years, the ratio had shifted to 64 : 16 : 19, closer to what nutritionists would term an ideal ratio.³⁴ Carbohydrate still contributed a great proportion of energy but to a much lesser degree. In 1992, the proportion of energy from fat began to exceed that from protein, but the difference, 3% in 1995, was very small. As we discuss later, the proportion of energy from fat for the Republic of Korea was much lower than that for other Asian countries with similar or lower income levels.

Anthropometry

As expected, mean weight and height trends among adults in the Republic of Korea showed an improvement between 1913 and 1994.²⁷ While there is some value in examining changes in mean weight and height, it is the distribution of these changes and the increases in obesity and reduction in chronic energy deficiency that are more important. The proportion of adult obesity in the Republic of Korea was very low, 0.8% for males and 2.2% for females, in 1995 (Fig. 5). The proportion of overweight adults in 1995 was close to 20% both for males and females. Because earlier data were not available, it was impossible to describe trends in the distribution of overweight. Instead, Fig. 5 shows comparable adult overweight and obesity data for China, Japan and other South-east Asian countries.^{11,28,35,36} The data are from the most recent large surveys that are representative of a region or country. The prevalence of overweight in the Republic of Korea, relative to its level of income and development, is lower than that in many other Asian countries. The level of obesity is much lower for people in the Republic of Korea than all others, except Chinese females. Levels in the Republic of Korea are even lower than earlier levels in countries whose income remains lower than the income in the Republic of Korea. Obesity rates are increasing rapidly in these countries and more recent data would show even higher

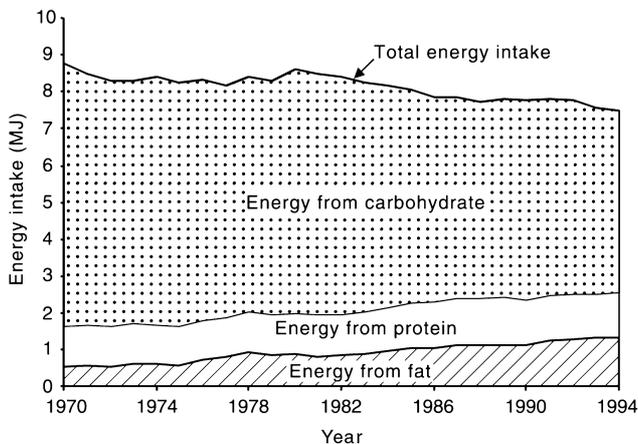


Figure 3. Trends in total energy intake and sources of energy in the Republic of Korea; a 3 year moving average for 1969–1995 showing energy from carbohydrates (▨), proteins (□) and fats (▩).

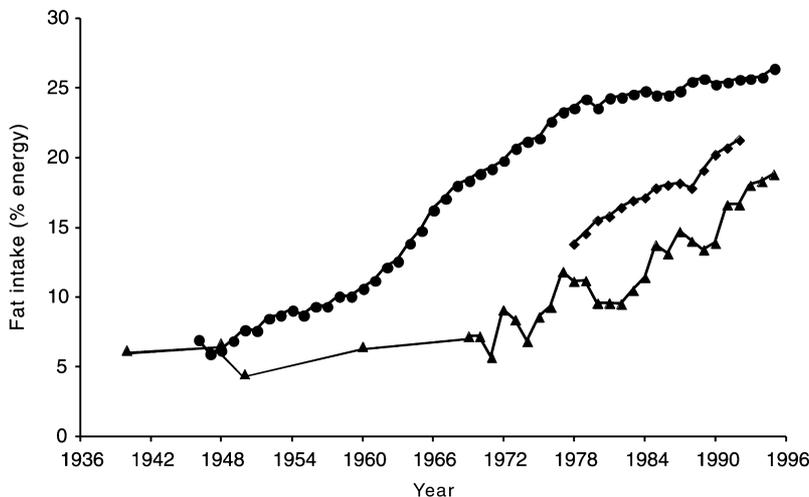


Figure 4. Percentage of energy obtained from fat (per capita per day) in China²⁴ (◆), Japan^{25,26} (●) and the Republic of Korea^{15,19,22} (▲) from 1940 to 1996.

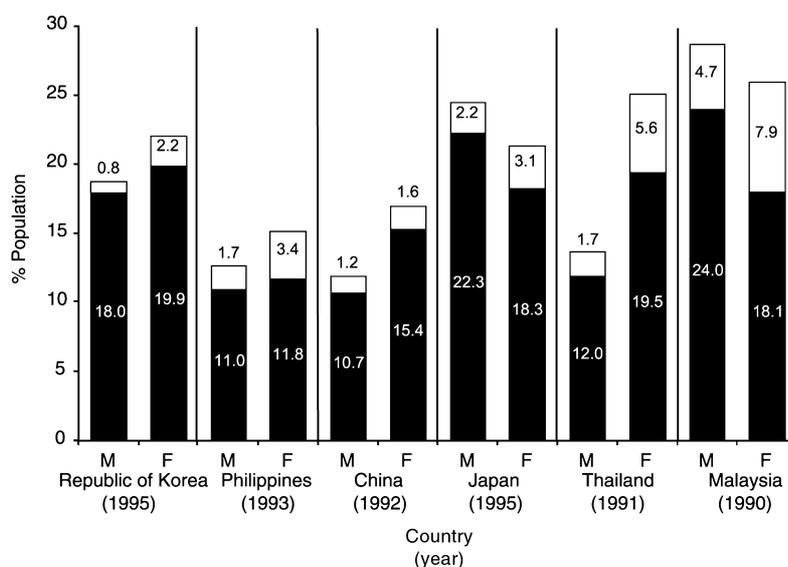


Figure 5. Obesity patterns in adults in the Republic of Korea,²⁴ the Philippines,¹¹ China,²⁸ Japan,³⁵ Thailand³⁶ and Malaysia.¹¹ (□), body mass index (BMI) ≥ 30 kg/m²; (■), BMI 25–29.9 kg/m².

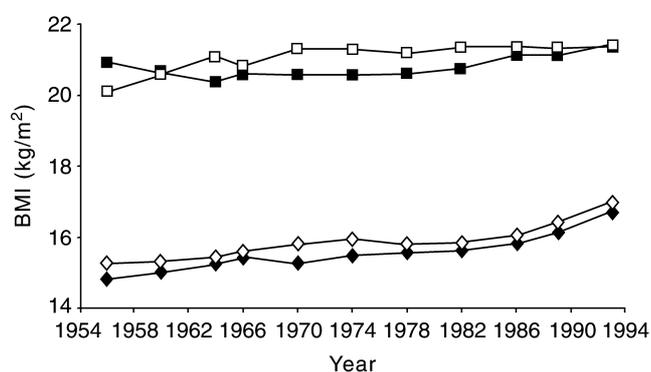


Figure 6. Body mass index (BMI) trends among 8- and 17-year-old children in the Republic of Korea from 1956 to 1993 (BMI figures are derived from mean heights and weights).²⁹ (◆), 8-year-old boys; (◇), 8-year-old girls; (■), 17-year-old boys; (□), 17-year-old girls.

levels than those presented here. For example, a recent report on Thailand has shown that overweight and obesity among adults (males and females combined) was 26.1% in 1995,³⁶ a significant increase over the 1991 level.

What appears to be a relatively recent increase in overweight among adults in the Republic of Korea was echoed by an increased BMI among younger children (Fig. 6). Again, it is important to note that BMI data on children were calculated using average weight divided by average height squared and not the mean of the BMI. While a slight increase occurred among 17-year-old children between 1956 and 1993, the greater increase in the 1990s for younger children portends future increases among all age groups. It would be ideal to see how the proportion of overweight children has gone up; however, such data were unavailable for a systematic comparison.

Causes of death

As the nutritional focus of the Republic of Korea started to shift from dietary deficit and food insecurity to overnutrition, one would expect to see concurrent and possibly related shifts in the causes of death. Data from 1938 to 1942 indicate that food insecurity and malnutrition were major concerns,

especially in rural areas (Fig. 7). Infectious and parasitic diseases predominated. It was only in the early 1970s that this pattern reversed and cancer and cardiovascular-related deaths became predominant. Since 1970, except for the cases of signs, symptoms and uncertain conditions, the diseases of the circulatory system, including rheumatic heart disease, hypertension, ischaemic heart disease, cerebrovascular disease, and diseases of pulmonary circulation have been the leading causes of death. Death from these causes began to accelerate especially rapidly around 1965. In the late 1970s, cancer also became another significant cause of death. Deaths from malignant neoplasms have increased steadily from 1938 to date. The disease classification system presented here does not distinguish individual diseases. For example, diseases of the circulatory system included rheumatic heart disease, hypertensive disease, ischaemic heart disease, cerebrovascular disease, and other diseases of the pulmonary system. When the diseases were classified individually, malignancy became the leading cause of death in 1993, exceeding deaths from cerebrovascular disease for the first time.³

Demographic changes cannot be overlooked. The dramatically increasing life span (from 22.6 and 24.4 years in 1910 to 64.9 and 71.3 years in 1985 among males and females, respectively)³⁷ and the subsequent increase in the relative size of the elderly population may have contributed to the increasing trend in chronic diseases. The elderly population (aged 65 years and older) rose from 3.3% in 1960 to 5.8% in 1996.¹³

Discussion

The Republic of Korea is far along in nutrition transition. Related to remarkable changes in the economy and socio-demography, large shifts in the overall structure of diet and disease patterns have become apparent, beginning in the 1970s. The change has been reflected in increased body size, especially among younger children, and in dramatic shifts in causes of death from communicable to chronic diseases.

The most noticeable feature of the nutrition transition in the Republic of Korea is that the dietary shift has not been linked with a level of fat intake commensurate with income

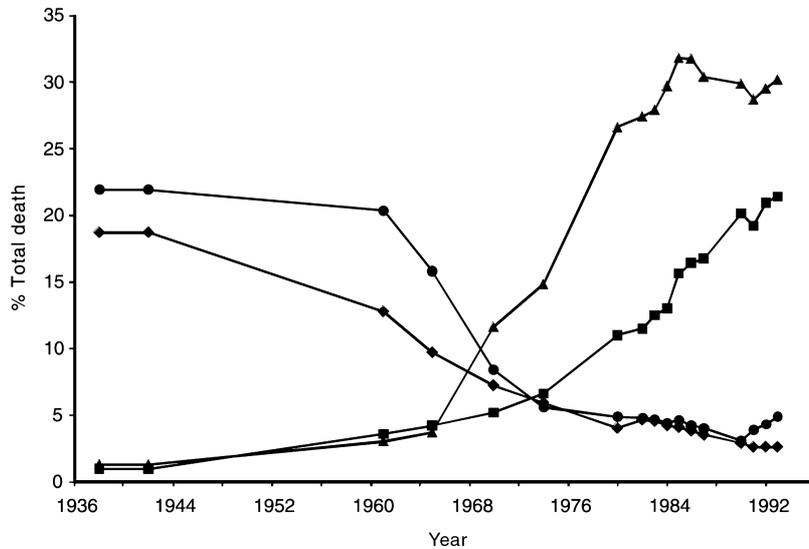


Figure 7. Trends in causes of death in the Republic of Korea from 1938 to 1993.^{30,31} (◆), infectious or parasitic diseases; (■), malignant neoplasm; (▲), diseases of the circulatory system; (●), diseases of the respiratory system.

level. The relationship between GNP per capita and dietary fat intake was studied for 88 countries⁸ and recently updated to include 121 countries (X Guo *et al.*, unpubl. obs., 1999). From these studies, we expected that in 1996 the proportion of energy from fat in the Republic of Korea would be 35.5%. The actual percentage of energy from fat was 16.7% less than this expected level. Given the fat intake level in 1996, we calculated that the GNP should be US\$311. If we focused on food disappearance data for the Republic of Korea, on which this relation was based for both studies, we would have found that the predicted fat intake as a percentage of energy was 13.5% more in 1996 than the actual food balance data, which is 22%.³⁷ Considering the current concerns about the worldwide increase in fat intake⁸ and diet-related diseases, the low level of fat intake in the Republic of Korea is of note. This low level of fat intake may be part of the reason for the lower level of obesity in the Republic of Korea compared with many other Asian countries.^{8,11} The following discussion focuses on unique aspects of the nutrition transition in the Republic of Korea related to the unexpectedly low fat intake and obesity level.

Why is the fat intake so low in the Republic of Korea? There are several potential reasons. One explanation may relate to the relatively high carbohydrate intake. Typically, GNP increases have been associated with rapid declines in the proportion of energy from carbohydrates.⁸ The Republic of Korea is an exception, possibly because rice has been, and still is, the primary element of the Korean diet.³⁸ The fact that Koreans' old common greeting 'Have you eaten rice yet?' is roughly equivalent to the English 'How are you?'⁶ shows the deep psychological connection to rice. The predominant intake of rice as a staple food may have kept fat intake relatively low in the Republic of Korea.

The low effect of GNP increases on fat intake in the Republic of Korea is explained partly by the style of cooking. Traditional Korean cuisine adds small amounts of sesame seed oil to vegetables after boiling or steaming, as opposed to Chinese cooking, in which foods are frequently stir fried. The method of stir frying has high potential to use extra amounts of oil when it is readily available. However, other

Asian countries that do not rely on stir frying have also rapidly increased their fat intake.¹⁰ The Republic of Korea is different.

Another more plausible explanation is that movements to retain the traditional diet have been strong in the Republic of Korea. These movements include mass media campaigns, such as television programmes that promote local foods, emphasizing their higher quality and the need to support local farmers (e.g. one Korean daily television programme 'Six o'clock my village' introduces famous products of villages in the Republic of Korea and promotes consumption of traditional dishes). The Republic of Korea has also promoted the concept of Sin-To-Bul-Yi (translated directly as 'A body and a land are not two different things' and interpreted to mean that a person should eat foods produced in the land where he or she was born and is living).

Part of this effort is reflected in a unique training programme offered by the Rural Development Administration. Beginning in the 1980s, the Home Management Division of the Rural Living Science Institute trained thousands of extension workers to provide monthly training sessions in cooking methods for traditional Korean foods, such as rice, kimchi (pickled and fermented Chinese cabbage) and fermented soybean food. These sessions are open to the general public in most districts in the country and the programme appears to reach a large audience.³⁹

Studies confirm the Republic of Korea's adherence to traditional dietary patterns. A small study has revealed that most adults, even young adults, consume a traditional breakfast,⁴⁰ which is typically steamed rice, soup, kimchi, cooked or uncooked vegetables and roasted or broiled meat or fish. In addition, many support the development of Korean-style fast foods, traditional foods modified to be faster and more convenient to serve.⁴¹ The dietary shifts in the Republic of Korea, such as increased animal food intake, are not necessarily westernization.⁶ For example, Koreans especially like meat dishes prepared traditionally. Traditional foods continue to represent a major element of today's Korean diet.

The household data contained potential measurement errors that may have led to underestimating fat intake. The

survey excluded the increasing number of meals eaten away from home, which potentially contain more meats and edible oils. The higher fat intake from these meals may have been ignored. The difference between the survey data and the food balance sheet may be related to the secular trend towards away-from-home consumption. Nevertheless, the food balance data for the Republic of Korea also showed a much lower level of fat consumption than expected. Failure to adjust for changes in the age composition of the population may have affected dietary intake, but it is unlikely that it would have affected the proportion of energy from fat.

The unusually low fat intake in the Republic of Korea may change. The implementation of the international trade agreement (the Uruguay Round of the GATT, 1994) may produce further changes as the Republic of Korea is forced to allow increased international food trade. It is impossible, at present, to predict the long-term effects of this agreement.

Obesity levels are lower than may be expected given the Republic of Korea's economic development level compared with other Asian countries (Fig. 4), let alone most western countries.¹¹ More thorough analysis of other determinants of obesity, in particular smoking and physical activity, is needed to better understand obesity trends.

Studies have indicated that child obesity in the Republic of Korea was a concern.⁴²⁻⁴⁴ A recent report on the prevalence of child obesity from 1979 to 1996 in Seoul revealed that the increase in the prevalence of obesity (95th percentile of the National Health and Nutrition Examination Survey I) was even greater than that of overweight (90-95th percentile).⁴⁵ Our results were consistent with the results of that report, showing a rapid increase in mean BMI, especially among younger children. It may predict increases in body fat among all age groups in the near future.

Identifying characteristics related to maintaining a relatively low fat intake would help us better understand how to promote a healthier diet. Further research on the efforts of the people and government of the Republic of Korea to retain features of the traditional diet should also analyse the healthiness of this diet. Additional research is needed to explore the full set of determinants of this dietary pattern and the subsequent health consequences not only for obesity, but for a range of diet-related non-communicable diseases.

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