

The rocky road from roots to rice: a review of the changing food and nutrition situation in Papua New Guinea

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SUMMARY

Although it is not happening uniformly within the country, the adoption of a modern lifestyle by Papua New Guineans is affecting their food habits and choices. More and more people consume rice, tinned fish and tinned meat. In towns and in villages with easy access to urban centres, these food items comprise an ever increasing part of the diet. These dietary changes are leading to increases in the prevalence of chronic lifestyle-related diseases such as obesity, hypertension and coronary heart disease. Although average calorie availability is similar in urban and rural sectors, at around 2600 kilocalories per person per day, the nutritional outcomes are different. This is mainly due to the higher energy density of the modern urban diet with a greater intake of fat and protein. The traditional diet is low in protein with rather high energy content from starchy root crops. Studies have shown that urban children tend to be taller and heavier than their rural counterparts and that the prevalence of overweight and obesity is higher among adults in urban than in rural areas. Finally, across all income groups and geographical regions, more women than men are chronically undernourished.

Introduction

Many Papua New Guineans have embarked on a journey with an unknown destination. They travel the rocky road from roots to rice. Their dietary pattern, one of the major influences on the development of lifestyle diseases, has changed. The major risk factors associated with lifestyle diseases – obesity, lack of exercise and tobacco use – are preventable. In several Pacific Island groups, prevalence rates of diabetes and obesity are some of the highest in the world (1). More than 10 years ago, Temu (2) wrote that the prevalence of diet-related noncommunicable diseases was increasing in Papua New Guinea (PNG). Admissions for cardiovascular diseases quadrupled in the period 1979-1988 (2).

Not everybody travels on this road. In many remote places, a traditional lifestyle is maintained. The prevalence of chronic degenerative diseases such as diabetes, hypertension, ischaemic heart disease and

cancer is low among peoples living a traditional lifestyle (1).

Traditional food patterns

The geographical location of the villages determines the kind of food cultivated for consumption. Gardening, hunting, fishing and gathering provide food for most communities. Rootcrops such as taro, cassava, sweet potatoes and yams are staple foods, as are bananas. These foods are supplemented by a variety of greens, corn, fish, marine life and wildlife (3).

This traditional diet is low in protein with rather high energy content from starchy root crops. More than 90% by weight is supplied through plant foods (4-6).

One must bear in mind that in PNG more than 780 local languages are spoken, reflecting many different cultures. Diversity is apparent in the absence of a standard 'PNG cuisine'. Food preparation and dishes, food patterns and food habits are different throughout the

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country. The results of the National Nutrition Survey (NNS) in 1982-1983 (7), in combination with standard linguistic divisions, resulted in the identification of 15 food culture areas (C. Jenkins and B. Zemel, Ancient diversity and contemporary change in the growth patterns of Papua New Guinea children, unpublished paper, 1990).

Changing food choices

Food habits and food choices of Papua New Guineans are different from those of thirty years ago, due to adoption of a modern lifestyle. People prefer to eat rice, tinned fish and tinned meat. The downward trend in consumption of sweet potato is matched by the increase in consumption of rice and bread (Figure 1) (8).

The per capita availability of food is a function of population and food production, with adjustments made for exports, imports, food aid, wastage and livestock feed. From the period between 1964 and 1966 to that between 1996 and 1998, annual per capita availability of the two major food groups (starchy roots, and fruit and vegetables) decreased, for starchy roots from 315 to 221 kg/person/year and for

fruit and vegetables, from 314 to 285 kg/person/year. In the same period the supplies of several food groups increased, especially that of cereals, which increased from 23 to 72 kg/person/year (Figure 1) (8).

Between 1965 and 1997, the contribution of fat to the dietary energy supplies (DES) rose steadily from 198 to 364 kcal/person/day. While the contribution of fat to the total DES increased from 12% to 17% in the period from 1964 to 1998, that of carbohydrates decreased from 80% to 74%. The share of protein in the DES remained the same, but in absolute terms availability rose from 35 to 46 g/person/day (8).

Thirty years ago, starchy roots represented the main source of energy in the diet of Papua New Guineans. They provided almost 50% of energy in 1964-1966, but have since decreased continuously and have been replaced by cereals, which provided 633 kcal/person/day in the period 1996-1998, equivalent to 30% of the DES. Fruit and vegetables represent the third major food group contributing energy in PNG. However, their share in the DES has reduced from 24% to 18% during the last thirty years (8).

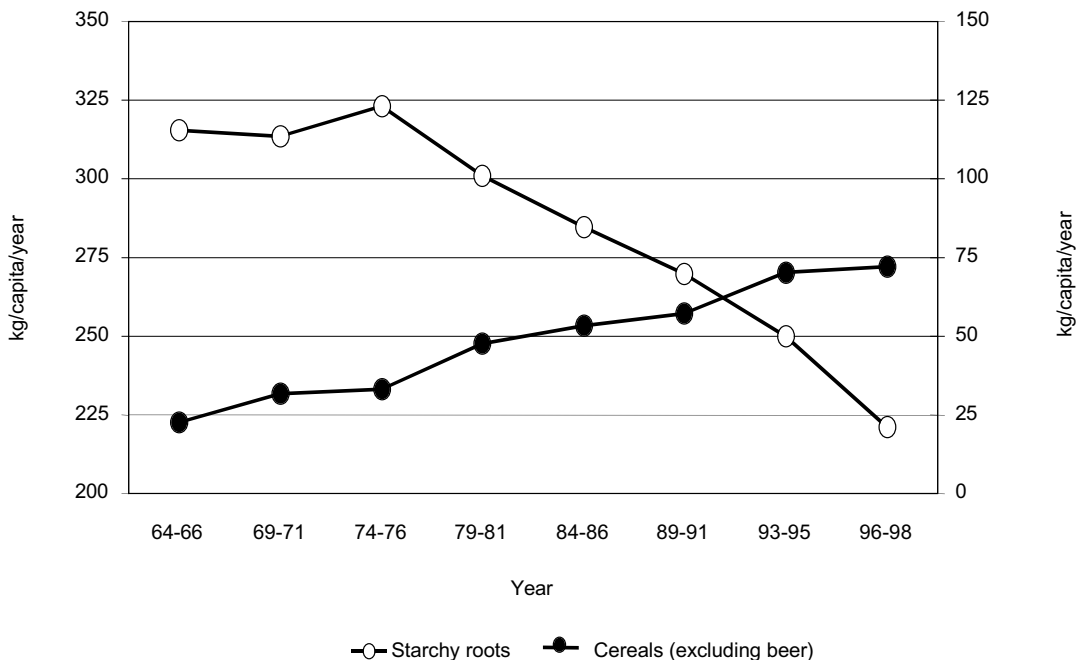


Figure 1. Supplies of starchy roots and cereals in Papua New Guinea (kg/person/year), 1964-1998. Derived from Mittendorfer and Saweri (8).

Studies on consumption patterns and nutrition status in PNG

Several studies have been conducted to estimate consumption patterns and nutrition status. These shed light on changes seen in travellers along the road from roots to rice. Most striking are the differences between the urban and rural populations in food choices and nutrition status. However, there has not been a comprehensive overview of changes in nutrition status due to the adoption of a modern lifestyle.

Papua New Guinea Household Survey

In 1996, the Papua New Guinea Household Survey (PNGHS 96) was conducted as part of a World Bank poverty assessment (9). This was a nationwide consumption survey comprising a random sample of nearly 1200 households from 73 rural and 47 urban census units.

Total household expenditure was estimated and the shares of 36 items in the budget were calculated. In the rural setting, sweet potato, banana, pork, rice, betelnut (including lime and mustard), 'taro tru' and Chinese taro accounted for the largest average share of the household budget. In the urban setting the items that accounted for the largest proportion of the budget were rice, chicken, tinned meat, beer, fish (other than tinned fish) and meals consumed outside the home. However, these leading six items supplied less than one-fifth of the average urban diet, an indication of the greater diversity of the urban diets. In the rural sector, the six most important items represented over one-third of the average diet, highlighting its monotonous character (10). Food as a whole was a smaller element of the total urban budget, representing just under half, whereas in the rural sector the average food share was two-thirds (11). The aggregate value of consumption of beer and betelnut each exceeded 100 million Papua New Guinea kina (PGK) in 1996 (10).

The Papua New Guinea Household Food Survey also collected data on food consumption using a 24-hour food recall (Table 1). The researchers asked the question "What did the family eat yesterday?". This

TABLE 1

TYPE OF FOOD CONSUMED DURING THE PREVIOUS DAY BY RURAL AND URBAN DWELLERS

	Rural	Urban	PNG
Greens	74.3	78.9	75.0
Sweet potato	65.0	33.6	60.2
Rice	25.8	87.4	35.1
Banana	33.6	38.7	34.3
Coconut	28.4	34.2	29.2
Biscuit/bread/ flour/scone	14.4	74.6	23.5
Taro, Chinese taro	23.9	9.6	21.7
Sago	13.3	18.9	14.2
Tinned meat	5.9	51.7	12.8
Legumes	12.7	7.8	12.0
Tinned fish	9.1	24.5	11.4
Yams	12.5	4.8	11.3
Fresh fish, shellfish	7.1	28.2	10.3
Chicken	4.1	26.5	7.5
Pork, beef, other meat	6.4	9.9	6.9
Cassava	6.9	4.3	6.5
Lamb, mutton	5.0	13.7	6.3
Bush meat	1.8	1.5	1.7

Derived from Gibson and Rozelle (9)

provided data for estimating the proportion of the population consuming each of 18 food types. The food choices of people in urban and rural PNG were different. On any given day, sweet potato was consumed by two-thirds of the rural population but only one-third of the urban population. Almost 90% of the urban population ate rice, compared to only 25% of the rural dwellers. A similarly large difference in the composition of rural and urban diets was seen with wheat products, which were consumed on any given day by 75% of the urbanites but only 15% of the rural population. Rice is becoming the second staple food, after sweet potato. Sweet potato is the commonest of the traditional root crops (11).

People living in urban areas more often consume bread, meat and fish, while the rural population eat more sweet potatoes, taro and

yams (9). An increased consumption of rice and bread was also observed among students in urban centres and in smaller provincial towns (12). Fish, banana, betelnut and sweet potato were the most important of the locally produced items in the urban diets (11).

The per capita consumption of locally produced fruits and vegetables and root crops in urban areas is approximately one-half to one-third that of rural areas. The proportion of total calories in the daily diet provided by fresh fruit (excluding banana), peanuts, ‘aibika’, other greens, vegetables and nuts is 4.7% for the rural population and only 2.6% for the urban dwellers (10).

Energy density and protein content of rural and urban diets

Average calorie availability of around 2600 kcal/person/day is similar in urban and rural settings (Table 2). However, there is a very strong variation in food intake across the groups and approximately 42% of the population, both in urban and rural sectors, did not meet the target food requirement of 2000 kilocalories per person per day (13).

The nutritional outcomes are different,

despite similar average calorie availability in urban and rural settings. The average rural diet provides approximately 1.3 kcal/g, due to the dominance of root crops (which have an energy density of approximately 1 kcal/g). In contrast, urban diets provide around 2 kcal/g due to the much higher content of cereals, fats and oils, and meat (13).

The average rural diet provided 46 g protein/person/day versus 67 g protein/person/day for the urban population (Figure 2). The average intake of protein across the whole country was 50 g/person/day, above the recommended World Health Organization (WHO) minimum requirement of 45 (13).

Regional differences exist; the highland population still eats mainly sweet potato and dark green leafy vegetables, resulting in a low intake of protein – 44 g/person/day – which is just below the recommended requirement (Figure 2). Intake of protein is slightly above the minimum requirement in Momase and the Islands Regions, whereas individuals in the National Capital District (NCD) and the Papuan Coast have an ample protein intake (Figure 2) (9). In all regions energy intake is well above the target daily food requirement of 2000 kcal. The South Coast has the highest

TABLE 2

NUTRITIONAL INPUTS AND OUTCOMES IN RURAL AND URBAN SETTINGS IN PAPUA NEW GUINEA IN 1996

	Rural	Urban	PNG
Inputs			
Energy - kcal/person/day	2665	2645	2662
Percentage of population with <2000 kcal available/day	41.9	42.6	42.0
Energy density (kcal/g)	1.27	1.92	1.35
Protein availability (g/person/day)	46.3	67.3	49.5
Outcomes			
Mother’s BMI (Mean)	21.6	25.3	22.1
Father’s BMI (Mean)	22.1	25.4	22.5
Percentage of mothers with BMI <18.5 kg/m ²	13.5	6.2	12.4
Percentage of fathers with BMI <18.5 kg/m ²	4.5	1.4	4.1

BMI = body mass index (kg/m²)
 Derived from Gibson and Rozelle (9)

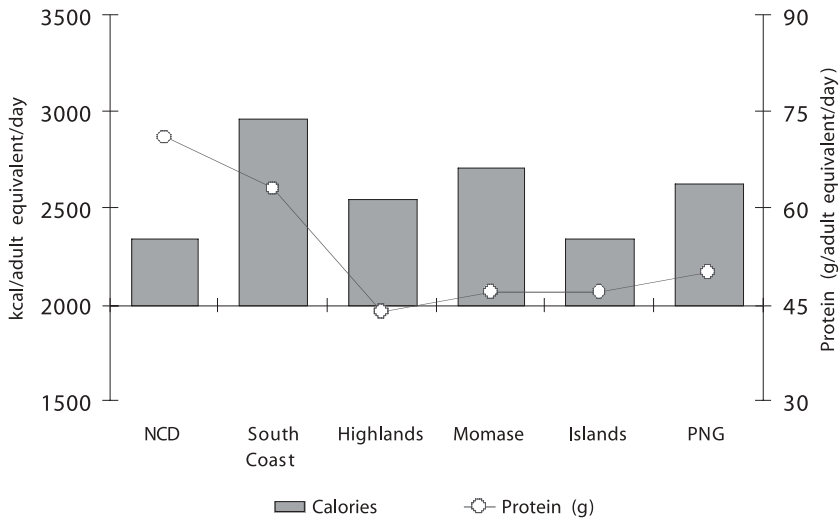


Figure 2. Calorie and protein intake in Papua New Guinea in 1996 according to region. Derived from Gibson and Rozelle (9) and Gibson (13). NCD = National Capital District.

daily intake and NCD and the Islands Region have the lowest (Figure 2) (9).

Energy and nutrient intake depend on socioeconomic status (Figure 3). Average calorie intake for the wealthiest 25% of the population is well above requirements and people are likely to become overweight or obese. Most of this group are people in formal employment, businesses or waged jobs, which are physically less demanding (9).

Nutritional status

The PNGHS 96 measured weight and height of all children under 5 years old and their parents. The adult sample was not randomly selected, because the parents of young children are less likely to be elderly. This is important since the body mass index (BMI) of elderly women may be low due to maternal depletion syndrome (13).

Children

PNGHS 96 revealed that almost half of rural children (47.0%), but only one-fifth of urban children (19.8%), were stunted (low height for age) (13). Previous anthropometric studies in PNG (14) revealed that children from the highlands are stockier: they tend to be shorter but heavier than their lowland counterparts. When only children from the lowlands in the

database are considered, then stunting is still more prevalent in the rural (40%) than in the urban areas (20%). The average rural child in PNG is only 92.5% of the median height of children of similar age and sex in the reference population, while urban children average 97.3% of the median (13).

Adults

The PNGHS 96 obtained height and weight of the parents of the children under five years in the survey population. The average BMI of urban males was approximately 15% higher than for rural males; the equivalent difference was 17% for females (Table 2). A rural female was twice as likely as an urban female to have chronic energy deficiency (a BMI of <18.5 kg/m²) and women were three times more likely than men to have chronic energy deficiency (13).

Nutritional status of adolescents in East New Britain Province

In 1997, a cross-sectional survey on health and nutritional status of more than 3500 primary school students was done in East New Britain Province (15). The survey identified the mean height of urban children to be around 4 cm higher than the mean height of rural children. Median percentage of fat mass, calculated from skin fold measurements, was

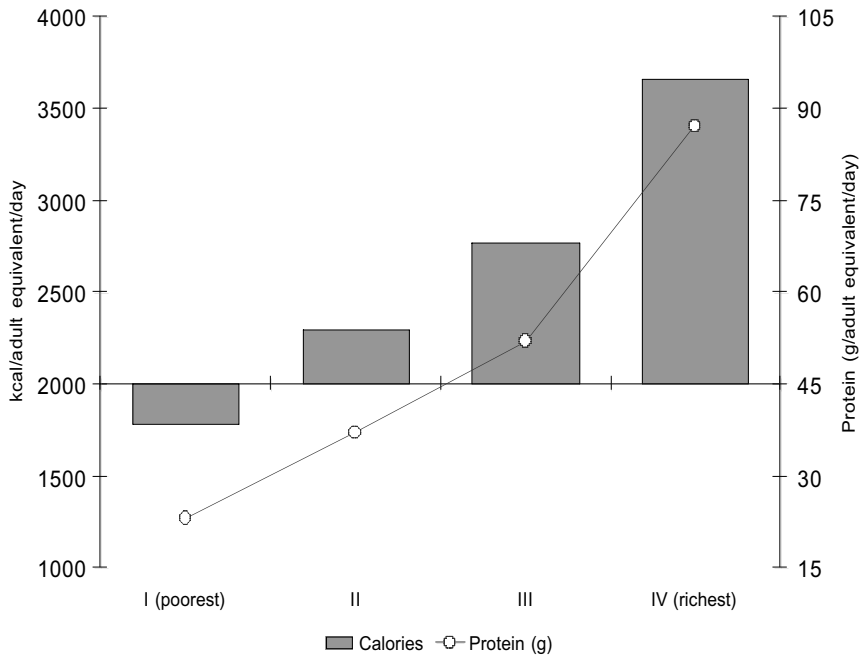


Figure 3. Calorie and protein intake in Papua New Guinea according to income. Derived from Gibson and Rozelle (9).

1% higher in urban than rural areas. Urban children were about 1 kg heavier and had a higher BMI. This tendency towards overweight in urban school children might produce future health problems.

Physical activity and diet of the Hulis

Urbanization influences the level of physical activity and food choices. Yamauchi et al. studied Huli villagers of the Tari Basin in Southern Highlands and compared their activity patterns with Huli migrants in the settlements of Port Moresby (16-18). The villagers were engaged in subsistence agriculture while the urban migrants were self-employed and earned money from activities such as the collection of empty bottles and selling of betelnut, cigarettes or cooked meat in markets and settlements.

Physical activity level (PAL) is calculated as energy expenditure (EE) over basal metabolic rate (BMR). PAL comprises three categories namely sleep, sedentary and activity. Activity is subdivided into moderate and light activity levels. Urban Huli men worked longer hours in sedentary cash-earning activities than their

rural counterparts did in their energy-consuming agricultural work. The result was that urban men had higher work energy expenditure. In contrast, urban women showed lower work energy expenditure, although rural and urban women spent almost equal time at work. However, work energy is only part of the total physical activity level. Other activities require less physical strain in an urban environment, eg a ride on the bus or even walking along the city roads as compared to bush-walking up and down the mountains (16,17).

Total energy intake (from food and drinks) and energy expenditure were similar in all groups, whereas protein and fat intake were considerably higher in urban subjects than rural dwellers. Urban Hulis were heavier than their rural counterparts (6.4 kg for either sex). Diet changed from the typical highlands diet of sweet potato and dark green leafy vegetables in rural Tari to purchased foods such as rice, tinned fish and lamb chops in the settlements of Port Moresby (18). The fat content of the urban diet was 71 g per day for males and 65 g per day for females. Lamb, butter and chicken accounted for 60% of the fat intake (18).

Nutrition studies in the Eastern Highlands

Koishi and his colleagues conducted a series of studies and estimated food intake in Beha, Eastern Highlands Province, through a 24-hour weighed intake for 3 consecutive days in men (20 to 40 years old) in 3 different years, 1978, 1980 and 1982 (5). Roots and tubers were the main foods consumed, with, however, a trend for decreasing consumption (1120 g/person/day in 1978 to 1041 g/person/day in 1982). The consumption of fruits and vegetables increased from 107 g/person/day in 1978 to 216 g/person/day in 1982 and cereals from 50 to 248 g/person/day. Furthermore, these studies suggest that fish, milk products, meat, pulses, oils and fats, and other highly nutritious foods accounted for less than 10% of the daily energy intake. In 1982, the average daily per capita energy intake for men 20 to 40 years old was 2837 kcal compared to 2390 kcal in 1978, of which only 8% was provided by protein and 7% by fat.

In June 1999, the Salvation Army Agricultural Development Program conducted a baseline nutrition survey to study the food consumption patterns and protein intake of 73 families in six areas of Kainantu and Okapa Districts in Eastern Highlands Province. Most people ate a meal only twice a day and sweet potato and greens made up the bulk of the diet. Animal protein, usually in small amounts, was included in the diet of families only 6 times per month on average. The most commonly mentioned animal protein was lamb flaps (48%) (19).

Study of food intake and food choices at Koki

In 1991 at Koki in the National Capital District, the food intake and food choices of the urban Wanigelans were studied. The average daily energy intake was estimated at 2738 kcal for men and 2500 kcal for women. The major contributions to energy intake were made by cooking banana (11%), white rice (10%), cassava (7%), white bread or roll (6%), fish (5%) and sweet potato (4%), most of which are food types that are low in fibre and highly refined (20).

About 23% of energy was derived from fat for both men and women (20). For men, the

average daily fat intake was 71 g, of which 46% was from animal products. For women, the average fat intake was 65 g/day, and 48% was of animal origin. Older people did not change their traditional food habits to the same extent as the younger ones. Unfortunately, only food consumption data of urban Wanigelans were collected.

Adoption of a modern lifestyle in rural areas

It is an illusion to think that only city dwellers adopt a modern lifestyle. However, the change in food habits and food choices is not uniform across the rural areas, being greatest in areas where people have access to ready cash. In rural areas, cash availability depends on large-scale projects that profit from natural resources.

People want to add variety to the diet through store-bought food (21). Some food items purchased are 'junk' foods, being highly processed and of low nutritional value. Rural people often sell garden produce and fish for cash to purchase store food. In villages with easy access to urban centres, these food items comprise an ever increasing part of the diet as it is difficult to make healthy food choices when people have little understanding of basic nutritional principles. To investigate the perception of instant noodles as a source of protein, a small survey was conducted using three groups of people at the Kainantu Hospital. The groups were outpatients, who were generally villagers, community health worker training school students and trained hospital staff – a total of 37 people. The interviewees were shown food posters of the three main food groups (energy, protein or bodybuilding and protective food) and the meaning of the three food groups was explained. Each of the participants was then given a packet of instant noodles and asked to match it with the food group on the poster. The only group that had a good idea of which group the noodles belonged to was the hospital staff. A possible reason for the perception that instant noodles are a protein source could be the taste and the picture of cattle, chicken, pigs or prawns on the packet (19).

A longitudinal study of the Wopkaimin people (the landowners of the Ok Tedi mine in

Western Province) compared changes in health and nutrition status with the people of Mt Obree in Central Province. The latter are without major economic developments. At the start of the study in 1982, health and nutrition status was comparable in study and comparator group. After 10 years mean weight had increased in all age groups of the study population, whereas body weights of the comparator population remained the same (6).

Villagers living closer to the mine bought up to 50% of their food intake by weight from the store. They tended not to have as many food gardens as people living further away from the mine (4,6). Store goods accounted for up to 50% of their food intake by weight (6). This has led to changes in the dietary habits of the local people and within a few years to an increasing prevalence of chronic lifestyle-related diseases such as obesity, hypertension and coronary heart disease (22).

In many parts of the country, more and more villagers are growing cash crops and selling garden crops, as well as coconuts, game meat and fish. The increased numbers of migrants to urban areas lead to more remittances to their home villages, which accelerate changes in the villagers' dietary lifestyle. The bulk of the cash income is usually spent on imported foods such as rice, flour, sugar and tinned fish (23). In villages with easy access to urban centres, these food items comprise an ever increasing part of the diet (3). For example, Gidra-speaking villagers in Western Province spend about 70% of their meagre cash income on imported foods. As a result, imported foods accounted for 42.5% of their energy intake and 39% of protein intake (23). In contrast to this village which is closest to the main centre, the other study villages further away did not show a major change in their diet.

Natsuhara's study in Frigano, a hamlet close to Goroka, Eastern Highlands Province, revealed that in the highlands people's intake of protein, fat and salt have rapidly increased with an increase in purchased foods (24). However, nutrient intake, BMI and blood pressure varied from person to person. The large individual variation was linked to the adoption of a modern lifestyle. Consumption of tinned food and rice was related to household modernity indicators such as annual

income, education of adults, paid employment, type of housing and fuel for cooking and lighting. Consumption of meat pies, fried flour and other snack foods was related to frequency of visits to town on an individual level, eg to sell garden foods, work in coffee factories or purchase foods at the wholesaler. The frequency of consumption of purchased food was highly correlated with BMI and the intake of salt and protein. Protein and salt intake were significantly correlated with each other (24).

Geographical location of the village influences food intake and the nutritional outcome of its inhabitants. In 1996, a health and nutrition survey was conducted in the Western Province along Lake Murray and the Strickland River. The mean height and weight of adults living along Lake Murray was significantly higher than that for people living in the flood plains and further along the river, probably because the Lake Murray people consume more fish (more protein) coupled with a lower malaria endemicity (25).

As part of a health-promoting school project, some schools in the Central Province were visited. Some of the schools were distant from Port Moresby. The children were asked what they had for breakfast and lunch. The majority ate biscuit, fried flour or bread with tea for breakfast and rice with tinned fish or tinned meat for lunch. Although the villages were located close to the sea, none of the villagers went out fishing because of rough weather (12).

Malnutrition

Malnutrition is a general term, meaning 'bad' nutrition. In PNG, with a long history of poor nutrition, automatically malnutrition is associated with undernutrition. Overnutrition can also be defined as malnutrition, because the balance between intake and energy expenditure is lost. Overnutrition or simply overeating is becoming more common in some areas. Reliable statistics on the prevalence of overnutrition and obesity are lacking.

Children

The higher energy density and higher protein content of urban diets may partly

explain the results cited above of child stunting being less prevalent in urban areas despite the similarity in calorie availability. Such a diet is good for young children who may not be able to ingest all of the calories they need from a bulky diet (13). Quality rather than quantity of food seems to be the major problem in PNG nutrition.

Re-analysis of the NNS 1982-1983 data found that consumption of tinned fish, meat and fresh fish was significantly positively correlated with child growth in length and weight, as well as a lower incidence of malnutrition. These foods are much higher in protein, zinc and energy than the local staples. High prevalence of stunting was related to the low protein and energy content of the rural diet (26). Families in the Eastern Highlands Province eat animal protein only 6 times per month on average, and usually in small amounts (19). It was noted that in the hamlet close to the town (Frigano) parents and other adults tended to give rice and tinned food to children. Leftover rice was consumed by children, including those of other households. Frequency of consumption of tinned food was higher in children, and a major determining factor of salt and protein intake in children (24).

Diet and socioeconomic status are the two most important variables predicting patterns of child growth in PNG. Differences in diet and to a lesser extent the physical environment were the main determining factors in differences between regions (26).

Adults

The nutritional status of adults is usually assessed using the BMI calculated as weight (kg) over height squared (m^2). For classifying individuals according to their nutritional status, cut-off levels of BMI have been proposed. According to WHO standards, adults with a BMI less than $18.5 \text{ kg}/m^2$ are considered to suffer from chronic energy deficiency. A BMI of over $25 \text{ kg}/m^2$ indicates overweight and adults with a BMI over $30 \text{ kg}/m^2$ are considered obese. Pacific Islanders, especially Polynesians, tend to be very large and muscular with high BMIs. Tentative proposed cut-off points for them for overweight and

obesity are $BMI \geq 26 \text{ kg}/m^2$ and $BMI \geq 32 \text{ kg}/m^2$ respectively (27), although more research is needed before definite recommendations can be made.

Less attention has been paid to overweight and obesity in PNG. With the average BMI of the urban subjects in the PNGHS 96 data sample close to the upper limit for the normal range of BMI according to WHO standards, one can expect high prevalence of overnutrition and obesity. The Koki study (28) revealed a high prevalence of obesity in urban participants with 27.2% of men and 38.8% of women having a BMI of over $30 \text{ kg}/m^2$. Prevalence was lower in their rural counterparts (16.1% of rural Wanigelan men and women had a BMI over $30 \text{ kg}/m^2$) and virtually absent in rural highlanders (3.3% in men and 2.2% in women) (28).

Results of the PNGHS 96 showed that the average urban dweller had a higher BMI than the rural villager. Rural females were twice as likely to have a BMI below $18.5 \text{ kg}/m^2$, indicative of chronic energy deficiency, and women in general were three times more likely than men to suffer chronic energy deficiency. This sample was not random, because parents of under fives are less likely to be elderly. Many rural women lose weight with advancing age, whereas men tend to maintain the same weight throughout their adult life (Figure 4) (29). This explains the lower average BMI in women compared to men, whereas in most countries women would have higher average BMI than men. Urban women have made up some ground, but not enough to surpass the average BMI of urban men.

The high prevalence of chronic undernutrition in women is worrying. Women who eat poorly before and during pregnancy are more likely to give birth to children who have a low birthweight and who are light for age. Byford studied the impact of women's work on the health and wellbeing of a community in Misima, Milne Bay Province (30). Women's health is affected by the demand of strenuous physical activity required for domestic chores and work in the gardens, plus the added burden of reproduction. Although working hard and eating poorly have a significant impact on women's reproductive health, their effect on women's overall health

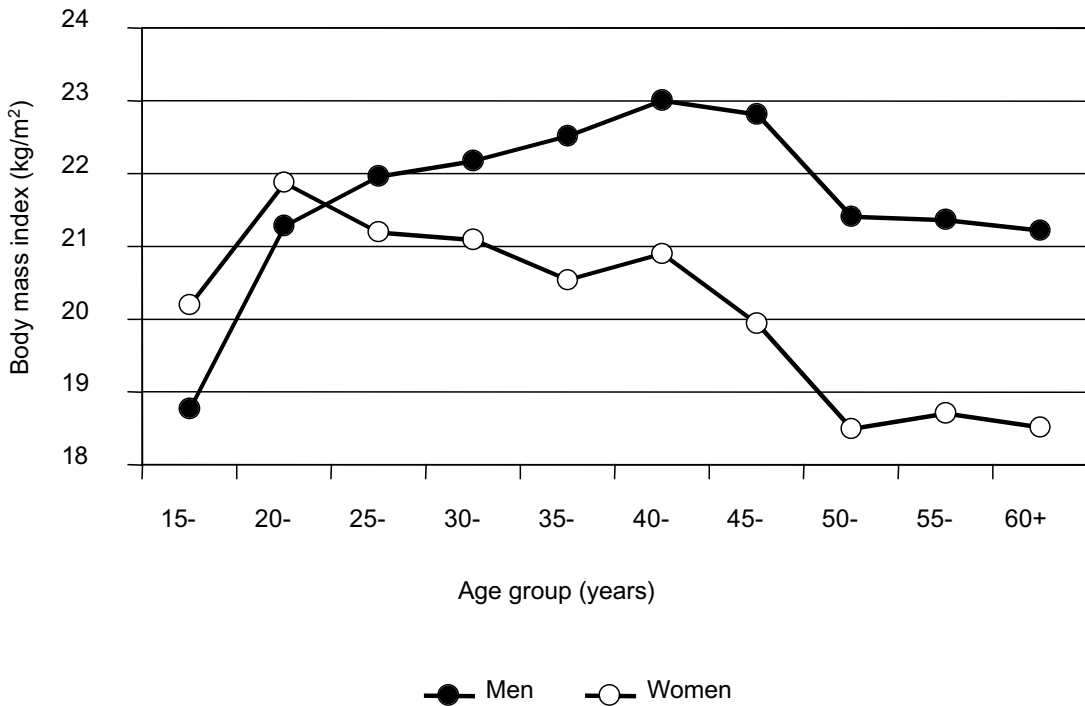


Figure 4. Body mass index by age and sex on Lihir Island, New Ireland Province, Papua New Guinea, 1991. Derived from Taufa et al. (29).

occurs long before and also after their reproductive years. Misiman people live on the coast and fish a lot but consume very little fish. Moreover, it is taboo for pregnant women to eat fish and nuts, thereby reducing even the small amount of protein in their normal diet. These negative impacts on women’s health have serious consequences for the rest of the community (30).

Research during the last decade has shown that children born light for age, especially when they become obese or overweight as adults, have a particularly high risk of developing diabetes and cardiovascular disease (31-33).

PNG is one of the countries with the highest prevalence of low birthweight (LBW) children outside South Asia. Newborns who weigh less than 2.5 kg at birth are classified as LBW. Within PNG, mean birthweights are known to show strong geographical differences. Children from the central PNG highlands and from affluent, mainly urban, lowland areas such as Rabaul and Port Moresby had the

highest birthweights, while those from the Sepik, Western, Madang and Milne Bay Provinces and remote highland fringe areas had the lowest (26). Between 1957 and 1977 the mean prevalence of LBW in the rural highlands was 15% and between 1954 and 1981 it was 19-36% among 5632 newborns in the rural lowlands (34).

Conclusion

Adoption of a modern lifestyle has a profound influence on the health and nutrition status of the population, not only on the urban dwellers but also on villagers with access to towns and those who take part in the cash economy. Money has replaced land as the most important asset (35). Studies by Yamauchi and colleagues showed that average energy output was lower in urban subjects than in their rural counterparts (16-18). The PNGHS 96 surprisingly established that on average energy intake was similar for urban townfolk and rural dwellers (13). The nutritional outcomes were, however, different both for children and adults. For children the

urban diet may be beneficial since nutritional outcome is improved due to the higher energy and protein density of the diet.

The higher energy density and protein of urban diets combined with increased fat intake and reduced PAL may cause obesity in adults and increase the risk of chronic degenerative diseases (16-18). Many urban people consume meals outside the home. Fast-food outlets ('kaibars') tend to serve deep-fried foods, which have a high fat content. Fat content of the daily food intake is mainly from animal origin, so the diet is high in saturated fatty acids, a known risk factor for the development of cardiovascular diseases.

When incomes rise, so do the daily food energy and protein intakes. Results of the PNGHS 96 indicate that among the higher socioeconomic groups the average energy intake was well above the minimum requirement. This group has the highest average body mass index for both men and women (9). Salt intake increases with protein intake, which may result in a higher prevalence of hypertension.

People should be encouraged to make healthier food choices. Although in PNG excellent fresh vegetables can be grown, transportation to city markets and shops is cumbersome. Consumers in urban centres use less vegetables and fruits than farmers in rural areas. Not only healthy food choices, but also healthy food preparation should be promoted: steaming, boiling, grilling and baking are preferred to deep-frying.

It is equally important to encourage daily physical exercise, especially for the urban population. The law-and-order situation should be improved, so that townspeople could enjoy walking. PNG society should show more respect for women, and family members should encourage women to eat well-balanced meals with sufficient energy and nutrients to sustain them. This could result in a lower prevalence of chronic undernutrition in women. Healthier women are more likely to give birth to babies with a normal birthweight and possibly result in a reduction in the development of diabetes and cardiovascular diseases in later life.

Further research is needed to elucidate the above suggestions. Studies are needed which compare food choices, activity patterns and nutritional status of rural residents and urban migrants of different linguistic groups and clans. Only then can evidence-based advice be given on how to avoid the rocks on the road from roots to rice and prevent further increases in the prevalence of chronic lifestyle-related diseases. In the meantime, it is wise to adhere to Nevin Scrimshaw's counsel, "Good nutrition and lifestyle matter from womb to tomb" (36).

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