(Part 3 of 3)

PROCEEDINGS
OF THE
SIXTH ASIAN CONGRESS OF NUTRITION

16-19 SEPTEMBER 1991

KUALA LUMPUR, MALAYSIA

FOOD INDUSTRIES AND NUTRITION

SPORTS NUTRITION

NUTRITIONAL ASPECTS OF EDIBILE OILS AND FATS

NUTRIENT COMPOSITION OF FOODS

CONTROL AND ELIMINATION OF IODINE DEFICIENCY DISORDERS

RAPID ASSSESSMENT PROCEDURES FOR THE EVALUATION AND IMPROVEMENT OF NUTRITION PROGRAMMES

DIETETICS IN ASIA - THE NEXT DECADE

ASSESSING, ANALYSING AND MONITORING CHANGES IN NUTRITION PROBLEMS

CHANGING NUTRITIONAL NEEDS IN THE WORLD TODAY

NUTRITIONAL EPIDEMIOLOGY IN THE ASIA PACIFIC REGION

SUB-THEME: BASIC ISSUES IN NUTRITIONAL EPIDEMIOLOGY

SUB-THEME: NUTRITIONAL EPIDEMIOLOGY TRAINING IN THE REGION

---

* Paper not submitted at time of printing.

Proc 6th ACN 1991: 426-431

Protective effects of tocopherol and tocotrienol supplementation against exercise-induced oxidative protein damage

[1]Eric H Witt, [2]Abraham Z Reznick, [1]Lester Packer

[1]Department of Molecular and Cell Biology, University of California, Berkeley, CA, USA

[2]Department of Morphological Sciences, Faculty of Medicine and Rappaport Institute for Medical Research, Technion, Haifa, Israel

Introduction

Physical exercise causes up to a 20-fold increase in whole-body oxygen consumption (1) and up to a 200-fold increase in oxygen consumption in the exercising muscles (2). It has been established that there is an electron leak in the mitochondrial electron transport chain which may allow the production of superoxide (3-5), so at the increased levels of oxygen consumption seen during exercise, an increase in superoxide production might be expected. In addition, ischemia-reperfusion mechanisms (6,7) that induce formation of reactive oxygen species (ROS) may be initiated during exercise, due to shunting of blood away from non-exercising areas, and/or due to local hypoxia in the exercising muscles themselves. Thus, much effort has been directed at detecting exercise-induced oxidative damage, and at preventing such damage through enhanced antioxidant nutrition. The present paper willl examine some of these investigations, directed at detection of damage to lipids, nucleic acids, or proteins, and report on our recent work on the detection of exercise-induced oxidative damage to protein, and the effects of tocopherol and tocotrienol supplementation.

Effects on lipids

Evidence of lipid peroxidation can be obtained in a number of simple ways, such as the assay of thibarbituric acid reactive substances (TBARS) or expired breath pentane; thus, effects of exercise, training, and antioxidant manipulation on lipids of a number of tissues have been extensively studied. Lipid peroxidation has been shown to occur in muscle and liver of exercising, untrained animals (8,9), and expired pentane measurements indicate that it also occurs in exercising humans (10). The amount of peroxidation is dependent on the intensity of the exercise and the state of training of the subjects — Lovlin *et al.* found no increase in plasma lipid peroxidation during exercise in humans at 40% and 70% VO_{2max}, but detected an increase at 100% VO_{2max}, while in two studies in humans using similar exercise protocols, plasma lipid peroxidation was not detected in one (11), but was

detected in another using less well-trained subjects (12). It should be noted that the majority of studies in this area have used plasma lipid peroxidation as an indicator of oxidative damage due to exercise, but conclusions based on plasma lipid peroxidation cannot be extrapolated to muscle or other tissues.

Deficiency of the antioxidant nutrient α-tocopherol decreases exercise time to exhaustion in rats (8, 13, 14); exercising α-tocopherol-deficient animals experience greater lipid peroxidation as evidenced by expired breath pentane (15), though at exhaustion lipid peroxidation products in muscle and liver are at the same levels as in α-tocopherol-sufficient animals (8). Since α-tocopherol is the major chain-breaking antioxidant in membranes (16), these results indicate that exhaustion during prolonged exercise may be related to a disruption of membrane integrity, which occurs more quickly in animals that are deficient in α-tocopherol. This implies that supplementation with α-tocopherol might decrease exercise-induced membrane damage and prolong the time to exhaustion. Supplementation of humans with α-tocopherol at levels of 300-600 mg/day has resulted in decreased breath pentane during submaximal exercise (10) and decreased plasma lipid peroxidation during exercise (12), and α-tocopherol-supplemented rats exhibit less exercise-induced lipid peroxidation compared to non-supplemented animals (17). However, studies of rats supplemented with α-tocopherol (18) indicate no increase in exercise endurance in supplemented vs. non-supplemented animals, nor did human swimmers supplemented with α-tocopherol exhibit an increase in swimming speed compared to non-supplemented swimmers (19, 20). In contrast to these studies, an increase in swimming endurance time to exhaustion has been observed in mice supplemented with α-tocopherol (21). Thus, deficiency of α-tocopherol is clearly deleterious to both performance and protection of membrances from lipid peroxidation during exercise, while supplementation with α-tocopherol protects membrances from exercise-induced lipid peroxidation: its possible effects on enhancing endurance performance are yet to be clearly delineated.

Effects of nucleic acids

All cellular components are potential targets for damage by ROS. Because of their central role in information storage and transfer, nucleic acids are an especially important component. However, studying exercise-induced damage to nucleic acids is not as easy as studying lipid damage. Blood levels are quite low since red blood cells are anuclear. Examination of tissue levels, in humans, involved taking biopsies and extraction of DNA or RNA; at present, such studies remain to be done. A more practical method of examining oxidative damage to nucleic acids is to monitor damaged bases excreted in the urine, before and after exercise. In one study which we have reported previously (22), moderately trained subjects were asked to exercise for 90 minutes at 65% VO_{2max} on a cycle ergometer, before and after one month of daily supplementation with an antioxidant mixture containing 533 mg of α-tocopherol, 100 mg of vitamin C, and 10 mg of β-carotene. Urine was collected before and after exercise and analysed for 8-hydroxyguanosine, an oxidised RNA base found in the urine after oxidative stress (23). No increase was seen with exercise, and antioxidant supplementation had no effect either on resting or post-exercise urine concentrations of this damaged base. While the results of this study were negative, this method remains a promising approach for further studies, perhaps involving more intense or prolonged exercise. Direct

examination of DNA and RNA in tissues is feasible in animal studies. Clearly there is a need for further investigation in this area.

Effects on protein

A third important cellular component that is subject to oxidative damage is protein. The side chains of the amino acids histidine, lysine, arginine, and proline, are subject to metal-catalysed oxidation, producing protein carbonyl groups which can be detected by several methods (24,25). We have previously reported (22) that rats subjected to endurance training exhibited muscle protein carbonyl levels over double those seen in untrained control animals, while liver protein carbonyl concentrations were unaffected by training. Muscle protein carbonyl levels returned to normal in rats allowed to detrain (i.e., trained then sedentary). These results indicate that chronic exercise results in an oxidative stress to cellular proteins whose effects are cumulative and are not completely counteracted by cellular antioxidant defences or mechanisms for the removal of damaged proteins; however, the effects appear to be reversible.

Recently we examined the protein-damaging effects of a single bout of exhaustive exercise in untrained rats. Sprague-Dawley rats (Bantin and Kingman, Fremont, CA) were placed on three diets: normal (60 mg *dl*-α-tocopherol acetate/kg diet) (n=11), α-tocopherol-supplemented (20,000 mg *dl*-α-tocopherol acetate/kg diet) (n=11), or supplemented with a combinaion of α-tocopherol and α-tocotrienol in an extract of palm oil (3750 and 6700 mg/kg diet, respectively) (n=9). *dl*-α-tocopherol acetate was a kind gift of Roche Vitamins and Fine Chemicals (Nutley, New Jersey), and the combination of α-tocopherol and α-tocotrienol used in these experiments was generously supplied by the Palm Oil Research Institute of Malaysia. After three weeks on the diets, half of each group was run to exhaustion on a treadmill (15% grade, 30 m/min) as described previously (8). The rats were killed immediately after exercise and the gastrocnemius muscle was removed and frozen in liquid nitrogen. Protein carbonyl concentrations in these muscles were determined by the method of Levine *et al.* (26). Our purposes were (i) to examine the effects of a single bout of exhaustive exercise on muscle protein carbonyl levels; (ii) to determine whether α-tocopherol supplementation has any protective effect on muscle proteins and (iii) to determine if α-tocotrienol has a protective effect greater than that of α-tocopherol. We used α-tocotrienol because we have found that, *in vitro*, it is a much more effective antioxidant than α-tocopherol (27).

It was found that a single bout of exhaustive exercise caused an 18% increase in the concentration of protein carbonyls in gastrocnemius muscle of the animals on normal diet ($p < 0.10$), but only an 8% and a 6% increase in the muscles of animals on α-tocopherol or α-tocopherol and α-tocotrienol, respectively (n.s.) (Figure 1). In addition, even at exhaustion, protein carbonyl concentrations were about 25% lower in both α-tocopherol and (α-tocopherol + α-tocotrienol) supplemented animals compared to normal resting animals ($p < 0.05$ and $p < 0.10$, respectively). These results indicate that a single bout of exhaustive exercise produces an oxidant load that overwhelms the muscle cells' antioxidant defences, leading to protein damage, but if these defences are supplemented such damage can be completely prevented. In addition, it appears that some of the protein carbonyl formation occuring even in sedentary animals can be prevented by supplementation with α-tocopherol and/or α-tocotrienol. Finally, these

results indicate that α-tocotrienol was as effective in preventing oxidative damage than α-tocopherol, though not more effective, at least under the conditions of this study.

Conclusions

Moderate physical exercise has been shown to be, on the whole, healthful and beneficial. However, numerous studies indicate that intense exercise, especially in untrained subjects, leads to oxidative damage to lipids. New evidence points to a damaging effect on muscle proteins, as well. Effects on nucleic acids remain largely unexplored. The protective effects of supplementation with α-tocopherol are also clearly established by a number of investigations. Thus, while exact relationships between such factors as exer-

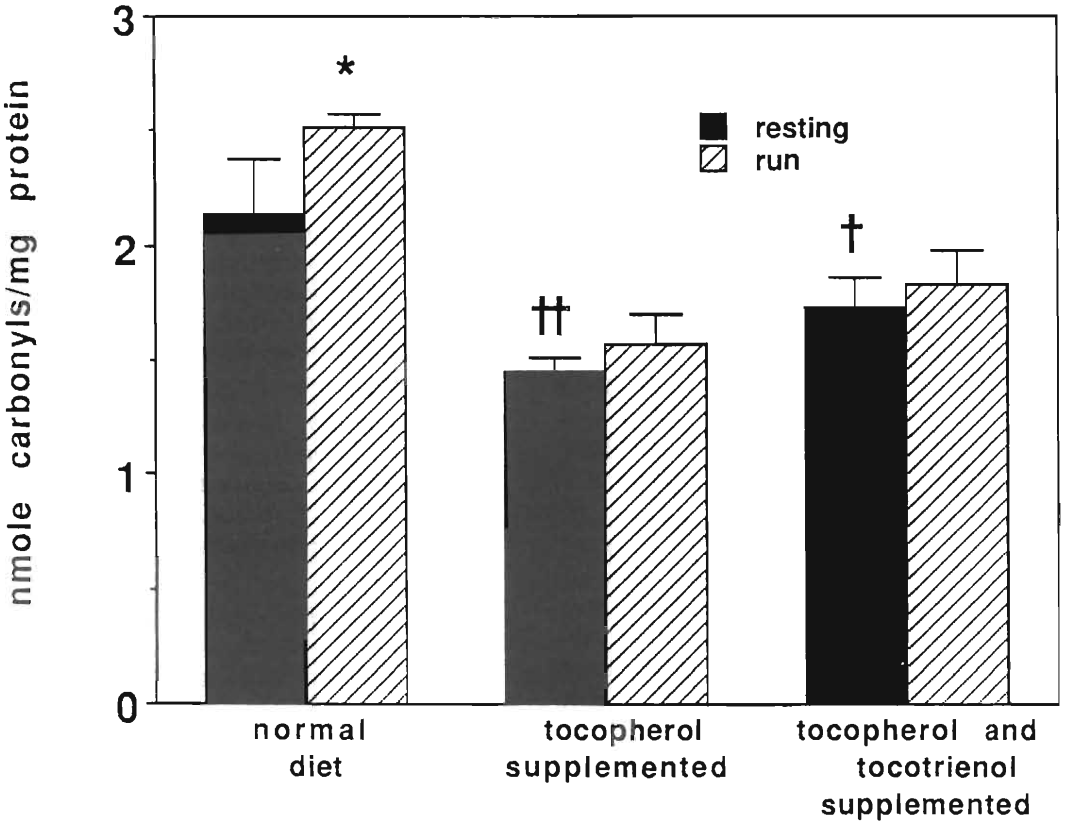


FIG. 1 Protein carboxyl concentrations in gastrocnemius muscles of rats run to exhaustion compared to resting control animals, rats on normal diet, α-tocopherol-supplemented diet, or (α-tocopherol + α-tocotrienol-supplemented diet). *different from rest, $p < 0.10$; † different from normal diet, $p < 0.10$; †† different from normal diet, $p < 0.05$.

cise intensity, duration, state of training, and aging remain to be elucidated, it appears that at least some of the possible deleterious effects of exercise may be ameliorated through enhance intake of α-tocopherol and/or α-tocotrienol; in this way, the positive effects to exercise can be enjoyed while the possibly damaging effects are minimised.

References

1. Astrand P-O, Rodahl K. Textbook of Work Physiology. New York: McGraw Hill, 1986.
2. Keul J, Doll E, Koppler D. Energy metabolism of human muscle. Basel, Switzerland: Karger, 1972.
3. Boveris A, Cadenas E. Mitochondrial production of superoxide anions and its relationship to the antimycin insensitive respiration. FEBS Lett 1975; 54:311-314.
4. Boveris A, Chance B. The mitochondrial generation of hydrogenn peroxide: general properties and effect of hyperbaric oxygen. Biochem J 1973; 134:707-716.
5. Cadenas E, Boveris A, Ragan CI, Stoppani AOM. Production of superoxide radicals and hydrogen peroxide by NADH-ubiquinone reductase and ubiquinol-cytochrome c reductase from beef heart mitochondria. Arch Biochem Biophys 1977; 180:248-257.
6. Wolbarsht ML, Fridovich I. Hyperoxia during reperfusion is a factor in reperfusion injury. Free Radical Biol Med 1989; 6:61-62.
7. Kellog EW III, Fridovich I. Superoxide, hydrogen peroxide, and singlet oxygen in lipid peroxidation by a xanthine oxidase system. J Biol Chem 1975; 250:8812-8817.
8. Davies KJA, Quintanilha AT, Brooks GA, Packer L. Free radicals and tissue damage produced by exercise. Biochem Biophys Res Comm 1982; 107: 1198-1205.
9. Alessio HM, Goldfarb AH, Cutler RG. MDA content increases in fast- and slow-twitch skeletal muscle with intensity of exercise in a rat. Am J Physiol 1988; 255: C874-877.
10. Dillard CJ, Litov RE, Savin WM, Dumelin EE, Tappel AL. Effects of exercise, vitamin E, and ozone on pulmonary function and lipid peroxidation. J Appl Physiol 1978; 45: 927-932.
11. Viinikka L, Vuori J, Ylikorkala O. Lipid peroxides, prostacyclin, and thromboxane A2 in runners during acute exercise. Med Sci Sports Exer 1984; 16: 275-277.
12. Sumida S, Tanaka K, Kitao H, Nakadomo F. Exercise-induced lipid peroxidation and leakage of enzymes before and after vitamin E supplementation. Int J Biochem 1989; 21: 835-838.
13. Aikawa KM, Quintanilha AT, De Lumen BO, Brooks GA, Packer L. Exercise endurance-training alters vitamin E tissue levels and red-blood-cell haemolysis in rodents. Bioscience Reports 1984; 4: 253-257.
14. Gohill K, Packer L, De Lumen B, Brooks GA, Terblanche SE. Vitamin E deficiency and vitamin C supplements: exercise and mitochondrial oxidaation. J Appl Physiol 1986; 60: 1986-1991.
15. Dillard CJ, Litov RE, Tappel AL. Effects of dietary vitamin E, selenium, and polyunsaturated fats on in vivo lipid peroxidation in the rat as measured by pentane production. Lipids 1978; 13: 396-402.
16. Burton GW, Cheesman KH, Doba T, Ingold KU, Slater TF. Vitamin E as an antioxidant *in vitro* and *in vivo*. In: R. Porter and J.Whelan (eds), Biology of vitamin E, Pitman, London, 1983; pp 4-18.

17. Brady PS, Brady LJ, Ulrey De. Selenium, vitamin E, and the response to swimming stress in the rate. J Nutr 1979; 109: 1103-1109.

18. Mehlhorn RJ, Sumida S, Packer L. Tocopheroxyl radical persistance and tocopherol consumption in liposomes and in vitamin E-enriched rat liver mitochondria and microsomes. J Biol Chem 1989; 261: 13,448-13,452.

19. Lawrence JD, Bower RC, Riehl WP, Smith JL. Effects of α-tocopherol acetate on the swimming endurance of trained swimmers. Am J Clin Nutr 1975; 28:205-208.

20. Shephard RJ, Campbell R, Pimm P, Stuart D, Wright GR. Vitamin E, exercise and the recovery from physical activity. Eur J Appl Physiol 1974; 33: 119-126.

21. Novelli GP, Bracciotti G, Falsini S. Spin-trappers and vitamin E prolong endurance to muscle fatigue in mice. Free Rad Biol Med 1990; 8: 9-13.

22. Witt EH, Reznick AZ, Viguie CA, Starke-Reed P, Packer L. Exercise, oxidative damage and effects of antioxidant manipulation . J Nutr 1992; 122: in press.

23. Shigenage MK, Gimeno CJ, Ames BN. Urinary 8-hydroxy-2'deoxyguanosine as a biological marker of *in vivo* oxidative DNA damage. Proc Natl Acad Sci USA 1989; 86: 9697-9701.

24. Stadtman ER, Oliver CN. Metal-catalysed oxidation of proteins: physiological consequences. J Biol Chem 1991; 266: 2005-2008.

25. Amici A, Levine RL, Tsai L, Stadtman ER. Conversion of amino acid residues in proteins and amino acid homopolymers to carbonyl derivatives by metal-catalysed oxidation reactions. J Biol Chem 1989; 264: 3341-3346.

26. Levine RL, Garland D, Oliver CN, Amici A, Climent I, Lenz A-G, Ahn B-W, Shaltiel S, Stadtman ER. Determination of carbonyl content inoxidatively modified protein. In: Meth. Enz. 186: Oxygen radicals in biological systems, Part B: Oxygen radicals and antioxidants, ed. by L. Packer and A.N.Glazer, Academic Press, New York 1990; pp. 464-478.

27. Serbinova E, Kagan V, Han D, Packer L. Free radical recycling and intramembrane mobility in the antioxidant properties of α-tocopherol and α-tocotrienol. Free Rad Biol Med 1991; 10: 263-275.

Proc 6th ACN 1991: 432-435

Sports nutrition: present status and future prospect in China

Jidi Chen

Institute of Sports Medicine, Beijing Medical University, Beijing 100083, China

Introduction

The integration of adequate exercise and rational nutrition is one of the most important component to keep people's health, it also enhances the ability to adapt physical stress. Thus, it helps to improve people's physique and quality of life.

Sports nutrition studies started mainly on the surveys of nutritional status of elite athletes in the early 1960s. Great importance has been attached to sports nutrition since the research results were closely related to improve athletes' physical performance and health in the last decade. The Research Division of Sports Nutrition attached to the Institute of Sports Medicine of Beijing Medical university was established in 1985. Sports nutrition course has been set for the students majoring in biological sciences at the Institute of Physical Education. Many young scientists and graduate students are joining in the research activities of sports nutrition. Besides, the international academic interchanges promotes the development of this branch of science.

Role of sports nutrition

The main tasks of sports nutrition at present in China can be described as follows:

1. To study the specific nutrition metabolism and requirement of athletes in different age-groups and sports events.
2. To monitor the nutritional status (including both nutritional deficiencies and overnutrition) and to develop strategies and interventions to prevent the nutritional problems.
3. To find out the relations between nutritional factors and sports diseases such as overtraining, anaemia, and low immunity of athletes etc.
4. To adopt measures for nutritional provisions to athletes training under special conditions such as weight reduction and intensive competition etc.
5. To make full use of natural resources such as wild plants and Chinese herbs and medicine in China in formulating "sports beverages and foods" for athletes to improve their health and performance.
6. To integrate nutrition and exercise prescriptions for the prevention and treatment of chronic diseases such as CHD etc.

In achieving the goals mentioned above, the following studies have been conducted regularly:

1. Investigation on nutritional intake, metabolism, performance, and health status of athletes during collective teams training and at competition site or in the community.
2. Studies on nutritional biochemistry and physiology of both humans and animals under strictly controlled experimental conditions in laboratory to find out the mechanisms of the effects of overnutrition and nutritional insufficiencies on physical performance and recovery.
3. Establish animal models of marginal or serious nutritional deficiencies or imbalances and identifying their effects on exercising organisms especially on the early and sensitive signs or lesions of nutritional problems.
4. Attach more importance on the basic research of medical biology (immunology, cytobiology, and molecular biology) and biochemistry, so as to provide a wide solid theoretical basis in prevention and treatment of nutritional problems.

Accomplishments in sports nutrition

The main achievements of sports nutrition in China at present are as follows:

1. Guidelines on the recommended dietary allowances (RDA) of Chinese athletes has been established on the basis of a series of systematic studies on nutritional metabolism and requirements of athletes. Physical exercise training increases the need for energy, protein, potassium, magnesium, iron, zinc, and some of the vitamins.
2. The major nutritional problems have been identified through periodical monitoring of nutritional status of athletes:
   i. Energy and protein intakes were sufficient for the majority of athletes investigated except those who were on weight - control regimes.
   ii. The intake of fat exceeded the RDA, and the incidence of hypercholesterolemia (>5.69 mmol/L) was 13.3% in adult and 2.2% in adolescents, respectively, from 253 athletes investigated which draws attention.
   iii. Although the total intakes of calcium and iron were adequate, the milk calcium and heme iron were inadequate. The incidence of iron - deficiency anaemia was high and some athletes also showed low serum zinc and copper. Some athletes had inadequate intakes of vitamin A, B1, and B2 as reflected by serum vitamin A levels and enzyme tests of transketolase and glutathione reductase. Further study of interactions between nutrition, exercise, and fitness are nevertheless needed, with particular emphasis on growing children and adolescents.
3. Research on functional evaluation indicated that there was a relationship between nutritional status and athletes' condition. Serum globulin levels decreased as physical conditions of athletes were getting worse and they improved as conditions get better. Serum IgG and IgA levels decreased in overtrained athletes as well. Serum vitamin C levels of overtrained athletes were low, the phagocytic activity of their WBC decreased significantly too. Different vitamin C status of athletes had distinct responses on the phagocytic activity of WBC.
4. Research on the etiology and prevention of iron deficiency anaemia (IDA) in Chinese athletes

showed that the anaemia incidence in 316 athletes was found to be 22.4% and 39.5% in adult and children athletes, respectively, in 1988-1989. Biochemical indices indicated that iron deficiency is most common. Although the total iron intake was adequate, heme iron intake was less than 10%. Sweat iron levels were 60 ± 30 and 42 ± 10 μg/dL in adult and children athletes, respectively. The iron absorption rate of athletes during exercise training (9.1 ± 2.9%) was significantly lower than that of non-training period (11.9 ± 4.7%) as determined by stable isotope neutron activation technique. Iron deficiency may induce RBC damage (shown by RBC filter rate, RBC suspension viscosity and percentages of abnormal shaped RBC), and it recovered after the iron deficiency was corrected. Heme iron-enriched food and tablets were effective in raising Hb and ferritin levels of anaemic athletes with no side effects.

5. Research results on weight reduction of athletes revealed rapid weight loss of lifters, wrestlers and judo players (by partial starvation along with fluid restriction, or exercise dehydration etc.) would cause dehydration, extra load on the cardiovascular and renal systems, depletion of glycogen store, hypoglycaemia, ketouria, loss of body protein, electrolytes and vitamins, etc. Weight loss has adverse effects on performance to a varying degrees. More seriously, it causes cramps and debility. A long term weight control adopted by girl gymnasts, divers or dancers (using long term low calorie diet combined with dehydration) would lead to growth retardation, malnutrition, mental stress, anorexia nervosa, muscular weakness and also impairment of physical performance. Comprehensive nutrition improvements including supplementation of energy and essential nutrients at safe levels showed good effects on preventing or decreasing the medical problems mentioned above, and the physical performance was also improved. However, a rational weight control measure is still in need of further research.

6. Many kinds of sports drinks and foods have been developed in China in recent years. One of the sports drinks made of kiwi fruit juice and some electrolytes of natural sources showed very promising effects. Comparing with the placebo, Kiwi fruit sports drink supplementation to athletes training in hot environments showed that their work time to exhaustion was longer and the work output was greater, their blood volume was expanded, blood glucose were maintained at normal levels as exercise lasted >2.5 hrs, without noticeable effect on insulin levels or any other side effects.

7. Although the average intakes of Zn and Cu was about two times that of the normal persons in China, the incidence of low serum Zn (<90 μg/dL) or 32.7% and (< 75 μg/dL) or 8.3% in 360 athletes investigated. Serum Zn levels of athletes (96 ± 19 μg/dL) was significantly lower than that of the medical students (108 ± 16 μg/dL) of the same age. Serum Cu levels of athletes decreased significantly by a two hour aerobic cycling on a Monark ergometer (heart rate was kept around 150/min) at 24 hrs after exercise. Sweat Zn and Cu levels were 117 ± 67 and 49 ± 25 μg/dL, respectively. Results of animal experiment showed that liver Zn and Cu contents of rats increased significantly after an exhaustive swimming test. There is a need to explore whether the low

serum Zn of athletes reflect poor absorption, increased utilization and loss, or metabolic changes.

We have found out than Zn deficiency would lead to an increase of free radical generation (detected by eletron spin resonance ESR technique), lipid peroxidation and a decrease of hepatic Cu Zn-SOD activity in both sedentary and exercised mice. Exercise training did strengthen the free radical defence system, but Zn deficiency would eliminate the exercise induced adaptation.

Future prospects on sports nutrition

The following subjects may be predicted as the key topics for research needs in the coming years in China.

1. The effects of nutrition combined with exercise and immunity.
2. The effects of nutrition combined with exercise and anti-aging.
3. The effects of nutrition combined with exercise and chronic diseases, and rehabilitation. (To find out the roles of exercise and specific dietary factors in the etiology and prevention of diseases such as CHD, diabetes, osteoporosis, obesity etc.).
4. RDA for populations involved in different loads of exercise.
5. Effects of marginal deficiencies of nutrition on physical performance and recovery process of athletes.
6. The roles and mechanisms of nutrition factors in the etiology and prevention of sports diseases.
7. Effects of natural resources and chinese medicine (from the nutrition aspects) on regulating immune functions, improving response to stress, prevention of chronic diseases, and anti-aging.

Conclusion

For the purpose of educating more sports nutritionists and medical professionals, we hope to establish some training centres attached to the Institutes of Sports Science or Medical universities to train specialists for these areas.

To develop the depth and scope of sports nutrition research, research methods in nutrition, biochemistry and physiology should be improved. There may be a need to use isotopes especially stable isotopes for tracing the metabolism of nutrients in the body. Measures of molecular biology will also be extensively applied and integrated into exercise physiology and nutrition. It is necessary to combine multiscience (e.g. exercise trainology, immunology, pathology, biophysiology, clinical sciences, genetics etc.) to study and to provide more information. Research on the relationship between exercise, nutrition, and fitness will have a brilliant future.

Proc 6th ACN 1991: 436-438

Fluid and electrolyte loss and replacement during exercise

RJ Maughan, JB Leiper, and GE Vist

Department of Environmental and Occupational Medicine, University Medical School, Aberdeen AB9 2ZD, Scotland

Fatigue in prolonged exercise

Many studies have demonstrated that the point at which individuals become exhausted during bicycle exercise lasting 1-2 hours coincides with depletion of the muscle glycogen stores. Other factors than CHO depletion may, however, also contribute to fatigue. Exercise capacity is reduced if the ambient temperature is high, even though the rate at which the body's CHO reserves are depleted is not greatly altered. This implicates thermoregulation as a cause of fatigue, at least when exercise is performed in the heat. Running a marathon in 2 h 30 min requires an oxygen consumption of about 4 l/min to be sustained throughout the race for a runner with a body weight of 70 kg, corresponding to a heat load of about 1 KW. When the ambient temperature is higher than skin temperature, heat will also be gained from the environment by physical transfer. In spite of this, rectal temperature measurements on marathon runners indicate that body temperature does not normally rise by more than 2-3°C about the resting level, indicating that heat is being lost from the body almost as fast as it is being produced.

At high ambient temperatures, the only mechanism by which heat can be lost from the body is evaporation. Evaporation of 1 l of water from the skin will remove 2.4 MJ (580 kcal) of heat from the body. For the 2 h 30 min marathon runner with a body weight of 70 kg to balance his rate of heat production by evaporative loss alone would therefore require sweat to be evaporated from the skin at a rate of about 1.6 l/h: at such high sweat rates, an appreciable fraction drips from the skin without evaporating, and a sweat secretion rate of about 2 l/h is likely to be necessary to achieve this rate of evaporative heat loss. This is possible, but would result in the loss of 5 l of body water, corresponding to a loss of more than 7% of body weight. It is often reported that exercise performance is impaired when an individual is dehydrated by as little as 2% of body weight, and that losses in excess of 5% of body weight can decrease the capacity for work by about 30% (1).

Fluid losses are distributed in varying proportions among the plasma, extracellular water, and intracellular water. The decrease in plasma volume which accompanies dehydration may be of particular importance in influencing work capacity; blood flow to the muscles must be maintained at a high level to supply oxygen and substrates, but a high blood flow to the skin is also necessary to convect heat to the body surface. When the ambient tempera-

ture is high and blood volume has been decreased by sweat loss during prolonged exercise, there may be difficulty in meeting the requirement for a high blood flow to both these tissues. In this situation, skin blood flow is likely to be compromised, allowing central venous pressure and muscle blood flow to be maintained but reducing heat loss and causing body temperature to rise.

The sweat which is secreted onto the skin contains a wide variety of organic and inorganic solutes, and significant losses of some of these components will occur where large volumes of sweat are produced. The electrolyte composition of sweat is variable, and the concentration of individual electrolytes as well as the total sweat volume will influence the extent of losses. Sweat composition undoubtedly varies between individuals, but can also vary within the same individual depending on the rate of secretion, the state of training and the state of heat acclimation. In response to a standard heat stress, the sweat rate increases with training and acclimation and the electrolyte content decreases. These adaptations allow improved thermoregulation while conserving electrolytes.

Effects of ingestion of carbohydrate-electrolyte solutions during exercise

Ingestion of fluids during exercise is aimed at supplying a source of substrate, minimising dehydration, and possibly also replacing electrolyte losses. The relative importance of these aims will depend on many factors, including the duration and intensity of exercise and the ambient temperature and humidity. There is also a large inter-individual variability in requirements. The effects of ingestion of CHO-electrolyte beverages on exercise performance have been extensively investigated in recent years as commercial interest in this field has grown (2,3). Not all of these studies have shown a positive effect of fluid ingestion on performance, but, with the exception of a few investigations where the composition of the drinks administered was such as to result in gastrointestinal disturbances, there are no studies showing that fluid ingestion will have an adverse effect on performance. Carbohydrate-electrolyte solutions have generally been shown to be more effective than plain water. Performance is commonly measured as the time for which a fixed exercise intensity can be sustained before fatigue forces the subject to stop: some investigations have shown improvements in exercise time of 30% or more. Studies involving simulated competition in the laboratory or field trials have generally shown much smaller improvements, as would be expected.

Availability of ingested fluids

The availability of ingested fluids depends on the rates of gastric emptying and intestinal absorption. Gastric emptying controls the rate at which fluids are delivered to the small intestine and the extent to which they are influenced by the gastric secretions. In high intensity exercise, the rate of gastric emptying is decreased, but moderate intensity exercise appears to have little effect on this process. The rate of emptying is determined by the volume and composition of fluid consumed. The volume of the stomach contents is a major factor in regulating the rate of emptying; emptying follows an exponential time course, and falls rapidly as the volume remaining in the stomach decreases. Where a high rate of emptying is desirable, this can be promoted by keeping the volume high by repeated drinking. Dilute solutions of glucose will leave the stomach almost, but not quite, as fast as plain water; the rate of emptying is slowed in proportion to the glucose content, and

concentrated sugar solutions will remain in the stomach for long periods.

An increasing osmolality of the gastric contents will tend to delay emptying, and there is some evidence that substitution of glucose polymers for free glucose, which will result in a decreased osmolality for the same CHO content, may be effective in increasing the volume of fluid and the amount of substrate delivered to the intestine. The results are rather variable, but it is worth noting that there are no reports of polymer solutions being emptied more slowly than free glucose solutions with the same energy density: even when the difference is not significant, there is a tendency for faster emptying of polymer solutions. Although it is often stated that cool drinks are emptied more rapidly, recent evidence suggests that this is not the case.

Absorption of glucose occurs in the small intestine, and is an active, energy-consuming process linked to the transport of sodium. Water crosses the intestinal mucosa in either direction depending on the local osmotic gradients. Hypotonic glucose-electrolyte solutions appear to maximise the rate of water uptake. Solutions with a very high glucose concentration will not necessarily promote an increased glucose uptake relative to more dilute solutions, but, because of their high osmolality, will cause a net movement of fluid into the intestinal lumen. This results in an effective loss of body water and will exacerbate any pre-existing dehydration. Other sugars, such as sucrose or glucose polymers can be substituted for glucose without impairing glucose or water uptake. Several studies have shown that exercise at intensities of less than about 70% of an individuals maximum capacity has little effect on intestinal function, although both gastric emptying and intestinal absorption may be reduced when the exercise intensity exceeds this level. In spite of these observations, gastrointestinal disturbances have been reported to be relatively common during exercise.

Addition of sodium will stimulate CHO and water uptake in the small intestine. Sodium is also necessary for post-event rehydration, which may be particularly important when the exercise has to be repeated within a few hours: if drinks containing little or no sodium are taken, urine production will be stimulated and much of the ingested fluid will not be retained. A high sodium content tends to make drinks unpalatable, although the taste and appetite for sodium certainly change when an individual is dehydrated and body temperature is elevated. However, it is important that drinks intended for ingestion during or after exercise should have a pleasant taste in order to stimulate consumption.

References

1. Sawka MN, Pandolf KB. Effects of body water loss on physiological function and exercise performance. In: Gisolfi CV, Lamb DR, eds. Fluid homeostasis during exercise. Carmel, Benchmark. 1990: 1-38.
2. Lamb DR, Brodowicz GR. Optimal use of fluids of varying formulations to minimize exercise-induced disturbances in homeostasis. Sports Medicine 1986; 3: 247-74.
3. Maughan RJ. Carbohydrate-electrolyte solutions during prolonged exercise. In: Lamb DR, Williams MH, eds. Perspectives in exercise science and sports medicine, Vol 5. Carmel, Benchmark. 1991: 35-89.

Proc 6th ACN 1991: 439-447

Effect of glycogen supercompensation on the endurance of Chinese elite athletes

Fu-Chun Tang

Department of Home Economic Education, National Taiwan Normal University, Taiwan, ROC

Introduction

With the past several years the importance of nutrition in the physical performance has been recognised by nutritionists, scientists, coaches, and athletes. For decades, coaches and athletes have looked for miraculous foods to increase the energy needed for endurance exercise. Attention has been focused on carbohydrates since the 1960s when a group of Scandinavian researchers began experimental observations of carbohydrate storage and utilisation with prolonged, endurance-type exercise (1,2). Results of those studies using biopsy techniques confirmed the importance of carbohydrates and suggested that carbohydrate supplementation would improve endurance performance since the depletion of muscle glycogen stores coincided with hypoglycaemia and extreme muscle fatigue. A review article (3) indicated that one can increase glycogen storage by performing a dietary manipulation known as 'carbohydrate loading' or `glycogen supercompensation'. Glycogen supercompensation is separated into three phases: Phase I, the depletion phase, consists of Days 7 to 4 before the athletic event; Phase II, the supersaturation phase, Days 3 to 1 before the athletic event; Phase III, the day of the event. There are several ways to accomplish this practice: A) 3 or 4 days high CHO diet without exhaustive training. B) 3 or 4 days high CHO diet after the glycogen of the specific muscles to be used for the event has been depleted by exhaustive exercise. Again, no exhaustive exercise should be performed during the period of the high CHO diet. C) 3 or 4 days high CHO diet after 3 days low CHO, high protein and fat diet; before the high protein and fat diet, exercise is once again used to induce glycogen depletion. Exhaustive exercise may be performed during the period of high protein and fat diet but not the high CHO diet.

Of the procedures described above, the third is most difficult to follow since this procedure causes a feeling of fatigue and exhaustion (4). However, several studies (5-7) have shown that more glycogen is stored after this full 7-day sequence. This is due to the increasing concentration and activity of glycogen synthetase, and high carbohydrate intake. Without depletion of muscle glycogen by heavy exercise and a low CHO diet at the beginning of the plan the activity of the glycogen synthetase would not be triggered, and carbohydrate can not be loaded in such a significant amount. Based on the study of Bergstrom *et al.* (1), the greater the initial muscle glycogen level, the greater the endurance capacity. In competition periods of less

than 20 minutes duration, normal glycogen stores in muscle tissue seem to be adequate (8). But, some researchers (4) have suggested that more glycogen might also help performers in sprint events, since the sprinters would compete in several different sprint events in one meet and run in several races to qualify for finals.

The experimental protocol of the present study was modified from the full 7-day sequence based on the fact that there is a higher carbohydrate percentage in the Chinese traditional diet. It was felt that the young athletes could not tolerate the high protein and fat diet along with exhaustive exercise. The purpose of this study is to understand the effect of glycogen supercompensation on the endurance of Chinese elite athletes.

Subjects and methods

Subjects

At the time of this study the subjects were all training at the Tsoying Athlete Training Center, Taiwan, R.O.C. Fifteen elite athletes (14 male swimmers and 1 male marathoner) were studied under controlled diet conditions: mean age 15.72 years (12-18), mean height 165.28 cm (138.5-187), mean body weight 131.61 lb (70-179 lb), mean swimming years 3.53 years (2-10 years). (male marathoner: age 23 years, height 165 cm, body weight 132 lb, running years, 2). The duration of the study was 3 weeks. This study protocol was approved and granted by the Chinese Taipei Sports Federation.

Methods

During the duration of the experiment, coaches, subjects, and researchers all lived on the same floor of the same building in the training center. Before the start of the protocol, each subject was required to pass a physical examination at Navy General Hospital, Taiwan, R.O.C. *Observation period* (7 days): After personal data was collected, subjects were given an eating-behavior questionnaire of food preferences, eating frequency, diet history etc. Food intake including regular meals, snacks, and beverages was also recorded after observing and asking. Diet composition and energy intake of the regular diet provided by the training centre were obtained by completely repeating the food preparation for 24 h of any day. This data was then compared with that of the daily diet analysis of the training centre so as to be as accurate as possible in measuring food consumption. Based on the information mentioned above, the maintenance caloric requirement and macronutrient intake for each subject were estimated. The high performance diet (glycogen supercompensation) including 2 days of high protein and fat diet (protein: 55%, fat: 35%, CHO: 10%), and 3 days and 1 breakfast of high CHO diet (protein: 10%, fat 5%, CHO: 85%) were then planned. Three meals and three snacks were given on each day (4) and endurance competition was tested after the breakfast (soft diet) of Day 6. Complete protein was used in the high CHO diet to maintain nitrogen balance and Composition of Food Used in Taiwan (9) was used for diet analysis. Skinfold measurements were taken at 7 sites: biceps, abdomen, suprailiac, thigh, calf, triceps, and subscapular by the same technician. Before the special diet, all the subjects (except the marathoner) were tested in a 1500 m crawl stroke. The protocol design for the measurements of body weight, heart rate, skinfold, urine, and competition is shown in Figure 1. Urinary ketone was qualitatively tested with Multistix (Ames Division, Miles Lab. Inc., Elkhart, Indiana). *Special diet period:* Subjects were then assigned into two groups (experimental group: 7 swimmers & 1 marathoner, control group: 7 swimmers) based on the

match of age and competition performance. The control group consumed the regular diet provided by the training centre. The experimental group was isolated and consumed foods prepared by the nutritionists only. Exhaustive exercise to deplete the glycogen of the specific muscles to be used was performed on each subject during the period of high protein and fat diet but not during the high CHO diet. After the period of the high performance diet, the two groups (first trial) competed in another 1500 m crawl stroke event (42.195 km race for the marathoner, and 2.5% glucose solution with 1% NaCl and hard candy were given at request). The temperature of the swimming pool was 25°C while outside temperatures measured 14-18°C for the day of marathon race. After an one day rest, the experimental sequence was repeated since this study design was a crossover trial. This time (second trial), the two groups competed in a 3000 m crawl stroke event (except the marathoner, who was tested on all other variables but did not run again). Subjects were instructed that the performance of all the tests was considered as the qualifier for the Olympic Trials and Atlantic Age-Group Swimming Championship so that they would compete at their optimum time.

Statistical analysis

Due to the limitation in the sample size of the marathoner, the statistical analysis assessed by the Student's t test was computed with the data of swimmers.

Results

Energy content and percent nutrient distribution of high performance diet and regular diet are shown in Table 1. Although about 4500 kcal/day was provided by the training centre, the control group did not consume that much since a significant amount of cooking oil was lost along

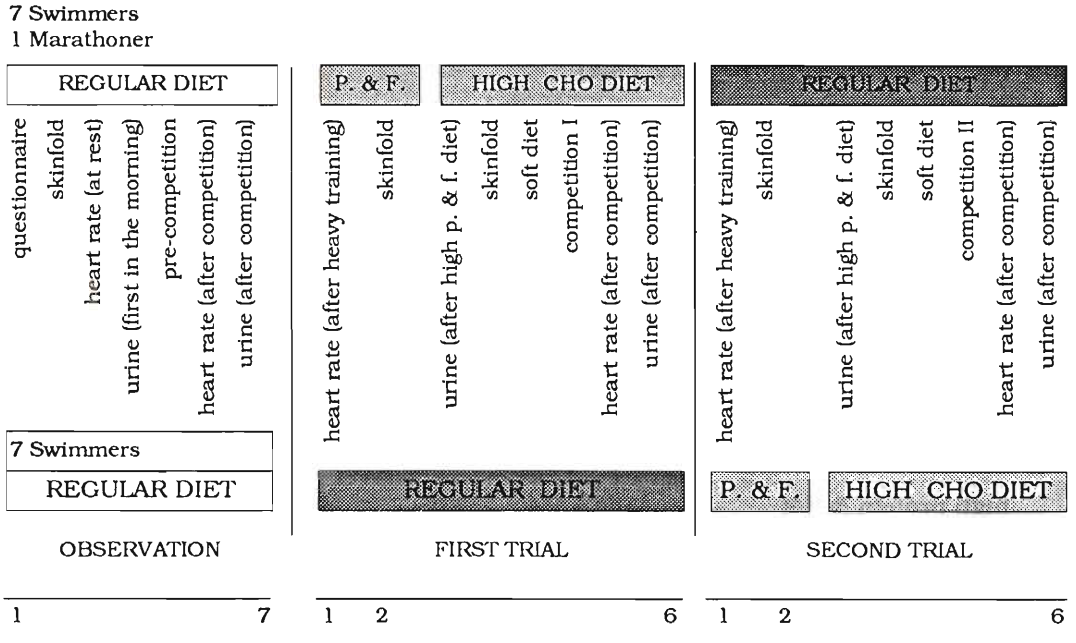


FIG. 1 Protocol design
*Body weight was taken twice per day: first, before breakfast; second, before supper.
*P. & F.: high protein and fat diet.

with the dish juice. Subjects were not familiar with liquid diet, therefore a soft diet was used for the breakfast of Day 6 which was given about 2.5 h before the competition for the swimmers and about 1 h for the marathoner. The lower energy content of the high protein and fat diet was due to the rejection of the low CHO diet by the young Chinese athletes. After the high performance diet, the endurance of the marathoner was improved from 2 hr. 38 min. 54 sec. (performance of the latest competition) to 2 hr. 30 min. 27 sec.. During his race, four hard candies and about 200 ml of 2.5% glucose solution with 1% NaCl was consumed twice. Although body weight was reduced 4 lbs after the 42.195 km race, the marathoner was not fatigued.

As shown in Table 2, there was a significant difference in the improvement of endurance between the swimmers on the high performance diet and that on regular diet in the first trial. Urinary ketone and heart rate determined in this study were used as the indices of muscle glycogen depletion and exercise strength, respectively. After the depletion phase (high protein and fat diet & exhaustive exercise) positive ketone response was found in the urine of 80% of the experimental group. This indicated that fat instead of muscle glycogen was used as an energy source. This result was not found in the control group which was assigned the same training program as the experimental group was. According to the study of McArdle *et al.* (10), a heart rate of 23 beats/10 sec. or more could be considered as an exhaustive exercise. During the depletion phase, the exercise strength of each subject was achieved.

Within the second trial (3000 m), the time difference of competition was made between second 1500 m and first 1500 m. There was no significant difference in the second trial as shown in Table 2. Actually, the exercise programme at this trial was affected by the training programme of South Africa Swimming Championship. There was no exhaustive exercise scheduled during the period of the high protein and fat diet, and urinary ketone response was negative. After all the competition tests, ketone was not found in the urine (including marathoner).

TABLE 1

Energy content and percent nutrient distribution of high performance diet and regular diet

Diet Treatment	Energy (kcal/day)	Protein (%)	Fat (%)	CHO (%)
High performance diet				
high protein & Fat diet	3423	49	40	11
high CHO diet	4819	11	5	84
Regular diet	4578	15	56	29

TABLE 2

Effect of glycogen supercompensation on endurance[1]

	High performance diet	Regular diet
First trial (1500 m crawl stroke)	n=7	n=7
time difference between competition I & pre-competition (sec.)	- 6.509±6.226*	8.003±19.624
Second trial (3000 m crawl stroke)	n=6	n=6
time difference between the second 1500 m & the first 1500 m (sec.)	-17.975±26.015	- 20.290±20.976

[1] mean±S.D.. Minus sign (-) indicated improvement in endurance

* Significantly different from regular diet, $P<0.05$ (Student's t test)

The sum of 7 sites of skinfold measurements was not affected by glycogen supercompensation for both trials as shown in Table 3. Therefore, body fat for each trial was not affected by high performance diet since the study of Wilson *et al.* (11) indicated that skinfold measurements could be used to estimate body fat. This result was also observed on the marathoner. In Table 4, there was no significant difference in the changes of the sum of 7 sites of skinfold measurements between the experimental group and control group for both trials. In the first trial, body weight increase after the high performance diet was significantly higher than that after regular diet. This was not found in the second trial. There was no significant differnce in body weight changes after competition between the high performance diet and regular diet for both trials. Body weights of each trial and group were decreased after the exhaustive competition.

TABLE 3

Effect of glycogen supercompensation on skinfold measurements[1]

		Before high performance diet	After high performance diet
First trial,	n=7	68.271±15.771	68.757±13.692
Second trial,	n=7	77.829±21.872	66.814±19.322

[1] mean±S.D.

The value represents the sum of 7 skinfold measurements.

TABLE 4

Effect of glycogen supercompensation on the change in skinfold measurements and body weight changes[1]

	High performance diet	Regular diet
	n = 7	n = 7
Changes in skinfold measurements after diet treatment (mm)		
First trial	0.486±6.201	1.843±4.326
Second trial	-11.014±4.495	-8.643±4.137
Body weight changes after diet treatment (lb)		
First trial	1.286±2.215*	-2.571±3.952
Second trial	-2.857±1.773	-4.429±2.225
Body weight changes after competition (lb)		
First trial	-2.000±1.291	-1.000±2.887
Second trial	-1.857±1.773	-2.000±1.633

[1] mean±S.D.. Minus sign (-) indicated a decrease.
* Significantly different from regular diet, P<.05 (Student's t test).

Discussion

Due to the rejection of the low CHO diet by the young Chinese athletes, the dietary manipulation of this study to induce glycogen supercompensation effect was designed so that there were 2 days of high protein and fat diet (protein: 49%, fat; 40%, CHO: 11%, about 3400 kcal/day) and 3 days and 1 breakfast of high CHO diet (protein: 11%, fat, 5%, CHO: 84%, about 4800 kcal/day). During the high protein and fat diet, the small amounts of carbohydrate given were essential to the central nervous system which depends totally on glucose as its source of energy. During this glycogen depletion phase, the exhaustive exercise was scheduled not only to challenge the activity of glycogen synthetase of the specific muscle to be used but also to prevent fat accumulation in the body, since a significant amount of protein and fat was ingested. During the high CHO diet, light exercise was scheduled to facilitate the glycogen loading process. Complex carbohydrates are preferred to sweets for carbohydrate-loading since they also provide other essential nutrients along with their

calories (3,8). Starch ingestion results in a delayed but more sustained elevation of serum insulin which activates glycogen synthetase. Sugar load consumed 30 min. prior to exercise can reduce endurance. This is due to the action of insulin which hinders fat mobilisation by the muscle, thereby causing the muscles to rely more on glycogen for fuel (12). This may result in fatigue during exercise. Once the individual begins exercising, insulin secretion is suppressed. Thus, glucose consumption during exercise does not hasten muscle glycogen depletion, and periodic glucose feedings during prolonged exercise will enhance endurance. This was demonstrated by the performance of our marathoner whose conpetition after the high performance diet was 8 min. faster than this previous one. But, too concentrated a solution will not leave the stomach until it was been diluted, so a small mount of 2.5% glucose solution was given during the marathon race. To avoid food staying in the stomach during competition, a soft diet was then used 1 h before the competition since it is emptied quickly from the stomach and contributes to hydration and energy intake, which benefited the marathoner's performance. Usually, the marathon race is held at 6:00 AM. For a mixed meal consumption, racers have to get up at 2:00 AM which would interfere with the racers' rest. With the swimmers, the time of the pre-game meal was 2.5 h before the competition, which was based on the report of Serfass (13). In the first trial, the 2 days of reduced carbohydrate intake and exhaustive exercise let to ketosis in 80% of the experimental group with associated nauses, fatigue, dizziness, and irritability; these were not found in the control group. During the high CHO diet, learning skills of the experimental group were enhanced when compared with that of the control group. After competition I, fatigue and dizziness were found in the control group but not in the experimental group.

In the first trial, body weight of the experimental group was significantly increased and that of control group was decreased (Table 4). This was due to the fact that glycogen loading resulted in an increased muscular storage of water (2.7 - 3 g water stored/g glycogen loaded) (4). Body fat content was not affected since there was no significant difference in changes of the sum of 7 skinfold measurements after diet treatment (Table 4). Therefore, body weight increased in the experimental group of the first trial was not due to an increase in body fat, it would be due to the glycogen loaded in the specific muscle. Although a feeling of stiffness and heaviness was observed in the experimental group due to the water stored in the exercising muscle along with glycogen loaded, the hydration state was good for body temperature maintenance during exercise.

After the glycogen loading process, crawl stroke competition was improved in the experimental group of the first trial but not the second trial (Table 2). This was due to the effect of the exercise training not the diet treatment since the dietary manipulation was identical for both trials. In the second trial, the exercise programme of the depletion phase might be inadequate since ketone response was negative, the activity of glycogen synthetase might not be significantly increased. During the supersaturation phase when light exercise was suggested, heavy exercise was scheduled. Glycogen loading process might be affected since body weight was decreased and body fat was not affected. Therefore, the result of the competition in the second trial was different from that of the first trial. Although body weight changes after diet treatment was not significantly different between the two groups of the second trial, some effect of glycogen supercompensation still

can be observed since the amount of body weight decreased in the control group was more than that of the experimental group. This could be due to the effect of glycogen loading since the training programme of both groups was identical. A conclusion can be drawn that to induce the effect of glycogen supercompensation on endurance, both the high performance diet and a proper training programme are required.

There are some potential risks of this plan. It has been suggested that athletes using carbohydrate loading may be destroying muscle fibres due to the high glycogen stores or to the heavy exercise (14). Myoglobinuria, chest pain, and abnormal electrocardiography have been reported (4). Extra body weight and muscle stiffness may affect performance. When 75-90% of caloric intake is supplied in the form of carbohydrate, incomplete absorption of the carbohydrate in wheat flour and macaroni was found, which may cause functional bowel syndrome (15). Therefore, a complete technique of carbohydrate loading should not be used more than three times per year (3). Further studies would be needed in this area as well as the post-effect of glycogen supercompensation.

Acknowledgements

The author wishes to thank the Chinese Taipei Sports Federation for the grants supported; Dr. P.C. Huang, Dr. K.S. Lai, and Mr. C.W. Lee for their precious suggestions, and all the coaches and athletes involved for their assistance and cooperation.

References

1. Bergstrom J, Hermansen L, Hultman E, Saltin B. Diet, muscle glycogen and physical performance. Acta Physiol Scand 1967; 71: 140-50.
2. Hermansen L, Hultman E, Saltin B. Muscle glycogen during prolonged severe exercise. Acta Physiol Scand 1967; 71: 129-39.
3. Forgac MT. Carbohydrate loading - a review. JADA 1979; 75: 42-5.
4. Fox EL. Sports physiology. Philadelphia: W.B. Saunders Co. 1979; 264-81.
5. Bergstrom J. Hultman E. Muscle glycogen synthesis after exercise: An enhancing factor localised to the muscle cells in man. Nature 1966; 210: 309-10.
6. Costil D. Muscular exhaustion during distance running. Phys Sportmed Oct. 1974; 36-41.
7. Bergstrom J. Guarnieri G, Hultman E. Carbohydrate metabolism and electrolyte changes in human muscle tissue during heavy work. J Appl Physiol 1971; 30: 122-25.
8. Bergstrom J, Hultman E. Nutrition for maximal sports performance. JAMA 1972; 221 (9): 999-1006.
9. Tung TC, Huang PC, Li HC. Composition of foods used in Taiwan. J Formosan MA 1961; 60(11): 973-1005.
10. McArdle WD, Katch FI, Katch VL. Exercise physiology. Lea & Febiger, Philiadelphia.
11. Wilson ED, Fisher KH, Fuqua ME. Principles of nutrition. 3rd ed. New York : John Wiley Sons, Inc., New York.
12. Coggan AR, Coyle EF. Carbohydrate ingestion during prolonged exercise: Effects on metabolism and performance. Exercise & Sports Sciences Reviews 1991; 19: 1-27.
13. Serfass RC. Nutrition for the athlete update, 1982. Contemporary N 1982; 7(4): 3-4.
14. Karlsson J, Saltin B. Diet, muscle glycogen and endurance perfor-

mance. J Appl Physiol 1971; 31: 203-6.

15. Anderson IH, Levine AS, Levitt MD. Incomplete absorption of the carbohydrate in all-purpose wheat flour. N Engl J Med 1981; 304: 891-1.

Proc 6th ACN 1991: 448

Sports nutrition-theory into practice

S Wootton

Dept. of Human Nutrition, University of Southampton, United Kingdom

Abstract

Athletes should be able to receive nutritional advice in much the same way that they would expect sound training and medical advice. Those working closely with athletes, especially coaches and trainers, should have access to reliable nutritional information either by educating themselves or by taking the advice of professionally trained nutritionists and dietitians. The responsibility does not lie just with the coach or trainer as athletes, with their own knowledge of nutrition, should be in a position to accept or reject the dietary advice offered to them; unfortunately this is the exception rather than the rule. The present degree of nutritional naivety, ignorance and confusion displayed by coaches and athletes alike only serves to further misunderstanding, and ultimately, to impair the development of individual athletes. New interest in nutrition amongst those in sport has developed in a climate of considerable nutritional confusion and misinformation to the extent that many people have difficulty distinguishing myth from truth. Mistaken concepts have been used to support nutritional practices which are, at best, questionable and inadequate and, at worst, dangerous.

There are two specific areas where our understanding of nutrition may directly assist the sports performer. Firstly, in ensuring that the metabolic demand for carbohydrate and other nutrients is satisfied by the habitual diet so that through training comes adaptation, and through adaptation comes improvements in performance. Secondly, dietary support in the preparation for competition and during competition. How can we ensure that the athlete competes in the best nutritional state? This presentation critically examines the evidence to support the dietary advice that may be offered to the athlete. Attention will also be directed towards those areas of concern amongst nutritionists, coaches and performers that require further investigation: optimal growth in children in heavy training, weight control and making weight, gastrointestinal disturbances, abnormal eating habits and supplements abuse.

Proc 6th ACN 1991: 449-452

Evolutionary aspects of diet and the omega-6/omega-3 balance

Artemis P Simopoulos

The Centre for Genetics, Nutrition and Health, Washington DC, U.S.A.

Introduction

Over the past 10 years epidemiologic studies, animal studies and clinical investigations indicate that omega-3 fatty acids are essential for normal growth and development of human beings. Omega-3 fatty acids are found in human milk whereas cow's milk does not contain omega-3 fatty acids. Omega-3 fatty acids have hypolipidemic, anyithrombotic and anti-inflammatory properties that contribute to the prevention and treatment of heart disease and hypertension. Omega-3 fatty acids, especially eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are benefical in the treatment of a number of autoimmune diseases and disorders such as rheumatoid arthritis, lupus erythematosus, ulcerative colitis, psoriasis and decrease the size and number of tumors in a variety of animal models. In epidemiologic studies fish eating populations have lower death rates from cardiovascular disease except in situations where the saturated fat intake is high (1).

It is considered that the current Western diet is deficient in omega-3 fatty acids in comparison to the diet that man evolved, and that the enormous increase in omega-6 fatty acids that has occurred since the turn of the century has contributed to the imbalance in the omega-6/omega-3 ratio (2-4). This paper examines the status of the omega-6/omega-3 ratio in the Western diet and some of the causes that have led to the omega-6/omega-3 imbalance.

Evolutionary aspects

Modern human beings (homo sapiens) appeared about 400,000 years ago and the human genetic constitution has changed little since then. Hunter-gatherers consumed wild game (hunting, fishing) and uncultivated vegetables foods. These are the foods that man is genetically "programmed" to eat, digest and metabolise. The development of agriculture began 10,000 years ago but even that had a minimal influence on our genes. The retention of intestinal lactase is the best example of man's genetic adaptability to nutrition. The new developments in food production and food processing over the past 150 years are too recent to influence our genetic constitution. Therefore the diets available to humans prior to agricultural development are still the diets for which we are genetically programmed today. The foods that were available then varied widely in accordance with the paleontological period, the seasons of the year and the geographic location. Such a diet provided a variety of foods suitable for the omnivore which is characteristic for most primates. The differences between the diets of early

humans and the diets of industrialised societies have been considered to have important implications for health.

Information on the diet of early man is obtained from archaeological studies and from observations of present day hunter-gatherer societies. Based on estimates from studies in paleolithic nutrition and modern day hunter gatherer populations, man evolved on a diet that was much lower in saturated fat than today's diet. Paleolithic diet had less total fat and more essential fatty acids and a much higher ratio of polyunsaturated fatty acids (PUFA)/saturates than ours. Our paleolithic ancestors consumed more structural and less depot fat. Furthermore, the diet contained roughly equal amounts of omega-6 and omega-3 polyunsaturates fatty acids (3,5-6). Wild animals and birds who feed on wild plants are very lean with a carcass fat content of only 3.9% (7) and contain about five times more polyunsaturated fat per gram than is found in domestic livestock (8-9). Most importantly, 4% of the fat of wild animals contains EPA.

Food production

Modern agriculture with its emphasis on production has decreased the omega-3 fatty acid content in many foods: green leafy vegetables, animal meats, eggs and even fish (10-12). Foods from edible wild plants contain a good balance of omega-6 and omega-3 fatty acids and are rich in vitamin C and carotenoids (3). Wild pursaline contain 10 times as much omega-3 fatty acids as cultivated green vegetables such as lettuce and spinach (10). Modern aquaculture produces fish that contain less omega-3 fatty acids than fish grown naturally in the ocean, rivers and lakes (12). In a study by Van Vliet and Katan, the ratio of omega-3 to omega-6 fatty acids was significantly lower in cultured than in wild fish (2 vs 5 in eel, 2 vs 7 in trout, and 6 vs 11 in salmon) (12). Cultured fish contained less omega-3 fatty acids, more omega-6 fatty acids and more total fat than fish in the wild.

In another study Simopoulos and Salem found that the ratio of omega-6 to omega-3 fatty acids was 1.3 in the Greek egg from free-ranging chickens versus 19.4 in the supermarket egg (11). With its emphasis on increased production, industrialization has led to the development of a chicken feed that allows increased egg production because its contains higher levels of protein, amino acids, and linoleic acid. These dietary components are reflected in the composition of the supermarket eggs consumed today; they are high in omega-6 and low in omega-3 fatty acids. In addition, modern agriculture with the emphasis on grain feeds for domestic livestock led to further increases in saturated fat and omega-6 fatty acids (grains are rich in omega-6 fatty acids). The increased consumption of omega-6 fatty acids in the last 100 years is due a large extent to the development of technology at the turn of the century that marked the beginning of the modern vegetable oil industry (13). Furthermore, prior to the 1940's cod liver oil was ingested mainly by children as a source of vitamins A and D with the usual dose being "a teaspoon." Once these vitamins were synthesised consumption of cod liver oil was drastically decreased and there was a decrease in the consumption of fish.

Conclusion and recommendations

Thus an absolute and relative change of omega-6/omega-3 fatty acids in the food supply of western societies has occurred over the last 100 years with an estimated ratio of omega-6/omega-3 of about 20-30/1 rather than the 2-5-7/1 found in human milk or 1/1 estimated from paleolithic nutrition.

Many dietary studies and interventions have been carried out and dietary recommendations have been made in relation to saturated fat and cholesterol. The indiscriminate recommendation to replace saturated fats with PUFAs from vegetable oils has led to increased amounts of omega-6 fatty acids in man's diet over the past 50-60 years. Thus man has been exposed to pharmacologic doses of omega-6 fatty acids for the first time in his evolution. Since the fatty acid composition of cell membranes modulates important cell functions, yet the fatty acids in the membrane are dependent on dietary intake, it is obvious that in referring to PUFAs it is essential to distinguish between omega-3 and omega-6 fatty acids in making dietary recommendations. Simply using the ratio of polyunsaturated to saturates (P/S) is inappropriate and inadequate, based on the knowledge we have today. However, the amount of omega-3 fatty acids in the diet and their effects on health and disease have not been considered in the development of dietary guidelines by national governments except for the most recent Canadian Nutrition Recommendations (14). In view of the fact that omega-3 fatty acids have different metabolic effects than those of the omega-6 series and that omega-3 fatty acids are essential for normal growth and development and for overall health, accurate knowledge of the amount and type of omega-3 fatty acids in foods is essential. Both terrestrial and marine sources of omega-3 fatty acids are important in this regard.

Differences also exist among the saturated fatty acids, lauric, myristic, palmitic, and stearic, and between the CIS and Trans forms of fatty acids in terms of their atherogenic and thrombogenic properties.

In making dietary recommendations, the importance of considering the functions of the different types of fatty acids (omega-3, omega-6, omega-9, and the various saturated fatty acids) rather than simply total fat (percentage of calories from fat) or the amount of polyunsaturates, is now being accepted. Fatty acids should be considered:

- in terms of their overall metabolic effects in growth and development, and
- for their effects pm serum lipids, inflammation, thrombus formation, and tumor development.

Polyunsaturated fatty acids (omega-6 and omega-3) should contribute 10% of calories with equal amounts of omega-6 and omega-3 fatty acids. In order to improve the omega-6/omega-3 imbalance it will be necessary to decrease consumption of omega-6 fatty acids while increasing the consumption of omega-3 fatty acids, particularly eicosapentaenoic acid and docosahexaenoic acid.

References

1. Simopoulos AP, Kifer RR, Martin RE, Barlow SM, eds. Health Effects of w3 Polyunsaturated Fatty Acids in seafoods. World Rev Nutr Diet, vol 66. Basel: Karger, 1991.
2. Leaf A, Weber PC. A new era for science in nutrition. Am J Clin Nutr 1987; 45 (supplement): 1048-53.
3. Simopoulos AP. Terrestrial sources of omega-3 fatty acids: pursane. In: Quebedeaux B, Bliss F, eds. Horticulture and Human Health: Contributions of Fruits and Vegetables. Englewood Cliffs, N.J.: Prentice-Hall 1988: 93-107.
4. Salem N Jr. Omega-3 fatty acids: molecular and biochemical aspects. In: Spiller G, Scala J, eds. New protective roles for selected nutrients. New York: Alan R. Liss 1989: 213-332.
5. Eaton SB, Konner M. Paleolithic nutrition. A consideration of its

nature and current implications. N Engl J Med 1985; 312: 283-289.

6. Simopoulos AP. Genetics and nutrition: Or what your genes can tell you about nutrition. In: Simopoulos AP, Childs B (eds): Genetic Variation and Nutrition. World Rev Nutr Diet, vol 63. Basel: Karger, 1990: 25-34.
7. Ledger HP. Body composition as a basis for a comparative study of some East African mammals. Symp zool Soc London 1968; 21: 289-310.
8. Crawford MA. Fatty acid ratios in free-living and domestic animals. Lancet 1968; i: 1239-1333.
9. Wo CRW, Draper HH. Vitamin E status of Alaskan Eskimos. Am J Clin Nutr 1975; 28:808-813.
10. Simopoulos AP, Salem Jr. N. Purslane. A terrestrial source of omega-3 fatty caids. N Engl J Med 1968; 315:833.
11. Simopoulos AP, Salem Jr. N. n-3 fatty acids in eggs from range-fed Greek chickens. N Engl J Med 1989; 321:1412.
12. Van Vliet T, Katan MB. Lower ratio of n-3 to n-6 fatty acids in cultured than in wild fish. Am J Clin Nutr 1990; 51: 1-2.
13. Kirshenbauer HG. Fats and Oils (2nd Edition). New York: Reinhold Publishing Corporation, 1960.
14. Nutrition Recommendations. The Report of the Scientific Review Committee 1990. Ministry of National Health and Welfare, Canada, (Cat. No. H49-42/1990E) Ottawa, Canada, 1990.

Proc 6th ACN 1991: 453-456

Excess linoleate syndrome

Harumi Okuyama

Faculty of Pharmaceutical Sciences, Nagoya City University, 3-1 Tanabedori, Mizuhoku, Nagoya 467, Japan

Introduction

The consequences of relatively long-term feeding of vegetable oils with different proportions of linoleic acid (omega-6) and α-linolenic acid (omega-3) were evaluated in rats and mice. The results together with those of longitudinal epidemiological studies are reviewed with regards to recommended dietary intakes of linoleic acid for the prevention of western type cancers and chronic diseases such as allergy, thrombotic diseases, apoplexy, hypertension and aging.

Effects of long-term feeding of vegetable oils on models of chronic diseases in rats and mice

Three kinds of vegetable oils were mainly used; safflowerseed oil (11% saturated, 10% monounsaturated, 78% linoleic and 0.1% α-linolenic acids), perilla seed oil (relatively common in northern parts of Asia) (10% saturated, 12% monounsaturated, 13% linoleic and 64% α-linolenic acids) and soyabean oil (12% saturated, 22% monounsaturated, 53% linoleic and 8% α-linolenic acids). Feeding these oils to rats or mice through 2 generations did not bring about any difference in appearance; all the groups grew apparently normally. However, the omega-3/omega-6 ratio of tissue lipids differed significantly among the dietary groups. In brain and retina, the major difference was seen in the proportions of 22-carbon omega-3 and omega-6 highly unsaturated fatty acids, whereas in kidney, leukocytes, macrophages and other cells, the proportions of 20-carbon highly unsaturated fatty acids were significantly different.

First, the effects of dietary oils on brain and retinal functions are summarised. The brightness-discrimination learning ability (food-enforced) and retinal functions (as measured by the amplitude of electroretinogram) decreased in the order of the perilla oil, soyabean oil and then the safflower oil groups (1-4). These results led to the conclusions that α-linolenic acid is essential for the maintenance of the nervous system functions at higher levels, and that 0.6 energy % of α-linolenic acid present in the soyabean oil diet is not sufficient to reach the maximum responses of these functions seen in the perilla oil group.

In the past 30 years, the mortalities of stomach cancer and uterus cancer tended to decrease in Japan, whereas those of lung, colon, mammary and several other cancers have been increasing rapidly, and are expected to reach the very high levels seen in the western countries (Figure 1a). In rats given carcinogens (DMBA and DMH) first and then dietary oils were changed, the incidences of colon and kidney tumors were significantly less in the perilla oil group as compared with the safflower oil group and soyabean

oild group (5). Spontaneous mammary tumorigenesis in mice was also higher in the safflower oil group than in the perilla oil group (6). Metastasis of tumour cells was suppressed in the perilla oil group as compared with the other dietary groups (7). Together with the results by others using fish oils and linseed oil rich in omega-3 fatty acids, it has been proved in animal experiments that raising the omega-3/omega-6 balance of diets is beneficial for the prevention of western-type cancers such as mammary gland, colon, lung, pancreas, skin, esophagus, prostate and kidney cancers. Although the mechanisms for the dietary omega-3/omega-6 balance affecting the carcinogenesis and metastasis have not been fully elucidated, now it is the time to apply these results to human nutrition.

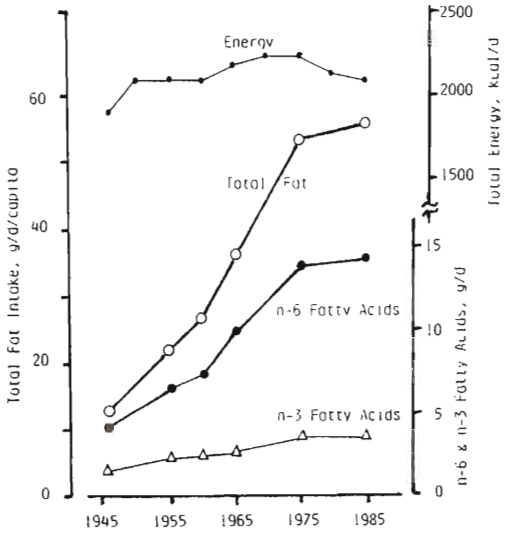


FIG. 1a Comparison of cancer mortalities by site in Japan and U.S.A.

The number of allergic patients increased several-fold in the past 30 years in Japan, and more than 30% of Japanese infants have been diagnosed as atopy. Allergen is known to activate mast cells and leukocytes to liberate mediators such as histamine, leukotrienes and platelet-activating factor (PAF), which induce allergic responses. We have shown that the activity and amount of leukotrienes liberated by calcium ionophore were significantly less (8) and the production of PAF was also significantly less in the perilla oil group than in the safflower oil group (9). Thus, the amounts and activities of these mediators were shown to be modulated by manipulating the dietary omega-3/omega-6 balance.

In the evaluation of nutritional value of vegetable oils, it is important to estimate the consequences of long-term feeding. As one of such experiments, we have determined the effects of oils on mean survival times of rats. The perilla oil group showed significantly longer mean survival times than the soyabean oil and safflower oil groups; the difference was more than 10%. The importance of this >10% difference is emphasised, because the conquest of cancer is calculated to elongate the life expectancy of Japanese by only 4%.

Other chronic diseases for which perilla oil was found to be beneficial, as compared with vegetable oils rich in linoleic acid, were thrombotic diseases, hypertension, apoplexy and aging.

Epidemiological studies

The average intake of total calories has been roughly constant after 1950 in Japan, but the total fat intake and the intake of omega-6 fatty acids (mostly linoleic acid) increased 3-fold. In contrast, the intake of omega-3 fatty acids did not increase so much (Figure 1b). These days in Japan, the younger generation tends to prefer western-type foods and do not eat fish and vegetables so much. Therefore, the essential fatty acid balance is much in favour of omega-6 (11). Animal experiments indicate that the increase in the intake of

[Figu

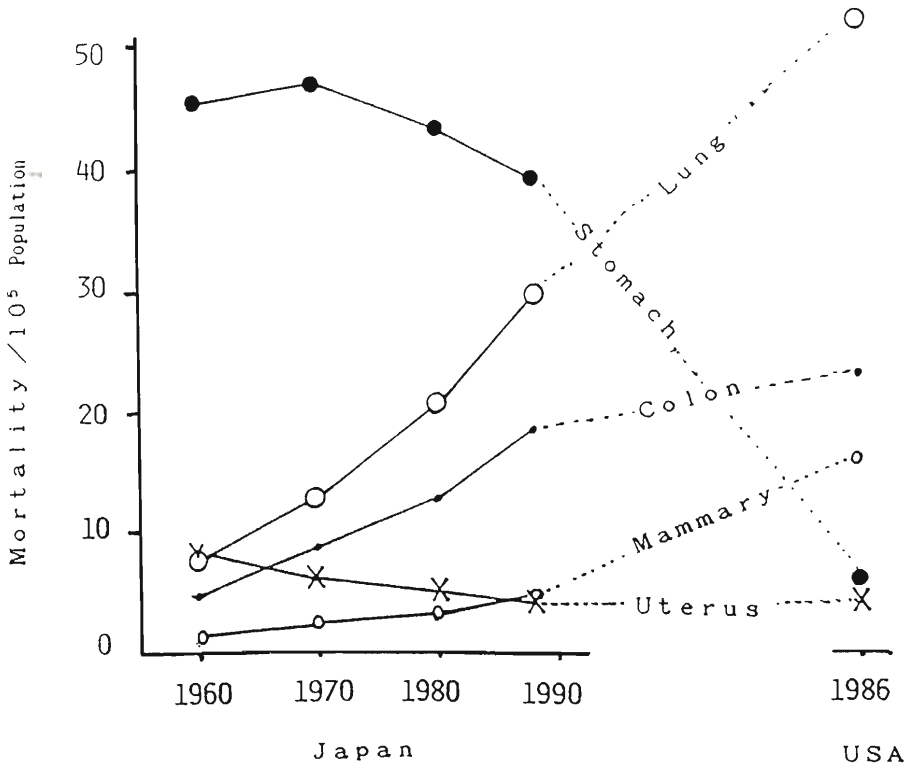


FIG. 1b Trends of energy and fat intake in Japan

linoleic acid contributed to the increase in chronic diseases seen in the past several decades in Japan.

A new nutritional recommendation for the prevention of chronic diseases

Based on animal experiments and longitudinal epidemiological studies, I propose the following guidelines for the prevention of chronic diseases listed above:

1. The intake of omega-6 should be decreased to as low as 3 energy %. One energy % is known to be more than enough. Currently, average Japanese are ingesting several-fold more linoleic acid than the amount required.
2. The intake of total fat should preferably be below 20 energy %, because fat-related chronic diseases began to increase in Japan when the total fat intake exceeded 15 energy % in 1960.
3. The intake of omega-3 fatty acids should be increased at least to the levels of linoleic acid (omega-3/omega-6 ratio > 1). The amount of α-linolenic acid as high as 10 energy % was found to be safe and beneficial in animal experiments.

References

1. Yamamoto N, Saitoh M, Moriuchi A, Nomura N, Okuyama H. Effect of dietary α-linolenate/linoleate balance on brain lipid compositions and learning ability of rats. J Lipid Res 1987; 28: 144-151.
2. Yamamoto N, Hashimoto A, Takemoto A, Okuyama H, Nomura M, Kitajima R, Togashi T, Tamai Y. Effect of dietary α-linolenate/lino-

leate balance on lipid compositions and learning ability of rats. II. Discrimination process, extinction process and glycolipid compositions. J Lipid Res 1988; 29: 1013-1021.

3. Yamamoto N, Okaniwa Y, Mori S, Nomura M, Okuyama H. Effect of a high linoleate and a high α-linolenate diet on the learning ability of aged rats. Evidence against an autoxidation-related lipid peroxide theory of aging. J Gerontol 1991; 46:B17-22.

4. Watanabe I, Kato M, Aonuma H, Hashimoto A, Naito Y, Moriuchi A, Okuyama H. Effect of dietary α-linolenate/linoleate balance on the lipid composition and electroretinographic response in rats. Adv Biosci 1987; 62: 563-570.

5. Hirose M, Masuda A, Ito N, Kamano K, Okuyama H. Effect of dietary perilla oil, soyabean oil and safflower oil on DMBA and DMH-induced mammary gland and colon carcinogenesis in female SD rats. Carcinogenesis 1990; 11: 731-735.

6. Kamano K, Okuyama H, Konishi H, Nagasawa H. Effect of a high linoleate and a high α-linolenate diet on spontaneous mammary tumourigenesis in mice. Anticancer Res 1989; 9: 1903-1908.

7. Hori T, Moriuchi A, Okuyama H, Sobajima T, Tamiya-Koizumi K, Kojima K. Effect of dietary essential fatty acid balance on pulmonary metastasis of ascites tumour cells in rats. Chem Pharm Bull 1987; 35: **3925**-3927.

8. Hashimoto A, Katagiri M, Torii S, Dainaka J, Ichikawa A, Okuyama H. Effect of the dietary α-linolenate/linoleate balance on leukotriene production and histamine release in rats. Prostaglandins 1988; 37: 3-16.

9. Horii T, Satouchi K, Kobayashi Y, Saito K, Watanabe S, Yoshida Y, Okuyama H. Effect of the dietary α-linolenate on platelet-activating factor production in rat peritoneal polymorphonuclear leukocytes. J Immunol 1991; 147 (in press).

10. Shimokawa T, Moriuchi A, Hori T, Saitoh M, Naito Y, Kabasawa A, Nagae Y, Matsubara M, Okuyama H. Effect of dietary α-linolenate/linoleate balance on mean survival time, incidence of stroke and blood pressure of spontaneously hypertensive rats. Life Sci 1988; 43: 2067-2075.

11. Lands WEM, Hamazaki T, Yamazaki K, Okuyama H, Sakai K, Goto Y. Hubbard VS. Changing dietary pattern. Am J Clin Nutr 1990; 51: 991-993.

Proc 6th ACN 1991: 457

Coconut oil in human nutrition and disease

CS Dayrit

United Laboratories, Metro Manila, Philippines

Abstract

The role of coconut oil in general nutrition and its effects on blood lipids and resistance to stress and mutagens will be discussed in the light of new findings on animals, stressed children and adults. The studies revealed:

1. Coconut oil was highly protective against mutagenicity in mutagen-challenged rats;
2. Coconut oil-corn oil 75:25 in physical mixture (PM) or chemically structured lipid (SL) form given to malnourished children improved nutritional status rapidly and lowered serum cholesterol levels;
3. Diets with coconut oil as high as 37% of total daily caloric intake raised HDL and lowered cholesterol: HDL ratio;
4. Coconut oil consuming people like the Filipinos have low serum cholesterol and low coronary heart disease prevalence.

Proc 6th ACN 1991: 458-466

Edible fats and oils, nutrition versus functionality

Lars H Wiedermann

The American Soyabean Association, Tokyo, Japan

Introduction

The dilemma for this subject is that when we look at one aspect, we often lose sight of the other. For the food scientist the want is functionality, the development of a particular useful property. The world need is for nutrition. These two intrinsic values of fats and oils are not necessarily counterproductive, especially in more developed societies consuming comparatively high levels of dietary fat calories. In lesser developed countries, consuming lower total calories and even lesser amounts of fat calories, the distinction between functionality and nutrition can have serious health implications that are exacerbated by a wide skew in their total food and fat calorie intakes. This paper defines the basic functional characteristics of fats and oils in food products, recognising that nutritional qualities make a special case for functionality, and describes the influences of these functional characteristics on nutritional quality as one moves through Asia and its divergent economies. There is no world demand for any specific oil source, there is only a demand for fat and oil calories. Initially, this is satisfied by indigenous supply defined as agricultural productions and the crushing of imported oilseeds. Deficits between this supply and demand are met by oil imports that are primarily based on price. Nevertheless, judicious blending can optimize nutritional quality while still providing primary functional needs. The urgency for this conclusion is suggested.

Finished food fat and oil systems are defined by their intrinsic characteristics that for this congress has its focus on nutrition. However, the defined nutritional characteristics are available in the market place. In reality, non-nutritional characteristics, which we define herein as functional properties, more often than not determine market place compositions. While these functional property dictates do not preclude nutritional quality, these products often provide less than their nutritional potential. This can be a serious shortcoming for food fat products, especially in developing countries and their poorer populations.

The basic functional, non-nutritional characteristics of fat and oil systems can be defined as those that provide **lubricity, structure, aeration,** act as a **moisture barrier** and **heat exchange media,** and are **carriers of flavours and colours** (1).

The simplest performance requirement of a fat and oil system is to provide lubricity (Table 1). Lubricity imparts smoothness and tenderness and adds to the richness and improved eating properties of foods; it provides a feeling of satiety after eating. Fat systems must be melted, be in liquid-form at body temperature to provide lubricity.

TABLE 1

Functional characteristics of fats/oils in food products* (2)

LUBRICITY**	Fried foods and snacks, salad dressings/mayonnaise, salad and cooking oils, filled food products, etc.
LUBRICITY/STRUCTURE	Margarines and vanaspati, and shortenings for bread, rolls, etc.
LUBRICITY/AERATION	Shortening for cakes, cookies, biscuits, etc.
LUBRICITY/STRUCTURE/AERATION	Whipped toppings, cream icings, bakery fillings, ice cream, etc.
LUBRICITY/STRUCTURE/MOISTURE BARRIER	Danish and puff pastry, confectionery coatings, etc.

* Imposed variables are flavor and flavor stability.

** For fried foods the fat/oil also serves as a heat exchange media

Some systems will require a structure even if their only function is to provide lubricity, as is the case with margarine and vanaspati applications.

Structure and aeration, alone or in combination, provide additional systems capabilities with the quality of each depending on the application. Aeration is an important functional property for providing good mixing and creaming characteristics. Here the ratio of liquid and structural entities, both quality and kind are most important.

Fats and oils also act as heat exchange media in frying or cooking operations, and moisture barrier characteristics are a unique property of specialty coating or enrobing fat systems.

The nutritional characteristics of fats and oils have traditionally concerned themselves as a source of calories or dietary energy, as a source of essential fatty acids and as carriers of the fat-soluble vitamins A, D, E and K. These are vital dietary considerations and describe fat's and oil's most basic nutritional functions.

Fats and oils provide energy and sufficient calories will spare proteins to have them available for more sophisticated bodily use and not be consumed as energy. The fat-soluble vitamins need a vehicle to bring the vitamins into the body and provide, along with serum proteins, for their transport within the body.

Discussion

There are two aspects of fats and oils nutrition that reflect the primary concern of this Congress and its application to a broad base of Asian populations.

The first call or demand for dietary fats and oils is to supply fat calories, dietary energy. The source or composition of that edible fat or oil is not a concern until that basic need is satisfied. This principle of nutrition is paramount for developing or Third World countries chronically deficient in fat calories.

Insufficient fat or energy calories in the diet is a widespread complication for protein utilisation in developing countries and is broadly identified as

PCM, protein-calorie malnutrition. More subtle than protein quality and quantity is something we can identify as the entropy factor, a condition that is associated with the quality of the body's nitrogen balance (3). Entropy is a measure of the energy unavailable for work in a closed thermodynamic system. In the instant case the term describes a potential of the system, the body, and represents a quantification of the body's nitrogen balance, its potential for additional nitrogen utilisation.

PCM is a complicated malady. Primary PCM is caused by an inadequate supply of food. In secondary PCM a return to adequate diet or treatment cannot improve protein-calorie status and illness evokes a higher, more negative entropy-factor. They body now has a higher threshold towards positive response.

Primary and secondary mechanisms frequently reinforce each other. The effects of infection can cause PCM more rapidly in individuals who previously subsisted on marginal diets than in healthy individuals.

Clinical assessment of PCM is characterised by decreased anthropometric measurements and by abnormal or impaired visceral protein status and cell-mediated immunity. The wasting of muscle mass and subcutaneous fat are its obvious symptoms. However, changes in visceral protein status, with no obvious changes in anthropometric measurements, is a more widespread, insidious manifestation of PCM. These serum proteins, albumin, transferrin, prealbumin and retinol-binding protein have short half-lives and their reduced levels are symptomatic of PCM. Their important physiological functions include vitamin and mineral binding for storage and transfer, and identifies their role in such deficiency diseases as beriberi and blindness or its earlier manifestation, night-blindness.

The two major recognised dietary deficiency related maladies in South and Southeast Asia are protein-calorie malnutrition and Vitamin A deficiency. Even vitamin and mineral supplementations are ineffective without a bodily transport system for their use. *The role of fat calories to spare proteins is not small matter.*

There is no world demand for any specific fat or oil source, there is only a world demand for fat and oil calories.

Palm oil, readily available at a lower cost in the world market, plays a major role in satisfying this demand and helps to reduce the potential for PCM and its related deficiency diseases in developing countries. This role transcends any discussions concerning composition and relates only to meeting a basic human need.

The second aspect of concern is the role of the essential fatty acids for mitigating the inherent stressfulness of diets low in total calories and even lower in fat calories. There are four categories of polyunsaturated fatty acids in animal tissue lipids. The lowest or shortest chain members in each category are oleic, palmitoleic, linoleic and linolenic acids. In biochemical terms these categories are identified as omega-9, 7,6 and 3 respectively.

The omega-9 and 7 substrates, represented by oleic and palmitoleic acids, can be synthesised by the body through de novo synthesis from proteins, carbohydrates or other fatty acids. The omega-6 and 3 categories cannot be synthesised by the body and defines them as the two essential fatty acid categories. Linoleic and alpha-linolenic acids are, respectively, the lowest members in these two categories. It would seem a straightforward conclusion, yet we still have difficulty with the basic concept of essentiality.

Linoleic acid has long been recognised as an essential fatty acid. It is converted *in vitro* to arachidonic acid,

its highest omega-6 homologue. For alpha-linolenic acid, recognition has come more slowly. It has only been with the opening of more biological windows, especially during the past five years, that its essentiality has been accepted; and the evidence mounts every day.

The classical clinical case study reported by Holman in 1982 (4) showed that a homeostatic or stabilised neurological condition was achieved when linolenate in the form of soybean oil was fed intravenously to a six year-old girl being maintained on total parenteral nutrition. High levels of linoleate in the form of sunflowerseed soil emulsion had caused adverse neurological behavior. As a result of that clinical study observation most U.S., European and Japanese manufacturers of fat emulsions for intravenous and tube or enteral feeding have switched to soyabean oil-rich preparations (5). The important observation that threads its way through much of the omega-3 research is that higher levels of total polyunsaturation are not as desirable as a balance of omega-6 and omega-3 substrates.

The Noble Prize for medicine in 1982 was awarded for the elucidation of the structure and function of the prostaglandins. In addition to their biological significance it was also found that prostaglandins and other autocoids often work as "antagonistic pairs" related to their omega-6 and omega-3 substrates. The steering of an automobile is an excellent analogy. To steer a straight line course, achieving, for example, homeostasis, it is necessary to be able to turn both left and right, an antagonistic pair of functions. If we can only turn in one direction, we steer in a continuous circle. And, we can define *dizziness* as an adverse neurological symptom!

During the past five years the biochemical research activities with omega-3 fatty acids has been significant and has identified its positive role in human health. The list is long and impressive and has dealt with, for example, heart disease and atherosclerosis, heart attack and thrombosis, hyperlipidemia and cholesterol, stroke, blood pressure, autoimmune disorders (rheumatoid arthritis, asthma and diabetes), brain development and visual acuity, requirements for human growth and development (pre/post natal and adults/elderly), psoriasis, and the subject of cell proliferation (6-12).

Blindness or its earlier manifestation, night-blindness is endemic in South and in some Southeast Asian countries. The specific essential substrates needed in the retina for vision are vitamin A and DHA, an omega-3 essential fatty acid that can be derived from dietary alpha-linolenic acid. Vitamin A is involved in photoreception, converting light into electrical energy. In all species studied, not only the photoreceptor membranes, but also those where the nerve cells receive and send messages, are rich in DHA. Essential fatty acid depletion studies in new borns result in cognitive and visual defects. When we tie this to what was said earlier about vitamin A transport and protein sparing, we underscore the basic importance of both quantity and kind of dietary fats and oils needed to sustain bodily functions.

More recently Emken, using deuterated alpha-linolenic acid, demonstrated its significant conversion in humans to its higher omega-3 homologues, EPA and DHA (13). Vegetable oils are a ready source of substrates for these higher essential fatty acid homologues.

The basic conclusion of these reported research investigations is that there is a demonstrated fundamental importance for the omega-3 fatty acids and that they work in concert with omega-6 fatty acids to establish homeostasis, an equilibrium of bodily functions providing optimum health status

by ensuring proper cell function and protection against disease and stress.

The only two internationally traded vegetable oils that contain significant quantities of both omega-3 and 6 fatty acids, linoleate and linolenate, are soyabean oil and LEAR, low erucic acid rapeseed or Canola oil. While they contain different amounts and ratios of these essential fatty acids, they are a ready source for these important dietary factors.

Before we conclude our subject, we need to develop some background information using published statistics. However, before we look at those data, we must say a few words about their purpose and integrity. One can have very little confidence in the absoluteness of statistics reported for fat and oil consumption or disappearance. The protocols used to develop those data supports such suspicion.

In more developed countries the spread between consumption and disappearance is directly proportional to economic status, and there is a greater and more reasonable uniformity of that stated consumption across the entire population.

In Third World countries, consumption more closely approaches disappearance. Food is more precious and not wasted. However, those populations experience a significant skew to their consumption patterns and per capita consumption or disappearance is simply dividing by total population. That tells us nothing about distribution.

Nevertheless, we cannot live in a vacuum, so we use the available data. In this instance the numbers suggest only a general picture for comparisons and a guide for discussions.

The scope of this subject, nutrition versus functionality and its compromises for the consuming public, varies significantly across Asia. The differentiating factor, aside from a diversity of cultures and the traditional eating habits of each country, is a country's position on the economic development ladder and its ability for indigenous fat and oil productions.

Unfortunately, those countries occupying a low position on the economic ladder are also fat calorie deficient countries and their populations are, therefore, at greater nutritional risk. These low GNP countries also have the largest populations, the highest birth rates and depend heavily on imports to make up for indigenous short falls. It is these countries that need to focus on nutritional quality and less on functional characteristics, real or perceived.

Table 2 illustrates this situation and compares the countries in South Asia, Southeast Asia and Eastern Asia in terms of their relative incomes, per capita fat consumption, life expectancy and population size.

South Asian countries, Pakistan, India and Bangladesh, have low incomes, eat, on average, the lowest amount of fat calories, have the shortest life expectancy, the largest populations, and a tendency to perpetuate their situations as suggested by the numbers in parenthesis indicating the years to double current population numbers. India will, if this trend continues, be the most populous country by the year 2023.

Pakistan appears to be an anomaly with a per capita consumption of 10-12 kilograms per year. However, a compounding factor is that in all populations there is some skew or disproportionate distribution in their per caput fat consumptions. This skewed pattern of consumption is greatest in least developed countries and suggests that a significant percentage of the population is eating at levels well below the norm.

This example (Table 3) for Pakistan applied to an annual consumption of

TABLE 2

Income, fat consumption, life expectancy and population in some Asian countries

	Income US$	Capita Fat	Life Expectancy*	Population**	
Pakistan	431	10-12	54	111	(24)
India	306	6-7	58	835	(32)
Bangladesh	153	2-3	52	115	(25)
Singapore	8162	16	73	2.7	(59)
Malaysia	1875	14	67	17.4	(28)
Thailand	1038	8-9	65	55.6	(41)
Philippines	667	7-8	66	65	(25)
Indonesia	404	10-11	58	185	(35)
Japan	15400	22	78	123	(141)
Hong Kong	9643	16	76	5.7	(91)
Taiwan	5520	16	73	20	(62)
South Korea	4040	9	65	43	(53)
China	283	5	66	1104	(49)

* Average for women/men, ± 2-3 yrs
** In millions; years to double in parenthesis

9.15 kg per capita suggests that 25% of the population eats 67% of the country's fat and oil supplies. The per capita consumption level of this group is about 24.6 kg and the remaining 75% of the population is eating at a per caput level of only 4 kg. And, we can assume a further skew for this lower consumption group indicating that a significant portion of the population is eating even lower levels of visible fat; 75% of the population in 1984 was at least 70 million people.

TABLE 3

Pakistan, skewed consumption pattern* (14)

	Solid	Liquid	Total	Per Caput
25%	23.0 kg (93.5%)	1.6 kg (6.5%)	24.6 kg	6.15 kg
75%	2.6 kg (65%)	1.4 kg (35%)	4.0 kg	3.0 kg
				9.15 kg

* 25% of population consumes 67% fats/oils

The same situation exists today for India, only more disparate (15). For a country caput consumption of 6.5 kilograms per annum, 25% of the population is eating 20 kilos, another 25% is eating 5 kilos and half of the population, more than 400 million people, are eating less than 3 kilos of visible fats and oils per year. Can we even imagine what the skew in that group is?

Three kilos for a 1,000-kilocalorie daily diet is 7.4% fat calories. If daily dietary calories are increased to, for example, 1,500 kilocalories, the situation gets worse and complicated if these additional calories are carbohydrates, low in protein, which would be the expected case.

Another look at Table 2 suggests that Indonesia with a large population also would experience a similar skewed consumption pattern.

South Korea is an outlier in that its life expectancy is low compared to the other newly-industrialised countries, Singapore, Taiwan and Hong Kong. However, so is its total fat calorie consumptions that results from traditional cooking practices that are less dependent on fats and oils. Nevertheless, its life expectancy is not as low as might be interpreted from this single observation. The answer in part, is that Koreans eat a daily diet higher in total calories containing a reasonable protein level requiring fewer fat calories to spare less proteins. Also, smaller populations can expect to have less skewing of their consumptions.

Table 4 data for Pakistan suggests that its population consumes very high percentages of vanaspati, a product that is traditionally prepared by the hydrogenation of vegetable oils. For Pakistan this figure is significantly over 75%, while in India it is traditionally about 30%.

Today more of the vanaspati products are being formulated with palm oil and, therefore, requires less hydrogenations. Nevertheless, developing countries suffering from the stressfulness of both low total calorie and low fat calorie diets should take maximum advantage of their available polyunsaturation. This is not done by hydrogenation for vanaspati productions.

The problem with the hydrogenation of polyunsaturated oils is not trans isomer formation, because they are proven safe (16,17). It is the destruction and loss of essential fatty acids

TABLE 4

Pakistan, fat/oil utilisations (14)

	Vanaspati	Oil	Total
25%	5.75 kg (93.5%)	0.4 kg (6.5%)	6.15 kg (67%)
75%	1.95 kg (65%)	1.05 kg (35%)	3.0 kg (33%)
Total	7.7 kg (84%)	1.45 kg (16%)	9.15 kg

and an opportunity to improve or maximise the nutritional level of total fat and oil supplies. Blending palm oil and polyunsaturated oil supplies will provide the primary functional characteristics of lubricity and heat exchange. Appearance aesthetics of crystal structure, a functional characteristic provided by hydrogenation, has no nutritional merit.

In the more developed countries of Asia, fat and oil consumptions are increasing. An exception is Japan where their fat calorie consumption has levelled at 25% of total calories. These populations are eating good levels of total dietary calories that together with a reasonable level of protein and growing levels of dietary fats, including the more polyunsaturated vegetable oils, suggests that compromises between nutrition and functionality of their fat systems are not a nutritional concern. The worst that could happen here is that excessive nutritional concerns could needlessly destroy or compromise functionality.

A recent article on *Evolution and the Origin of the Human Brain* (18) provides a succinct and prophetic summary for this subject; to paraphrase: "The role of food in homo sapien evolution has hardly been considered. Although food was considered important as an energy source, one food was generally considered the same as another food; this is wrong. It generally is recognised today that food (and that would include dietary fats and oils) is relevant to major health problems throughout the world...the evidence proves that food is not just food and that there are qualitative differences in a manner which has profound biological influence."

This is true for our fats and oils situation. There is no potential for significantly increasing the quantity of dietary fats for populations eating stressful diets; therefore, there needs to be some focus for qualitative changes, to make better use of what is available.

This could be a warning sign: a recognition that evolution is non-directional, it only has dynamic potential for change.

The urgency for that observation is that 90% of the world's population growth is in developing countries and about 80 percent of this growth is in the lower socioeconomic group, a figure that identifies more than 70 percent of potential world population growth!

These are people that had little yesterday, have very little today and cannot expect to have much more tomorrow. What of their evolution?

References

1. Wiedermann LH. Integrity of fat system formulations. Presented at the ISF-OTAI Congress, New Delhi, India, February 3-8, 1985.
2. Cochran MV. Size and functional implications of edible oil markets as a basis for selecting research programmes. AE Bailey Award Lecture, North Central AOCS Meeting, 19 March 1975.
3. Wiedermann LH. soybean and soybean Intermediates: An ever emerging source of food. Presented at the 5th Convention, Association of Food Scientists and Technologies (India), April 3-5, 1985, New Delhi.
4. Holman RT, Johnson SB, Hatch TF. A case of human linolenic acid deficiency involving neurological abnormalities. Am J Clin Nutr 1982; 35: 617-23.
5. Bjerve KS, Mostad IL, Thoresen L. Alpha-linolenic acid deficiency in patients on long-term gastric tube feeding: estimation of linolenic acid and long-chain unsaturated n-3 fatty acid requirement in man. Am J Clin Nutr 1987; 45: 66-77.

6. Hunter EJ. Fats & Oils News: PUFA and Eicosanoid Research. JAOCS 1987; 64:8, 1088-1092.
7. Hunter EJ. Health & Nutrition: Scientists discuss dietary fatty acids, JAOCS 1989; 66:9, 1251-1258.
8. Latta S. Feature: Dietary fats, new directions in research, INFORM (AOCS) 1990; 1:4, 238-258.
9. Anom. Health Nutrition: Omega-3 event focuses on functional changes, Ibid 1990; 1:6, 520-524.
10. Hansen HS. Health & Nutrition: How do n-3 fatty acids affect prostaglandins? Ibid 1990; 1:7, 644-653.
11. Hunter EJ. Health & Nutrition: Course reviews dietary fat knowledge, theories, Ibid 1990; 1:11, 974-977.
12. Hunter EJ. Health & Nutrition: Dietary fat, thrombosis links reviewed. Ibid 1991; 2:8, 723-727.
13. Emken EA. Metabolism of deuterium-labelled oleic, linoleic, linolenic, stearic and palmitic acids in human subjects. Presented at the Third International Symposium on the Synthesis and Application of Isotopically Labelled Compounds, Innsbruck, Australia, July 17-21, 1988.
14. Butt NS. Private Communication. Ghee Corporation of Pakistan, Lahore, Pakistan, December, 1984.
15. Anom. INFORM (AOCS) 1990; 1:8, 687.
16. FASEB Report of the Ad-Hoc Committee of the Federation of American Societies for Experimental Biology (1985). Health Aspects of Dietary Trans Fatty Acids. Senti FR (ed), FDA 223-83-2020, Washington D.C., USA.
17. BNF task force on trans fatty acids by the British Nutrition Foundation (1987), ISBN 0-90-7667-058, London, England.
18. Crawford MA, March DE, Harbige L. Evolution and the origin of the human brain, INFORM (AOCS) 1991; 2:2, 120-122.

Proc 6th ACN 1991: 467

Dietary palmitic acid is hypocholesterolaemic relative to lauric + myristic acids in humans

[1]Sundram K, [1]Hassan AH, [1]Siru OH, [2]KC Hayes

[1]Palm Oil Research Institute of Malaysia and [2]Brandeis University, Waltham, U.S.A.

Abstract

Saturated fatty acids (SAFA) are generally recognised as hypercholesterolaemic. The most common SAFA in the human diet are palmitic, lauric, myristic and stearic. Stearic acid is regarded as a neutral fatty acid with respect to its influence on serum lipids. Unlike stearic acid, however, the individual responses of palmitic, lauric and myristic acids on serum lipids have not been clearly alienated. A human study using 18 volunteers in a 4-week cross-over design was conducted using diets enriched with either palmitic acid (PA) or lauric + myristic acids (LM) to evaluate the impact of these SAFA on serum lipids and lipoproteins. Total fat blends were adjusted such that total PUFA (3 en %), total MONOs (14 en %) and SAFA (15 en %) were held constand while only 10 en % as LM was exchanged for 10 en % as PA. The results (Means ± S.D.; mg/dl) were as follows:

The data indicate that a PA-enriched diet lowered TC, LDL-C and improved the LDL/HDL ratio compared to the LM-enriched diet. We conclude that PA (16:0) exerts a distinctly different impact on cholesterol metabolism from LM (12:1 + 14:1) in normocholesterolaemic humans.

	n	TC	LDL-C	HDL2-C	HDL3-C	LDL/HDL	TG
Entry:	18	164 ± 18	104 ± 25	12 ± 5	24 ± 5	2.6 ± 0.7	85 ± 35
PA:	17	154 ± 17	93 ± 18	12 ± 4	23 ± 4	2.3 ± 0.7	95 ± 33
LM:	18	170 ± 24	106 ± 18	12 ± 5	26 ± 5	2.4 ± 0.6	87 ± 36

Proc 6th ACN 1991: 468-473

Photosensitised oxidation of vegetable oils with chlorophyll and its related compounds

[1]Kaneda T, [2]Fujimoto K, [3]Usuki R, [2]Endo Y

[1]Dept. of Food Nutrition, Koriyama Women's College, Koriyama 963;
[2]Dept. of Food Chemistry, Tohoku University, Sendai 981;
[3]Shokei Women's Junior College, Natori 981-12, Japan

Introduction

It is known that chlorophyll (CHL) shown in Figure 1 exhibits prooxidant effect to edible oils (1-3). CHL acts as a photosensitiser of oils, accompanying the generation of singlet oxygen when exposed to light. However, the prooxidant effects of CHL derivatives such as pheophytin (PHY) and Pheophorbide (PHO) present in vegetable oils and lipid foods on the deterioration of oils have never been systematically studied. In addition, what role the decomposition products of CHL play on the oxidative stabilities of oils has not been known. This investigation was carried out to measure the residual CHL and its related compounds in edible vegetable oils and also to know their prooxidant effects on edible oils.

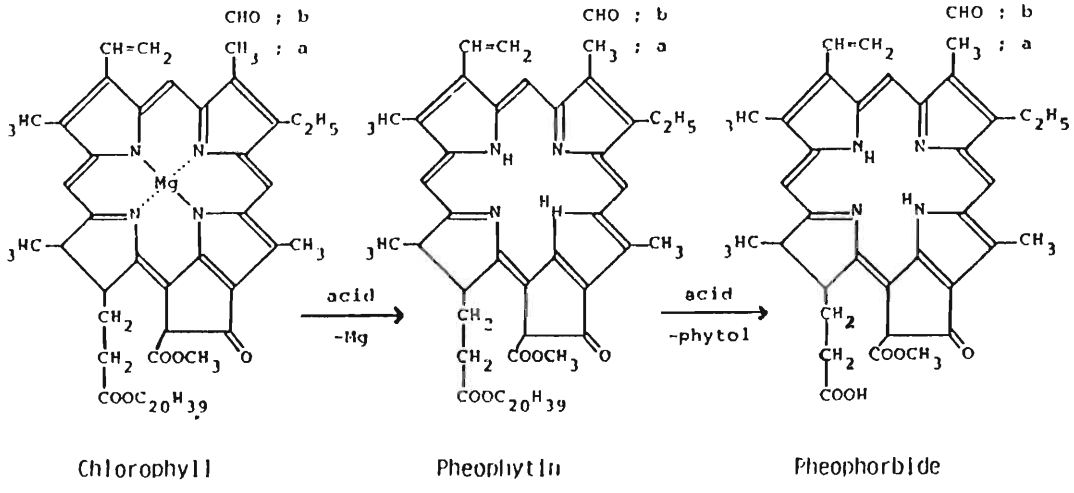


FIG. 1 The decomposition of chlorophyll.

Materials and methods

CHLs A and B were prepared from fresh spinach. PHYs A and B, and PHOs A and B were prepared from corresponding CHLs by acid treatment (4). All vegetable oils were obtained from oil manufactures in Japan. Extracted rapeseed oils were obtained from Canola seeds with several organic solvents (5).

CHL and its derivatives present in crude rapeseed oils were determined by HPLC analysis. A reversed phase column (NOVA-PAK Cartridge C18, 8x100mm) and acetone/method (75:25) mixture as a mobile phase were used for HPLC analysis. Flow rate was 1.0ml/min. CHL and its derivatives were detected with a fluorescence detector (Ex430-Em650nm). Contents of CHLs A and B, and PHYs A and B in vegetable oils and extracted rapeseed oils were determined by the fluorometrical method that we have designed (6).

Methyl linoleate supplemented with CHL, PHY amd PHO (2.2x 10-7mol/g) was exposed to a fluorescent lamp (500lux) at 0 C (4). Peroxide value of sample oils was measured after photooxidation. Residual CHL and its derivatives in sample oils were measured spectrophotometrically (7). The rapeseed oil was passed through an activated carbon-Celite column to remove photosensitisers prior to addition of CHL and PHY (15ug/20g oil) and then was oxidised under room light at room temperature (8).

Results and discussion

Chlorophyll pigments present in vegetable oils

To identify green pigments present in vegetable oils, the HPLC analysis was applied to the crude rapeseed oil (Figure 2). Major CHL pigments in oils were PHYs A and B although CHLs A and B were major green pigments in oilseeds. Furthermore, PHY A', possibly

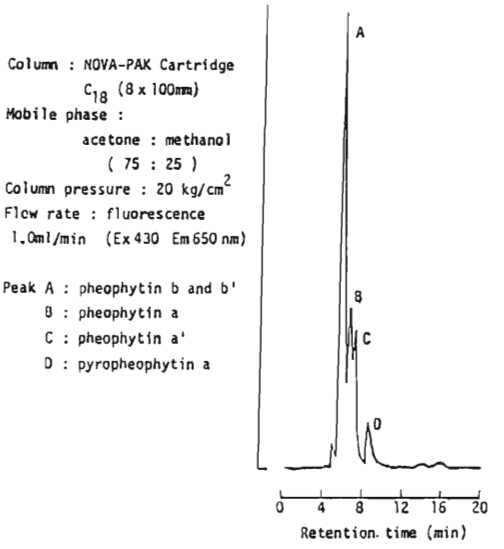


FIG. 2 High Performance Liquid Chromatogram of Chlorophyll Derivatives Isolated from Rapeseed Oil.

a chiral isomer of PHY A and pyropheophytin A were also detected. On the other hand, CHLs A and B content was very low and dephytylated pigments such as PHO and chlorophyllide were not observed in the crude rapeseed oil.

Residual CHLs A and B and PHYs A and B in commercially produced edible oils were determined fluorometrically. As shown in Table 1, each refined edible oils contained different amounts of CHL and PHY (10-600ug/kg). PHY was present in a much higher proportion than CHL, and PHY A showed the highest content (>60%) and PHY B content was 15-25%. On the other hand, CHL A was the smallest, and near the limit of detection by fluorometric method. The mean compositional ratio of A and B types were 70% and 30%, respectively, and were similar for all oils.

Changes of 4 components (CHLs A and B, and PHYs A and B) in rapeseed oils during refining processing are shown in Table 2. The contents of CHL and PHY were decreased with the progress of purification. However, a

TABLE 1

Chlorophyll and pheophytin content in refined vegetable oils

Oil	Total	CHL A	CHL B	PHY A	PHY B
			μg/kg oil		
Soybean	69.1	0.0	4.9	50.8	13.5
Soybean	116.0	2.0	13.3	73.1	27.7
Rapeseed	180.2	3.6	21.4	107.5	47.7
Rapeseed	187.6	6.3	27.8	119.2	34.4
Cottonseed	278.8	9.7	39.8	184.9	44.3
Safflower	311.9	31.7	60.2	167.2	52.8
Corn	161.7	0.0	18.9	114.4	40.5
Olive	142.0	7.7	16.9	97.0	20.6
Palm olein	579.4	15.3	106.4	359.3	98.5
Palm olein	582.9	30.3	113.8	341.2	97.6
Rice bran	626.0	29.6	79.5	396.7	120.3
Sesame	1189.5	125.1	318.9	542.8	202.7
Mean ratio±SD(%)		4.1±3.0	11.3±6.0	65.7±7.9	19.0±4.7

TABLE 2

Changes of chlorophyll and pheophytin composition during refining and processing of rapeseed oils

	Total	CHL A(%)	CHL B(%)	PHY A(%)	PHY B(%)
			mg/kg oil		
Pressed oil	39.9	2.53 (6.3)	4.91 (12.3)	30.3 (76.9)	1.75 (4.4)
Extracted oil	46.1	2.62 (5.7)	2.92 (6.3)	35.6 (77.2)	4.99 (10.8)
Crude oil	35.7	0.88 (2.5)	0.30 (0.9)	27.8 (77.9)	5.35 (18.8)
after degumming	43.1	1.78 (4.1)	1.13 (2.6)	33.3 (77.2)	6.93 (16.1)
after neutralisation	39.1	0.89 (2.3)	0.00 (0.0)	31.5 (80.5)	6.84 (17.5)
after bleaching	0.386	0.028 (7.3)	0.059 (13.6)	0.235 (60.9)	0.071 (18.3)
after deodorisation	0.171	0.007 (4.1)	0.0023 (11.9)	0.108 (62.9)	0.036 (21.1)

relatively constant compositional ratio of the 4 components was observed. These observations mean that PHY was not formed during oil refining.

To know the reason why PHY showed the highest content among CHL analogues, oils containing green pigments were extracted from rapeseeds with different kinds of solvents. Total amounts of CHL and PHY were very low when used hexane (Table 3). The percentage of PHY A was about 77% and the next was PHY B in rapeseed oils extracted with hexane. PHYs A and B were selectively extracted with hexane. Vegetable oils were commonly extracted with hexane so that PHY content was higher than CHL content in edible oils.

Photooxidation of oils with chlorophyll and its derivatives

Methyl linoleate and refined rapeseed oils supplemented with CHL, PHY and PHO were oxidized in the presence of light irradiation (Figures 3 and 4). As shown in Figure 3, the peroxide value of methyl linoleate supplemented with CHL and its derivatives was drastically increased without no induction period. In particular, the peroxide value of methyl linoleate with PHY and PHO was higher than that of oils with CHL during photooxidation. These observations mean that PHY and PHO also acted as photosensitisers to accelerate the oxidation of oils as well as CHL and that their prooxidant activities were stronger than those of CHL. Moreover, stronger prooxidant activity of PHYs A

TABLE 3

Effect of extraction solvents on chlorophyll and pheophytin composition in extracted oils from rapeseed

Solvent*	Extracts (%)	Total	CHL A(%)	CHL B(%)	PHY A(%)	PHY B(%)
			mg/kg oil			
H	22	4.16	0.14 (3.0)	0.00 (0.0)	3.22 (77.4)	0.80 (19.6)
C-M(2:1) after H	17	120.91	92.01 (76.1)	24.77 (20.5)	1.78 (1.5)	2.35 (1.9)
HP-E(3:1) after H	12	166.24	88.03 (53.0)	32.64 (19.6)	27.68 (16.7)	17.89 (10.7)
C-M(2:1)	37	69.78	45.92 (65.8)	14.51 (20.8)	7.22 (10.3)	2.13 (3.1)
HP-E(3:1)	30	78.23	40.40 (51.6)	14.79 (18.9)	15.43 (19.7)	7.61 (9.8)
H-E(2:1)	27	50.03	23.31 (46.6)	7.78 (15.6)	13.35 (26.7)	5.39 (11.1)
A-W(4:1)	18	82.98	1.27 (1.5)	12.26 (14.8)	59.16 (71.3)	10.30 (12.4)

* A: acetone, C: chloroform, E: ethanol, H: hexane, HP: heptane, M: methanol, W: water.

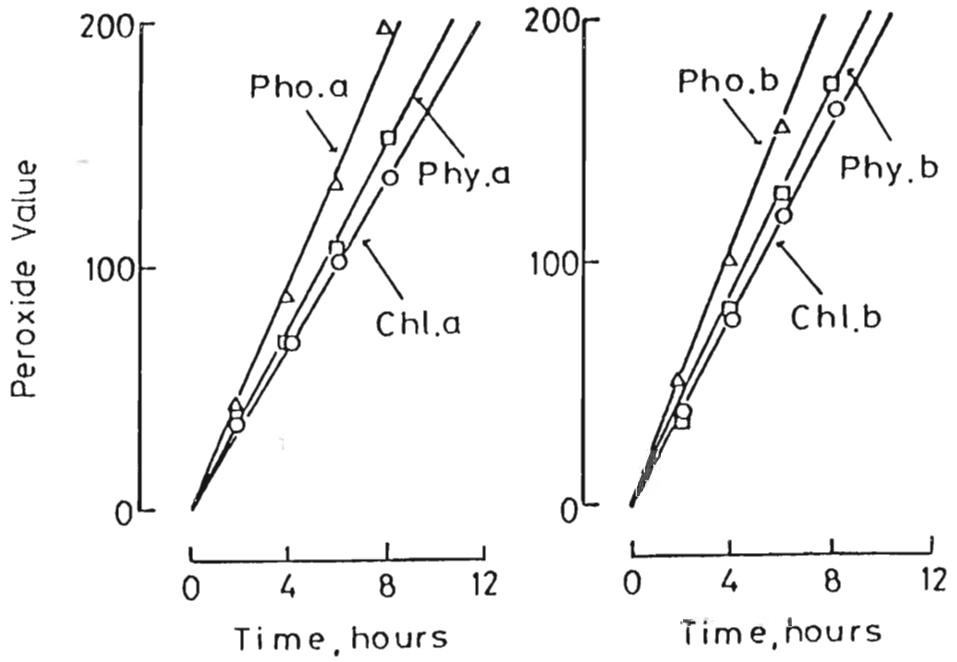


FIG. 3 Effects of chlorophylls, pheophytins and pheophorbides on photo-oxidation of methyl linoleate.

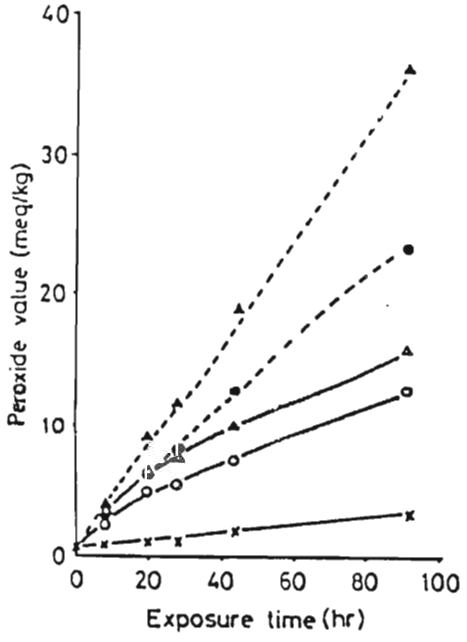


FIG. 4 Effects of Chlorophylls and Pheophytins on the Autoxidatin of Rapeseed Oil under Room Light.
Each pigment (15 μg) was added to photosensitized-free rapeseed oil (20g) and autoxidized under room light at room temperature. ○, Chl a; △, Chl b; ●, Phy a; ▲, Phy b; x, control.

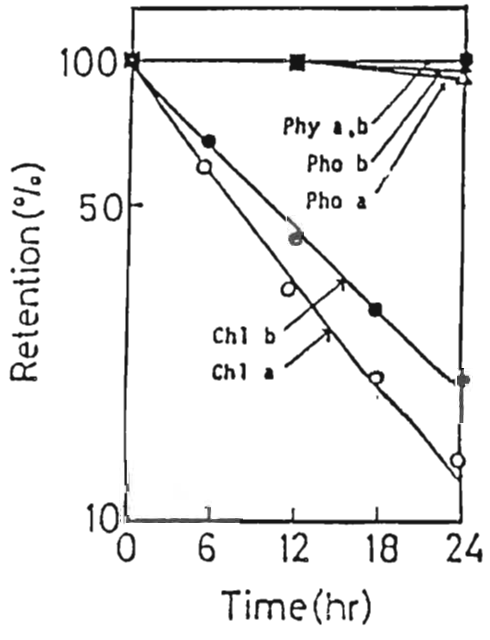


FIG. 5 The Degradation Chlorophylls, Pheophytins and Pheopharbides during Photo-oxidation of Methyl Linoleate at 0°C.

and B was also observed in refined rapeseed oils containing carotenes and tocopherols (Figure 4). It was an interesting finding that B type pigments accelerated the oxidative deteroration of oils to a greater degree than A type. Comparing with stabilities of CHL and its derivatives against photooxidation, PHY and PHO were stable against photooxidation and scarcely decomposed during light irradiation (Figure 5). On the other hand, CHLs A and B were unstable and decomposed easily to colourless compounds. These observations indicate that the stronger prooxidant activities of PHY and PHO were due to their oxidative stability.

These results suggest the importance of the PHY content in vegetable oils, considering the their oxidative stability.

References

1. Rawls RH, PJ Van Santen. J Am Oil Chem Soc 1970; 47: 121.
2. Frankel EN, WE Neff, TR Bessler. Lipids 1979; 14: 961.
3. Terao J, R Yamauchi, H Murakami, S Matsushita. J Food Proc Peserv 1980; 4: 79.
4. Endo Y, R Usuki T Kaneda. J Am Oil Chem Soc 1984; 61: 781.
5. Usuki R, Y Endo J Jpn Oil Chem Soc 1987; 36: 21.
6. Usuki R, T Suzuki, Y Endo, T Kaneda. J Am Oil Chem Soc 1984; 61: 784.
7. Endo Y, R Usuki, T Kaneda. Agric Biol Chem 1984; 48: 985.
8. Usuki R, Y Endo, T Kaneda. Agric Biol Chem 1984; 48: 991.

Proc 6th ACN 1991; 474 - 478

Food composition programme in Malaysia and its coordination with regional networks

E-Siong Tee

Division of Human Nutrition, Institute for Medical Research, Kuala Lumpur, Malaysia

Introduction

Ten years have lapsed since a systematic food composition programme was initiated in 1980. From its humble beginning of a literature survey of available data on food composition, a systematic analytical programme was soon initiated. Data from the analytical programme enabled the publication of the first update to the Food Table in 1985, which was a considerable improvement over the preliminary table of 1982. The programme continued smoothly, albeit slowly, and covered a wide variety of raw, processed and cooked foods, enabling the publication of yet another update in 1988. At the same time, numerous other countries were also improving and intensifying their national food composition programmes. In order to collaborate these efforts and improve the amount, quality and availability of food composition data, various international and regional networks were initiated. This report describes the development of the food composition programme in Malaysia, and its linkages with various regional networks.

The Malaysian food composition programme

A systematic programme to compile a comprehensive food composition table for use in Malaysia was initiated in 1980. The first phase consisted of a definition of the state-of-the-art of food composition studies in the country, and compilation of a preliminary table for immediate use in 1982 (1). In the second phase, systematic chemical analysis of local foods commenced, and was carried out as a collaborative programme among the Institute for Medical Research (IMR), the Malaysian Agricultural Research and Development Insitute (MARDI), Universiti Pertanian Malaysia (UPM) and Universiti Kebangsaan Malaysia (UKM). To execute the Programme, a Working Group was formed, comprising of scientists from the participating institutions. Financial assistance for the analyses was obtained under the ASEAN Protein Project, which was funded by the ASEAN-Australian Economic Cooperation Programme (AAECP). At the end of the second phase, an update to the preliminary table was published in 1985 (2).

The analysis and compilation programme continued for another four years into its third phase. Continued financial assistance was obtained from the AAECP, under the ASEAN Food Habits Project. The climax of the programme was the publication of Nutrient Composition of Malaysian

Foods 1988 (3). Besides the printed copies, the database was also available in dBase format. In cognizance of the need for continuous interaction between food composition data generators and users, a Workshop for Users of Food Composition Data was organised in late 1988. The primary objective of the Workshop was to understand the needs of data users, and to maximise the distribution and effective use of data. Nutritionists, dietitians, food scientists and educationists provided inputs for improvements to the 1988 Table, as well as recommendations for future work in food composition data generation and compilation (4).

With the publication of the comprehensive edition of the Food Table in 1988, the systematic food composition programme in Malaysia has achieved an important stage of development. Work on the programme continued, and current activities emphasise on providing further input and refinement to the database established. These included analyses of selected nutrients which have not been given sufficient attention, selected groups of foods for which information is lacking, as well as studies on analytical methodologies. Effort was also made to improve the management, storage and retrieval of the large amount of data that has become available.

Two groups of foods which the government was encouraging their consumption, but for which compositioned data were lacking were studied. In the first group, 19 types of local vegetables, used mainly as *ulam-ulam*, were studied. The nutritional value of 20 species of fresh-water fishes (5) were compared with that of 50 species of marine fishes from 31 families (6). In response to the great interest generated on the consumption of snack foods, the nutritional value of these foods was also examined (7). Studies into analytical methodologies placed emphasis on several nutrients, including vitamin C, calcium and iron (8, 9, 10).

Studies on several specific nutrients were carried out. In response to increasing interest in the dietary fibre content of foods, a study of this "neglected nutrient" was initiated. In conjunction with this unavailable carbohydrate, the "available carbohydrate" content of foods was examined, to obtain more accurate data on carbohydrate content, as opposed to results obtained "by difference" (11). The study of cholesterol content of foods was initiated, to meet increasing demand for these data in the control and prevention of cardiovascular disease.

There has been a great deal of interest in the vitamin A and carotenoid contents of foods in recent years, in relation to their importance to vitamin A deficiency as well as to their possible roles in the prevention of cancer (12). Much progress has been made in the development of analytical methods for more accurate determination of these two groups of closely related nutrients (13). A systematic project to develop an improved method for the analysis of retinol and carotenoids was thus initiated (14). The HPLC method developed was found to be suitable for the simultaneous analysis of retinol and carotenoids in a variety of fruits and vegetables (15), as well as foods of animal origin (16). Besides making available an improved methodology, the project has also resulted in making available the carotenoid composition of these foods, to provide more accurate estimations of the vitamin A values of foods.

Further to the above-mentioned completed project on the development of a HPLC method for more accurate analysis of retinol and carotenoids in foods, two other studies were carried out. In the first study, the HPLC method developed was successfully adapted for the simultaneous determination of retinol and carotenoids in

blood sera. For the first time, the carotenoid composition of a sample of "normal" sera of Malaysians has become available. The method would be useful for more accurate determination of these nutrients in human subjects, e.g. in the assessment of vitamin A status. In order to provide more accurate data on the vitamin A value of foods, the biological utilisation of carotenoids in selected plant sources was investigated using experimental rats in the second study.

Coordination with regional networks

The Malaysian food composition programme in Malaysia has been developed in coordination with various international and regional networks. At the commencement of the programme in the early 1980's, the establishment of the International Network of Food Data Systems (INFOODS) in 1983, aimed as an international effort to improve the amount, quantity and availability of food composition data, had provided additional impetus for the programme. It was comforting to know that Malaysia was not alone in its effort. Details of INFOODS will be presented elsewhere in this Symposium. The following year, Malaysia participated in the inauguration of ASIAFOODS (17), one of the several regional networks subsequently established.

In the ASEAN region, Malaysia has collaborated fully with other member countries in a number of activities in food analysis. Two workshops on food analytical techniques were organised, the first was held in Singapore in 1981 (18), followed by another workshop in Indonesia in 1984 (19). Arising from discussions during these two workshops, the ASEAN Food Data Network was established in 1986. Coordinated from Bangkok, various activities have since been organised, including two workshops in 1986 and 1989 (20, 21). Besides discussions on a variety of analytical methods, emphasis was also given to the generation of national food composition databases, quality control and interlaboratory testing, and computerised databases. An interlaboratory trial on nutrient analysis among the various laboratories in ASEAN was carried out in 1988. Activities being planned for the immediate future include the publication of an ASEANFOODS newsletter in late 1991. Plans are also being made for the convening of a consultative meeting in early 1992 for the development of a ASEANFOODS Database.

More recently, the Asia-Pacific Food Analysis Network (APFAN) was established, with the nucleus in Australia. The author has participated in two recent activities of the Network, namely a regional seminar in Penang in October 1990 (22) and a workshop in Brisbane, in July 1991 (23). The seminar focused on the analysis of trace constituents in foods, and covered developments in the analyses of vitamins, minerals, additives, adulterants and mycotoxins in the region. The workshop was held in the Queensland Government Chemical Laboratory, and was aimed at upgrading the analytical capabilities of workers from developing countries. Participants had the opportunity to have `hands-on' practical sessions in the analysis of dietary fibre, carotenoids (and vitamin A), trace minerals, and aflatoxin, as well as some tips in trouble shooting in liquid chromatography and atomic absorption spectrometry. A second regional seminar is being planned for November 1992 in Kuala Lumpur, with some thrust on quality assurance and validation of analytical methods.

These associations with various regional networks have proved useful as they enable sharing and exchange of experiences, and the development of harmonised food composition databases. Malaysia will continue to work towards strengthening these

collaborations, in order to further update and improve its food composition programme, as well as other programmes in the region.

References

1. Tee ES. Nutrient composition of Malaysian foods: a preliminary table. Kuala Lumpur: Institute for Medical Research; 1982.
2. Tee ES. Nutrient Composition of Malaysian Foods - A Preliminary Table (First Update). Kuala Lumpur: ASEAN Protein Project, National Sub-Committee Malaysia; 1985.
3. Tee ES, Mohd Ismail N, Mohd Nasir A and Khatijah I. Nutrient Composition of Malaysian Foods. Kuala Lumpur: ASEAN Sub-Committee on Protein - Food Habits Research and Development; 1988.
4. Khatijah I and Mohamad Nordin AK (editors). Proceedings of the Workshop for Food Composition Data Users. Kuala Lumpur: ASEAN Sub-Committee on Protein - Food Habits Research and Development; 1988.
5. Tee ES, Siti Mizura S, Kuladevan R, Young SI, Khor SC and Chin SK. Nutrient composition of Malaysian freshwater fishes. Proc Nutr Soc Mal 1989; 4: 63-73.
6. Tee ES, Siti Mizura S, Kuladevan R, Young SI and Khor SC. Nutrient composition of Malaysian marine fishes. ASEAN Food Journal 1987; 3: 67-71
7. Tee ES, Siti Mizura S, Anuar A, Kuladevan R, Young SI, Khor SC and Chin SK. Nutrient composition of selected cooked and processed snack foods. Pertanika 1989; 12(1): 15-25.
8. Tee ES, Young SI, Ho SK and Siti Mizura S. Determination of vitamin C in fresh fruits and vegetables using the dye-titration and microfluorometric methods. Pertanika 1988; 11: 39-44.
9. Tee ES, Siti Mizura S and Khor SC. Determination of calcium in foods by the atomic absorption spectrophotometric and titrimetric methods. Pertanika 1989; 12(3): 303-311.
10. Tee ES, Siti Mizura S and Khor SC. Determination of iron in foods by the atomic absorption spectrophotometric and colorimetric methods. Pertanika 1989; 12(3): 313-322.
11. Siti Mizura S. Annual Report 1989. Kuala Lumpur: Institute for Medical Research; 1989.
12. Tee ES. Carotenoids and Retinoids in Human Nutrition. Crit Rev Food Sci Nutr 1992; 31:103-163.
13. Tee ES and Lim CL. The analysis of carotenoids and retinoids: a review. Food Chem 1991; 41: 147-193.
14. Tee ES and Lim CL. Development of a HPLC Method for the Analysis of Carotenoids in Vegetables and Fruits. Proceedings of the Universiti Pertanian Malaysia Seminar on Advances in Food Research III, 19-20 November 1990, Serdang, Selangor Darul Ehsan, Malaysia; 188-216.
15. Tee ES and Lim CL. Carotenoid Composition and Content of Malaysian Vegetables and Fruits by the AOAC and HPLC Methods. Food Chem 1991; 41: 309-339.
16. Tee ES and Lim CL. Re-analysis of Vitamin A Values of Selected Malaysian Foods of Animal Origin by the AOAC and HPLC Methods (in press in Food Chemistry).
17. Tee ES. Status, resources and needs for food composition data: a Malaysian report. Proceedings of the 1st ASIAFOODS Conference, 17-21 September 1984, Bangkok; 65-67.

18. ASEAN Sub-Committee on Protein, Singapore. Proceedings of the ASEAN Workshop on Analytical Techniques. 12-14 February 1981, Singapore.

19. Imamkhasani S (editor). Proceedings of the Second ASEAN Workshop of Food Analytical Techniques. 18-24 March 1984, Surabaya, Indonesia. National Institute for Chemistry, Indonesian Institute of Sciences, Bandung, Indonesia.

20. Roestamsjah, Karossi TA and Tsauri S (editors). Proceedings of the 1st ASEAN Workshop on Food Composition. 22-25 October 1986, Jakarta, Indonesia. National Institute for Chemistry, Indonesian Institute of Sciences, Bandung, Indonesia.

21. ASEAN Interim Project Management Committee on Protein. Proceedings of the ASEAN Workshop on Food Data System. 25-27 October 1989, Bangkok, Thailand.

22. Tee ES. Developments in analysis of vitamins in foods in Malaysia. Paper presented at the Asia-Pacific Regional Seminar on Analysis of Trace Constituents in Foods. 15-17 November 1990, Pulau Pinang, Malaysia.

23. Tee ES. Developing capabilities in food analysis: regional needs and benefits. Paper presented at the Asia-Pacific Food Analysis Network (APFAN) Food Analysis Workshop, 15-19 July 1991, Brisbane, Australia.

Proc 6th ACN 1991; 479 – 482

National food composition programme in Australia

Ruth M English, Janine L Lewis

National Food Authority, PO Box 9848, Canberra 2601, Australia

Introduction

The first set of Australian food composition tables was published in the late 1930's in a report of the National Advisory Council on Nutrition (1). These tables, developed by Dr Geoffrey Bourne, provided proximate values on some 1200 foods for an analysis of a dietary survey, conducted in four States - New South Wales, Victoria, South Australia and Queensland. The first published monograph of food composition data, under the title of "Tables of composition of Australian foods", was compiled by Anita Osmond and released in 1946 as the National Health and Medical Research Council's (NHMRC) Special Report Series No 2 (2). These tables were revised in 1954 by Winifred Wilson (3) and republished in 1970 with extensive revisions and re-formatting under the authorship of Sucy Thomas and Margaret Corden (4). In 1979, a Working Party of the Nutrition Committee of NHMRC was established to plan a revision of the Australian food tables to be based on a major analytical programme of national foods. The analytical programme commenced in 1981 and has been maintained through the 1980's and now into the 1990's.

Sampling programme

The sampling programme for the food analysis is based on foods available to the consumer in the marketplace, taking into consideration the contribution of foods to the national diet or the diet of subgroups in the overall population. Within the limitations of resources available for the Australian or indeed any food composition programme, it is not possible to consider analysing the majority of food items in a modern food supply, estimated to be some 16,000 individual products in the Australian marketplace. Therefore, it is important that within each major analytical programme for a specific food grouping, foods selected are those commonly consumed, balanced by the significance of their nutrient contribution.

For the actual sampling process, consideration is given to the geographical density of the population, the venues where food is purchased, the originating source of the food and factors that might influence the variability of the nutrients in the food at the time of purchase and during and after sampling. For processed and manufactured foods, sampling is based on market shares and production runs. Packaged foods are analysed within the product shelf-life, as identified by the use-by date.

For most foods, a composite sample is prepared for analysis from multiple individual samples.

Determination of nutrients

Currently, nearly all analyses are

undertaken by the Australian Government Analytical Laboratories. Through their food analytical work, Associate Professor Heather Greenfield and colleagues at the University of New South Wales have contributed significantly to the analytical programme and subsequent publications. The analysis of a number of nutrients has required a considerable time period for setting-up methods, solving problems and achieving acceptable quality assurance standards. Nutrients included in the analytical programmes to 1989 were:

Water, nitrogen, amino acids

Fat, fatty acids, cholesterol

Sugars, starches, organic acids

Ash

Dietary fibre (AOAC method)

Vitamins - A, carotenes, B-1, B-2, niacin, C

Minerals - Na, K, Ca, P, Mg, Fe, Zn, Cu, Mn.

Since 1989, the following nutrients have been included in the analytical programme:

Vitamins - B-6, biotin, pantothenic acid, B-12, folates

Minerals - Se, S, Cl, F.

Todate, some 2000 foods have been analyzed in the current food composition programme.

Validation process

Nutritionists previously within the Department of Health, and now in the National Food Authority, have the responsibility for developing the sampling programme, overall monitoring of sample purchasing and analysis, and validating of analytical data for publication. The validation process may result in repeating, extending or rejecting data analyses, based on detailed scrutiny of nutrient results with reference to Australian food standards, package labelling information, data from other food composition tables or from other sources, and discussion with the relevant food industry body or food manufacturer.

Programme publications

Since August 1989, eight publications have been released from the food composition programme, in three different formats to meet specific user demands. The main product is the "Composition of foods, Australia" series, with five volumes now published. These are:

Volume 1 – Meat, vegetables, fruit, take-away and snack foods (5)

Volume 2 – Cereal and cereal products (6)

Volume 3 – Dairy products, fish and eggs (7)

Volume 4 – Fats and oils, processed meat, fruit and vegetables (8)

Volume 5 – Legumes and nuts, beverages and miscellaneous foods (9)

The second major product is the computerised database NUTTAB, commercially released in 1989 and revised in 1990 and 1991 (10).

The last of the present formats is the popular, condensed and tabulated publication "Nutritional values of Australian foods" (12). It includes all foods detailed in the "Composition of foods, Australia" series, providing data on 25 nutrients for each food.

Asian foods

One major aspect of the current food composition work is the inclusion of a major analytical programme on ethnic foods. The Asian region is the origin of the majority of foods in this programme which includes 28 Chinese, 20 Indonesian/Malaysian, 20 Vietnamese and 14 Thai foods. These

foods are being analyzed under contract at the University of New South Wales.

Australian nutrient data bank

The development of the Australian nutrient data bank (ANDB) - a mainframe system designed to store, process and report nutrient data - has significantly facilitated the availability of food composition publications from the programme. Nutrient profiles are entered and stored together with a detailed description of the analyzed sample. This can be done manually or via electronic transfer from the principal analytical laboratory.

The processing of nutrient data involves compilation of analyses from one or more samples into a set of data suitable for publication, with the flexibility of weighting, averaging or combining data. Particular components can be calculated from analysed data, such as energy content, and retinol and niacin equivalents. A recent enhancement to ANDB allows the calculation of nutrient profiles of recipe foods by the combination of ingredient nutrient profiles and by the application of weight change and nutrient retention factors.

The system can report data in a number of formats, e.g. one page/one food for the COFA series, tabulated for "Nutritional values of Australian foods" and the data appendices for the COFA series. Data can be reported per 100g or mL or per specified serving size. For these and other reporting formats to be produced, the ANDB has a flexible system whereby the report details (within a fixed "shell") for publication or other uses, are decided by the user.

Regional activities

Within the last ten years, liaison has been developed with food composition programmes in the Asian region. Nutritionists working in the Australian food composition programme have shared their publications with those carrying out similar programmes in other countries, including Malaysia, Thailand, Indonesia, the Philippines and Vietnam. Through an FAO nutrition improvement project, funded by the Australian International Development Assistance Bureau, support currently is being provided for nutrient analyses of carotene and vitamin A - containing foods at the National Institute of Nutrition in Vietnam. Also, Australian membership of OCEANIAFOODS has helped to develop contacts with nutritionists and food analysts involved with ASEANFOODS - another regional group of the international umbrella organization INFOODS.

Future activities

In the continuing updating of the COFA series, information will be released on an extended range of nutrients, including for those foods for which some nutrient data have already been published. As well, updates will increase the number of foods for which data are provided, with an emphasis on ethnic and recipe foods and foods for infants, as well as new products entering the market-place. The computerised database - NUTTAB and the condensed, tabulated publication of "Nutritional values of Australian foods" should be updated regularly. A simplified version of the food tables for use by the general community, is in the planning stages.

References

1. Advisory Council on Nutrition. Reports No 1-6: 1936-39. Canberra: Commonwealth Government Printer, 1939.
2. Osmond A. Tables of composition of Australian foods. National Health and Medical Research Council Special Report Series No 2. Canberra: Commonwealth Government Printer, 1946.

3. Osmond A, Wilson W. Tables of composition of Australian foods. Canberra: Commonwealth Government Printer, 1954.
4. Thomas S, Corden M. Tables of composition of Australian foods. Canberra: AGPS, 1970.
5. Cashel K, English R, Lewis J. Composition of foods, Australia. Canberra: AGPS, 1989.
6. English R, Lewis J, Cashel K. Composition of foods, Australia. Volume 2, Cereal and cereal products. Canberra: AGPS, 1990.
7. Lewis J, English R. Composition of foods, Australia. Volume 3, Dairy products, eggs and fish. Canberra: AGPS 1990.
8. English R, Lewis J. Composition of foods, Australia. Volume 4, Fats and oils, processed meat, fruit and vegetables. Canberra: AGPS, 1990.
9. Lewis J, English R. Composition of foods, Australia. Volume 5, Nuts and legumes, beverages and miscellaneous foods. Canberra: AGPS, 1990.
10. Lewis J, Hold R. NUTTAB91-92. Nutrient data table for use in Australia. Canberra: AGPS, 1991.
11. English R, Lewis J. Nutritional values of Australian foods. Canberra: AGPS, 1991.

Proc 6th ACN 1991; 483 – 490

Food composition data generation and compilation in the Philippines

Aida R Aguinaldo

Food and Nutrition Research Institute, Department of Science and Technology, Manila, Philippines

Historical perspective

The historical account of the food composition work undertaken in the Philippines is viewed in the light of events before and after the INFOODS initiative (Table 1).

The first food composition data reported in the country were those generated in 1907 on infant food and milk by two American scientists (Musgrave and Richmond) of the Philippine Bureau of Science. This was followed by many more works, by other people, for a variety of purposes.

TABLE 1

Milestones in the food composition data generation and compilation activities in the Philippines

A.	*Before INFOODS*	
	1907	Proximate composition of infant food and milk, Bureau of Science (Musgrave and Richmond)
	1925	First compilation (Adriano)
	1951	First Food Composition Tables, Institute of Nutrition
	1980	Fifth revision of the Food Composition Tables, Food and Nutrition Research Institute
B.	*After INFOODS*	
	1985	First National Workshop on Food Composition Creation of the National Committee on Food Composition
	1986	Start of development of a Laboratory Network
	1987	Start of data generation (at FNRI) using INFOODS Guidelines
	1990	Start of development of a computerized data system

The first compilation of food composition data was done in 1925 by a Filipino scientist (Adriano), using data mostly generated in the U.S. It was not until after the war that food composition data generation for compilation purposes was institutionalised, the task being given to the newly created Institute of Nutrition. Thus, the first compilation, which was subsequently known as the "Food Composition Tables (FCT) Recommended for Use in the Philippines", was published in 1951, with most data borrowed from the U.S. This function continues today in the Institute under its new name, the Food and Nutrition Research Institute.

When the INFOODS was followed up in Asia, in 1984, the Philippines began examining its FCT, with results which were then emerging as the norm - data were not complete, nor up-to-date, nor accurate, nor easily accessible - as would have been desired (Tables 2 and 3).

TABLE 2

Gaps in the Philippine FCT in food groups/items and nutrients

Food Group(s)	Food Item(s)	Nutrient(s)
Cereals (particularly flour, noodles)	Processed/convenience instant foods (including imported foods)	Fatty acids
Bakery products		Dietary fibre
Meat, poultry, eggs		Starch and sugars
Fish	Cooked single foods (including fried, broiled, sauteed)	Amino acids
Fruits		β-carotene, vitamins C and D
Vegetables	Unusual/alternate foods	
Beans/nuts/seeds (including vegemeat, coconut products)	Raw single foods	Iron, iodine, and zinc
	Recipes	Total vs. available carbohydrate
Root crops	Spices	
Milk and milk products	Baking soda powder	
Miscellaneous (including spices)	"Junk" foods	
	Jams and jellies	
Herbal medicine	Infant formulas	
Fats and oils	Dietetic/special diet foods	
Beverages		
Wines/beer	New products	

TABLE 3

Limitations of the Philippine Food Composition Tables (1980 Edition)

1. *Technical*

   Relate to the representativity of the sample and to the accuracy of the sampling and analysis methods, i.e.:

   a. limited sampling due to nearly exclusive Metro Manila sourcing, few and arbitrarily selected market/groceries, market stalls and food units for analyses.

   b. inaccurate analyses due to low specificity, sensitivity and precision of methods.

2. *Conceptual*

   Relate to nutritional significance of data to users, e.g.:

   a. limited application of "carbohydrate by difference" to diabetics.

   b. little utility value of "crude fiber" vis-a-vis "dietary fiber" to dietitians.

   c. over-estimation of "protein" (if not taken from amino acid composition), or of "iron" (if without non-heme vs. heme differentiation), or of "vitamin A" (if without carotenoid fractionation).

   d. over-estimation of nutrient potential from chemical analyses (if uncorected for bio-availability).

Thus, in 1985, the first National Workshop on Food Composition was conducted with 60 data generators and users participating. The Workshop formalized the gaps in then operating system and, more importantly, made the recommendation to form an inter-agency coordinating body, the National Committee on Food Composition (NCFC) to formulate a Philippine National Plan (PNP).

The Philippine national plan

The PNP, so formulated by the created NCFC, takes a 4-pronged approach: needs assessment and guidelines formulation; data generation by a laboratory network; data banking and management; and continuing education programme (Table 4).

Needs assessment and guidelines formulation

The PNP envisions the periodic assessment and appropriate action by the NCFC or task forces. Todate, the NCFC has approved and the FNRI has implemented (and continue to implement) the identified strategies for prioritization of foods and nutrients; the sampling and analysis methodologies; and the content/format of the Philippine FCT (Table 5).

Data generation by a laboratory network

The present food composition data generators belong to a cross section of the laboratory community, with specific mandates that direct data generation

TABLE 4

The Philippine national plan for food composition data generation and compilation

- Data needs assessment and guidelines formulation by task forces.
- Data generation by a Laboratory Network with FNRI as central note.
- Data banking and management for various users.
- Data generators' and users' continuing education and development through seminars, conferences, workshops and training courses.

TABLE 5

Needs assessment and guidelines formulation

1. Prioritisation of food items and nutrients
   a. food items - based on use of data, primary being the national nutrition surveys
   b. nutrients - based on existing local RDAs
2. Choice of sampling and analytical methodologies
   a. sampling
      i. sampling centres – based on assumption that Metro Manila food supply represents that in other parts of the country
      ii. sampling points – based on findings that certain public markets/ supermarkets are main distribution points ofmost foods or are main-sources of specific foods
      iii. sampling time – initially based onHorwitz concentration vs. variability equation currently based on INFOODS Guidelines
   b. chemical analyses - based on "consensus" methods monitored by control charts on in-house standards
3. Content and format of FCTs
   a. food groupings
   b. explanatory notes
   c. indices
   d. appendices
   e. contents of tables

protocols (Table 6). The PNP envisions a laboratory network system that reconciles major differences to rationalize compilation of data generated by participating laboratories. This task involves a number of coordinated activities within and among laboratories (Table 7).

Within the FNRI laboratory, methods comparison and/or validation, as well as establishment of precision data, have become standard practices since 1987. The INFOODS draft guidelines have been used in many sampling/analysis improvement activities. In-house standards are continually developed. Better performing analysis methods and sampling protocols are in place.

To initiate the Laboratory Network, an inventory of analytical capabilities of food laboratories in the country was made. In 1988-1989, interlaboratory tests for proximate, vitamin and mineral analyses demonstrated the low accuracy and precision of certain routine methods and the subsequent improvement of these parameters when "consensus" methods were used.

Data banking and management

The PNP includes the compilation of data by the FNRI and the easy access to them, by users of various/different needs, hence the development of a computerized system (Table 8). A user-friendly programme employing the D-base IV (version 1.1)

TABLE 6

Generators of food composition data in the Philippines

1. Department of Science and Technology
   - Food and Nutrition Research Institute
   - Industrial Technology Development Institute
   - Philippine Nuclear Research Institute

2. Department of Health
   - Bureau of Food and Drugs
   - Department of Agriculture
   - Bureau of Plant Industry
   - Bureau of Animal Industry
   - Bureau of Fisheries and Aquatic Resources
   - National Food Authority
     - Food Development Center
     - National Post-Harvest Institute for Research and Extension Philippine Coconut Authority

3. State and private universities: faculties of agriculture, food and nutrition, public health and medicine (degree and research programmes)

4. Internationally funded research organizations International Rice Research Institute (IRRI) Southeast Asian Fisheries Development Center (SEAFDEC) ASEAN Post-Harvest Research Center (APHRC)

5. Private industry (QC and R&D Laboratories)

TABLE 7

Data generation by a laboratory network

A. *Within Laboratories*

- Methods comparison/validation
- Establishment of precision data on selected methods
- Development of a quality assurance programme
- Development of Procedure Manuals

B. *Among Laboratories*

- Inventory of analytical capabilities
- Inventory of training course offerings
- Interlaboratory tests programmes
- Harmonization of analytical methods
- Harmonisation of food identification/documentation system
- Development of data compilation system (for food composition database)
- Organization of continuing series of seminars, conferences, workshops, training courses

TABLE 8

Data banking and management

- Collection of data from sources other than FNRI
- Survey of uses of/queries on food composition data
- System analysis
- Development of software for encode-compiler
- Development of software for various uses, e.g.
  - food/diet rating, e.g. nutrient density and index of nutritional quality
  - food/diet adequacy relative to RDA
  - nutrient variability and food sourcing
  - nutrient norms and nutritional labelling
- Development of Software Operation Manuals
- Systematization of outputs

software is presently being tested and refined to accommodate all reasonably acceptable local food composition data in order to respond to pre-determined queries. Decisions on the content and format of the database have been finalised.

At the same time, collection of data generated by other laboratories (from literature, researchers, etc.) is underway.

Continuing education programme

The training needs of data genera-

TABLE 9
Continuing education programme for data generators and users

A. *Data Generators*

- Sampling techniques
- New methodologies, especially automated ones
- Maintenance and repair of laboratory instruments
- Statistics in analytical chemistry
- Computer/software applications in analysis/documentation
- Quality assurance techniques
- Networking

B. *Data Users*

- Limitations of FCTs or data sets
- Food Composition Database applications
- Networking

tors and users are many (Table 9); however, only a few have been filled. Some aspects of the continuing education programme for data generators have been addressed by the seminar series programme of the Philippine Association of Laboratory Instrument Users, which todate, has sponsored lectures on the use and maintenance of basic equipment (e.g. pH meters; UV/VIS and IR spectrophotometers; GCs/HPLCs; basic electronics and computers in laboratory instrumentation; laboratory management and operations; quality assurance; laboratory data handling and evaluation; and safety in the laboratory).

The future

While the present data generation for compilation work in the FNRI makes slow progress due to priority problems (for research) and budgetary contraints (for personnel and operations), the database system (which makes available data from other sources) serves a responsive alternative.

With hopefully more external funding and the continued support of the local Laboratory Network, the future for complete, up-to-date, accurate and accessible food composition data in the Philippines looks promising. The collaborative efforts in the Asia-Pacific region, and sustained initiatives from INFOODS can continue to make sooner the realisation of the Philippine food data system, which we would like to call PHILFOODS, in the tradition of INFOODS.

References

Aguinaldo AR. Food Composition and Quality. In: Florentino RF, ed. Nutrition Research in the Philippines, Philippine Council for Health Research and Development; 1990; 123-157

Aguinaldo AR, Lontoc AV and Florentino RF. Country paper: Food Composition Data Generation, Compilation and Use in the Philippines. Presented at the 2nd ASEAN Workshop on Food Data System, Bangkok, Thailand, 25-27 October

1989.

Aguinaldo AR, Portugal TR, Madamba LSP and Bongga DC. Country paper: Food Composition Data Generation, Compilation and Use in the Philippines. Presented at the 1st ASEAN Workshop on Food Composition, Jakarta, Indonesia, 22-25 November 1986.

Florentino RF and Aguinaldo AR. Country paper: Food Composition Analysis, Compilation and Use in the Philippines. Presented at the 1st ASIAFOODS Conference, Bangkok, Thailand, 17-21 September 1984.

Proc 6th ACN 1991; 491 – 492

Establishing MENAFOODS

Mohamed Amr Hussein and Mohamed I Hegazi

Nutrition Institute, Kasr El Aini Street, Cairo, Egypt

Food composition programme in Egypt

Complete and accurate knowledge of the composition of food in essential not only for the purpose of menu planning, but it is also essential for the entire range of nutrition activities. The National Nutrition Institute in Cairo is continuing its effort to establish a food composition data. The following procedures were followed.

Sampling

Samples are collected from local retail market as purchased and consumed by the population concerned. Prepared cooked foods are collected from homes, or places where foods are prepared for consumption. For each cooked food preparation, a control sample is cooked in the laboratory according to the recipe book of the Home Economics college in Cairo. Full details are recorded for the cooking method including temperatures, times and volumes used.

Analysis

The appropriate analytical procedures for the measurement of the nutrients were chosen. Such procedures are documented in the AOAC handbook and other sets of official methods.

Our laboratories, with the limited facilities, could focus on improving the quality of the analytical techniques that are currently used, rather than getting involved in a wide range of sophisticated automated equipments.

The nutrients analysed in our laboratory included crude protein, ether extract, crude fiber, and ash. Carbohydrates are calculated by difference. Some vitamins are also determined as A, B1, B2 and C. The minerals determined by using the Atomic absorption technique are: sodium, potassium, calcium, magnesium, manganese, zinc, copper and iron.

According to our records, we have the complete data on the nutrient composition of:

(a) Food consumed fresh; vegetables and fruits — 93 samples

(b) Raw foods without cooking — 156 samples

(c) Cooked composite dishes — 158 samples

A final check on the suitability and reliability of reported results lies in their consistency with our previously reported values, either for the food or for its ingredients. Essentially, all data, whether expected or unexpected, should be interpreted to explain the actual values obtained. It is usual in food composition studies to compare new information with previously published values for the same food.

Communication with other laboratories from countries of the region for exchange of information about food composition data is proceeding.

It is expected that several problems may come up which need closer and wider discussion aiming at a sound and practical resolution suitable for our laboratories. This needs holding a regional meeting for solving these problems.

Use of food data in Egypt

Egypt is an Afro-Asian country. It lies in a central position to the Arab world and the Middle East. The staple foods in Egypt are: bread, faba beans and rice. Foods exported are rice, vegetables and fruits. The main imported foods include: wheat and wheat flour, maize, refined sugar, fats and oils.

The present food composition table was published in 1985, it is the result of work carried out in the Nutrition Institute in Cairo. It is planned to compile data from other Egyptian Institutions to produce and Egyptian food composition table.

These tables are used in Egypt by:

1. Dietitians in hospitals and dietetic consultants.
2. Nutritionists in government health agencies, for purpose of assessment of dietary intake and consumption pattern.
3. Food scientists, and food analysts in government institutions as well as industries.
4. Students in home economics and in universities.
5. Agriculture engineers dealing with agriculture economics.
6. Research workers in food sciences.
7. Central Bureau of Statistics, in calculation of food balance sheet.

Analysis of foods for amino acids and fatty acids content is felt to be necessary. Hence, in our future plans, analysis of food for these acids will be included. It is important to upgrade the unit of data management and computer centre so it can cope with handling the expected data from the region.

References

AOAC. Official Methods of Analysis, 12th edition, Washington DC, USA, 1975.

Food composition tables, Cairo, National Nutrition Institute, 1985.

FAO, USDA, Food composition tables for the Near East, Rome: FAO/USDA, 1987.

Pellet P, Shandarevion S. Food composition tables for use in the Middle East. 2nd edition, Beirut, Lebanon, American University of Beirut, 1970.

Proc 6th ACN 1991; 493 – 496

Status and future of INFOODS

John C Klensin and Nevin S Scrimshaw

INFOODS is the acronym for the International Food Data Systems Project of the United Nations University, designed to improve the quantity, quality and availability of food composition data in every country, with particular focus on developing countries.

Background

Good, readily available data about the nutrient composition of foods consumed by people are critical in many sectors and disciplinary areas - health assessment, the formulation of appropriate institutional and therapeutic diets, food and nutrition training, epidemiological research, etc., as well as for a variety of applications in trade, research, and assistance. The amount, quality, and availability of these data vary among and within countries and regions. However, for no area is there a body that users feel is fully adequate for their needs. Accurate and accessible data for all the essential nutrients simply do not exist for most of the foods of the world. INFOODS was organised to stimulate and coordinate efforts to improve the status of food composition data around the world and to ensure that eventually anyone anywhere will be able to obtain adequate and reliable food composition data as needed.

In previous years, INFOODS has promoted the successful establishment of regional organisations in most of the world and vastly expanded communication among organizations and individual scientists in the field. Regional associations include not only ASIAFOODS and OCEANIAFOODS, but also LATINFOODS, EUROFOODS, AFROFOODS, and as you have heard from Dr Hussein, MENAFOODS. The more technical parts of its work, focusing on computerised databases and communication and data interchange among them, have been essentially completed and are ready for use. We are now beginning to develop regional centres, the first one to be located in Thailand, that will store regional data and support national databases. The work has been slowed by limited resources but, more importantly, by the need for the regional groups and the countries and organisations within them to establish food composition programmes of their own that they perceive as adequate for participation in an international effort.

The data interchange model developed by INFOODS does not rely on a single centralised database, but on a distributed system of databases, with established conventions about efficient data transfer when needed. In addition to being technically most appropriate for data of this type, this strategy will disseminate to personnel in individual developing countries knowledge about, and the ability to use, advanced scientific databases management techniques. The INFOODS data storage and interchange model represents a significant advance in ways of handling

very complex data sets, and has been reported on and discussed in several papers in the computer science community. It can deal with detailed descriptions of each sample, complete tags for each nutrient, as well as the complete range of nutrients known today and as many important non-nutrient components of food as desired. Thus, it can cope with several hundreds of data points for each food sample and many thousands of food samples.

Regional programmes are now well-established in many parts of the world. Their potential, especially for actual database work, has not been reached in most areas, including Asia, due to lack of adequate resources.

If resources became available as anticipated, the next few years will see operating regional data centres in most regions, including centres serving most developing countries. It will also see an advance in indexing and directories of what data are available and where they are located, the other element in improved accessibility.

The INFOODS effort is intrinsically interdisciplinary, depending on the efforts of food scientists, analytical chemists, and nutritionists working together with computer and information scientists. The latter, in turn, are doing new work on data interchange models, statistical and scientific databases, statistical data description, and models of information retrieval and classification despite uncertainty.

Activity since the 1989 ICN in Seoul

Since the time of the Seoul meeting in 1989, several of the regional groups have moved forward, with the most dramatic activity occurring in Europe and Oceania. Several of the long-awaited INFOODS guidelines and recommendations have been published or are nearing publication: the terminology committee's recommendation on food description was published a few months ago in the Journal of Food Composition and Analysis, established by UNU and Academic Press for INFOODS. The monographs on compiling food composition tables and on the interchange system itself are expected to be published before the end of the calendar year, as UNU monographs. EUROFOODS is continuing with the development of the Greenfield-Southgate Guidelines, and a publication of a significantly revised version is expected next year.

Worldwide trends in food composition data and interchange today

Food composition work worldwide is at a crossroad. In some cases, with INFOODS encouragement and in others spontaneously, many countries are now developing food composition tables and databases for the first time. Some of these are of high quality. But the nutritionists and chemists involved look to INFOODS for guidance as to how information should be structured and presented for maximum effectiveness and for exchanging data among regional and national tables. There is no other practical source for this information since, when they ask questions in their own countries, they often get either no answer at all or simply the names of popular microcomputer database management packages.

If INFOODS can provide the advice, consultation, and training that is needed on a timely basis, it is likely to emerge from this period of data growth with higher standards of data and database quality and much greater accessibility. If this is not done, individuals and institutions will certainly develop their own systems. However, if many different and incompatible systems are developed, the international community will discover that it will be much more costly to build an

integrated and coordinated food composition data environment in the future than it would be today. It would then be necessary to ask people to change their then-established ways of doing things, rather than simply adopting one alternative among many.

Objectives and plans for the near term

We are now planning on training workshops and core data centre installations for ASIAFOODS and possibly OCEANIAFOODS before the end of this calendar year. These centres will be able to support some database services for their regions and will become the core facilities for INFOODS regional data centres. They will also serve to improve communications between regional facilties and the INFOODS secretariat, which is essential for rapid progress. The INFOODS secretariat has several major tasks for the next few years, which will be pursued as resources permit. These include:

Fully-operational regional centres, able to exchange data

INFOODS expects to see at least three regional data centres in operation in 1992 for South Asia, Western Pacific, and Latin America. At first, they initially will assist users and institutions in participating countries in locating and understanding data. They should eventually be able to exchange data with each other. They would provide help for national food composition databases. Each regional data centre would include an installed computer, computer-readable databases, working and locally-adapted software, trained personnel, and sufficient computer network and data communications facilities to make access to the data convenient. INFOODS would also expect to develop and implement a new directory model for locating food composition data of interest and to see data moving back and forth between countries. These specific projects will now be described in more detail.

Publications

INFOODS expects to resume publication of a newsletter on a regular basis. It will be refocused to be of maximum use to the regional organizations and the countries and institutions that make them up, rather than appealing to direct contact with individuals. For the regional groups to succeed optimally, they must gradually become the focus of food composition activity within their regions with the INFOODS "core" operating principally among them.

While plans are not clear, we anticipate that the regional centre-building effort will lead to additional articles and monographs on the subject of regional centre organisation and interactions, in database organisation, and on food and data description. At least one of these will be a paper in the mainstream computer science/database literature describing the interchange model in the context of management of meta data-rich databases.

The abridged, paper form of the *Directory of Food Composition Tables* will be updated as required, although we expect that, for many purposes, it will gradually yield in usefulness to electronic, computer-searchable forms.

Databases

The database goal of INFOODS may be thought of either as building a collection of integrated and coordinated regional and national food composition databases or as building a single world database using a model that is highly distributed in terms of both data location and data control, authority, and responsibility. A significant portion of this global database should be operational within the next few years.

Effective access to that database requires an efficient way of locating information within it. That, in turn, requires a directory (or directory-database) that contains very comprehensive information, as discussed below.

An international directory/index of food composition data suitable for data location

As mentioned above, the existing INFOODS directory is limited to listing published tables, rather than databases, and does not identify data, only table names and countries of origin. In this sense, it is not even as extensive as the old FAO bibliography of food composition data, although that document was completed in much simpler times. A project will be initiated to identify databases as well as tables and to identify these down to the level of the foods and food components (individual nutrients) they contain, not just in terms of names and computer addresses. This information will be made available to the regional centres and, through them, to interested national institutions. The expected size of the resulting directory-database, and the number of different ways in which it will be referenced, make publication on paper impractical and undesirable. Consequently, we will expect to "publish" it on high-density diskettes and later, if the size requires it, on CD-ROM.

Reactivation and completion of work on an international system for food description

The INFOODS terminology committee has produced and published in the Journal of Food Composition and Analysis a solid framework document for international food description that takes a different, and much less "eurocentric" approach to the problem than previously. This work is vital to understanding "what a food is" across databases and cultures, quite independent of "what it is called". This food description work should now be completed. It will require reconvening a terminology committee and preparing vocabulary and definitions in the areas outlined in the original report.

Standards and International Coordination of Recommendations

Several of the recommendations and guidelines produced by INFOODS will not be effective, even among those anxious to use them, until they achieve the status of "official UN recommendations" or, perhaps preferably and more easily, "International Standards". The effort to formalise these relationships will be pursued over the next year.

Conclusion

There seems to be general agreement in the world that food composition data are important. At the same time, it has proven very difficult to find support for efforts in the area. This has been especially true of efforts that require technology development, real technology transfer, and collaborative efforts to adapt the results to needs in the recipient area.

While we foresee a bright future for international collaborative efforts to improve the quality and accessibility of food composition data, this will depend on attracting greater support to this area.

Proc 6th ACN 1991; 497 – 511

Systematic development of trace element of common Thai foods

Prapasri Puwastien, Prapaisri Sirichakwal, Pongtorn Sungpuag and Ratchanee Kongkachuichai

Institute of Nutrition, Mahidol University, Phutthamonthon 4, Salaya, Nakhon Chaisi, Nakhon Pathom 73170, Thailand

Introduction

Data on the composition of foods (either printed or computerized) are used by a wide selection of individuals and organisations, ranging from the Food and Agriculture Organisation of the United Nations, which calculates food balance sheets for countries around the world and advices them on the global allocation of foods and other resources; to hospital personnel, university instructors and researchers involved in the relationship between health and disease and what people consume; to the individual shopper who may scan the ingredients list, nutrient contents, and percentages of requirements fulfilled on the labels of packaged goods.

While making some progress, current activities involved with the generating and compiling of food composition data are, for the most part, isolated and often produce inaccessible, incompatible, inconsistent, and redundant information. Additionally, large gaps exist in the available data on what is in foods; data on many biologically important components of many commonly consumed foods simply do not exist. Yet the need for access to more data on more foods is far surpassing the amount of data being made available.

This paper's purpose is to begin to partially fill in some of these problematical gaps. The discussion centres on four major areas. First, the status of existing nutrient data in Asian Food Composition Tables is presented. Second, different preparation methods (wet digestion versus dry ashing) are assessed to make recommendations about which method is most effective in preparing samples for specific trace and macro-elements. Third, a brief summary is presented on developing mineral data concerning Thai foods. Special attention is placed on sampling and sample preparation, data generation, the expression of results. The paper's final section discusses the identification of good food sources for minerals.

Status of existing nutrient data in Asian food composition tables

For Asia, the completeness of data found within Food Composition Tables (FCTs) varies from country to country. Most include at least 15 basic nutrients and some cover many more. The general information available include main nutrients (proximate composition) in which fibre is presented as crude fibre, in addition to certain minerals and vitamins (e.g., Ca, P, Fe, vitamins A, B1, B2, C and niacin). Information

on other specific nutrients are obtainable from certain FCTs or research papers published in local and international journals. Among these existing FCTs, those of China and the Philippines are the most complete.

The status of existing trace element data in various Asian FCTs is shown in Table 1. Most evidently, current data on iron is noted in all of the FCTs, however, other trace element data are not available in most FCTs, including that of Thailand. For the latter especially, published information exists but is not yet included in Thailand's FCT. Japan, Malaysia and Thailand are also developing specific trace element data for later inlcusion in their FCTs.

For Thailand (as elsewhere), trace element information is becoming increasingly important for the prevention, treatment and management of mineral deficiencies and related diseases. As a result, the Institute of Nutrition at Mahidol University has been systematically developing needed trace element data concerning common Thai foods. The project's main aim is to incorporate such generated data into the national food composition table.

Systematic development of trace element data in Thai foods

Evaluation of analytical process

Two common food sample preparation methods are employed for mineral content determination, namely, wet digestion with sulphuric and nitric acids and dry ashing. Many elements, especially the easily volatile ones, however, are lost during dry ashing. This loss could be due to the easy ignition of high-lipid-containing samples during the burning process of organic materials or due to over-heating during dry ashing (1, 2). The objective of this evaluation, therefore, is to select the most appropriate food sample pretreatment method for mineral analysis and to test the reliability of the alternative methods. During this process, macrominerals are also evaluated and included along with trace minerals.

Sample pretreatment - wet digestion versus dry digestion

The wet digestion and dry ashing of soybean and sesame, purchased from 10 markets in Bangkok, were conducted as shown in Figures 1 and 2. The samples were then analysed for

TABLE 1

Status of existing trace element data in various FCTs

	China	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Thailand
Iron	*	*	*	*	*	*	*	*
Cu	*	-	(2)	-	(2)	*	-	(1)
Zn	*	-	(2)	-	(2)	*	-	(1)
Se	*	-	(2)	-	-	*	-	(1)
Iodine	*	-	(2)	-	-	*	-	(2)

* Data available in FCTs
(1) Data available in published papers, but not yet included in the national FCTs.
(2) Data are being developed.

trace elements (i.e., iron, copper, and zinc) and macro-minerals (sodium, potassium, phosphorus, calcium, magnesium) using the methods shown in Table 2.

Under a controlled sample preparation process (i.e., without flame during ignition of sample on the Bunsen burner), the different methods of pretreatment had no effect on the amounts obtained for macro-elements and iron. However, dry ashing reduced considerably the amount of zinc and copper to less than 50% of the value obtained from wet digestion (Table 3).

TABLE 2

Methods of mineral measurement

Minerals	Method Used
Iron, zinc, calcium, magnesium	Flame atomic absorption spectrophotometer
Copper	Non-flame atomic absorption spectrophotometer
Sodium, potassium	Flame emission photometry
Phosphorus	Gravimetric method

TABLE 3

Macro and trace element contents (mg/100g)* in sesame and soybean samples prepared by wet digestion and dry ashing

	Sesame		Soybean	
Elements	wet digestion	dry ashing	wet digestion	dry ashing
Sodium	16 ± 0.1	117 ± 0.4	104 ± 1.2	103 ± 2.1
Potassium	410 ± 0.03	410 ± 0.1	1583 ± 3	1528 ± 12
Phosphorus	697 ± 0.03	699 ± 0.8	575 ± 3	571 ± 4
Calcium	688 ± 0.1	689 ± 0.1	71 ± 3	70 ± 3
Magnesium	210 ± 0.1	211 ± 0.2	71 ± 3	70 ± 3
Iron	16 ± 0.02	16 ± 0.03	7 ± 0.04	7 ± 0.6
Zinc	3.9 ± 0.04	1 ± 0.7	4 ± 0.37	1.8 ± 0.5
Cu	5 ± 0.1	2.4 ± 0.02	2 ± 0.2	1.3 ± 0.4

* Values are mean ± SD of five replicates analysed.

FIGURE 1

Pretreatment of sample: wet digestion

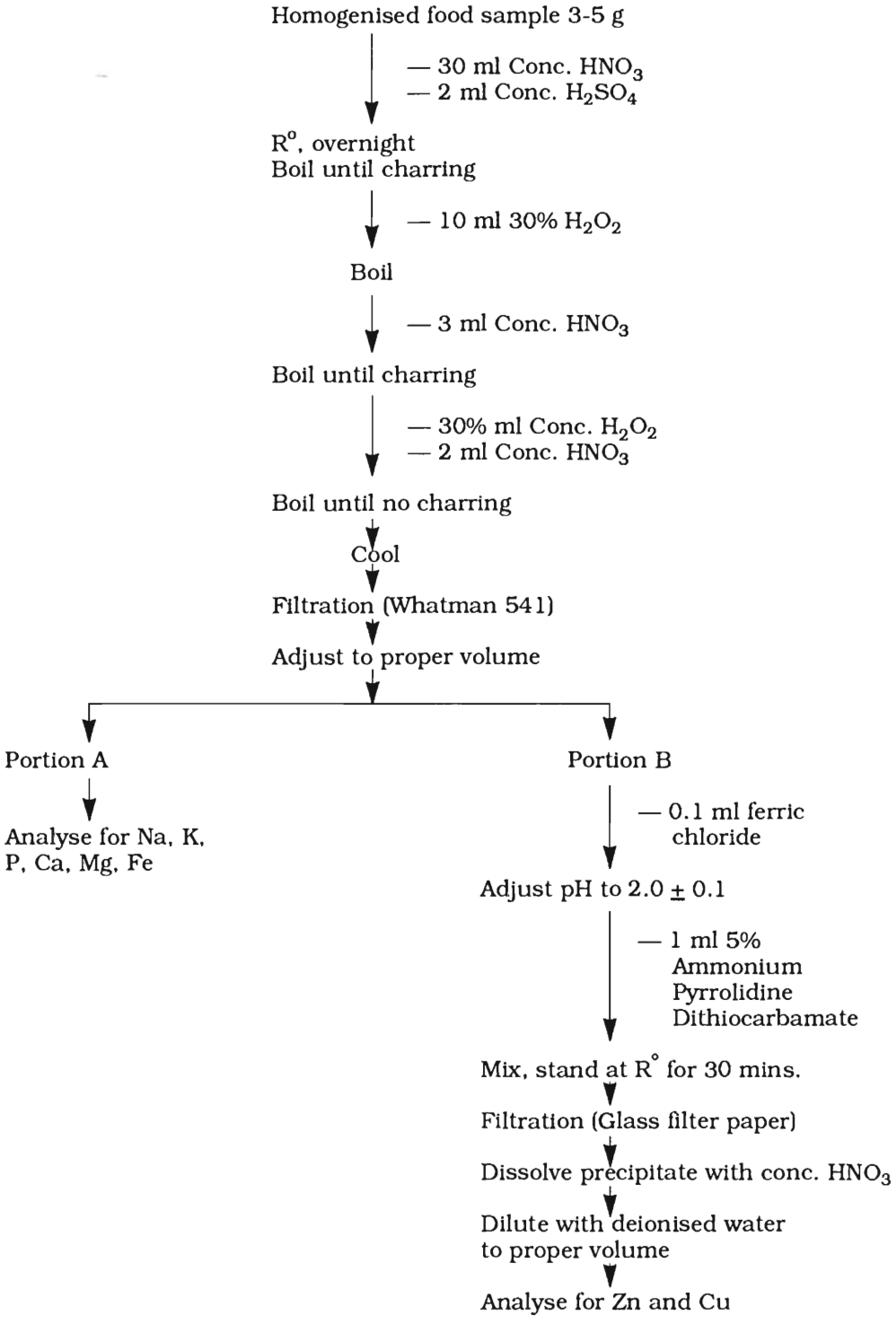
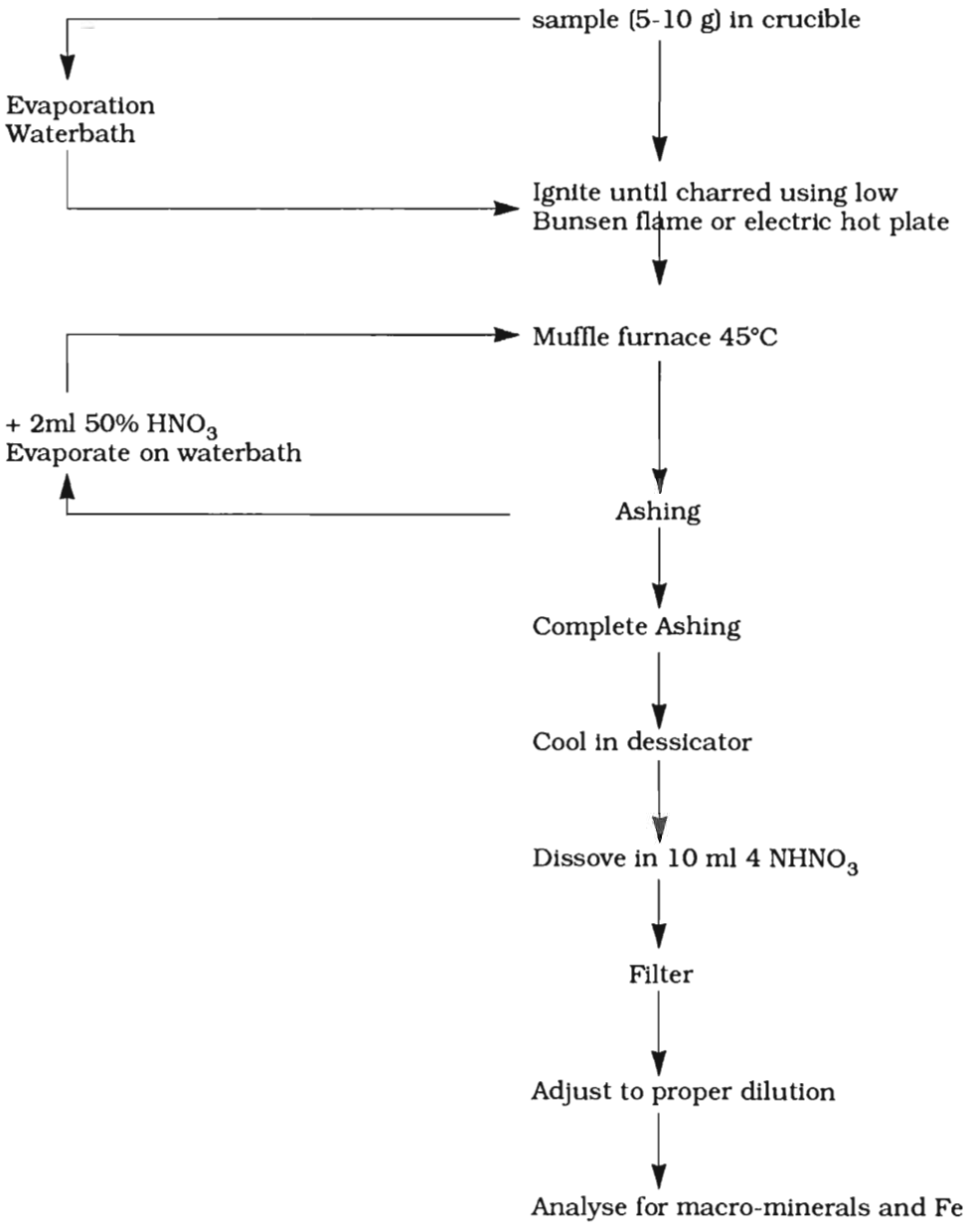


FIGURE 2

Pretreatment of sample: dry ashing



Effect of Ignition During Dry Ashing on Mineral Content. In the dry ashing process, high lipid containing foods such as oil-seed legumes and seeds (which contain 20-35 g% and 45-50 g% of lipid respectively) tend to ignite flamed during charring on Bunsen burner. This could in turn increase mineral loss in the sample. As can be seen in Table 4, when sesame was flamed during charring, this process reduced the mineral content tremendously. Less than 50% of most elements were eventually detected.

Different sample preparation methods used by different laboratories in Thailand and ASEAN countries could, therefore, have contributed to the large discrepancies of trace and macro-elements found in collaborative studies on methods of nutrient analyses (3, 4).

Reliability test: standard adding technique

A reliability test for each sample preparation method (prior to mineral measurement) was carried out by adding each element's proper amount [50-100% of original level] to the samples before pretreatment. Percent recovery obtained from the analsyis of 8 elements in 10 spiked soybean samples after wet and dry ashing is shown in Table 5. There was no effect of the treatments on percent recovery, mean range from 94-99%, of macro element and iron. The percent recovery of zinc and copper in sample which wet digestion was applied for sample preparation ranged between 97-99%, but a wide variation of the trace element levels, 64-84%, was found for the samples prepared by dry ashing. Volatilisation of the trace element during dry ashing could be contributed to the lower values obtained.

Wet digestion was applied to different food samples of animal and plant origins to ensure taht it can be used for various food matrices. Percent recovery of mineral contents obtained from these samples ranged from 95-102% as shown in Table 6.

TABLE 4

Macro and trace element contents (mg/100 g sample)[a] in sesame under different conditions during dry ashing

Elements	dry ashing without flame	dry ashing with flame[b]	Average % loss
Sodium	117 ± 0.4	67 ± 1	43
Potassium	410 ± 0.1	218 ± 6	47
Phosphorus	699 ± 0.8	330 ± 1	53
Calcium	689 ± 0.1	350 ± 3	49
Magnesium	211 ± 0.2	150 ± 2	29
Iron	16 ± 0.03	6 ± 1.7	62
Zinc	1 ± 0.7	0.5 ± 0.44	50
Cu	2.4 ± 0.02	1 ± 0.6	58

[a] Values are mean ± SD of five replicates analysed.

[b] Flame occurred during ignition on Bunsen burner.

TABLE 5

Percent recovery of macro and trace elements in soybean prepared by wet digestion and dry ashing

Elements	Percent recovery[a]	
	Wet digestion	Dry ashing
Sodium	97 ± 1 (95-99)[b]	97 ± 2 (95-101)
Potassium	98 ± 2 (95-101)	98 ± 3 (95-99)
Phosphorus	97 ± 1 (95-100)	96 ± 3 (93-98)
Calcium	98 ± 1 (95-100)	98 ± 2 (95-100)
Magnesium	98 ± 2 (95-102)	94 ± 2 (91-98)
Iron	99 ± 1 (98-100)	97 ± 2 (95-102)
Zinc	99 ± 2 (96-101)	87 ± 49 (35-168)
Cu	97 ± 1 (95-99)	64 ± 24 (47-130)

a Values are mean ± SD of 10 replicates analysed.

b Range

TABLE 6

Percent recovery of mineral content obtained from wet digestion for various food commodities

Element	Percent recovery[a]				
	sesame	soybean	beef	mussel	milk
Sodium	98 ± 0.4 (98– 99)[b]	97 ± 1.5 (95–99)	100 ± 0.1 (99–100)	97 ± 0.3 (96–97)	98 ± 0.3 (97–98)
Potassium	99 ± 0.9 (98–100)	98 ± 0.2 (95–101)	99 ± 0.1 (99–99)	98 ± 0.3 (97–98)	96 ± 0.7 (95–97)
Phosphorus	98 ± 1.1 (97–99)	97 ± 1.0 (95–100)	98 ± 0.2 (97–98)	99 ± 0.2 (98–99)	99 ± 1.3 (98–99)
Calcium	99 ± 0.7 (98–100)	98 ± 1.0 (95–100)	98 ± 0.1 (97–98)	97 ± 0.2 (94–95)	98 ± 1.0 (97–99)
Magnesium	99 ± 0.1 (98–100)	98 ± 2.0 (95–102)	99 ± 0.3 (98–99)	97 ± 2.0 (98–99)	98 ± 0.2 (97–98)
Iron	100 ± 0.6 (99–100)	99 ± 1.0 (98–100)	100 ± 0.2 (99–100)	100 ± 03 (99–100)	98 ± 0.6 (97–100)
Zinc	99 ± 0.5 (98–100)	99 ± 2.0 (95–101)	99 ± 0.4 (98–100)	100 ± 0.2 (99–100)	99 ± 0.9 (98–100)
Copper	98 ± 1.0 (96–99)	97 ± 1.0 (95–99)	99 ± 0.6 (98–100)	99 ± 0.2 (98–99)	98 ± 0.5 (97–98)

a Mean ± SD of three replicates

b The value in parenthesis are the range of three replicates analyses

Precision test

Wet digestion was applied to reference material of mixed diet (H-9) prepared from International Atomic Energy Agency (IAEA). The values of macro and trace-elements obtained were within the range of recommended values as shown in Table 7.

TABLE 7

Mineral content in reference material (food mixture : H-9)

Element	Recommended value (IAEA) (mg/100g)	This study (mg/100g)[a]
Sodium	811 ± 70	836 ± 4
Potassium	825 ± 78	833 ± 4
Phosphorus	340 ± 28	364 ± 2
Calcium	236 ± 21	221 ± 1
Magnesium	78 ± 7	80 ± 0.4
Iron	3.4 ± 0.4	3.5 ± 0.03
Zinc	2.8 ± 0.3	2.7 ± 0.03
Copper	0.28 ± 0.06	0.21 ± 0.03

[a] Mean ± SD of three replicates

Recommendations

Based on these experiements, the following recommendations can be made.

(a) Either wet digestion or dry ashing can be used to prepare samples for macro-elements and iron analyses. However, for dry ashing, sample ignition (especially in high lipid containing foods such as oil seed legumes and seeds) must be avoided.

(b) Only wet digestion is recommended for sample preparation for zinc and copper determination.

Development of mineral data of Thai foods

Sampling and sample preparation

Ten single samples of different fresh foods (i.e., cereals, meat and poultry, seafoods, fish, milk, egg, vegetables and fruits) were randomly purchased from 10 main markets throughout Bangkok. Edible portions of these foods were prepared and homogenised individually. For some expensive and tedious foods, single composite samples were prepared from samples collected from at least three markets. All samples were kept in screw-top polyethylene bottles and stored at -20°C until analyzed.

Data generation

Following the above recommendations, dry ashing was chosen for as the sample preparation method for sodium, potassium, calcium, phosphorus, magnesium and iron analyses. Zinc and copper were concurrently prepared by acid digestion. They were then quantitatively analyzed for individual minerals using the methods noted in Table 2.

To evaluate the reliability of results, two house standards - soybean flour and milk powder - were included in each set of samples. A control chart was used for quality assurance of the analysis.

Expression of results

The figures obtained were rounded-off and the results were expressed in micrograms or milligrams of minerals per 100 gram wet weight of sample. In

this study, since single samples of each food commodities were analysed, mean ± SD as well as ranges of the mineral contents (which indicate the distribution and variability of the minerals for each food commodity) were obtained. (It should be noted that single sample analysis is not really necessary, especially when limited resources are available. In practice, most users require only the mean value of the data.)

In this paper, only mean data of trace elements in various food commodities are summarized and presented in Figures 3 through 5. Generated mineral data of each Thai food commodity will soon be incorporated into the printed national food composition table and nutrient database.

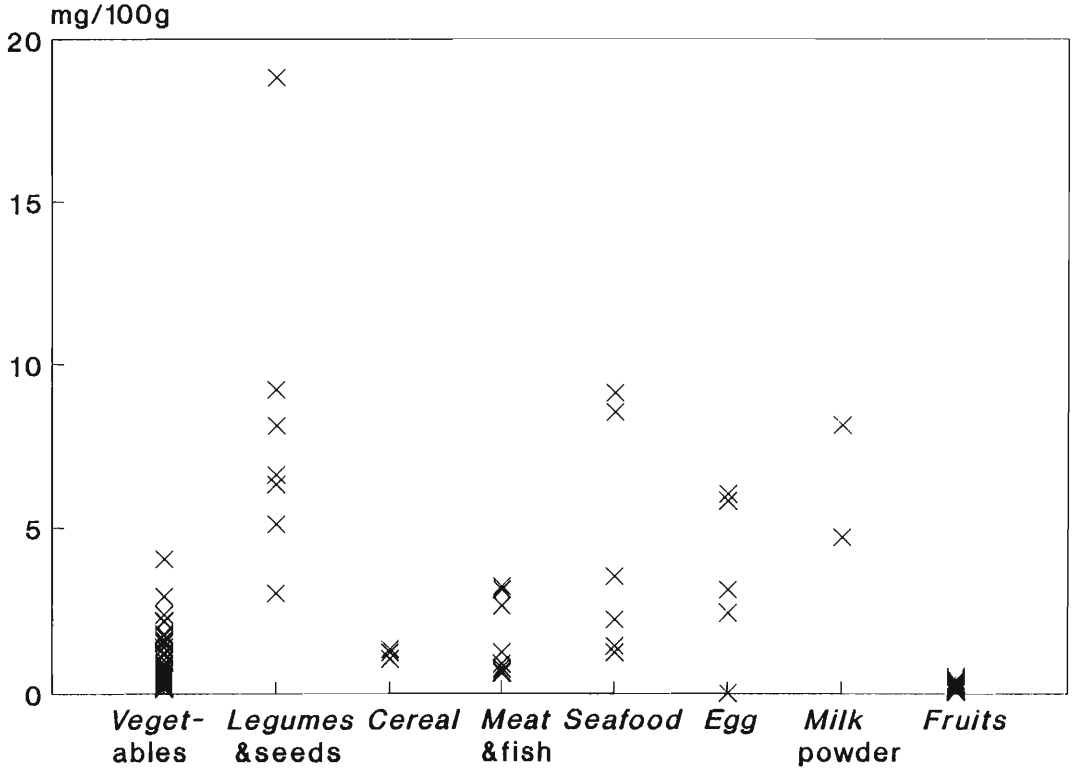


FIG. 3 Iron Distribution in Various Thai Foods.

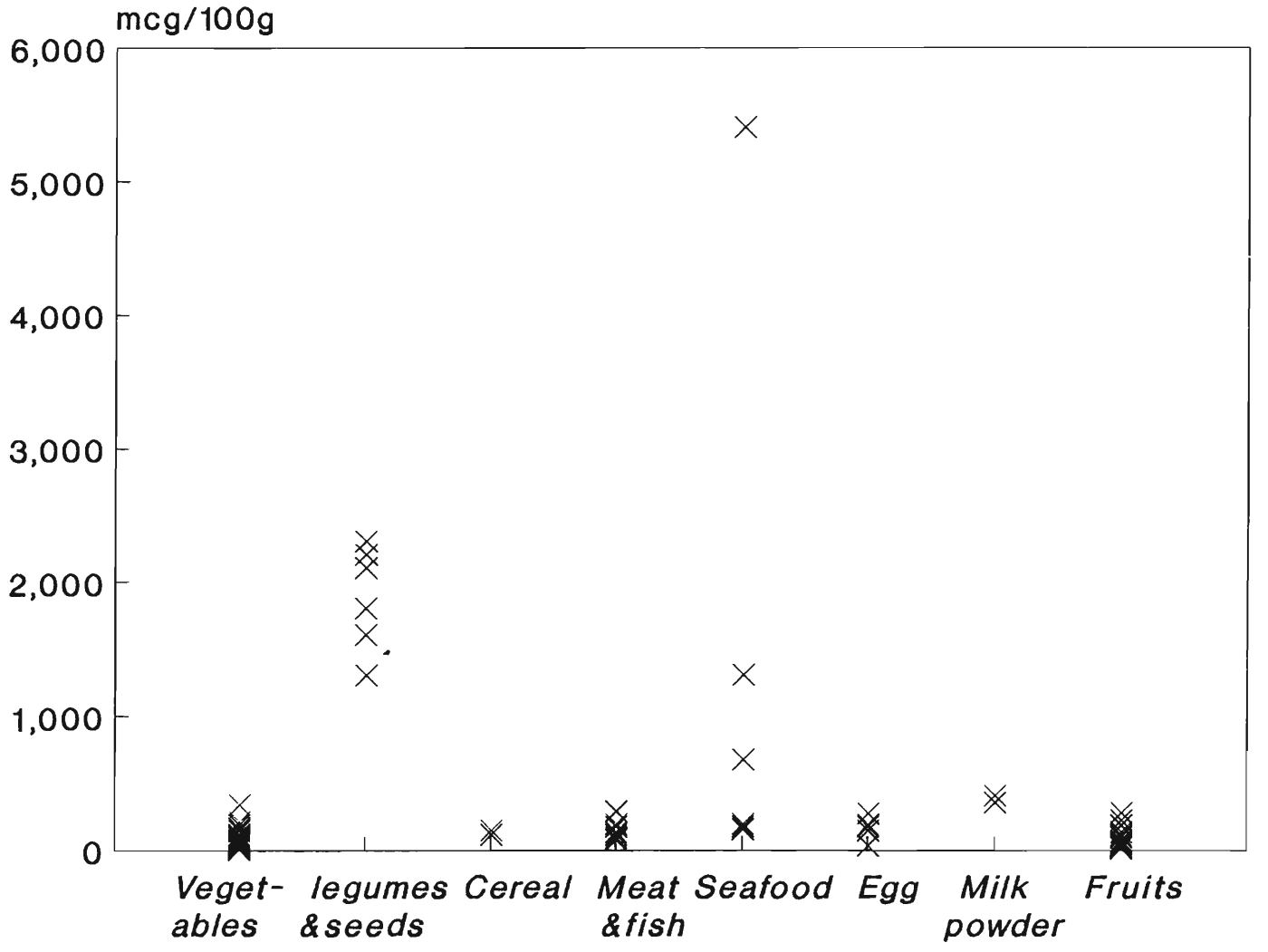


FIG. 4 Copper Distribution in Various Thai Foods.

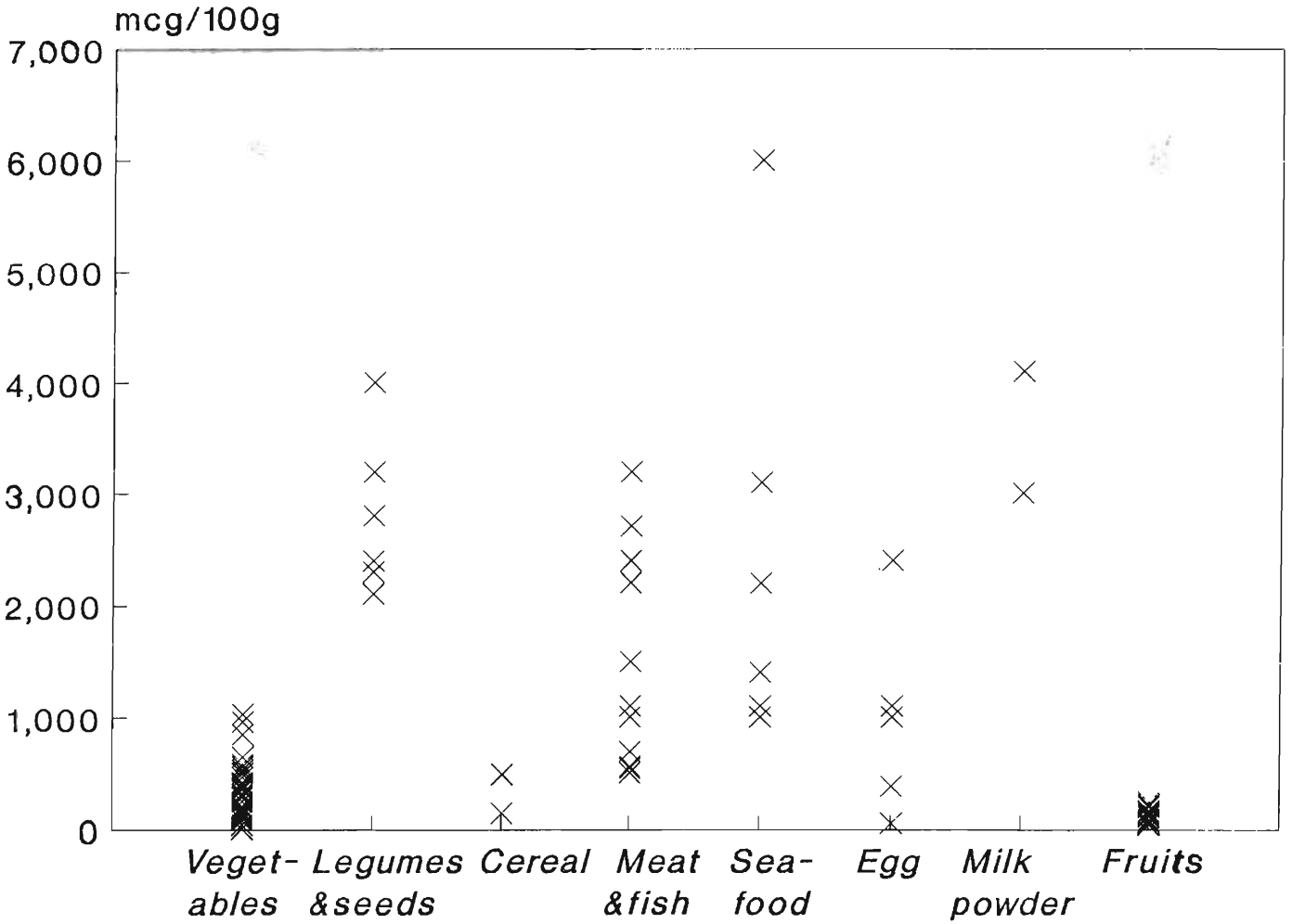


FIG. 5 Zinc Distribution in Various Thai Foods.

Identification of good sources of minerals

One of the main reasons for food analysis is to search for good sources of nutrients, especially ones related to national health and nutritional problems. To identify good sources of a nutrient, certain important factors must be taken into consideration including **amount of the nutrient in particular foods, the requirement of that particular nutrient in a specific age group, and amount of foods practically consumed (serving size).**

The US Department of Agricultural, Human Nutrition Information Service (5) has developed a guideline to identify and score the degree of good food sources as follows (Table 8). It is based on the idea that a selected serving size of good food source should contain a substantial amount of the nutrient and thus contribute at least 10% of the RDA.

Following this guideline, good food sources of each minerals are identified and scored as shown as an example in Table 9.

In practice, it is often found that many food items, especially those in vegetable and fruit groups, contribute only minute amounts of nutrients. This is actually due to their high moisture content. Hence, information on the moisture content of each food item is essential evaluating and interpreting results.

Conclusion

In conclusion, food is a major component of man's environment. Data on actual nutrient composition of foods are critical for the important activities of a great variety of individuals and groups including those involved with epidemiological research into disease patterns, formulation of dietary recommendations, health assessment of individuals and populations, and national and international trade in foods. Owing to the fact that food types and their preparation vary tremendously from country to country and region to region, efforts must continue to be made by each country in the generation and compilation of food composition data specific for their own

TABLE 8

Criteria for consideration as good food source

Nutrient content in a selected serving size (% US RDA of > 4 y - Adults)	Relative degree of good source
<10	minor contribution
10-24	+
25-39	++
>40	+++

Source: US Department of Agriculture, Human Nutrition Information Service (reference 5)

TABLE 9

Example of good food sources of trace elements in common Thai foods

Composition per 100 gram edible portion	Serving Size (g)	Fe (mg)	Cu (mg)	Zn (mg)	Se (μg)
CEREALS					
Rice, milled, polished, raw	75	1.2[b]	0.14[b]	0.48[a]	5.4[b]
LEGUMES AND SEEDS					
Soybean, dry seed	25	8.1[c]	1.8[c]	4.0[b]	12.7[a]
Sesame, black	2	18.8[a]	2.2[a]	3.2[a]	23.0[a]
MEAT AND EGG					
Beef, lean, raw	100	3.1[d]	0.17[b]	2.7[c]	15.8[c]
Egg, whole, chicken	5	2.4[c]	0.17[a]	1.1[a]	32.7[c]
MILK AND MILK PRODUCTS					
Milk powder, whole (1 glass of milk)	24	8.1[c]	0.35[a]	3.0[b]	6.4[a]
VEGETABLES					
Ivy gourd, leaves (*Coccina indica*)	25	9.84[a]	0.14[a]	0.49[a]	0.3[a]
FRUITS					
Papaya, ripe	100	0.28[a]	0.02[a]	0.06[a]	1.2[a]
Requirement 5y - adult	—-	10-15	2-3	10-15	50-200

Contribution of nutrient per serving:

[a] - Insignificant, <5% RDA
[b] - Minor, 5-9% RDA
[c] - Good, 10-24% RDA
[d] - 25-39% RDA
[e] - 40% RDA

use. These data, moreover, can be beneficial nationally and internationally when required.

Through this presentation, it is hoped that our experience in the development of mineral data has contributed some ideas for generating good quality nutrient data as well as producing a good quality food composition model which meets the needs of key users. It is also hoped that the continuous sharing of experiences among ourselves - as either generators, compilers or users - can lead to some standard guidelines for developing a maximally useful nutrient database. The latter can then be used as an essential tool to combat the most perplexing nutritional problems in each of our countries as an ultimate goal of INFOODS and other regional networks.

References

1. Paul AA and DAT Soutgate. The Composition of Foods. 4th ed. New York: Elsevier/North-Holland Biomedical Press, 1978.
2. Association of Official Agricultural Chemists (AOAC). Official Methods of Analysis. 11th ed. Washington DC, 1970.
3. Puwastien P, Silva P. Collaborative Study on Analytical Methods of Food Analysis. In THAIFOODS Document No 2, Thailand Network of Food Data System (THAIFOODS). Bangkok: Institute of Nutrition, Mahidol University, 1986.
4. Puwastein P, P Sungpuag and C Chitchumroonchokchai. Report of the ASEAN Inter-laboratory Trial on Nutrient Analysis. In: Proceedings of the ASEAN Workshop on Food Data Systems. Bangkok: Institute of Nutrition, Mahidol University, 1989; 171-253.
5. United States Department of Agriculture/Human Nutrition Information Service. Eating Right the Dietary Guidelines Way: Good Sources of Nutrients - IRON. Washington DC, January 1990.

Proc 6th ACN 1991; 512 – 516

Composition of pigeon pea

Geoffrey Savage

Department of Biochemistry and Microbiology, Lincoln University, Canterbury, New Zealand

Introduction

The pigeon pea (*Cajanus cajan* [L.] Millsp.) is a tropical bush legume considered to be the fifth most important source of vegetable protein after soya beans, peas, chickpeas and broadbeans. As a wild species, it is probably a native of the Sub-Saharan region (1). Tomb remains indicate that the pigeon pea was cultivated in Egypt between 2,200 and 2,400 BC (2). It has now become widely distributed throughout the tropics and subtropics. Currently, India produces 90% of the world supply of this legume where the cooked mature seeds are eaten, often in the form of dhal. As far as Indian cooking is concerned, there is a preference for pigeon pea cultivars which cook rapidly, thus saving fuel and that show a maximum increase in cooked volume with a minimum of solids lost on cooking. These characteristics are not always found in the same cultivar.

Although very frost sensitive, pigeon peas grow well on almost all soil types, provided the soils are not waterlogged or deficient in lime or phosphorus (3). They are also drought resistant and therefore, are an important food crop in semi-arid, low fertility regions, such as parts of India. High yields can be obtained even if there is good rain only during the first two months of growth and non during the remaining 2 to 4 months before harvest. This is an indication of the ability of pigeon pea to survive on residual soil water, although it does perform better when annual precipitation is at least 500 mm (1). Crops mature from 90 to 250 days, depending on genotype, time of planting and whether the particular line is photoperiod sensitive.

Composition

Proximate composition

The proximate composition of pigeon pea varies considerably due to experimental and varietal differences (4). Crude protein is relatively high and varies from 13.5 to 28.0% and is comparable with that of many other legume seeds except soyabeans which can contain up to 43% crude protein. When the seed is cooked, the crude protein tends to decrease, in some cases quite markedly, due to loss of protein and amino acids into the cooking water (5).

The fat content of pigeon pea ranges from 1.1 to 4.4% with unsaturated fatty acids predominating. This low level is comparable to many other grain legume seeds. Khalil, et al (5) reported a 50% decrease when the seeds were boiled.

The mineral content is low and similar to that of many common legumes (5). Removing the testa causes a 13% decrease in the mineral

content while cooking markedly reduces mineral levels due to leaching into the cooking water.

Carbohydrates

The total carbohydrate content of whole pigeon pea ranges from 57 to 73% . A significant portion of carbohydrates in pigeon peas consists of _-galactosides. Large amounts of raffinose, stachyose and verbascose have been identified in pigeon pea. They are mainly found in the kernel, and cause flatulence in man. It has been shown cooking and sprouting significantly reduce the levels of the oligosaccharides (6,7). Pigeon pea seeds also contain variable amounts of crude fibre ranging from 1.0 to 10.2%. Total plant fibre can be reduced by removal of the husk. The high levels of indigestable carbohydrates in pigeon pea tends to limit their wider use in human diets.

Vitamins

Pulses are considered to be relatively high in water soluble vitamins, such as thiamin, riboflavin, niacin and choline and pigeon pea is no exception. They also contain high levels of carotene and ascorbic acid compared with many other foodstuffs (8). Cooking leads to significant decreases while germinating the seeds leads to increases in the ascorbic acid, nicotinic acid, riboflavin, thiamine, and carotene contents (9).

Antinutritive factors

Many legumes contain toxic factors which may adversely affect the nutritive value of the seed. These toxic factors are a group of unrelated chemical compounds with varying effects on the metabolic processes of the animals that consume them. A positive feature of pigeon peas is that they contain relatively low levels of antinutritive factors when compared with other important legumes.

Haemagglutinins

The haemagglutinin content and its activity have been reported to be low compared to other grain legumes (4).

Trypsin inhibitors

These proteins inhibit the proteolytic action of the enzyme trypsin, and seed contents were found to vary greatly. The inhibitor is stable over a wide pH range (2.5 to 10.1) (10). Pigeon pea contains one of the more stable trypsin inhibitors found in the seeds of grain legumes, no decrease in activity occurs after 60 minutes in boiling water and only a 4.5% decrease was observed when autoclaved for 30 minutes.

Tannins

The tannin levels in pigeon pea range from 0.3 to 18.3 g/kg. This is due to varietal colour differences as most of the tannins are found in the testa; brown or red seeds contain more than twice the levels of white seeds (11). The kernel has a less variable and much lower tannin content (1.4 to 1.9 g/kg). Removing the testa is a practical way of reducing the total tannin content (12). Germinating the seed decreases the tannin content by 20 to 30% while iron availability is doubled. The absorption of phenolic compounds by mammals may not prove to be toxic but the detoxification of these polyphenolic compounds in mammals involves methylation which puts further stress on the already limited methionine content of pigeon pea.

Phytate content

Phytic acid is the principal form in which phosphorus is stored in plants and it is a powerful chelating agent for divalent cations such as Ca^{2+}, Mg^{2+}, Zn^{2+}, and Fe^{2+}/Fe^{2+}. The level of phytate in pigeon pea is variable (0.7 to 3.68 g/kg) but is generally much lower than in other legumes.

During germination, phytic acid is hydrolysed to release available phosphate and inositol. Phytic acid content also has an effect on the cooking time of the seeds, the higher the phytate content, the shorter the cooking time of the dehusked seeds (13).

Protein quality

Pigeon pea is a good source of dietary protein in many tropical and subtropical regions, as it contains 13.5 to 28% protein. It is rich in lysine but, as with many legumes, its protein quality is limited by deficiencies in the sulphur amino acids (methionine and cystine) and tryptophan. The availability of amino acids, particularly the limiting ones, is more important than the total content. Only 56 to 58% of pigeon pea methionine and cystine is available, which is a much lower availability than other legume seeds (14). Geervani and Theophilus (14) found that boiling pigeon pea kernels increased methionine and cystine availability by 10% whereas roasting only resulted in slight increase. Boiling was found to decrease the available lysine by 10% whereas roasting decreased it by 20%. Improvements in amino acid composition and therefore protein quality may be obtained from breeding programmes but the effects of antinutritive factors and the low digestibility of the protein also have important roles.

Effect of cooking

The varied results observed in the literature are due to varietal differences in the amino acid content and heat lability of the antinutritive factors. Elias, et al (6) showed that the nutritive value of cooked pigeon pea seed was considerably lower when the cooking water was retained compared with when it was discarded (the antinutritive factors in pigeon pea are particularly thermally stable). In many experiments, the fate of the cooking water is not clear and this may also help to explain the range of nutritive values on cooking pigeon pea seed.

Effect of sprouting

Dried seeds of pigeon peas can be stored for long periods of time and sprouts can be easily obtained by germinating the moist seeds in the dark for up to four days. Griffiths (16) showed that the true digestibility of sprouted pigeon pea protein was significantly improved when compared with the raw legume (72.9 vs 62.4). The true digestibility of cooked pigeon pea protein was 82.1. The biological value of the sprouted pigeon pea was 78.3 which was considerably higher than the values for raw pigeon pea (55.6) or cooked pigeon pea (53.7). The biological value of the protein was improved by destruction of antinutritive factors in the seed (16).

Effect of amino acid supplementation

In order to increase the quality of protein, not only must the antinutritive factors be destroyed but the balance of amino acids must be improved by addition of the limiting amino acids.

Deo (17) showed that the true digestibility and biological value of pigeon pea was considerably improved on cooking. Addition of L-methionine to raw pigeon pea, while having no effect on the true digestibility, had a considerable effect on the biological value which increased to 79% on addition of 0.15% methionine. Addition of L-methionine to cooked pigeon pea gave a marginally higher biological value (83%) on addition of a smaller amount of methionine (0.1%). These results suggest that the negative effect of the antinutritive factors such as trypsin inhibitors in pigeon peas can be overcome by additional methionine in the diet. These results highlight the possible metabolic effect of trypsin inhibitors in all legume seeds. Deo (17)

went on to show that cooked pigeon pea grown in Fiji was not deficient in tryptophan. Overall the experiments carried out have shown that in many earlier experiments, too much methionine may have been added to obtain the maximum response (17). Only small additions of methionine 0.15% for raw pigeon pea and 0.10% for cooked pigeon pea are required to obtain maximum response.

Pigeon pea breeding

Crop improvement is often primarily based on agronomic features, such as yield, disease resistance and drought tolerance. Lesser emphasis has been placed on nutritional quality. There is no correlation between seed size and protein content (18). Variable relationships between seed size and protein content of pigeon pea - *Atylosia* (a generally high protein wild relative) hybrids have been observed (19). One hybrid showed a positive correlation between seed size and protein content, two hybrids were negatively correlated and two others had no correlation. By using the hybrid with the positive correlation, it could be possible to simultaneously increase size of the seed and its protein quality.

Research into the production of high protein products, such as those based on soyabean, would be of benefit to malnourished countries. Priority, though, should be given to the selection of protein rich, and better balanced proteins in new cultivars of pigeon pea.

References

1. Rachie KO, Roberts LM. Grain legumes of the lowland tropics in Advances in Agronomy 1974; 26: 32-44.
2. Sturtevant EL. Edited by UP Hedrick, Stutevant's notes on edible plants. 1919; New York Agr Expt Sta, Geneva New York.
3. Purseglove JW. Tropical Crops - Dicotyledons. 1968; Longman 236-241.
4. Griffiths AG, Savage GP. The composition and nutritive value of Pigeon Pea (*Cajanus cajan* Millsp.). Nutrition Abstracts and Reviews (Series A) 1991; 61: 261-286.
5. Khalil JK, Sawaya WN, Al-Mohammad HM. Effects of experimental cooking on the yield and proximate composition of three selected legumes. Journal of Food Science 1986; 51: 233-234, 236.
6. Jood S, Mehta U, Singh R, Bhat CM. Effect of processing on flatus-producing factors in legumes. Journal of Agriculture and Food Chemistry 1985; 33: 268-271.
7. Jood S, Mehta U, Singh R. Effect of processing on available carbohydrates in legumes. Journal of Agriculture and Food Chemistry 1986; 34: 417-420.
8. Miller CD, Branthoover B, Sekiguchi N, Denning H, Bauer A. Vitamin values of foods used in Hawaii. Technical Bulletin - Agricultural Experiment Station, Hawaii 1956; 30: 9-81.
9. Chattopadhyay H, Banerjee S. Studies on the choline content of some common Indian pulses and cereals both before and during the course of germination. Food Research 1951; 16: 230-232.
10. Singh U, Eggum BO. Factors affecting the protein quality of pigeon pea (*Cajanus cajan* L.). Qualitas Plantarum - Plant Foods for Human Nutrition 1984; 34: 273-283.
11. Singh U. The inhibition of digestive enzymes by polyphenols of chickpea (*Cicer Arietinum* L.) and pigeon pea (*Cajanus cajan* L.). Millsp; Nutrition Reports International 1984; 29: 745-753.

12. Rao NBS, Prabhavathi T. Tannin content of foods commonly consumed in India and its influence on ionisable iron. Journal of the Science of Food and Agriculture 1982; 33: 89-96.

13. Narasimha HV, Desikachar HSR. Objective methods for studying cookability of tur pulse (*Cajanus cajan*) and factors affecting varietal differences in cooking. Journal of Food Science and Technology 1978; 15: 47-50.

14. Geervani P, Theophilus F. Effect of home processing on the protein quality of selected legumes. Journal of Food Science 1980; 45: 707-710.

15. Elias LG, Hernandez M, Bressani R. The nutritive value of precooked legume flours processed by different methods. Nutrition Reports International 1976; 14: 385-403.

16. Griffiths AG. Chemical and Nutritive Evaluation of Pigeon Pea (*Cajanus cajan* Millsp.) 1988; Hons thesis Lincoln College, University of Canterbury, New Zealand.

17. Deo S. Chemical composition and nutritive value of mung pigeon peas, urd lentils and peas. 1987; M.Sc. Thesis - Lincoln College, University of Canterbury, New Zealand.

18. Dahiya BS, Brar JS, Kumar R. A preliminary observation on the protein content of pigeon pea crosses. Tropical Grain Legume Bulletin 1976; 5: 22.

19. Saxena KB, Faris DG, Singh U, Kumar RV. Relationship between seed size and protein content in newly developed high protein lines of pigeonpea. Qualitas Plantarum - Plant Foods for Human Nutrition 1987; 36: 335-340.

Proc 6th ACN 1991; 517 - 519

The elimination of iodine deficiency disorders (IDD) by the year 2000

Basil S Hetzel

International Council for Control of Iodine Deficiency Disorders, P.O. Box 10041 Gouger Street, Adelaide 5000, Australia

Iodine deficiency is the major cause of preventable mental defect estimated to affect at least 20 million in the world today.

The major gap between knowledge of prevention of iodine deficiency disorders (IDD) and the application of this knowledge to the millions at risk led to the formation in 1985 of the International Council for the Control of Iodine Deficiency Disorders (ICCIDD).

The ICCIDD has put forward a Global Action Plan (GAP) with the objective of the elimination of IDD as a public health problem by the year 2000. This objective has been accepted by the World Health Organisation (World Health Assembly, Geneva May 1990), UNICEF (Executive Board, New York April 1990), and the World Summit for Children (United Nations, New York attended by 71 Heads of State and 80 representatives of other countries).

The GAP encompasses coordination, advocacy, information and monitoring systems at the global level, a series of Regional IDD Working Groups made up of ICCIDD, WHO and UNICEF representatives, and which together with key bilaterals and country representatives, promote the development of National IDD Control Programmes. At the national level, baseline assessment, advocacy, planning seminars and laboratory services for monitoring and evaluation are included.

Through GAP, the ICCIDD believes that the elimination of IDD as a public health problem by the year 2000 can be achieved.

The iodine deficiency disorders (IDD)

The prevention and control of IDD is now regarded as an urgent problem for large populations in Asia. Some one billion people are estimated to be living in an iodine deficient environment - of these 350 million live in China and 200 million in India (1, 2, 3). These people are at risk of developing one or more of the effects of iodine deficiency on growth and development - that is the iodine deficiency disorders (IDD). Other efforts to bring about development will be limited by a passive iodine deficient population, including particularly children. More than five million are suffering from mental retardation as gross cretins but in addition three to five times this number suffer from lesser degrees of mental defect (4).

The control of IDD

Appropriate mass technology is available in the form of iodised salt and iodised oil. These measures are of proven value in China, India and Indonesia in pilot studies (1, 2, 3). Their effective application to the many millions who require iodine is now being achieved. There are formidable obstacles at the technical, the organisational, and the political level. Injections of iodised oil in Nepal (4 million), Burma (2 million), Zaire (1.5 million) have been carried out as emergency measures in severely iodine-deficient countries to meet the problem until an effective salt iodisation programme can be introduced. Such a programme has to overcome many obstacles if the production of salt is not under government control, but as in Java, remains with a myriad of small suppliers (70%). In excess of 10 million injections have already been given, but in these circumstances, iodised oil has to be considered as a longer-term measure for severe IDD. New technologies need also to be considered and developed (e.g. iodinated water supplies).

The development of a National IDD Control Programme involves much more than technology - it includes assessment, communication, planning, political support, implementation and evaluation. These various aspects are considered further elsewhere (2,3). The development of the programme requires the establishment of a National IDD Control Commission with full political and legislative authority. Such Commissions are now being established in many countries.

The International Council for Control of Iodine Deficiency Disorders (ICCIDD)

The ICCIDD has welcomed as members, all who have concern and expertise regarding IDD and IDD control (2, 3). The main role of the ICCIDD is to cooperate and make its expertise available to the international agencies and the national governments who have responsibility for the control of IDD and so bridge the great gap between available knowledge and its application. The inaugural meeting was held in Kathmandu, Nepal 23-28 March 1986. A global review of the IDD problem took place with an appraisal of current expertise in iodine technology and IDD control programmes. The first ICCIDD monograph appeared in 1987 (3).

The ICCIDD is now a global multidisciplinary group of some 300 members with a quarterly Newsletter and a secretariat in Adelaide, Australia, where the Executive Director has his office. Support is currently being received from UNICEF (New York) and the Australian Government.

Since 1987, the ICCIDD has become fully active in facilitating interagency cooperation in the prevention and control of IDD. This has been achieved by a series of interagency meetings, the establishment of regional interagency working groups (particularly involving WHO and UNICEF, but also some of the bilaterals as well as other activities e.g. publications and expert groups).

A global Action Plan has now been endorsed by the UN agencies to take account of these developments. The purpose of the Global Action Plan is to provide global and regional support for the establishment and monitoring of effective national IDD control programmes. It includes activities at the National, Regional and Global levels.

At the National level, initial assessments, national seminars, communication packages, intersectoral planning with a National IDD Control Commission, evaluation and monitoring with laboratory services are included. In Indonesia and China, International

Working Groups have now been established by ICCIDD in collaboration with WHO and UNICEF.

At the Regional level, the development of a series of regional IDD working groups provides for the necessary close working relationship between ICCIDD, WHO and UNICEF. The IDD Task Force for Africa has been particularly successful in developing a coordinated strategy involving both multilateral and bilateral agencies.

At the Global level, the major function of advocacy and public information, and a global monitoring system are covered, together with continuing expert working groups, and research activity.

In view of the progress already achieved and the promising potential of current and planned national prevention and control programmes, the elimination of IDD as a major public health problem by the year 2000 has been recently accepted as a goal by the World Health Assembly (4).

The virtual elimination of IDD was included in the Plan of Action of the World Summit for Children which was adopted by 71 Heads of State and 80 representatives of other governments who met at the United Nations on 30 September 1990.

There is now a perceptible tide running towards prevention and control of IDD. With appropriate funding a large measure of control could be achieved in the next decade with incalculable benefits to millions of people now suffering the deadening effects of iodine deficiency on their lives.

References

1. Hetzel BS. Iodine Deficiency Disorders (IDD) and their eradication, Lancet 1983; 2: 1126-29
2. Hetzel BS. The story of iodine deficiency: An international challenge in nutrition, New Delhi: Oxford University Press, 1989.
3. Hetzel BS, Dunn JT, Stanbury JB eds. The prevention and control of iodine deficiency disorders, Amsterdam: Elsevier, 1987.
4. World Health Organisation Report to World Health Assembly, Geneva: World Health Organisation, 1990.

Proc 6th ACN 1991; 520 – 522

Progress towards the elimination of IDD in China

Ma Tai

Institute of Endocrinology, Tianjin Medical College, Tianjin, China

China is a country with large mountainous and hilly areas. The natural vegetation has been deteriorated by a long period of cultivation. Iodine in the soil has been leached away from those over-cultivated areas. Iodine deficiency disorders constitute a very serious problem in China. Among 31 provinces, municipalities and autonomous regions, 30 have IDD problems. The Shanghai municipality is the only one without sucha troublesome problem. The population living in the iodine deficient areas under the risk of IDD is about 400 million, that is 1/3 of the total population of the country and 40% of the population under the risk of IDD in the whole world. There were 37 million endemic goitre patients before the initiation of a large scale iodisation programme; presently eight million such patients remain. The endemic cretin patients have been found in the most severe IDD endemic areas. The total number has been placed at 230,000. This is the figure of very typical cretin patients. The subclinical cretins should be 5-10 times more than this figure.

The first salt iodisation programme had been implemented since 1944 in Yipinglang salt mine, and since 1960, small scale irregular iodisation programmes had been offered in many endemias. The prophylactic works had been interrupted for many years during the period of Chinese "cultural revolution" and had been resumed again since the reconstruction of the national supra-ministries central leading group on endemic diseases control in 1973. The leader of the central leading group should be a member of executive committee of the governing party. The members of the central leading group included the vice-minister of Public Health, the vice-minister of light industry (taking care of the salt production), the vice-minister of commerce and the vice-manager of central cooperatives. Besides the central leading group, there is a scientific advisory group which provides prophylactic and monitoring expertise. Provincial and county levels leading groups with a similar membership have been set up simultaneously in the provinces and counties with significant IDD problem. In this way, a nationwide control network has been established. An Institute of Endemic Diseases Control and Research in each province with IDD problems has been set up too.

The central leading group organises the so-called "Three ministries and one co-op meeting" every 1-2 years to solve the problems related to the administration of salt iodisation. In 1979, a national control programme had been set up and in 1986, 87.3% of the IDD endemias had supplementary iodine; fifteen provinces have met the goal of control by the IDD control criteria of China.

The supra-ministries central leading group was in existence until 1986,

and the IDD control work was being taken care mainly by a department in the Ministry of Public Health. In such a way, coordination with other preventive sections became more close, but the cooperation between the Ministry of Public Health and other Ministries, especially the ministries in charge of production and distribution of the iodised salt became much more difficult than before. The dismissal of the central leading group led to some provincial and many of the county leading groups also being dismissed. However, some of them have been maintained but they are not so authoritative as before. An endemic diseases control research centre has been set up in Harbin in 1987 to take care of the regular technical works of IDD control. Through its great effort, iodate has been used instead of iodide and a nationwide monitoring net-work has been set up.

International cooperation in IDD control started in 1980s. In the Chinese Australian Technical Cooperation Project, Australian scientists trained many young Chinese doctors to work on the monitoring works. UNICEF also helped us to search for an appropriate way to control IDD in the remote areas where iodisation programmes are very difficult to carry out. In 1989, through the suggestion of ICCIDD, an international working group for IDD control in China (IWGIDD) has been set up. The main functions of this group are: (a) To provide international experience of IDD control; (b) To solve the technical difficulties in China; (c) To assist in identifying potential international funding; (d) To review the progress of the revised national IDD control programme towards the goal of elimination of IDD by 2000. By the help of IWGIDD, in 1989, we revised our national control programme which just met the target. Presently among the 29 provinces in China with a significant IDD problem, 17 provinces have already met the goal of control; 10 others could meet the goal by the end of 1995. The Xinjiang Uygur Autonomous Region and Xizan Tibetian Autonomous Region are expected to meet the goal by the end of 2000. We noticed after the iodine supplementation has been implemented that an accurate monitoring system will be the most important measure to keep watch on the progress of the iodisation programme. Since 1989, China has set up 23 monitoring areas scattered in the IDD endemias of China. The size of each area is about 10-20 thousand population. Assessment is carried out by the Institute of Endemic Diseases Control of the respective provinces, and the data are analysed at the National Endemic Disease Control and Research Institute in Harbin. Besides this, each provincial Institute also has its own monitoring areas of the same size, and the prefecture also has its own monitoring areas. By this monitoring network, in 1990, we had got valuable information which indicated that there were many loopholes in our iodisation programme.

Now in order to eliminate the IDD by 2000 in China, we noted that several essential tasks should be worked out.

1. Among the provinces which have not met the goal of IDD control, only southern Xinjiang is a 'hard nut to crack'. Problems are not only the efforts required but also the technology of iodisation. In the desert, inhabitants could get rock salt without charge. Thus salt iodisation is almost impossible. We have proposed to collect the most authorised Chinese experts and some foreign scientists to work over there for a period of time to achieve the goal of IDD control.
2. The present monitoring network has provided valuable information, but the methods used are not sufficiently sensitive and objective. We

need to modernise our monitoring system so as to guide the neonatal hypothroidism by paper spot method. The monitoring area could be shifted frequently to avoid artificial fortification of iodisation on the fixed monitoring areas. We need to set up an organisation to coordinate the efforts between the ministry of Public Health and the ministries of light industry and of commerce soon.

3. Presently, almost all the supplementary iodine are imported. This means we have to pay a lot of hard currency to support the iodisation programme among the 400 million people. China does not lack in iodine resources. We hope to have foreign expertise and investment to explore the new iodine resources.
4. After the economical reformation, salt production and salt purchase need not be monopolised by the government. Privately produced non-iodised salt can easily be found in the market. As the salt iodisation has not been legalised in China, the policy to privatise salt iodisation is difficult to implement presently.
5. Our present control criteria in China serve as a guide only to control the appearance of apparent endemic goitre and frank endemic cretinism, but not to guarantee the promotion of physical as well as intellectual well being of the younger generations. So we are drafting higher level criteria for the 17 provinces which have already met the goal of the present control criteria. We would ask the 17 provinces to meet the higher level criteria in 1995 and the provinces to do so by 2000.

We realise it is a very hard task for us to fulfil the goal by 2000. On the other hand, by the great determination of our government and our people and by the enthusiastic help from abroad, we have our full confidence that we can conquer the IDD in China — the largest IDD country in the world.

Proc 6th ACN 1991; 523 – 527

New developments in iodine technology

Romsai Suwanik and Rudee Pleehachinda

Section of Nuclear Medicine, Department of Radiology, Siriraj Hospital Medical School, Bangkok, Thailand

New methods in iodine technology have been developed for difficult situations such as those found in some geographical areas. For example, a mountain-rugged area in one of the provinces at the border is almost inaccessible especially during the monsoon season. The higher-endemic goitre villages are very poor, isolated and subsistent. The prevalence of goitre is high with presence of some endemic cretins due to unavoidably inadequate and irregular distribution of iodated salt.

What should we do: (a) to overcome the inaccessibility, (b) to reduce the current goitre prevalence and (c) to prevent new cases of cretinism?

In trying to solve these problems, we propose three things: (i) use the smallest transportable salt mixing units (ii) use concentrated iodate solution in dropper bottles and (iii) use of low dose oral oil drops (indigenous products).

The methods and materials of development for salt and drinking water iodination, and iodised oil are briefly described below.

Salt

By using smallest mixing unit made of wood (Figure 1), 12-24 kg of salt sprayed with 120-240 ml diluted from 30 to 60 ml of concentrated KIO3 solution was mixed by hand rotating 10 rounds clockwise and 10 more rounds anti- clockwise. The output is about 240 kg per day or 72 tons per year, - the amount of salt for a group of villages. The unit is detachable and therefore transportable. The cost is about 500 bahts or approximately US$20/- (1)

Drinking water

Two drops (Figure 2) of concentrated KIO3 solution (2,000 μg/L) are added into a small jar of 10 litres of water (13 times the Me Khong Wiskey bottle). The concentrated KIO3 solution is prepared by dissolving 24 g KIO3 in one whiskey bottle of water divided into 24 x 30 ml plastic dropper single bottles as previously described (2). The method has been used together with iodination of the **salt**, giving good results of IDD control.

The detection kit is prepared as twin bottles for monitoring the iodated water and the iodated salt at the same time with preparing the single bottle, containing concentrated KIO3 (2) as described above.

The reasons for limiting the application to two means of iodination are:- (i) because of many administrative constraints, we cannot depend on salt alone, (ii) from human or bio-psychosocial consideration, we seek to provide a choice of alternative means to the consumer population in any locality

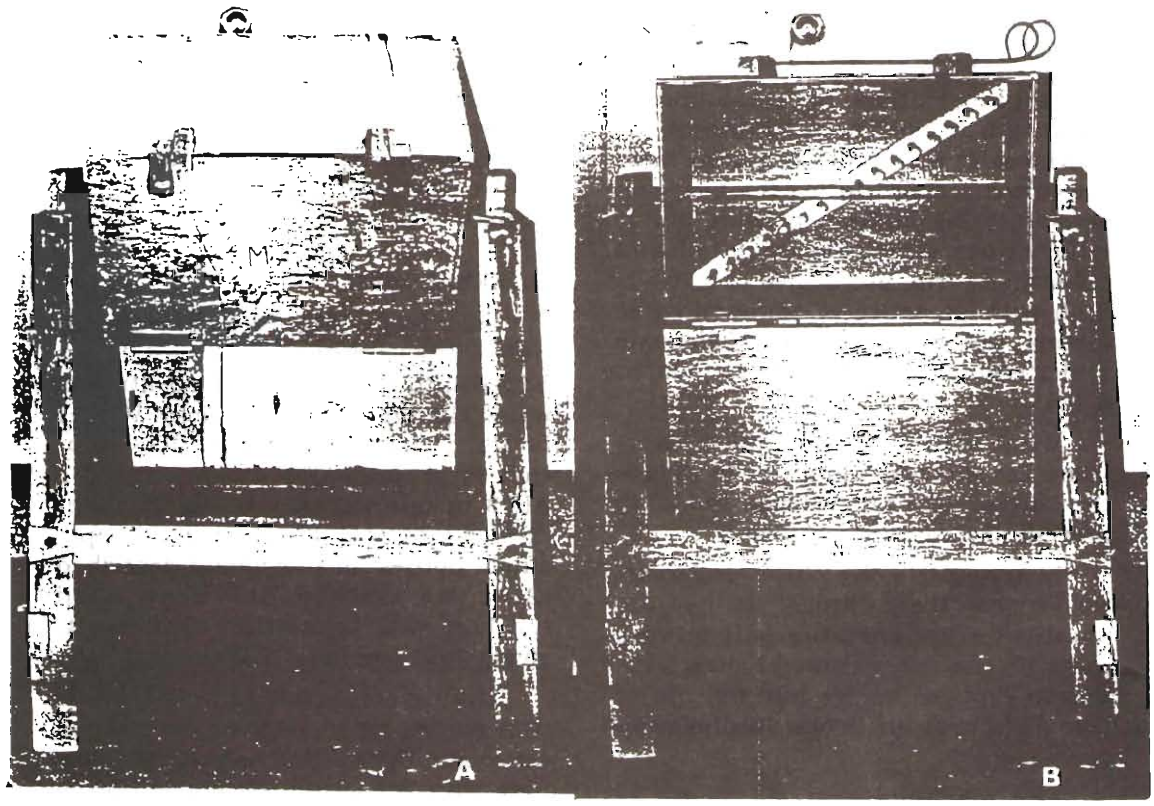
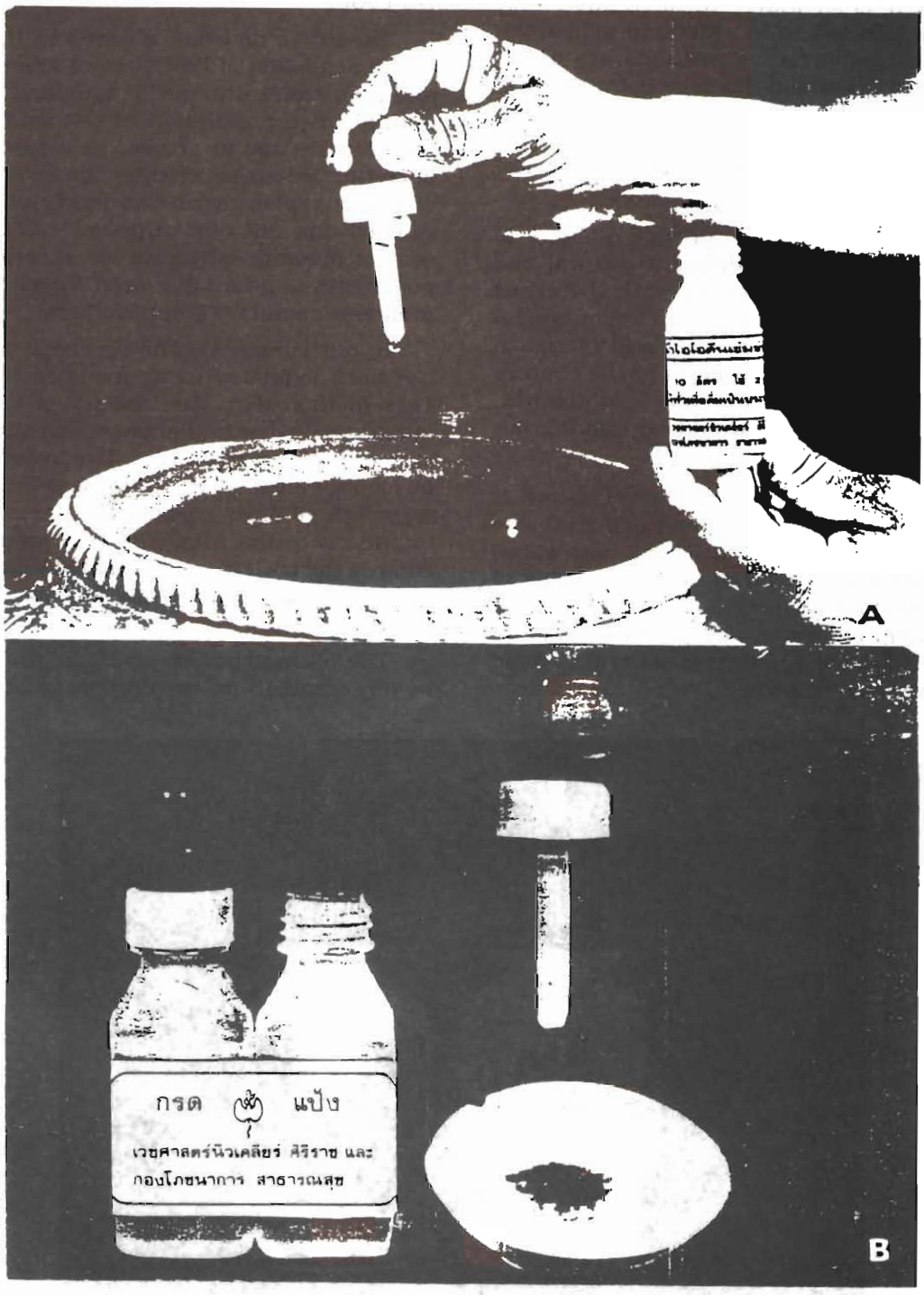


FIG. 1 The smallest salt mixing unit (12 kg capacity) made of wood. This revolving unit is transportable, non-electrical and good for accessibility. Note the fish bone barriers inside the box.



[Figure 2. (a) A single dropper bottle of conc. iodate solution (2 drops into 10L of water).
(b) Twin bottles to detect iodine in salt and water (*on site*)]

such as for water, the alternatives may include iodine in wells and iodinators. Other alternative methods are developed for adding the concentrated KIO3 solution into (6 drops in a bottle of 750 mL) (a) fish sauce or soy sauce and (b) fish condiment or "Pla Dak or Pla Ra" (6 drops in one kg).

These methods provide a choice to consumers from different cultural and geographical region with different dietary habits and socio-economical conditions, e.g. the people in the north and north-eastern parts of the country consume regularly fish condiments. Thus, this food would be suitable for iodination for these people.

It should be emphasised that cautions must be taken to limit the use to two means (such as salt and water; with the exception of the package of low dose oral oil specifically for the group of women of reproductive age in villages with cretins) to prevent chronic overdose of iodine.

Oil drops

The iodine repletion is based on the recommendation of Prof. Russell Fraser and Prof. Andre Ermans (3, 4, 5), and it is applied to population of women of reproductive age to prevent new cases of cretin. In our experience, the extent of iodine replacement was mild, fully utilised and not over-suppresive. The cost of mass prophylaxis for specific poplations is affordable even for non-profitable voluntary group workers.

In our laboratory, the soyabean oil has been iodinated using modified Ma Tai's method (6). The testings of the indigenous iodised oil showed that it is stable and non-toxic (7). The supra-physiologic dose (4) is 10 drops (20 mg iodine) three times a year. The urinary iodine excretion after the first week showed the pattern approximated those given 50, 100 and 200 mg iodised oil per oral dose (8).

The oil preparation was contained in very small 15 ml eye dropper plastic

FIG. 3 The small dropper bottle containing an indigenous iodized oil provides a dose of 20 mg per 5 drops which when administered three times a year to women of reproductive age, prevents new cretins with re-assuring results.

bottles (Figure 3). The method of application is very convenient with good acceptability. The repletion of iodines lasts for 4 months before the next dose.

By such means, the goals to overcome meal inaccessibility, to reduce goitre prevalence and to prevent occurrence of cretins, could be fulfilled with reassuring results as obtained in our trials at the borders in the provinces of Kanjanaburi, Pitsanulok and Mae Hong Son.

It may be concluded at this stage that the methods are workable because the techniques are simple, low cost and effective (9) and may lead to more self-sufficiency and self-reliance.

Summary

In endemic goitre villages, to overcome the problems of accesibility, to eradicate goitre, to prevent cretins from being born in women of reproductive age and to prevent re-appearance of goitre, specific means are proposed. By applying three methods: (a) using the smallest transportable mixing unit to overcome difficulty in transporting the salt to the endemic areas; (b) using dropper bottles of concentrated KIO3 solution to iodinate drinking water; and (c) giving low dose of oil drops every four months to women of reproductive age may independently prevent new cases of cretins. These methods have been subjected to trials in different provinces and proved to be simple, low cost and effective. However, supportive social processes are needed to study the knowledge, attitude and practices of the population and the health workers.

References

1. Suwanik R, Pleehachinda R, Pattanachak S. A small transportable mixing unit. (To be published).
2. Suwanik R, Pleehachinda R, Pattanachak C, *et al.* Simple technology provides effective IDD control at the village level in Thailand. IDD Newsletter 1989; 5: 1-5.
3. Burrell CD, Fraser TR. The iodide repletion test. Quart J. Med. 1957; 26: 559.
4. Ermans AM. Effectiveness of discontinuous administration of Supra-physiological doses of iodine in the long-term control of sporadic non-toxic goitre. Abstract No. 95. Sao Paulo, 9th International Thyroid Congress. 1985; p.88.
5. Ermans AM, Tonglet M, Tshilembi M, Bourdoux P. Control of iodine deficiency through yearly oral administration of small amounts (0.1 or 0.25 ml) of iodised oil. Abstract N- 94, AOTA Symposium on IDD, Tianjin, China. 1989; p.47.
6. Jaipetch T, Pattanachak C, Chongchirasiri S, Pleehachinda R. Synthesis of iodized oil. In: Vichayanrat A, Nitiyanant W, Eastman C, Nagataki S, eds. Recent progress in Thyroidology. Bangkok, Proceedings of the 3rd Asia and Oceania Thyroid Association Meeting. 1986; pp. 426- 30.
7. Chaisomboonpan T. (Personal communication).
8. Pleehachinda R, Pattanachak S, Jaipetch T, Suwanik R. Urine I excretion after varying oral doses of iodized vegetable oil in euthyroids and iodine-deficiency subjects. (To be published).
9. Suwanik R, Pleehachinda R, Pattanachak C, Jaipetch T. The effects of small divided oral doses in women of reproductive age. (Under preparation).

Proc 6th ACN 1991; 528 – 533

Monitoring and evaluation of national IDD control programmes in Indonesia and China

GF Maberly

Emory University School of Public Health, GA, USA

Iodine deficiency is currently the leading cause of intellectual impairment worldwide. Central nervous system development depends on an adequate supply of thyroid hormones, which require iodine for biosynthesis. Thus, iodine is an essential micronutrient for normal intellectual development and function. If the adequate microquantities of iodine are not consumed, absorbed and metabolised by the pregnant mother and newborn to meet biological needs, mild to severe mental retardation may occur. The World Health Organisation (WHO) estimates that 10-20% of humanity is at risk of iodine deficiency disorders (IDD). More than one-third of those at risk live in China and Indonesia (1). Prior to prophylaxis, in severely affected regions of both countries, cretinism ranged from 10-15%. A broad spectrum of less severe effects has been well documented, including delayed age of walking and suppression of the average IQ of the population by 10-15 points (1-3).

In the past, evaluation of the severity of iodine deficiency in population has been based largely on clinical criteria of goitre grades. The use of ultrasound in the field to more accurately estimate thyroid volume has demonstrated the inaccuracy and unreliability of goitre grading as the traditional indicator of iodine status (4). In the search for more reliable indices of iodine deficiency in populations, measurement of thyrotropin (TSH) from dried blood spots has found a new place alongside measurement of iodine in urine. The advantage of TSH is that it is the body's homeostatic signal to the thyroid glad of the brain's need for thyroid hormones. Recently, Delange noted that variations in iodine intake influenced the frequencies of TSH levels above 50 mIU/L in data collected from routine newborn hypothyroid screeningprogrammes in different parts of Europe. He reported an inverse relationship between the recall (values >50 mIU/L) rate at screening and the iodine supply to the newborn population (5). Measurement of TSH levels in neonatal blood spots by sensitive IRMA TSH assays is most relevant where venous blood sampling is most difficult or is unacceptable, as often occurs in many developing countries. Moreover, blood spots are easy to transport and to store and TSH in the blood spot is particularly robust in hostile environments (6). Adaptation of the highly sensitive IRMA TSH test from serum to blood spots is a considerable advance for the study of the epidemiology of iodine-deficient populations because TSH can be measured precisely across the spectrum from low normal physiological levels to extremely high levels of obvious hypothyroidism. This wide applicability means that all the TSH values in the population being monitored can

be accurately assayed. Thus, epidemiologic assessments do not have to rely solely on the levels observed in overtly hypothyroid individuals to define iodine status of a population. Hence, this method for TSH determination can not only serve as a method for individual case detection but can also serve as an epidemiological indicator of iodine status in populations.

The Indonesian case study

In Indonesia, iodine deficiency disorders (IDD) are recognised as severe and extensive nutritional problems. Since 1974, a national programme to control IDD has been implemented to improve iodine intake with iodised salt and with iodised oil injections. The progress of this programme has been monitored based primarily on the prevalence of goitre in school children coupled with the determination of urinary iodine excretion among small samples of the population. This study was undertaken in the Dukin sub-district of Central Java by Dr. Faisah Yasin, the principle subdistrict's health officer. The purpose of this study was to evaluate the effectiveness of the national iodine prophylaxis programme in the subdistrict.

The region selected for study comprises 15 villages and 160 hamlets with a total population of 38,585 and a density of 722 people/km2. Since 1976, iodised salt has been distributed in the local market. A national regulation proclaimed in 1982 that all salt should be iodised to 40 ppm. A trial in which iodised oil (lipiodol) injections were administered was conducted between 1974-1976. By 1982, lipiodol injections had been administered to the residents of all 15 villages. A second series of lipiodol injections were administered to the inhabitants of 4 villages between 1981-1986. This study includes data on 913 pregnant women (assessed mid-pregnancy) and their (3-10 day old) neonates, collected consecutively. The 913 women enrolled in the study represents 84% of all pregnancies that occurred in this district over a 2-year period.

The mean age of the women in this study was 25.5 (sd 5.2) years. 94% of the women were raised in this subdistrict. Almost all the neonates were delivered at home by traditional birth attendants. Pregnant women were examined before and after confinement. Their goitres were graded using the method of Perez et al. (1960), as modified by Stanbury and Querido (1983;7). Urines (n=913) were collected for iodine (alkaline ashing) and creatinine measurements (8). Capillary blood samples were collected from pregnant women (n=841) and 3-10 days old neonates (n=860). These samples were spotted onto filter paper and dried at room temperature for 2-4 hours. Samples were stored in the Health Centre freezer for later transportation in batches to Sydney for assay. TSH was measured by a commercial immunoradiometric assay (IRMA) (Biomedical Systems Pty Ltd. Sydney, Australia). The sensitivity of the assay was 1.97 + 1.0 mlU/L inter-assay coefficients of variation ranged from 7.8% to 9.3%. Samples of salt were collected from the subjects houses for measurement of residual iodine content (9). One thousand New South Wales Australian neonates consecutively born in the first quarter of 1988 were selected as controls. Filter paper blood spots were collected by heel prick on the fifth day of life. These samples were kindly supplied by the Oliver Latham Laboratory, Sydney, from their routine neonatal screening programme for congenital hypothyroidism. The TSH concentrations in the control samples were measured by the same IRMA TSH method as that used on the samples from Central Java.

By the clinical criteria used in this study, the Central Javan mothers were judged to be euthyroid. Palpable and

visible goitres were defected in 24% and 2%, respectively, of these pregnant women. Results of the goitre grading are summarised below:

Goitre grade	OA (%)	OB (%)	1 (%)	2 (%)	3 (%)
(n = 913)	77.1	17.5	3.8	1.0	0.6

The prevalence of goitre among women less than 20 years of age (12.9%) was significantly less than that found among older women (24.3%). The highest frequency of goitre was found among women over 40 years of age (chi-square test for trend p=0.015). Significant differences were also found when goitre prevalence were analysed according to the number of past pregnancies or parity. Primiparous women had the lowest prevalence of goitre, while those carrying their fifth or subsequent child had the highest prevalence (42.1%; chi-square test for trend p = 0.0046). This association between parity and higher goitre prevalence might be explained by the greater probability that older women have a higher parity. Analysis of the salt samples obtained from women's cooking places are summarised below:

Iodine salt (ppm)	0 (%)	1-10 (%)	11-20 (%)	21-30 (%)	31-40 (%)	>40 (%)
(n=898)	51	29	5	5	2	8

Approximately half of the pregnant women used salt with an iodine content of zero. Of the 12 salt brands available in the local market, 5 contained no iodine, 3 contained less than 10ppm, 2 contained less than 20ppm, and the remainder had less than 30 ppm.

The distribution of urinary iodine concentrations is as below:

Urinary iodine concentration (μg/dl)	Frequency in the population n = 913 (%)
0 - 20	3
2.1 - 5.0	10
5.1 - 10.0	20
10.1 - 15.0	22
15.1 - 20.0	24
20.1 - 25.0	12
25.1 - 50.0	5
50.1 +	4

The median urinary iodine concentration was 13.6 μg/dl with a range from 0.7 to 173 μg/dl (n = 913). 33% and 13% of mothers had urinary iodine levels of less than 10 μg/dLl and 5 μg/dL respectively, while 3% had levels of less than 2 μg/dL. The median creatinine level was 77.8 mg/dL with a very wide range from 2 mg/dL to 367 mg/dL. The median value is approximately half the average concentration found in a comparable Sydney poplation (135 mg/dL; Westmead Hospital, unpublished data) and is less than the mean level measured in a group of pregnant women in Ubangi, Zaire (mean: 101 mg/dL). However, the median value in mothers in this study was similar to the values reported from Kivu, Zaire (mean: 78 mg/dL).

Almost a quarter of the pregnant women in the Dukun Subdistrict had elevated serum TSH levels (>5 mIU/L). The highest serum TSH level was 115 mIU/L. The distribution of TSH values in the neonates serum showed that 16% had elevated serum TSH concen-

TSH (μU/mL)	Mother n = 841 (%)	Dukin Newborn n = 860 (%)	NSW Iodine replete Newborn n = 1000 (%)
0 - 50	77.0	83.6	100
5.1 - 10.0	17.0	10.6	
10.1 - 15.0	3.7	3.0	
15.1 - 20.0	0.3	0.5	
20.1 +	2.0	2.3	

trations (>5 mIU/L). In 2.3% of the neonates serum TSH levels were greater than 20 mIU/L. By contrast, serum TSH concentrations were less than 5 mIU/L in the 1,000 Australian neonate controls. There was a positive association between elevated TSH levels (>5 mIU/L in the mothers and their babies (p=0.0017; Chi-Squared).

The China case study

Since 1978, China has established national control programmes using iodised oil and salt. Since 1980, the effectiveness of these programmes was monitoring using periodic surveys of goitre prevalence in school children. Using goitre prevalence as indicator of iodine status, 22/29 provinces in China were categorised as iodine-replete. In these "controlled" regions the China-Australian Technical Co-operation on Iodine Deficiency established laboratories and commenced monitoring the effectiveness of prophylaxis with new biochemical indices. Results were presented in a 1990 project workshop in Guiyang. Iodine deficiency (ID) was found to still be present in the population. In the Qinghai, Heilongjiang and Guizhou Provinces of China, the iodine (I) content in household salt varied widely and I was usually dramatically less than the target I content for the salt factories. Urinary levels, in spot samples, were low (<100 μg/L) in 30-80% of subjects. TSH levels were elevated (>5 mIU/L) in 20-40% in newborns.

Discussion

The results of this study illustrate many of the difficulties and the inadequacies usually encountered whild attempting to monitor iodine prophylaxis and in detecting the persistence of iodine deficiency in a community. In these studies mothers and babies were judged to be euthyroid by conventional clinical methods, yet major biochemical abnormalities were subsequently found by laboratory analyses of blood spot samples among a high proportion of each supposedly normal group. It is the lack of overt clinical manifestations of iodine deficiency that makes these disorders so often apparently invisible to the clinical observer. Acceptance of the fact that hypothyroidism is difficult or even impossible to diagnose clinically with any degree of certainty in the neonatal period has been the rationale for establishing congenital hypothyroid screening programmes in developed countries. The data from Indonesia and China reveal a spectrum of TSH values in both mothers and neonates

from euthyroidism to unequivocal hypothyroidism. The high correlation between the elevated TSH levels in the mother and her offspring suggests a common cause for both, namely iodine deficiency. It is not known whether these results represent transient neonatal hypothyroxinaemia and are of no long-term significance or, alternatively, represent mild hypothyroidism which is most likely the cause of the various manifestations of subclinical cretinism found in this and other iodine-deficient populations. Although it would be premature to conclude that every infant with an elevated serum TSH level is at risk of subsequent neurological disability or decreased intelligence, it is of considerable concern that many are at potential risk of such irreversible disorders.

The studies in the Dukun subdistrict suggest that monitoring early in pregnancy may be as sensitive and as effective as neonatal hypothyroid monitoring. Recent studies of the pathogenesis of cretinism in China, coupled with other studies in Indonesia, point to two critical time periods when iodine deficiency may affect human brain development (2, 3). These two periods encompass the early second trimester of pregnancy and the early months of postnatal development. This knowledge, and recent confirmation of the fact that the foetus is dependent upon maternal thyroid hormone by placental transfer, highlight the need to monitor maternal iodine nutrition and thyroid hormone secretion early in pregnancy, as well as newborn iodine nutrition and thyroid hormone secretion in order to prevent irrversible brain damage (10).

The time to mount a global effort to eliminate iodine deficiency is now. Seventy Heads of State attended The World Summit for Children in September, 1990 and endorsed The World Declaration and Plan of Action on the Survival, Protection and Development of Children. The Plan stated that the world is in a position to "overcome the worst forms of malnutrition .. to halve protein-energy malnutrition, virtually eliminate vitamin A deficiency and iodine deficiency disorders and to reduce nutritional anaemia significantly". Governments formerly agreed to meet this challenge by developing national plans to intervene. Thus, the international community is poised to address the problem. Feasible interventions known to prevent IDD are to fortify commonly eaten foods such as salt, tea, fish paste, bread and sugar and to supplement hard-to-reach population groups with iodised oil injections or capsules. National programmes against iodine deficiency need to have strengths in all the components of advocacy, programme management, communications and social marketing, interventions, evaluation and surveillance and research and development. These components need to be integrated in an effective sustainable programme. The new approaches used in this study have the potential to play an important role in overall programme strategy. Furthermore, the monoclonal assay based on blood spot analysis has the potential to be useful not only for IDD but for the assessment of other micronutrients including iron and vitamin A deficiencies. This fits well with our strategy to develop a new Programme Against Micronutrient Malnutrition (PAMM) focussed at assisting countries develop a more integrated public health approach.

References

1. Hetzel BS, Dunn JT and Stanbury JB, eds. The prevention and control of iodine deficiency disorders. International Council for Control of Iodine Deficiency Disorders, Elsevier, Amsterdam edited by 987; 1-240.
2. Boyages SC, Halpern J-P, Maberly GF, Eastman CJ, Morris JG, Collins JK, Jupp JJ, Jin CE, Wang

ZH and You CY. A comparative study of neurological and Myxoedematous endemic cretinism in Western China. J Clin Endocrinol Metab 1988; 67: 1262-1271

3. Halpern J-P, Boyages SC, Maberly GF, Collins JK, Eastman CJ and Morris JGL. The neurology of endemic cretinism; A study of two endemias, Brain 1991; 825-841.

4. Gutenkust R, Smolarek H, Hasenpusch U, Stubbe P, Friedrich HJ, Wood WG and Scriba PC. Goiter epidemiology: Thyroid volume, iodine excretion, Thyroglobulin and Thyrotropin in Germany and Sweden. Acta Endocrinol 1986; 112: 494-501.

5. Delange F. Iodine nutrition and congenital hypothyroidism. In: Research in Congenital Hypothyroidism. Delange F, Fisher DA, Glinoer D, Dussault JH, Ermans AM, Irie M, eds. New York: Plenum Press, 1989; 173-185.

6. Waite KV, Maberly GF and Eastman CJ. Storage conditions and stability of Thyrotropin and Thyroid hormones on filter paper. Clin Chem 1987; 33: 853-855.

7. Stanbury JB and Querido A. Policy and planning for endemic goiter control. In: Nutrition in the Community, Mclaren DS ed. USA: John Wiley & Sons, 1983; 24:451.

8. May W, Wu D, Eastman CJ, Bourdoux P and Maberly GF. Evaluation of automated urinary iodine methods: Problems of interfering substances identified. Clin Chem 1990; 865-869.

9. Bourdoux PP. Measurement of iodine in the assessment of iodine deficiency. IDD Newsletter 1988; 4,8-12.

10. Vulsma T, Gons MH, De Vijler JJM. Maternal-Fetal transfer of thyroxine in congenital Hypothyroidism due to total organification defect or thyroid agenesis. New Eng J Med 1989; 321:13.

Proc 6th ACN 1991; 534 – 538

Rapid assessment procedures for nutrition and primary health care

Nevin S Scrimshaw

United Nations University, Tokyo, Japan

Introduction

In 1983 the UNU and UNICEF initiated a programme to apply anthropological methodologies to the qualitative evaluation of the impact of nutrition and health-related interventions on health-seeking behaviours.

It was recognised that conventional nutrition and health surveys for this purpose were not being used because they are time consuming, expensive, and invasive. Moreover, while essential for determining health **status**, they would not reveal whether a given intervention influences that status, or explain **why** or **why not**. It was believed that an anthropological approach, focusing only on health issues could be used rapidly, cheaply, unobstrusively, and effectively. The initial effort involved anthropologists in 12 countries who, along with their students and/or assistants, spent in-depth time with a limited number of households. The approach proved powerful and useful. It was clear, however, that it needed to include the appraisal of the behaviour of **providers** as well as **recipients**, and that community involvement could be increased by the use of focus groups.

Preliminary guidelines were revised and expanded and more investigators were recruited for further studies of both households and providers in communities receiving nutrition and health intervention programmes, ranging from routine primary health care to the implementation of individual child survival strategies.

In two to four weeks, at a cost ranging from $5,000 to $10,000, the methodology gave a clear idea of whether and why a programme was or was not influencing nutrition and health-related behaviours in a specific population. At a workshop in Sri Lanka in 1986, the first edition of the guidelines was finalised and the acronym RAP adopted. The guide, entitled "Rapid Assessment Procedures for Nutrition and Primary Health Care" has since gone through four printings in English, and is available in Spanish, French, and Portuguese. A 16-minute descriptive video sponsored by UNICEF is available in English and Spanish, and a training manual has been developed.

What *is* RAP ?

RAP is the application of an anthropology approach to the qualitative evaluation of nutrition and health-related behaviors. It is relatively rapid and inexpensive, and acquires information usually unobtainable by questionnaire or other surveys. It is **not** a substitute for epidemiological surveys, but is a valuable **additional** tool for nutrition and health workers. It can help plan surveys as a **complement** to **quantita-**

tive surveys, or function as an independent approach to assess the impact of programmes on the behaviour of recipients, in order to guide programme improvement. RAP is being applied to studies of behaviours associated with a wide range of health issues, as well as programmes that deal with these issues.

Why use RAP ?

RAP provides information on the **functioning** of programme, which is unobtainable from surveys. The information is valuable because it indicates how these programmes may be improved. This morning, in his plenary lecture, Kraisid Tontisirin pointed out the need to involve community members in development. RAP does this and can be used to empower the community to deal with their own problems and generate commitment. It can also empower **health workers** with the information needed to improve their results. It can serve **three** masters: the **community**, the **planners**, and the **providers**, while sensitising each to the problems.

What is RAP Methodology ?

After this introduction, you may be expecting something exotic. However, RAP is no more than systematising familiar approaches that most of you may feel you already know. Peter Heywood explained the methodology completely and effectively in his symposium paper.

Informal interview

More or less open-ended questions are asked on certain topics. The researcher follows a general outline, but may incorporate additional topics if appropriate. The advantages of informal interviews are that 1)any factors affecting a problem can be noted, 2) sensitive topics can be explored in context, and 3) information can be obtained with minimal time constraints.

Conversation

Important data can also be obtained through informal individual or small group conversation. Some people are more at ease in an informal setting and talk more freely. The advantages of conversation are that they reveal attitudes as well as yield unanticipated information.

Observation

Careful observation of events and behaviour provides valuable non-verbal evidences of what is **actually** occurring.

Participant observation

The researcher participates in an observes the interactions of household members with health community providers withiout the health delivery system or the constraints imposed by obligatory activities. The advantages of observing **households** are that they distinguish real from reported ideal behaviour and reveal patterning and interrelationships. The advantages of observing **health providers** is that household perception is matched with actual performance, rather mercilessly revealing where improvement is required.

Focus groups

Focus groups of 5 to 15 people can help to check information with a larger number of persons and obtain reactions to intended innovations (e.g. educational materials, the locations of a clinic, and the behaviour of health workers). Most importantly, it gives the **community** an opportunity to focus on diagnosis and on suggesting how their problems should be solved. The advantages of Focus Groups are that information obtained from a few households can be verified with larger and more

representational samples of a community. It can also be used to test whether the conclusions of a RAP study in one community apply to others. It is particularly helpful in determining what questions are appropriate.

Formal interview or questionnaires

These can provide basic demographic and socio-economic data. Information can be obtained form a larger sample and the data treated statistically. However, they are complementary to the RAP and not the basis of it.

RAP is not a survey methodology. It should be noted that surveys based on predetermined structured interviews may miss factors such as **actual** behaviour, as distinct from **idealised** behaviour, or behaviour which has been forgotten or not noticed by the respondent. Surveys may also miss information which may be considered too personal or too risky to reveal to a stranger. If survey questions are culturally inappropriate, they may be interpreted in a manner different from the researcher's intent. The answers may be misinterpreted as well. Moreover, the validity of survey responses cannot usually be checked because the methodology involved and the time allotted do not allow for this.

The **core** of the RAP method is the data collection guide or checklist which suggests information to be collected for a given topic. Examples of such guidelines are in the RAP manual, but must be adapted to individual needs. The information may be collected using any or all of the methods mentioned when appropriate. For example, data on feeding patterns during illness would ideally be collected through informal interviews, conversation, and actual observation of what is really done.

What is the validity of RAP findings?

When RAP is properly applied by skilled investigators, the validity is high for the specific population studies. There are some strict requirements for validity and pitfalls to be avoided.

1. The **investigator** must have experience at the village level and language facility in the culture studied.
2. The approach must be kept flexible and the guidelines revised as experience is gained.
3. Detailed and accurate notes must be taken. Any individuals present when the information was being obtained should be noted.
4. The conclusion must be based on what is **heard** and **observed**, **not**, on what has been presumed to be true about the group studied.
5. There must be a constant effort to identify and eliminate observer/researcher bias, i.e. outsider bias and influence.
6. Continuous effort must be made to **confirm** conclusions by translations.
7. There is no more or less inherent validity in **qualitative** data. The reliability of both depend on appropriate design or lack of it, execution, and analysis. This means examining the same issue from several different techniques and points of view, e.g. different informants and interview, observation, and focus groups.

Can RAP conclusions be generalised?

The question of how one can generalise about a programme from interviewing only a few households in one community frequently arises. Of course, one cannot generlise without further checking. However, once one

knows what to look for, this checking can often be done by short visits to other communities, e.g. focus groups alone, or even by observing that the programme is operating in the same way in other communities. At a minimum, RAP studies can identify questions to ask about the programme in other localities.

Who can do RAP studies?

This is a significant and controversial issue. **Anthropologists** are often opposed to placing this method in the hands of persons without formal social science training. However, experience indicates that most persons with field experience at the community level **and** empathy for the community can apply RAP methodologies successfully when trained and supervised. For example, RAP enables workers in health centres in Panama to determine the deficiencies of their programme and try to correct them.

Public health physicians often make excellent "rappers". However, individuals with a fixed mind-set that respects only quantitative survey data, including physicians who are purely clinically oriented, cannot readily be trained on this methodology. Such individuals may even insist on immediately correcting the informant's concepts instead of listening to them.

While the **original** intent was to involve anthropologists in public health programmes of NPHC, experience has shown that nutritionists, mid-wives, community nurses, and others with community experience are usually excited and feel empowered by a method that **they** can use directly to evaluate and improve their activities.

How rapid is RAP?

There are many who prefer emphasis on relevant rather than rapid. They want to select RAP, not because it is rapid, but because it provides valuable information not obtainable in any other way. Nevertheless, compared to the process of designing, conducting, and analysing surveys, it **is** both rapid and cheap.

A comprehensive RAP survey in a community may require 4-6 weeks, but usually, most of the information desired can be obtained in two weeks: for a limited number of issues, one week may be sufficient. For a single, specific issue such as growth monitoring, a single day in each locality may suffice.

The RAP **principle** should be used in even short visits to health programmes where observation alone can sometimes yield convincing information on programme shortcomings. Even brief conversations or interviews can suggest (but not confirm) failings. Such visits can indicate the need and scope of confirmatory RAP or other kinds of evaluation required.

What is the current status of RAP?

With the English version of RAP alone, in its fourth printing, and copying of the RAP video encouraged, UNU has long since lost track of the multiple uses of this methodology. In addition, the same appraisal has been used under other names and auspices. RRA or Rapid Rural Appraisal shares many of the same features.

RAP training workshops have been held in Arabic in Egypt, in Englsih in Kenya and Indonesia, in Spanish in Costa Rica and Chile, in Portuguese in Brazil, and in French in Brazzaville, and more are planned.

At a conference on the use of RAP held at the Pan-American Health Organisation (PAHO) headquarters in Washington, DC, participants from 60 countries and 40 agencies and organisations described their experience with RAP and similar qualitative techniques, including RRA.

Interest now is in adapting the RAP Guidelines for the study of specific diseases and conditions. A RAP for epilepsy has been published, and RAPs for AIDS-related behaviour and for diarrhoeal disease are in press. RAP guidelines are also being adapted for tropical infection diseases, family planning, malnutrition in the elderly, and breast-feeding and weaning practices.

Conclusion

RAP is valuable tool for nutrition and health workers. It does not replace or fulfill the role of nutrition surveys. Every nutrition and health field worker should be familiar with the qualitative approach and be able to use it when appropriate, either alone or in combination with quantitative methods.

Copies of the RAP guidelines can be obtained from the Centre for Latin American Studies at the University of California, Los Angeles. The desired language must be indicated. The video can be obtained at a cost of about $10.00 form the Cambridge, MA Programme Office of the UNU, or from UNICEF. It can be freely copied and distributed. Specialised RAP Guidelines for AIDS and Diarrhoeal Disease will be available early in 1992.

In this symposium, speakers will give examples of the application of the evaluation of RAP to the ongoing programmes at the community level.

Proc 6th ACN 1991; 539

Field methodologies and rapid assessment procedures: towards mass-campaign alternative strategies against nutritional diseases in India

D Raghunandan, A Sen Gupta and R Baru

Society for Economic & Social Studies, New Delhi, India

Abstract

Nutrition related diseases and disorders in India remain prevalent in high degrees despite the numerous efforts at tackling them. While some problems are structurally embedded, such as those stemming primarily from inadequate quantum of ffood (rather than ffrom imbalances in it), some others may be addressed through "intermediate" strategies. Given the limitations of current programmes, there is urgent need for alternative methodologies and delivery mechanisms/structures.

In recent years, a nationwide network of NGOs of the Peoples Science Movement have demonstrated the capability of mass-campaign strategies with peoples' delivery mechanisms (rather than official-bureaucratic ones, but with financial and other support from governmental agencies) in the area of Literacy. This experience is examined briefly with focus on its potential for similar programmes on nutrition-related diseases and disorders.

A critical component in such a strategy is a field methodology, such as "RAP", for assessment of needs and for formulating appropriate location and need specific mechanisms and institutional linkages for delivery. This is essential in addressing nutritional problems and potential solutions which have a wide variety of forms according to a range of social, economic and cultural factors.

The paper presents a perspective for the above and sketches the outlines of such a methodology.

Proc 6th ACN 1991; 540 – 545

Rapid rural appraisal and rapid assessment procedures: a comparison

Yongyout Kachondham

Institute of Nutrition, Mahidol University at Salaya, Phutthamonthon, Nakhon Pathom 73170, Thailand

Introduction

Among the most difficult problems confronting the world community since the history of mankind has been food shortage and dietary deficiencies. However, little dispute exists that remarkable increases in food production have been achieved in providing for the nutrition needs of people over the past decades in many developed and developing countries alike. Yet the number of hungry people has increased due to rapid population growth and, more importantly, the lack of effective food distribution and political will to solve inherent problems. Experience has shown that ample food production in itself is not enough to cope with the mounting challenge of feeding people. Other elements, both economic and social, can also indirectly influence nutritional status. Agricultural production, food prices, purchasing and investment power, marketing systems and food habits are example of important socioeconomic factors (1).

Presently, no single body of knowledge nor discipline can provide the direction and means to win over hunger or lack of food security and malnutrition. No firm formulas can satisfy the ecological, cultural, economic, political and social diversities which characterise each region of a country. A growing body of knowledge on nutrient requirements and a healthy diet may exist, but interventions to ensure adequate food entitlement and consumption by communities and households are far from clear and usually confined with disciplinary boundaries.

To cope with this ever-increasing challenge, we must carefully assess and address the numerous complex linkages among factors involved in the food and nutrition pathway, from production either by natural or human intervention to optimal nutrition for all. To formulate strategies and design effective interventions require comprehensive assessment and cooperation from a variety of disciplines. However, food and nutrition research efforts are often fragmented and overwhelmingly deductive, that is, based on disciplinary theories that do not necessarily address the current issues facing communities and mankind. The challenge is to create and apply methodologies and institutions that are more relevant, multi-disciplinary and holistic. Rapid Rural Appraisal (RRA) and Rapid Assessment Procedures (RAP) are examples of relatively recent approaches that are responsive to this challenge. This paper's purpose, therefore, is to give an overview of each method, their approaches, similarities,

differences and application for food and nutrition problems.

Rapid rural appraisal

Rapid rural appraisal (RRA) has its origin and application in rural development-related research. An RRA workshop and conference, held at the Institute of Development Studies at the University of Sussex in 1978 and 1979, fostered an emerging new methodology to improve the cost-effectiveness, timeliness and quality of rural development-related research. RRA was described by Grandstaff and Grandstaff as a process of learning about rural conditions in an intensive, iterative and expeditious manner (2) or any systematic activity designed to draw inferences, conclusions, hypotheses, or assessments, including the acquisition of new information, in a limited amount of time (3).

RRA characteristically relies on small multi-disciplinary teams that employ a range of methodological tools and techniques specifically selected to enhance understanding of rural conditions in their natural context, with particular emphasis on tapping the knowledge of local inhabitants and combining the knowledge of modern scientific expertise, but minimizing *a priori* assumptions. Relevant and accurate information can be accumulated quickly and cost-effectively by rapid cycles of interactions among team members, in addition to the refinement of data collection tools and techniques (e.g. direct observation, short questionnaires, semi-structured and in-depth interviews). RRA also stresses flexibility and judicious judgement that allows for creativity and modification along the process and where appropriate.

Summarily speaking, RRA activities include three broad phases. The first is preparatory work that includes selecting a multidisciplinary team, background information retrieval through the maximum utilisation of existing data, team discussions for developing preliminary hypotheses, and selection of research tools and techniques. The second phase is relatively short, either single or multiple, field visits to study areas. The final phase arises as team members discuss and analyses accumulated data and then reach a consensus on what has been learned and what is still unclear. Write-up should also take place immediately following fieldwork as any delay may result in the loss of valuable information and insights.

In the area of food and nutrition, RRA has been utilised mainly to investigate, identify and diagnose rural problems and to evaluate nutrition programmes and projects. For example, RRA was applied to study the natural sources used in the daily diet of rural Northeastern Thai families (4). Trip (5) has evaluated the improper targeting of nutrition programmes that allowed privileged minorities to capture major and disproportionate benefits. Heywood and others (6) applied RRA to investigate the cause of malnutrition in rural areas with particular emphasis on the role of agriculture and health in Papua New Guinea. RRA in nutrition studies has also highlighted problems of seasonality, intra-family food sufficiency, women's roles and the importance of so-called "minor crops". All of these issues had not been well identified before through conventional survey research (7).

Rapid appraisal procedures

Rapid assessment procedures (RAP) are the outcome of collaboration among many individuals, mostly anthropologists and social scientists, who envisioned that practical anthropological methods and theoretical perspectives could be applied to evaluate and improve primary health care (PHC) and nutrition programmes. Led by

Scrimshaw and Hurtado in early 1980, the procedures were revised at a workshop in Geneva in 1983 and published as a monograph in 1987 (8). Unlike traditional anthropological approaches which entail long periods of fieldwork and a tremendous amount of ethnographic material, RAP is a more problem-oriented and purposive approach that can be quickly employed at low cost. The RAP methodology was developed originally for the United Nations University Research Programme to improve understanding of the successes and problems related to PHC services.

RAP methods mainly entail direct observation, informal conversations, group interviews, key-informant interviews and participant-observation. They focus on indigenous beliefs and perceptions regarding patterns of disease, perceived causes, health seeking behaviours, knowledge, attitudes and practices (KAP), crucial entry points for intervention, and local responses to health and nutrition programmes. Conceptual issues include the structure of incentives, the complex relationship between cognition and behaviour, and how people interact with traditional and biomedical health resources.

Exploring the structure of incentives gives researchers clues as to why people behave the way they do, for example, whether people seek well-being (pleasure) or avoid pain. Behaviours are not always consonant with cognition. On the contrary, people often act in a manner not consistent with their knowledge and beliefs (cognitive dissonance). Symbolic interactions observed between household members, between clients and health care providers, or among providers themselves may have a greater impact on the outcome of a health problem than the efficacy of the intervention employed. Information obtained in this manner from the sociocultural context can give better indications as to why programmes fail or succeed.

For instance, the author employed a RAP methodology in a current study in Thailand, and it shed light on why pregnant women would not accept iron supplementation. In short, health personnel were mostly indifferent to or unaware of the hidden worry of pregnant women that by taking iron supplements they might have bigger babies and thus difficult deliveries. Due to poor communication between health providers and clients, pregnant women perceived that the iron tablets were mechanisms for nurturing big foetus substances or vitamins rather than something that would prevent them from anaemia in pregnancy.

Another study has identified community members explanatory models about how villagers assess malnourished and healthy children, identify the causes of malnutrition as well as the quality of breast milk. The authors also identified a number of areas where community members' and health providers' explanatory models differed which led to non-compliance in recommended child nutrition promotion activities. The main thesis is that nutrition education programmes can be placed on firmer ground if they first identify people's explanatory models, negotiate between these and professional models and then develope programmes which satisfy both (9).

Finally, a cultural study of diarrhoeal illness in Central Thailand used the Explanatory Model Interview for Classification as a RAP method. Results showed that two-thirds of community members expected ORS to reduce or stop diarrhoea altogether. However, for many patients troubled by copious stools, ingesting more liquids may be counter-intuitive, seeming to add to rather than alleviate the problem. Hence, community members attributed powers to ORS that it did not have, and unrealistic expectations

arose (10).

In any of these cases, such in-depth information is extremely difficult, if not impossible, to obtain by conventional research using survey questionnaires.

Similarities and differences

RRA in rural development-related research and RAP for PHC and nutrition research are newly-emerging methodologies for a process of learning and acquiring relevant information in a limited time. Both share the new paradigm that rests on a world view composed of a highly interactive and rapidly changing system, including a balance and interaction between the emic (local or indigenous perspectives) and the etic (outside or expert perspectives) from the anthropological point of view. More attention is paid to the cultural, traditional and social factors involved in the target problems as well as indigenous knowledge of the beneficiary groups. The approach of each method is more inductive than deductive. That is, they start out from "facts" and look for generalisation on which to build theory. Both RRA and RAP also represent a response to a well-recognised need for improving the cost-effectiveness, timeliness and quality of field research. Specifically, they represent mechanisms for getting around resource limitations (i.e. scarcities of skilled manpower, budgets and time) and the lack of holism and other limitations characteristic of conventional quantitative methods.

The similarities between RRA and RAP also include systematic methods for obtaining new information in a relatively short time using semi-structured interviews, focus group discussions and direct observation. The interviews are not necessarily chosen randomly, but are rather key informants within communities such as monks, the elderly and other non-formal and formal leaders. These people can supply direct information more quickly than collecting the same information from a large population using a questionnaire. Priority is given to indigenous knowledge and the opinions of local people. This knowledge and opinions serves as one core basis for identifying solutions to target problems in a way that ensures better acceptability of interventions by the local people. Both RRA and RAP use a problem-focused approach as a tool for diagnosis, evaluation and action. They compliment both cross-sectional and longitudinal studies that may show cultural and contextual biases. They also provide a more holistic picture and background upon which to place often fragmented findings. As a result, better and more plausible explanations can be obtained, not just only statistical relationships.

However, RRA and RAP have limitations. Both are inappropriate where statistical representativeness is an important issue. Bias may arise due to three different kinds of sampling errors: (a) distortions in the situations sampled for observations, (b) the time periods during which observations take place, and (c) selectivity of the people sampled (11). Both techniques also do not have a standard methodology, especially for RRA. Thus, both require high levels of expertise and are heavily dependent on full-fledged researchers of the highest professional calibre. Further, information obtained by any RRA or RAP is at best indicative in the area and as such can be very helpful in formulating working hypotheses. If generalisation is an issue, however, both RRA and RAP are not adequate substitutes for careful and detailed investigations.

Although RRA and RAP tend to share a number of common characteristics, they are two entirely independent processes with important differences. Of the two procedures, RRA is more interdisciplinary adopting from a

variety of fields of study such as agricultural, anthropology, geography, geology, sociology and even journalism. RAP, on the other hand, is more anthropological and is employed as a rapid assessment of human behavior. RRA is more rigorous by using the triangulation technique which has been described as employing a number of different approaches that seeks different perspectives from team members from various disciplines to improve the understanding of existing variations in any particular phenomenon (7,12) and complimenting or comparing information from several sources (13). The technique is also considered as a counter to the criticism "that a study's findings are simply an artifact of a single method, a single data source, or a single investigator's bias" (14). This characteristic may also overcome criticism of the inductive approach that "facts" usually are observed with disciplinary biases and there are no "pure" observers. The balance or reconcilable perspectives among team members who often bring their disciplinary perspectives will allow the team to observe with less disciplinary bias. RRA is also highly iterative so that the method allows the abandonment of any hypotheses which have become inappropriate along the course of the research as well as reformulation of more appropriate based on newly acquired information.

RAP, though, is more focused on a specific issue or problem set for assessment using a more holistic manner that balances out indigenous and expert views, and/or scientific and cultural aspects of the issue at hand. Moreover, RAP may be action-oriented hoping to lead to an improvement of community members' health and nutrition situation. Finally, RAP has a shorter history than RRA which developed in the 1970s. RAP only aims mainly to improve understanding of the successes and failures of implementing PHC programmes, nutrition interventions and related research.

Conclusion

RRA and RAP have become very useful as tools for collecting desirable information in a relatively short time. Their advantages over conventional survey procedures include the tendency to approach the problem in an organised and holistic manner which takes into account the knowledge, perceptions and beliefs of the local population. The process also allows a great deal of flexibility and an opportunity for multi-disciplinary cooperation, especially for RRA. To maintain their benefits and uniqueness, RRA and RAP should withstand pressures to be standardised and remain a developmental process of information acquisition which enables diversity to grow, thus knowledge to be discovered and refined. Concurrently, both should also avoid the pitfalls of becoming an object of unrealistic expectations and a development research panacea.

References

1. Rabidhadana A. The role of social science in nutrition research. A paper presented at the workshop on integration of food crops, fisheries and nutrition research in Northeast Thailand. Khon Kaen, December 7-9, 1988.
2. Grandstaff SW, Grandstaff TB, Lovelace GW. Summary report. In: Proceedings of the 1985 international conference on rapid rural appraisal. Khon Kaen, Thailand: Khon Kaen University, 1987:3-30.
3. Grandstaff TB, Grandstaff SW. Report on rapid rural appraisal activities. Khon Kaen University-Ford Rural Systems Research Project. Khon Kaen University, 1985.
4. Somnasaeng P, Rathakette P, Ratanapanya S. A Study of Natural

Food Resources in Northeast Thailand Villages in the Rainy Season. Khon Kaen University-Ford Rural Systems Research Project. Khon Kaen, Thailand: Khon Kaen University. 1984.

5. Tripp R. On-farm research and applied nutrition: Some suggestions for collaboration between institutes of nutrition and agricultural research. Food and Nutrition Bulletin 1984; 6:49-57.
6. Heywood PF, Allen B, Fandim T, et al. A rapid appraisal of agriculture, nutrition and health in Wosera Sub-district, East Sepik Province. Papua New Guinea Institute of Medical Research, 1986.
7. Gibbs CJN. Rapid rural appraisal: an overview of concepts and application. In: Proceedings of the 1985 international conference on rapid rural appraisal. Khon Kaen, Thailand: Khon Kaen University, 1987; 193-206.
8. Scrimshaw SCM and Hurtado E. Rapid assessment procedures for nutrition and primary health care. Tokyo, Japan: The United Nations University, 1987.
9. Yoddumnern-Attig B, Attig G, Kanungsukkasem U. Incorporating explanatory models in planning nutrition education programmes in Thailand. Nutrition and Health 1992; 8:17-31.
10. Choprapawon C, Chunsutiwat S, Kachondham Y, Weiss MG. Cultural study of diarrhoeal illness in Central Thailand and its practical implications. J. Diarrhoeal Dis Res 1991;9(3):204-212.
11. Heywood PF. W(h)ither rapid (rural) appraisal techniques in nutrition. Paper submitted to Ecology of Food and Nutrition, 26 July 1990.
12. Grandstaff TB, Grandstaff SW. A conceptual basis for methodological development in rapid rural appraisal. In: Proceedings of the 1985 international conference on rapid rural appraisal. Khon Kaen, Thailand: Khon Kaen University, 1987; 69-88.
13. Carruthers I, Chambers R. Rapid appraisal for rural development. Agricultural Administration 1981;8:407-422.
14. Pattron MQ. Qualitative evaluation methods. London: Sage Publications, 1980.

Proc 6th ACN 1991; 546 – 551

Application of new methodology for comprehensive planning and evaluation of nutrition-oriented rural development programmes at local levels[1,2]

Ma Corazon P Ramos, Josefa S Eusebio, Remedios C Dacanay, Lolita L Lantican

[1]*A joint project of the Institute of Tropical Medicine (IMI, Antwerp, Belgium) Royal Tropical Institute (RTI, Amsterdam Netherlands) and Institute of Human Nutrition and Food (IHNF) College of Human Ecology (CHE), University of the Philippines Los Banos (UPLB) as supported by the Commission of the European Communities "Rural and Development Programme" Science and Technology for Development" (STD), subprogramme: "Medicine, Health and Nutrition in Tropical Areas" [Contract No. CD/E 19's(1988)].*

[2]*The project is under the umbrella programme of the Barangay Intergrated Development Approach for Nutrition Improvement (BIDANI) Network Programme of the IHNF-CHE funded by the Netherlands Government through the RTI*

Introduction

A weak point in any programme or project is the lack of simplified yet workable planning and evaluation scheme. By and large, programmes and projects concurrently failed to show nor to maintain the expected final outcome. The National Economic and Development Authority (NEDA) also raised some problems like: technical correctness, limited interphasing between planning and evaluation; no feedback of results to the source; results are not used for planning activities; low priority given to evaluation; lack of methodological tools for planning and evaluation; and lastly, perceived high cost of evaluation (1). The Boston University Centre for Educational Development in Health (2) identified important issues such as failures (a) to plan on time, (b) to develop consensus and teamwork, (c) to identify and analyse problems and resources, (d) to establish realistic goals and thus, (e) to effectively organise human resources to carry out workable programmes. The source of the breakdown is human failure. However, basic elements for elaborating planning and evaluation methodology are already available.

In 1983, Beghin and associates from IMT and RTI proposed a procedure to assess nutritional status for use in formulating, selecting and evaluating nutrition interventions for nutritional improvement. The proposed methodology consists of: (i) building a causal model, (ii) constructing input, process, output and outcome (HIPPOPOC) tables, (iii) designing a

dynamic model, and (iv) selection of indicators. A testing of the methodology in 1985 made use of existing secondary data from past evaluation studies of BIDANI as the case study area at the UPLB. Results show that the newly created methodology is feasible, and understandable: it suggested that a sizeable proportion of the answers sought through evaluation can be provided if the methodology is correctly applied (3). The methodology need to be proven and validated among users at various administrative or operational levels. As has been adopted and implemented in some parts of the world like Nicaragua, Ecuador, Indonesia, Brazil, a continuous exchange of communication among participating countries was the identification of strength and weaknesses to further improve the methodology.

An attempt was made by UPLB to target local-level programme planner, implementers and trainers in familiarising the concepts and procedures of the methodology. Thus a research was aimed to (i) test a field guide on systematic, practical, comprehensive and participative method of planning, and evaluation of nutrition and rural development programme or projects and (ii) to determine the prospective use of the newly- developed methodology in a City/Municipal Integrated Development Programme.

Method

Preliminary testing of the field guide

Based on the existing draft manual authored by Beghin and associates (4), a field guide with eight (8) modules was drafted combining the text and notes for trainers. Two separate drafts on trainers manual and a field guide were prepared after use of municipal level personnel. Then, same materials were modified and adjusted for municipal users and were tested on November 12-16, 1989 during a seminar-workshop of 12 members of the Tanauan Management and Supervisory Team representing different agencies. The activity consisted of lecture-discussion, and small groups sessions.

Modification of the field guide

Based on the drawbacks gathered from the said activity, modifications were made on some modules. e.g. technical document, dynamic model for its prospective use by municipal level personnel.

Second testing of field guide

A follow-up seminar-workshop was held in January 23-25, 1990 for 26 Tanauan Management and Supervisory Team. This provided an occasion to incorporate the methodology in Planning and Evaluation of a Municipal Integrated Development Plan (MIDP) for 1991 in Tanauan municipality, Batangas province and to discuss the prospective use of the developed methodology in their Municipal Integrated Development Programme.

The seminar-workshop was a mixture of lecture-discussions, workshops, output presentation and open forum on the topics presented by the resource speakers from the BIDANI staff. Learning process derived from the participants experiences, the tested concepts and observations served as basis for the modifications of the material. Thus four parts of the material were completed on planning, evaluation, notes for trainers and a case example. A final output, then was a publication of a field guide (planning and evaluation), and separate supplements for case example (Supllement 1) and notes for trainors (Supplement 2).

Results

The tested methodology was instrumental in the formulation and evaluation of the 1990 Tanauan Municipal Integrated Development Plan (TMIDP).

In the revisions, the tested steps were grouped into two parts: Part I is the Formulation of the City/Municipal Integrated Development Plan (C/MIDP), and Part II is the Evaluation of the C/MIDP.

Part I. Formulation of City/Municipal Integrated Development Plan

This focuses on participatory work, in reconciling the approaches of bottom-up and top-down planning instead of fragmentary, sectoral planning or the decision-making process from the top. Thus, participatory integrated development programme planning was conceived.

Two stages were necessary for the planning of the City/Municipal Integrated Development Programme with sequential steps to be followed (Figure 1).

A. Pre-planning stage

Step 1. Team Preparation: Organisation of the C/MIDP Team

The activity involved an orientation meeting with the mayor, local administrator and line agency personnel on the C/MIDP's goals and objectives, organisational set-up, and duties and responsibilities of the team . This is followed by a seminar-workshop to provide knowledge and skills, and reinforce favourable attitude for the operation and management of a programme.

Step 2. Identification and Selection of the Members of the Management and Supervisory Team.

The programme leads in facilitating the formation of the team composed

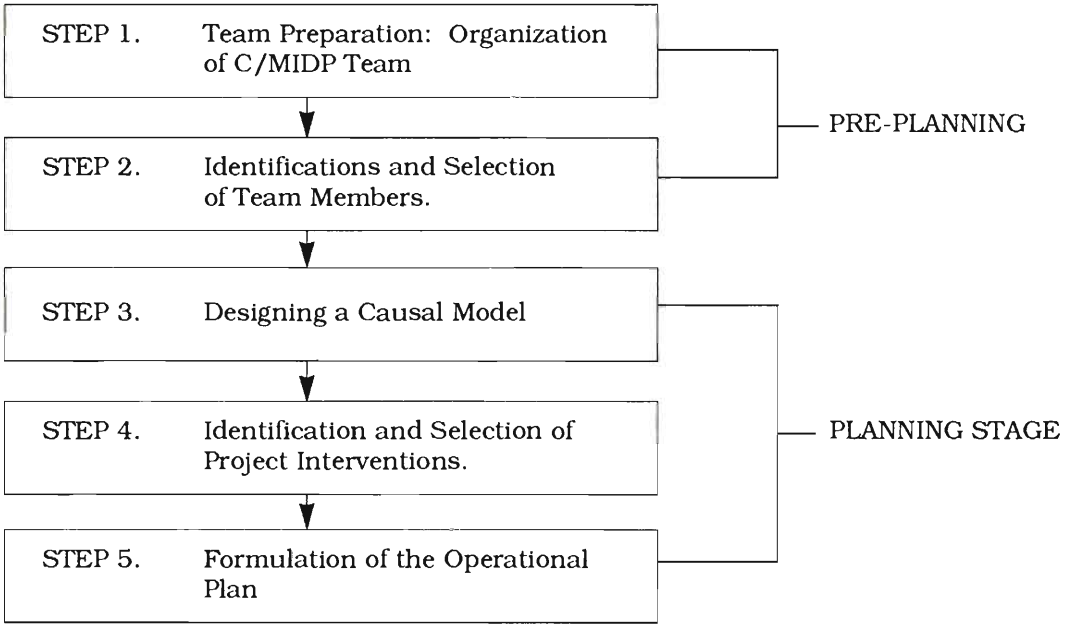


Figure 1. Overview of the Programme Planning.

of;15-24 members selected from the municipal council, heads and field technicians of government and non-government organisations, and duly appointed Municipal Officers.

B. Planning stage

Step 3. Design of a Causal Model

A causal model, as a simplified representation of reality, is a communication tool for use in identifying the causes and mechanisms of a problem under consideration. It is used in situational analysis, identification of relevant interventions and evaluation. Identification and analysis of nutritional situation are conducted during team sessions with free discussion using gathered data, information and observed priority problems of a city or municipality.

Step 4. Identification and Selection of Project Interventions

An intervention is any activity, project or programme to contribute to change, correction or improvement of the root factors identified in the causal model. The same group is convened to select intervention based on the programme action plan.

Step 5. Formulation of the Operational Plan

This is a fundamental tool which describes the characteristics and operation of selected interventions by sector or by sub-team in special sessions, identifying the intervention, objectives, target, operational strategy and resources needed.

Part II. Evaluation of City/Municipal Integrated Development Programme (C/MIDP)

Evaluation is classified in two types such as (i) process evaluation which is an analysis of the transformation of its inputs to outputs, and (ii) results evaluation which is an analysis of output and outcomes to effect the major determinants of problem in hierarchical manner.

A new methodology for a systematic, comprehensive and participatory approach to monitoring and evaluation of programmes, projects or activities stipulated in the C/MIDP is presented in Figure 2 in sequential steps for two stages.

A. Pre-Evaluation Stage

Step 6. Organising an Evaluation Team

The evaluation team consists of internal evaluators who are directly involved in the programme and specialists of experts as indirectly participating. The team formulated relevant questions for evaluation and corresponding objectives based on their need.

B. Evaluation Stage

Step 7. Constuction of Hypothetical input-Process-Output-Outcome (HIPPOPOC) Table

The HIPPOPOC table describe the different components of the intervention such as input (financial, human, technical resources), process (action or steps to be done to transform inputs), outputs results anticipated from operational objectives of project), and outcome (result from a combination of action undertaken by the project).

Step 8. Designing a Dynamic Model for Specific Project

This is a comprehensive and structured explanation, represting the transformation of input into final outcome. It is a combination of operational

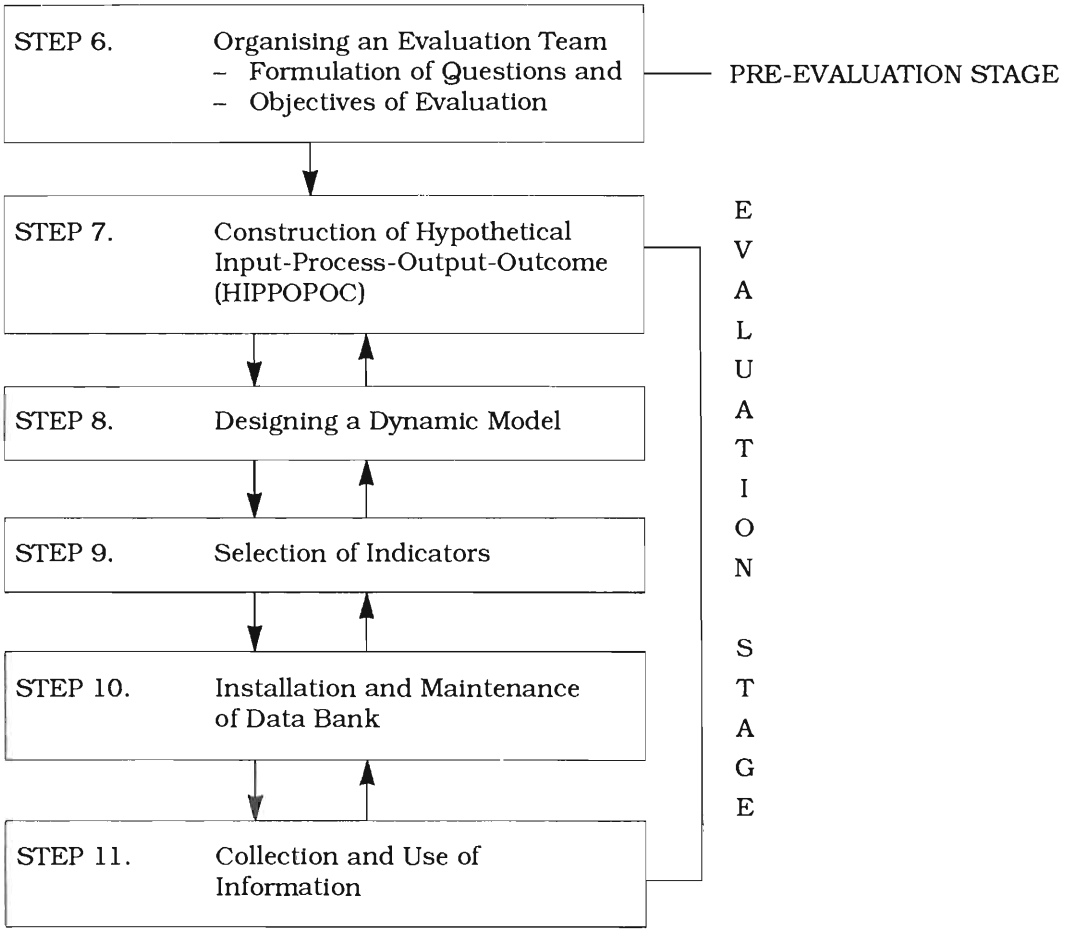


FIG 2. Systematic, comprehensive and participatory approach to monitoring and evaluation of programmes.

approach (shows how inputs are transformed through series of process into outputs) and outcome approach (presents analysis of major causes of problem in hierachical manner), utilising a prepared causal model and HIPPOPOC table.

Step 9. Selection of Indicators

Indicators are selected on the basis of the contained variables for input, process, output and outcome column of the HIPPOPOC table, or the dynamic model based on formulated questions and objectives of evaluation.

Step 10. Installation and Maintenance of Data Bank

Data information system at the municipal level is established for data collection to sustain and increase data quality and to improve flow of information through assigned personages. A yearly calender of activities for the data bank is also prepared.

Step 11. Collection and Use of Information

An organised data collection scheme with functioning data bank in place is transformed into useable form,

its validity counter-checked and reliability ensured, as basis in evaluation of C/MIDP.

The managerial capabilities of mayor, heads of different line agencies, field personnel staff of government and non-government organisations are believed to be enhanced by an update on new methodologies in planning and evaluation.

Discussion

The cohesive spirit and interest manifested by the Tanauan municipal management team with the new methodology introduced brought better teamwork to pursue on all the steps necessary to come up with the C/MIDP. The level of comprehensiveness and length of work exposure of the participants added to careful appraisal of specific steps. In actual programme management and operation, the adaptability and usefulness of methodology will vary depending on the working environment of the locality. The working environment brings forth obstacles and confounding factors such as political support, low levels of functional literacy, structural and institutional barriers, the bureacracy, etc.

To conclude, the basic underlying concepts were proven to acceptable (3) and considerable insights were gained on the usefulness of the theory and practice of comprehensive planning, monitoring and evaluation of nutrition-oriented rural development programmes at local levels.

The need is to further adapt and retool for simplication the methodology for use in communication, training and management at local levels to increase efficiency and nutrition impact despite intensive training during pre-testing and some validation. Aside from being comprehensive, the methodology should also be participatory. The exchanges/interactions that are needed exert undue demands on time and resources to convene people.

References:

1. Juat V. Monitoring and Evaluation in an Urban Setting. NEDA Report delivered during the 42nd Annual Convention of the Philippine Association of Nutrition, Inc. July 20-21, 1989, Occupational Safety and Health Centre. North Avenue, Diliman, Quezon City.

2. Vandershmidt L and Lent M. Systematic Project Design: A Handbook for Volunteer, Boston: Boston University Center for Educational Development in Health, 1981.

3. Beghin I, Eusebio J, Kusin J and Van der Stuyft P. Development of a methodology for selection, formulation and evaluation of interventions aimed at improving nutrition of the rural poor. Medicine, Health and Nutrition in Tropical and Sub-tropical Areas. First STD. Programme (1983-1986). Institute of Tropical Medicine (Antwerp, Belgium).

4. Beghin I, *et al.* Comprehensive Evaluation of the Nutritional Implication of Projects and Programmes: A Field Guide (Draft), 1989.

Proc 6th ACN 1991; 552 – 553

Maximising potential for dietetic professionals in Asia

Leh-Chii Chwang

Department of Food and Nutrition, Veterans General Hispital, Taipei, Taiwan

Introduction

As one of the resolutions evolved from the first Asian dietitians meeting during the Asian Symposium on Rice and Nutrition, organised by the Taipei Dietitians Association in 1990, a questionnaire on manpower, training and role of dietitians in Asia was sent to the participating dietetic/nutrition associations : Hong Kong Nutrition Association (1980), Indonesia Nutrition Association (1957), Japan Dietetic Association (1945), The Korean Dietetic Association (1969), Nutrition Society of Malaysia (1985), Nutritionist-Dietitians Association of the Philippines (1955), Singapore Nutrition and Dietetics Association (1984), Dietitian Society of Thailand (1965), and Taipei Dietitians Association (1989). The total number of dietetic professionals from the aforementioned associations is around 36,600, which is mainly composed of dietitians from Japan, Philippines and Korea, the three oldest dietetic organisations in Asia. The estimated number of practicing dietetic professionals in Asia exceeds 1000,000.

The present status of dietetics profession

Dietetics is the application of food, nutrition, biochemistry, management and social science to promote optimal nutritional status of the population. The wide educational background has provided a base for a variety of activities for dietitians.

The majority of dietitians are working in hospitals and other health care facilities delivering patient care through dietary consultation and food service management.

With the increasing awareness of nutritions and rapid expansion of knowledge of food and nutrition, dietitians are practicing in diversified worksites throughout Asia. A growing number of dietitians are working in government and community agencies, and in schools and universities. They are employed as consultants to guide the public towards sound nutrition, and as managers of quantity food service, and school nutrition program.

It is interesting to note that some dietitians, though the numbers are not large, are private practice, academia and industrial corporations. They are engaged in individual consultation, teaching and research, and product development and promotion.

Qualification of dietitians

Except for Hong Kong and Singapore, undergraduate and graduate level of training are available domestically in Asia. It is generally regarded that dietitians are nutrition and dietetic majors,

who have completed certain specific academic requirements and/or with internship components from accredited college or university. Percentage distribution of the core courses differing from country to country indicates varying emphasis on educational foundation. Whether current curriculum could meet career challenges is worth discussing.

Licensure and qualification examination of dietitians are mandatory in Japan, Korea, Philippines and Taiwan, ROC. Areas of examination include: nutrition science, food science and sanitation, therapeutic nutirition, food service administration, community nutrition, biochemistry and physiology. In addition, Law/Act regulating dietitians have also been passed in these countries.

Career enhancement

Though the precise supply and demand for dietetic manpower is unavailable, it appears that the scope of dietetics continues to broaden. In order to extend career opportunities, appropriate training and education must be formulated to develop professional competence and expertise. Efforts must also be made to improve image and positioning of the dietitian.

In addition to completion of academic preparation and requirement of continuing education, dietetic registration or licensure should be encouraged to safeguard the quality performance of dietetic professionals, and for the benefit of the public.

Consideration should be given to the representation of dietetic professionals in dietetic/nutrition associations, or to the formation of a dietetic organization that would especially concern and facilitate the interests of dietetic professionals.

Acknowledgment

This research is supported in part by Taipei Dietitions Association, Taipei, Taiwan, ROC.

Proc 6th ACN 1991; 554 – 560

Combating malnutrition in Asia

Myra Bondad

Project Officer/Nutrition, UNICEF Hanoi and Member, Nutritionist - Dietitians Association of the Philippines

Introduction

Global assessments of child malnutrition have shown that nearly one child in two is malnourished in Asia and that this region bears the burden of at least two-thirds of the problem of child malnutrition in the world (Table 1). With the slow decline in the proportion of underweight children in this region, coupled with the increase in child population, the number of malnourished children continues to mount. While recognising that the regional average can hide important country differences, the magnitude of the problem in the region is still staggering. Asia's malnutrition problem must rank as one of the world's most serious issues of human welfare.

TABLE 1

Global and regional prevalence of malnutrition in children under five[1]

Region	Underweight (Weight-for-age)		Stunting (Height-for-age)		Wasting (Weight-for-height)	
	Millions	%	Millions	%	Millions	%
Total Developing	150	35.7	163	39.0	35	8.4
Africa	29	26.6	39	35.3	11	10.2
South Asia[3]	73	45.2	66	41.3	16	9.8
Rest of Asia[2]	40	43.3	43	46.2	7	8.3
Americas	8	13.8	15	27.7	1	1.3

[1] Percent below reference median minus two standard deviations
[2] Excluding China
[3] Afghanistan, Bangladesh, Bhutan, India, Maldives,Nepal,Pakistan and Sri Lanka

Source: A Global, Regional and Country Assessment of Child Malnutrition 1990, UNICEF.

In many of the poorer communities dietary inadequacies may be caused by an inadequate supply of food or by mothers having too little time to prepare food or to adequately feed their children, or ignorance. Similarly, death from disease may result from one or a combination of causes, such as the lack or low utilisation of health services, inadequate water supplies and sanitary facilities, poor food hygiene or inadequate child care (Tables 2 and 3).

TABLE 2

Nutrition, food and health situation in some Asian countries

Country	% Children (1980-89)								
	Underweight Moderate/ severe	Severe	Wasting (12-23 months)	Stunting (24-59 months)	<5 Mortality Rate (1989)	IMR (1989)	%LBW (1980-88)	Food Production Index/ capita	Daily/ Capita Calorie Supply
Bangladesh	71	31	70	70	184	116	28	170	83
Pakistan	52	10	17	42	162	106	25	350	97
Indonesia	51	1	11	46	100	73	14	124	116
Viet Nam	42	14	12	60	84	61	18	113	105
Myanmar	38		17	75	91	67	16	120	119
Laos	37		20	44	156	106	39	120	104
Philippines	33	2	7	42	72	44	18	88	104
Thailand	26	4	10	28	35	27	12	108	105
Malaysia	24		16	22	30	23	9	153	121
Cambodia	20	3		200		127		145	98
Korea, Rep.			31	24		9	99	122	
Korea, Demo			36	27			108	135	

Source: The State of the World's Children 1991, UNICEF

TABLE 3

Water/health services and breastfeeding practice in some Asian countries

Country	% Population with access to safe water 1985-88	% Population with access to health services 1985-88	% of mothers breastfeeding 1980-88		
			9 mos	6 mos	12 mos
Bangladesh	45	45	91	86	82
Pakistan	44	55	87	74	51
Indonesia	38	80	98	97	76
Viet Nam	46	80	–	–	–
Myanmar	27	33	–	–	–
Laos	21	67	–	99	93
Philippines	52	–	–	74	–
Thailand	64	70	83	79	68
Malaysia	84	–	88	–	–
Cambodia	3	53	100	93	72
Korea, Rep.	77	93	58	–	27
Korea, Demo	–	–	–	–	–

Source: The State of the World's Children 1991, UNICEF

It is only in a particular context that the exact causes can be identified. These underlying causes can be numerous and are usually interrelated. Most of them can be considered as the insufficient fulfillment of specific needs of children and women. The causes are usually multiple, and the mix can vary over time and place and as such the appropriate dietetic strategies to improve nutrition. Nonetheless, three basic dietary strategies can be identified as critical in any situation.

Improving maternal nutrition

Dietary support for a child's growth and development starts at conception. Under normal conditions, the mother's weight increases, on the average, 12.5 kilograms during pregnancy. However, studies have shown that in some Asian countries nutritional intakes during pregnancy are generally low and the total energy intake is deficient.

Most of maternal undernutrition is closely linked to poverty. It is common knowledge that a woman's activity may not decrease even at the end of pregnancy to maintain or supplement the family's income. Many women continue to till the soil, carry wood and water and take part in other strenous jobs until delivery (Table 4).

The increase in dietary intake to meet the energy and nutrient needs during pregnancy, especially during the second and third trimesters (four to six months and seven to nine months), can be met if the mother eats about one-fifth more of her ordinary mixture of foods provided that she is already consuming an adequate diet (some 2,000 kcal daily). Any dietary advice given to her at this time must be in terms of foods familiar to her, and expressed in quantities of local measures, such as handful of rice, or extra pieces of bread with stew.

Mother from the poor sectors of Asian society frequently have not only inadequate diet available (Table 5) but also very limited opportunites for

TABLE 4

Rural women's daily work patterns (hours) in Asia

Location	N	Child care	Food activities	Fuel/Water hauling	Other	Agri-culture	All others
Bangladesh	174	0.8	3.52	0.36	2.01	0.28	1.33
Java	33	1.02	2.71	0.07	1.33	1.44	4.49
Nepal	171	1.32	2.6	0.12	0.98	4.73	2.68
Pakistan	63	0.50	3.25	0.5	3.75	3.75	2.75
Philippines	99	2.06	2.06	0.07	3.23	0.85	1.72

Source: McGuire J and Popkin N. Beating the Zero Game: Women and Nutrition in the Third World. ACC/SCN Symposium Report, Nutrition Policy Discussion Paper No. 6, October 1990

TABLE 5

Summary of studies on dietary intakes of women in some Asian countries

Study	Sample	Calories (kcal)	% WHO RDA	Protein (g)	% WHO RDA
India	Low SES:				
	Pregnant (100)	1815	76.1	44.0	93.5
	Lactating (70)	1858	71.5	42.7	73.0
India	LW : very poor (54)	1439	55.3	39.6	67.7
	poor (50)	1872	72.0	46.1	78.8
	middle (57)	1906	73.3	47.2	80.7
	upper middle (49)	2279	87.7	55.6	65.9
India	LW : (39): 4 wk	1702	65.5	35.0	59.8
	16 wk	2090	80.4	42.6	72.8
	52 wk	1711	65.8	35.6	65.9
Korea	Avg. SES, rural Pregnant (93)	2635	110.5	77.5	164.9
Philippines	Urban household survey: Housewives (94)	81.7%	81.4%		
	Adult offspring (31F)				
Philippines	URBAN Pregnant:				
RURAL	3rd trimester (255)	1595	66.9	51.0	108.5
	Pregnant: 3rd trimester (772)	1159	48.6	38.3	81.5
Singapore	Random clinic patients 3rd trimester (23)	2487	104.3	69.0	146.8

Source: McGuire J and Popkin B. Beating the Zero Game: Women and Nutrition in the Third World, ACC/SCN Symposium Report, Nutrition Policy Discussion Paper No. 6, October 1990.

proper antenatal care, which includes the prevention and treatment of malaria, anaemia, and infections due to inadequacy of health services. This largely explains why lower birth weights are found in these groups. The poor diet may be caused by poverty, but more often it is due to ignorance or to food taboos imposed especially during the first pregnancy which are not corrected during the course of prenatal care.

To ensure the best foetal growth and thereby give the child a good start, it obviously is important to supervise the pregnancy as closely as possible. That includes preventing and treating infectious diseases, and making the mother and father understand the importance of a good and sufficient diet. In addition, the parents should understand the need to slow the work pace of a pregnant woman or at least include regular daily rest periods to allow her to recuperate before delivery.

Breastfeeding

Breastfeeding provides the necessary energy and nutrients for growth during the first four to six months of life. Because breastmilk is both rich in nutrients and has a high-energy density, among other benefits, it is important to promote breastfeeding for up to two years of age or longer.

Breastfeeding has been identified as a key strategy not only for improvement of child nutrition but also for the attainment of other child survival and development goals, such as : control of diarrheal diseases, birth spacing, and mother's health and well-being. A gobal goal has been set to empower mothers to breastfeed their infants exclusively from birth through 4-6 months of age, and to continue breastfeeding with the addition of complementary foods for up to two years or longer. The stragety to achieve that goal is to create an environment of awareness and support such that those women who choose to exercise their right to breastfeed are able to do so.

Some progress has been made in protecting and promoting breastfeeding in Asia as a result of the World Health Organisation (WHO)/United National Children's Fund (UNICEF) International Code of Marketing of Breastmilk Substitutes and of other initiatives - principally those of UNICEF, the International Baby Food Action Network (IBFAN), and the national governments in the region. More work, however is needed in this area as in the case of restricting the availability of feeding bottles, among others.

Among urban families, if the women are in the labor force, they might be entitled to paid maternity leave for a month or two and breastfeeding might be replaced with bottle feeding by the time the infant is just a few weeks old. Arrangements should be made at a mother's place of work to enable her to breastfeed her baby for a suitable length of time.

As in other regions, there seems to be the same trend toward shortening the duration and making more extensive use breastmilk substitutes in Asian countries. This tendency has spread from the privileged classes especially in the urban areas. Thus, there has to be a strong commitment and advocacy for social mobilisation of the "bottle-feeding culture" while at the same time empowering them and ensuring them adequate nutrition for optimal health.

Young child feeding

The term wean which comes from an ancient word that means "accustom" has come to mean the period during which an infant gradually becomes accustomed to food other than breast milk. This also has been called the "transitional period", and in many developing countries cover the

time between six months and about 2 and 1/2 years, when the incidence of protein-energy malnutrition and other deficiency diseases is at its height. The well-being of the infant during the weaning period depends on : the environment in which the baby lives; the length of the period on exclusive breastfeeidng; whether weaning is abrupt or gradual; the quantity and quality of weaning food; and, the hygiene (or lack of) practices during food preparation.

One of the greatest dangers of the weaning period can be the result of the change over from sterile breast milk and its anti- infective factors to animal milk, semisolid and solid foods, often acquired, stored, and fed in unhygienic and unsanitary fashion. In fact, weaning process is associated with the highest rate of infection, particularly of the gastrointestinal tract, that the child will encounter in its entire lifetime. Infections, in turn, prepare the way for malnutrition and exacerbate th effects of dietary deficiencies - hence the well known vicious circle of malnutrition/infection/malnutrition.

Weaning starts at various times and is considered to end when breastfeeding is stopped completely. It may not begin until well into the second six months of life and may be extended for more than two years. In exceptional cases, it might last up to four years. In the poor urban communities, there is a clear-cut tendency to start weaning when the infant is only a few months old. Sometimes, the process may be extended to a year or more, but often breastfeeding stops before six months of age and from then on the young child must depend solely on foods other than breastmilk. This is critical and often leads to early undernutrition.

Weaning should always be gradual but it is not impossible to formulate a weaning schedule that will suit all conditions which vary from country to country and from rural to urban. Therefore, weaning schedule best suited to each area should be worked out locally by the appropriate health personnel. This requires knowledge about breastfeeding patterns, existing weaning practices, and the available foods, either those produced by the family or purchased at the local market. It is a good rule to try to modify existing feeding pratices rather than condemning them. The same applies to those weaning foods that have poor nutritional value, that is, modify them so that they are more nutritious and suitable for the young child.

Improving the dietary patterns in Asia involves confronting a rapidly changing environment and several key challenges.

On the positive side, the concept of approaching nutrition has gradually shifted from curative to promotive as scientific knowledge increased in modern societies and the biological basis for malnutrition became well established. This change in focus includes increased attention to the social issues that lie at the roots of malnutriion and increase its risks.

The rate of expansion in scientific knowledge is almost incomprehensible. Knowledge of malnutrition, the body's intricate chemistry, and its interaction with the environment is constantly increasing. Computers and nutritional analysis software have become regular tools for use in assessing nutritional status, planning for nutritional care. In addition, there has been recognition of the contribution of the behavioral sciences - sociology and anthropology - in providing insights concerning human behavior in response to illness and other life stresses as well as to food habits. These scientific and social developments, together with changing attitudes toward nutritional health and diseases will certainly produce far-reaching effects on the health care system

Although we now seem to know about how to deal with the malnutrition problem, the relentless statistics on child malnutrition in Asia continue to stare at us. Although we know the general strategies to tackling it, we must recognise that nutritional well-being is a relative concept in any culture and it must be viewed in relation to a person's total wants and needs. Nutrition competes with other values and is relative to a culture's way of life. And, Asia has a diversity of cultures. Achieving impact through dietetic strategies pose a formidable challenge because it requires careful consideration of the appropriateness and compatibility of technologies to the culture and way of life of the people.

References

1. Carlson B and Wardlaw TA. Global, Regional and Country Assessment of Child Malnutrition, UNICEF Staff Working Paper Number 7, April 1990.
2. Cameron M and Hofvander Y. Manual on Feeding Infants and Young Children, Second Edition, Protein-Calorie Advisory Group.
3. McGuire J and Popkin B. Beating the Zero Sum Game: Women and Nutrition in the Third World. ACC/SCN Symposium Report, Nutrition Policy Discussion Paper No. 6: Women and Nutrition, October 1990.
4. UNICEF. Strategy for Improved Nutrition of Children and Women in Developing Countries, A UNICEF Policy Review, 1990-1.
5. UNICEF. State of the World's Children 1991.
6. WHO. Protecting, Promoting and Supporting Breastfeeding: the Special Role of Maternity Services, a Joint WHO/UNICEF Statement, 1989.
7. WHO/UNICEF. Infant and Young Child Feeding Current Issues, 1991.

Proc 6th ACN 1991; 561 – 562

Interfacing nutrition policy with dietetic practice

Tan Wei Ling

Food and Nutrition Department, Ministry of Health, Singapore

Introduction

In the recent decades, there has been much government and public interest in health and the principal causes of morbidity and mortality in many countries. This has resulted in many human nutrition research on diet and chronic disease relationships. Scientific studies and epidemiological investigations of diseases like coronary heart disease, hypertension and stroke, diabetes mellitus and cancer have shown associations between dietary patterns and disease prevalence; some of these associations are strong, some are weak, and in others, the dietary link is suspected but not proven. These observations, together with the reorientation of health policies towards disease prevention and health promotion and the increasing pressure to provide health for all by the year 2000, have led many governments and health institutions in Asian countries into formulating national nutrition policies.

Nutrition policy

A nutrition policy aims to improve the nutritional status and thereby the overall health and well-being of the people through the food they eat. It contains a set of measures based on scientific principles and directed towards ensuring an adequate and safe food supply of good nutritional quality. Such a food supply has to be accessible, affordable, properly labelled and appropriately promoted to all population groups. Measures thus have to include intended actions to increase consumers' awareness of the associations between diet and health, widen the variety of healthy food choices, and encourage and facilitate the consumption of a healthy diet.

The task of formulating and implementing national food policies is indeed multi-sectorial in nature. It will demand close links between sectors dealing with nutrition research, health, finance and economics, agriculture, food industry, food and environment control, consumer affairs, education and public information. The nutrition and dietetics community has a fundamental and leadership role to play in shaping the nation's nutrition policies. Armed and equipped with the scientific knowledge and skills of food and nutriton matters, it is in a unique position and should consider its top priority to enhance the understanding of both policy-makers, food and nutrition related professionals and scientists, as well as the public, of the importance of nutrition to the health and well-being of the nation.

Nutritionists and dietitians must work in partnership with counterparts in related sciences and services, and develop logical and productive coalitions for effective actions. Areas of collaboration include formulating and conducting periodic reviews of national dietary guidelines, protocol and standards for disease treatment and

prevention; providing consumers with dietary guidance and consistent nutrition information and messages; encouraging and supporting the food industry in producing, developing, labelling and marketing a healthy food supply; participating in research and developing effective tools for nutrition monitoring, surveillance and evaluation; providing technical support for legislation that enables consumers make informed food and menu choice; and achieving nutritionally sound and effective food service, not only in hospitals and health care institutions, but also in armed forces, school canteens, student hostels, day care centres and homes for preschool children and the elderly, workplace canteens and in mass catering at public eating places.

Conclusion

Increasing interest in nutrition policies by governments has definitely posed a tremendous challenge to the dietetic profession. In the next decade, the dietetic practice in Asia has to upgrade its expertise and extend its scope of services beyond hospital walls in order to be fully in line with the increasing reorientation of health policies towards disease prevention, nutrition promotion and the creation of a favourable environment for healthy eating.

Proc 6th ACN 1991; 563 – 564

Upgrading food services in non-profit institutions

Teiji Nakamura

St. Marinna University Seibu Hospital, Yokohama City, Japan

Introduction

In recent years extensive reforms are demanded in non-profit institutions like hospitals, schools, and welfare facilities. This is because users expect to be able to use not only the functions originally inherent to these facilities, but in addition be able to use them comfortably. For example, items highly evaluated by hospitalised patients are the friendliness of doctors, nurses and dietitans, tastiness of the meals, cleanliness of the facility and the like. These items are now evaluated according to the same standards applied to hotels. In this regard we must consider hospital meals not only with respect to its therapeutic effect in dietary therapy, but similarly as an item determining a comfortable hospital stay. Improvement of hospital food services has in the past few years frequently been reported in newspapers, magazines, television etc.

Hospital food services

The present hospital food services are troubled by the following concrete problems.

1. Dinner time is too early
2. The meal is already cold
3. There is no choice of menu
4. The place where the meal is taken is inadequate

According to a national investigation carried out in 1989, the percentage of dinner served after 6 pm is not more than 21.8% of the hospitals. The rest of the hospitals served dinner before 6 pm. For the Japanese at present the average dinner time is between 6:30 and 7:30 pm. Therefore, the meal provided in hospital is comparatively very early. However, in recent years the number of improving hospitals is increasing.

To serve a meal of adequate temperature thermoisolatory tableware, trays and carts are required but at present only 29.6% of the hospitals possess these kind of equipment. Moreover, these conditions exist for the last 2 or 3 years, such that services in hospitals have become social problems.

Only a few percent of the hospitals realised the importance of the choice of the menu, as it is seen in the industrialised countries of America and Europe.

The environment for meals also need consideration. We established a dining hall exclusively for patients in one corner of the ward. The interior of this dining hall was fashionably designed like a restaurant with background music during meals. Patients requiring rest should not use this facility, but it strictly meant for dining purposes. Thus going out to the dining hall to have a meal can change mood and increase appetite. We began testing this facility in our hospital approximately 15 years ago, and this kind of facility to improve the enviroment of

meals are spreading nationwide. An investigation reveals that 55.9% of the patients who formerly took their meals could not eat in their room, but after coming to the dining hall they began to eat again. The main reason cited here was "I can eat in the dining room because of the good atmosphere there".

However, an increase in medical expenses has recently developed into a social problem. When these expenses continues to increase as before and in conjunction with the growing population of aged people, it was forecasted that the cost will exceed 10% of the GNP in the 21st century. This would lead to a situation where one works to pay for medical expenses. The government is putting a scheme into action to stop the increase in medical expenses and curb welfare budgets. Accordingly, the income from medical services may not necessarily be sufficient for the hospitals. Additionally, rising labour costs, shortage of personnel and reduction of working hours also pose problems. Establishment of a reasonable and efficient system is required in order to improve the above mentioned services.

Being heartily felt and rationalisation of the services, these sounds first paradoxical, but it is the demand systematisation of the food services. This is the basic proposition for the future. I propose as a solution according to the concept of "soften outside and hardening inside". That idea envisions employment of sufficient personnel in places where there is direct contact with the patients to attain a soft, humane performance, and in places where personnel is not directly related to patients, e.g., administration and cooking, consequent promotion of rationalisation.

Upon establishment of a concrete system one deals finally with the three factors namely man, machinery and information. A good system works rationally while maintaining mutual interaction of these factors. To run the individual factors rationally people need education and training, information requires computerisation systems and the machinery be automatized. Finally it may require robotisation.

When we enter this kind of era, turning toward the 21st century, we need not be a dietitian calculating caloric values and preparing the menu, but a system of computers and robots. Additionally, we will need the knowledge and the technique to satisfy human emotional needs.

Proc 6th ACN 1991; 565 – 568

Marketing dietetics in the 90's

[1]MI Prakoso, [2]S Sutardjo, and [1]K Sukardji

[1]Dr Cipto Mangunkusumo Hospital, Jakarta, Indonesia
[2]Centre of Education and Training for Health Personnel, Department of Health, Indonesia

Introduction

Like most developing countries, Indonesia is facing nutritional deficiency problems which are known to have serious health consequences particularly among young children, pregnant and lactating mothers. Recently malnutrition among hospitalised patients has been recognised. The number, types and levels of training of nutrition manpower required in Indonesia have been based on the needs of existing nutrition programmes.

With the improvement in the social economic conditions, environment, health services and the increase of the life expectancy rate, the disease pattern among the population has changed. By the year 2000, we may be facing more problems of nutritional deficiency and infectious diseases and at the same time chronic degenerative diseases. In the coming 25 years, curative services and preventive services are planned by our government to be integrated in the daily life of the community and nutrition improvement will be emphasised to lighten for the prevention of over-nutrition or the prevention of the risk of degenerative diseases. The promotion of healthy food diversification will still be carried out (1).

Recently the subject of nutrition and dietetics in developed region of Indonesia has become so popular that the general public are interested in the healthy way of life. And in the last decade we have heard and read a great deal about the benefit ouf social marketing. Several articles focus on the importance of social marketing in the health care field, including marketing for dietetic professionals. With this improvement, all nutrition professionals in Indonesia and other Asian regions should be made aware about this situation.

Dietetic practices in the 90's

At the moment, the dietetic practitioners in Indonesia are not called "dietitian", but they are called nutritionist (Ahli Gizi, Ind.). This include both who work as community nutritionist as well as in the hospital or other institutions. Most nutritionists in Indonesia are employed by government institutions, 87% in the field of health/nutiriton while 20% worked in hospitals. The scope of dietetic practice is broad; the majority of the professionals involved are presently working in the hospitals, as community nutritionists, and in education and research institutions while a small number are working in the business and industrial sector and as consultants. To become a nutritionist in Indonesia, we have to attend a three years course after finishing high school. A BSc/D3 Diploma in nutrition is awarded. A D4 Diploma in nutrition will be awarded for an

advance course of 1 1/2 years, which is equal to a graduate study from a faculty which is usually a 4-5 years education who hold an Strata-1 (S1) degree Diploma. A post-graduate course for Master degree (S2) or Doctorate degree (S3) needs another 2-5 years.

Nasution (2) had described that in the future, most nutrition professionals of course will be the persons who carry out government policies on food and nutrition in several departments such as Dept. of Health, Home Affairs, Agriculture and Transmigration. Due to the projections of the social economic behaviour and conditions of the population, the future nutritionist should become or capable of:

1. Inventing new recipes which are practical, nutritious, modified traditional recipes of all the regions.
2. Food Inspector for quality assurance of food, hygiene and sanitation in food service institutions, due to the increasing number of restaurants, cafetarias etc.
3. Increasing efforts in fast food management.
4. Solving the problems concerning psychology of food selection, feeding and appetite.

Karta (3) indicated that factors known to influence the demand for dietetic services are social and economic trends, public policy, health values, attitudes and behaviours, technology diffusion, competition and professional leadership. Potential field opportunities for dietitians are health care institutions, government organisations, educational institutions, business and industry and private health clinics.

Helm (4) described the diverse career avenues which dietitians can pursue:

- Writing and speaking
- Consulting to hospitals on clinical specialities and in health programs
- Acting as sales representatives in business and industry
- Offering nutrition assesments in private offices
- Consulting at eating disorders clinics
- Consulting on media, marketing and food technology for food industries
- Consulting on kitchen design and management
- Development of computer software

An Indonesian nutritionist, Sunardi (5) who has become a public figure, succeeded in improving and promoting enterpreneurship in the field of food and nutrition. She has been doing dietetic practices as follows:

1. As permanent writer for a nutrition column of some magazines.
2. She creates new recipes for magazines, food factories etc.
3. Delivering talks on food, nutrition and diet, for women organisation in Jakarta, and other cities of Indonesia.
4. She is a nutrition consultant for supermarkets, and food factories.
5. She develop a home catering service for special diets.
6. Conduct symposiums and seminars.
7. Lecturer at the Academy of Nutrition.
8. Author of 4 (four) famous recipe books.
9. Established a firm : Indonesian Culiner Institute.

Wellness of the people and the private sector will be the greatest areas of future job growth. There are more people who are well and want to stay healthy. Acute care will always be important, however, more people are

interested in good eating, healthy foods, sports nutrition, prevention nutrition, weight loss, eating disorders, and nutritional changes through the life cycle. Individuals are encouraged to be responsibile for themselves. Marketing to reach this public sector will become our professional challenge. The possibilities range from creating a simple menu/recipe item until taking responsibility of a more complex challenges i.e. the enteral product formulation. Nutrition professionals should have an optimistic mind, as it is said by Dodd (6) that the 1990's promise unlimited opportunities to use our skill to fill an unmet need in the market place of nutrition and dietetics.

Why marketing

In Indonesia most nutrition professionals are employed by goverment institution, mostly in the field of health/nutrition (87%) and small number are working in the business and industrial sectors. We are highly dedicated employees carrying out goverment policies.

Why Marketing ? The answer is simple, to increase our efforts in our professional ability, to advance our individual careers and our profession, regardless of whether we are working in a hospital or community setting.

Parks and Moody (7) mentioned that a maturing profession with static strategies will limit the professional future growth. What strategy can dietetic/nutrition professionals adopt to survive in the next several decades ? The available strategies include : (1) developing entrepreneurs, (2) introducing the marketing concept into practice, (3) stimulating innovation and creative thinking, and (4) identifying strategic thinkers into the profession.

Furthermore Dunlop (8) described that marketing:

a. Represents way of thinking that helps practitioners respond to potential opportunities in the health care field.
b. Can help develop abilities for planning profit-making strategies.
c. Causes an organisation to focus on its consumer services. Through a market orientation, programmes and services can be developed to meet the wants or needs of identified publics (patients, hospitals, referring agencies and employers).
d. Can guide a health organisation in adopting/implementing strategic plans to accomplish its objectives.

Implementing the marketing dietetics

The skills and knowledge now becoming necessities for most practitioners in their work setting (4):

* Management skills so that practitioners are more involved in policy making and revenue allocation.
* Communication skills (writing, speaking, media work and scientific publishing) so that practitioners can be recognised more readily as experts in their field.
* Marketing know-how to be involved more effectively with the "buying" public who inevitably supports us.
* Networking can expand the practitioner's influence, power, resources, and professional and personal fulfillment. Nutrition can not be seen as a single narrow field, but as one of many dynamic ones.
* Negotiating skills should be improved for power and effectiveness.
* For counsellors, their level of humanistic care can be expanded through more expertise in hebavioral and social sciences.
* Learn how to influence public policy and become active in the process.

* Learn how to influence public policy and become active in the process.

A list of potential individual and organisation in Indonesia are available to be included in the marketing activities:

1. Women organisations:

   PKK = Family Welfare Movement

   Dharma Wanita = Organisation of Wives of Civil Servants

   IWAPI = Business Women Organisation

   KOWANI = Congress of Indonesian Women

   PIA Ardiagarini] Organisation of
   Jalasenastri] Wives of the
   Bhayangkari] Army
   Dharma Pertiwi]

2. Professional HealthOrganisation/ Association (Medical, Nursing etc.)
3. Hospitals
4. Health Foundations (Cancer, Heart)
5. Fitness centres
6. Individual & Group of Physician
7. TV, Radio, Magazines
8. Supermarkets, Food Industries
9. Cooking School Directors, etc.
10. Food & Agricultural Organisation/ Association

Summary

Today activities of dietetic professionals are increasingly varied, providing challenging diverse career opportunities ahead. Not only as the person who carries out government policies on food and nutrition, but "wellness" of the people and the private sector will be also the areas of future job growth.

To be ready to meet the necessary challenge, new skills and knowledge are needed outside the formal training programme.

References

1. Brotowasisto. Dimensi Kesihatan dan Pembangunan Jangka Panjang (Dimension of Health and Long Term Development Plan). Seminar Ahli Kesihatan Masyarakat. July 2, 1991.
2. Nasution AH. Program Pendidikan Tenaga Gizi Menghadapi Masa Depan (Nutrition Manpower Training Program to meet the future). Prosiding KPIG VIII, 1989; 126.
3. Karta SK. Dietetic Practices in Singapore - Challenges Ahead. The Singapore Dietitian 1989; 4(2): 7.
4. Helm KK. The entrepreneurial nutritionist. NY: Harper & Row, 1987.
5. Sunardi T. Kewiraswastaan dalam Pangan dan Gizi, Pengalaman Pribadi (Interprenership in Food and Nutrition, a Private Exprience). Prosiding KPIG VIII, 1989, 134.
6. Dodd JL. Marketing skills for the 1990's: Practical steps for promoting dietetic professionals. J Am Diet Assoc 1990; 90: 37.
7. Parks SC and Moody DL. Marketing: A survival tool for dietetic professinals in the 1990's. J Am Diet Assoc 1986; 86: 33.
8. Dunlop BJ. Marketing in the health care arena: A preventive approach. J Am Diet Assoc 1986; 86: 29.
9. Manoff RK. Social Marketing: New Imperative for Public Health. NY: Praeger, 1985.

Proc 6th ACN 1991; 569 – 571

Constraints on nutritional surveillance

Peter Heywood

Nutrition Programme, The University of Queensland, Brisbane, Australia

Introduction

Nutritional surveillance is defined as watching over nutrition in order to make decisions and to take actions to improve nutrition in populations (1).

Nutritional surveillance has been used for policy and planning, programme management, timely warning and intervention, advocacy, and monitoring the effects of structural adjustment.

In each of these situations the elements of surveillance can be summarised as a feedback loop as shown in Figure 1. Thus, the state of the food and nutrtion system is assessed; a decision is made; and action is taken. Information becomes an input into the system and is used to make decisions about the level of other inputs, such as food, modification of existing programmes, initiation of entirely new activities, and so on.

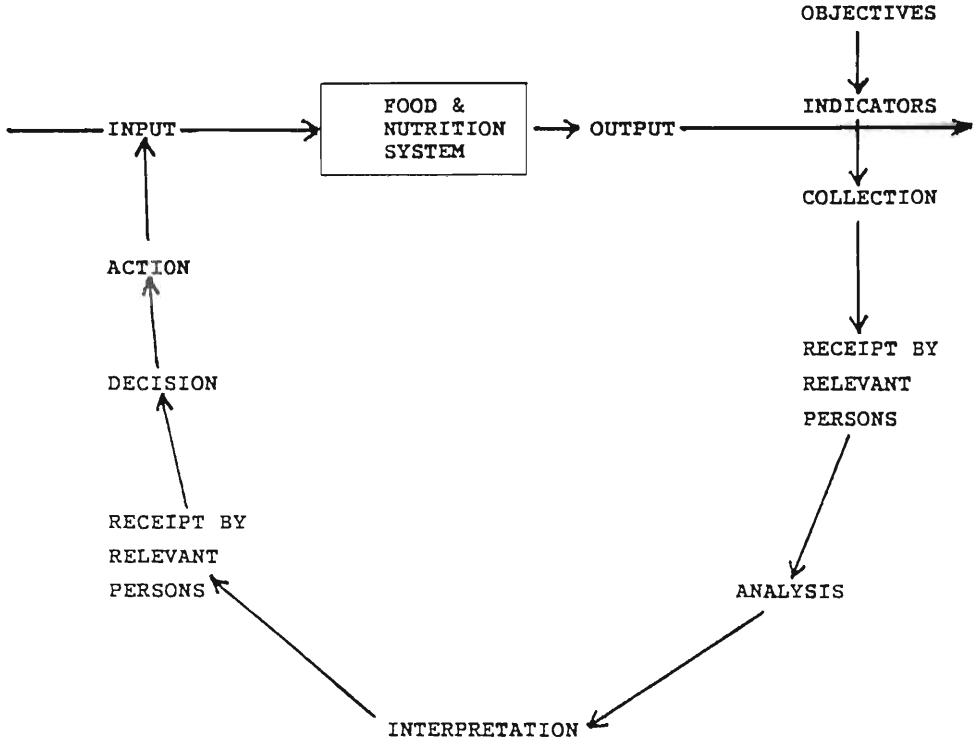


FIG. 1 The feedback loop in nutrition surveillance.

Thus, the key elements of nutritional surveillance are:

1. Describing and assessing the situation with respect to the particular nutrition problem. This involves selection of indicators and collection, analysis and interpretation of data.
2. Making a decision based on the information derived from the surveillance system.
3. Carrying out the corrective action.
4. Continuing to assess status regularly to provide information about changes in the situation and the effectiveness of the action taken.

Constraints to the effectiveness of a surveillance system can occur within any of these elements.

Constraints to describing and assessing the situation

The most important issue here is specification of objectives based on the decisions which can reasonably be expected to be made from the information the surveillance system will provide. Often objectives are based on notions of an ideal surveillance system. But there is little point in setting objectives which are unrealistic in the current administrative structure. For example, in a highly centralised system objectives related to national planning may be realistic whereas objectives related to programme management at the provincial or district level may not.

The objectives determine the most appropriate indicators and the frequency with which information is required. If possible, it is better to use existing information systems and sources of data. Whilst data may be available through existing systems, its nature and quality may limit what surveillance can actually be carried out. Where necessary, new information may have to be collected. The costs involved will depend on the frequency required and the extent to which a new system must be established and may limit what can be done.

The analysis, interpretation and presentation of data depends on adequate human and other resources and may also be a limiting step. Given the diversity of most countries, it is important that the local situation is carefully considered when selecting indicators and interpreting results.

Constraints to making timely decisions

There are three important issues in making decisions based on surveillance information. First, identification of who the decision makers are and whether they are located at the appropriate level of government. If decisions are not made at the appropriate level (e.g. in the province if decisions are being made about management of provincial programmes) the objective may not be realistic. Second, providing clear decision rules to the decision makers. As the meaning of a particular indicator may vary with the local situation, it is vital that decision making is decentralised and decision rules are location-specific. Third, ensuring that information is transmitted to decision makers as soon as possible so that the time available before the information is out-of-date is maximised.

Constraints to carrying out timely corrective action

The single most important constraint is the delegation of authority to the appropriate administrative level. This authority should include control over the resources needed to take the action indicated before it is no longer relevant. In many surveillance systems this delegation has not occurred and actions are either not taken, or, if they are, they occur well after the information is out-of-date.

Constraints to continuity

These may occur because the information is not being used, the data collection system fails for reasons unrelated to surveillance, the cost of continuing to collect data is greater than the perceived benefit, or the interval between rounds of data collection is so great that the impetus of the programme is lost. In some cases surveillance activities, commenced with significant external inputs, have not continued once the external funds finished because they were not viable when only local funds were available.

Constraints can occur at any of these points. However, the constraints involved in "describing and analysing the situation" have attracted most of the activity to date in the area of surveillance. Much less attention has been paid to making decisions, taking action and ensuring continuity. For this reason objectives have often borne little relation to the decisions and actions which can, in practice, be made and controlled by those at various administrative levels. This is particularly true for the use of surveillance information for programme management which, to be successful, usually has to occur at the provincial or district level. More effort is now needed to identify constraints to making decisions and taking actions in each of the levels at which surveillance has been used.

References

1. World Health Organisation. Methodology of nutritional surveillance: report of a joint FAO/UNICEF/WHO Expert Committee. Technical Report Series 593. Geneva: World Health Organisation. 1976.

Proc 6th ACN 1991; 572 - 576

Setting up a national nutritional surveillance system in Vietnam

Tu Ngu, Ha Huy Khoi and Vu Manh Thien

National Institute of Nutrition, Hanoi, Vietnam

Introduction

Nutritional surveillance is the systematic collection of specific information related to the nutrition situation of the community for:

- nutrition, health and development planning
- timely warning and intervention
- evaluation of intervention programmes

In the past, information on population food consumption and nutritional status were collected by short-term or ad hoc surveys but these were neither frequent nor systematic work.

The newly-formed system of nutritional surveillance in Vietnam has been set up as a result of a two-year (1989-1990) study on nutrition. Some aspects of organisation, data collection and data analysis are presented.

Methodology

Selection of information related to nutritional status

Birth weight, including low birth weight (i.e. below 2500 g) and mean birth weight (MBW).

Prevalence of malnutrition in under-fives by weight-for-age (WHO's classification, NCHS reference).

Mean weight and height of children at school entry (i.e. 6 years old).

Average food consumption and nutrient intake per head/day.

Sites of nutritional surveillance

Sites of nutritional surveillance were selected based on stratifying the whole country into 6 ecological areas and from each, 6 communes were randomly selected.

Organisation for information collection

Personel who are responsible for information collection are community health workers, assisted by local administrative government, women union and Red Cross Association members.

Personel training consisted of short-term training for commune health workers, local government officers, district and provincial health officers, and was conducted in order to define the objectives and standardise the methods for information collection viz.:

- pretesting data collection
- supplying tools for data collection

The period and frequency of data collection were as follows:

Birth weight was collected monthly

Food consumption and nutrient intake survey were conducted in May each year.

Anthropometric measurements

were made in July for children under five, and in September for children at school-entry age.

Supervision of data collection was done at different levels viz. central, provincial, district, and commune. The data flow would be directly posted from commune to the National Institute of Nutrition (NIN) in Hanoi.

Data processing and analysis

The data collected were processed and analysed at NIN, using the micro-computer programme.

The results were used for recommendations on the nutrition situation, practical actions by urgent interventions, and for short-term or long-term nutrition and health planning.

Results and discussion

The following are results derived from nutritional surveillance information:

Birth weight

The proportion of low birth weight (below 2500 g) is shown in Table 1. The average proportion of low birth weight is greater than the upper limit of 10% recommended by WHO for the year 2000.

There is no significant difference between the 1989 and 1990 data.

The values for mean birth weight (Table 2) are similar to the NIN data for 1988 and that of Duong Quynh Hoa in 1983. In comparison with WHO's standard (3,300g), mean birth weights recorded under the surveillance system were only 87%.

TABLE 1

The proportion of newborn below 2500 g

Year	Male		Female		Combined sexes	
	n	%	n	%	n	%
1989	647	12.5	610	15.1	1,257	13.5
1990	1,392	10.5	1,306	14.5	2,698	12.4

TABLE 2

Mean birth weights (kg)

	Nutritional surveillance system		Reference data		
	1989 n = 1,257	1990 n = 2,698	South VN1983	North VN1988	WHO 1981
Male	2.91 ± 0.18	2.95 ± 8.16			
Female	2.85 ± 0.17	2.85 ± 0.15			
Average	2.88 ± 0.18	2.90 ± 0.16	2.95	3.0	3.3

TABLE 3

The nutritional status of under 5 children based on WHO's classification, NCHS reference

WHO's classification	1989 n = 4,620	1990 n = 8,225
- 2SD to - 3SD	34.9%	34.5%
- 3SD to - 4SD	16.8%	13.8%
< -4SD	3.5%	2.9%
Total < -2SD	55.2%	51.2%

Nutrition status of children under 5 years of age

The data in Table 3 shows that prevalence of malnutrition by weight-for-age is still very high, approximating 50%. In comparision with 1989 data the prevalence of weight-for-age below median -3SD and median -4SD has significantly decreased ($p<0.05$).

Mean weight and height of children at school entry age (6 years old)

The mean weight: Table 4 shows that the current mean weight of children at school entry age in those communes is similar to that of NIN data in 1985, but lower than the values for the reference population.

TABLE 4

The mean weight (kg) of children at school entry age

	Nutritional surveillance System		Reference data	
	1989	1990	NIN 1985	NCHS 1980
Males	16.0 ± 2.1 (n = 1106)	16.1 ± 2.2 (n = 1790)	15.4 ± 1.8	20.7
Females	15.9 ± 2.4 (n = 1012)	15.6 ± 1.8 (n = 1674)	14.9 ± 3.02	19.5

TABLE 5

The mean height (cm) of children at school entry age

	Nutritional surveillance system		Reference data	
	1989	1990	NIN 1985	NCHS 1980
Male	106.7 ± 4.8 (n = 1106)	106.7 ± 3.0 (n = 1790)	103.7 ± 7.0	116.1
Female	105.1 ± 3.2 (n = 1012)	105.7 ± 3.4 (n = 1674)	102.2 ± 3.4	114.6

The mean height: The findings of this study indicate that the mean height is greater than that of data of NIN, 1985 and is 91% in comparision with WHO's standard, 1980 (Table 5).

TABLE 6

Average food consumption and nutrient intake per head per day in 3 ecological regions

Ecol. Regions	HANOI's Suburb		North Delta		Central North	
Food Items (g)	1989	1990	1989	1990	1989	1990
Rice	491.3	477.7	487.4	467.5	327.4	312.0
Other cereals	8.9	9.1	5.0	8.0	1.8	4.0
Tuber	11.2	4.2	5.4	9.7	161.2	143.2
Bean	8.0	1.9	3.8	-	0.6	-
To FCU	15.3	45.0	4.3	12.4	-	4.1
Sesame, Peanut	3.7	3.8	0.2	0.3	3.1	1.8
Oil and fat	4.0	9.9	4.2	4.4	0.8	3.6
Meat	22.5	30.3	9.6	15.8	4.4	11.2
Fish	11.6	14.2	14.2	18.0	30.5	54.2
Shell fish	9.9	8.8	10.5	19.4	5.3	-
Eggs	2.6	4.8	12.5	2.1	0.1	2.3
Vegetables	173.0	178.0	167.0	208.6	150.4	147.2
Sauce	15.8	19.0	31.6	15.1	15.1	4.9
Riped fruits	0.3	-	4.8	2.5	-	-
Sugar	1.6	-	2.1	-	0.2	-
Energy (kcal)	1932	2004	1891	1833	1796	1660
Protein (g)	51.7	57.4	49.8	51.8	39.9	43.5
Animal protein	6.1	9.4	7.4	8.7	8.2	8.2
Lipid (g)	20.4	26.4	13.1	13.2	9.2	16.0
Vegetable lipid	8.0	17.1	4.8	8.4	3.6	6.6
Glucid (g)	385.1	371.4	397.2	364.0	386.0	331.0

Food consumption and nutrient intake

The food consumption data in 3 regions are presented in Table 6. Commonly, the average consumption was still low, the energy and nutrient intakes were poor in terms of quantity and unbalanced in term of quality. The main food consumed was rice. There was no remarkable difference during the 2 years. Some high biologically nutritive foods such as meat and fish were consumed in higher in amounts in 1990 than in 1989, although these were still inadequate. Energy intake of the population in the North Central area was lowest compared to the other regions.

Conclusion and recommendation

Indicators of Nutritional Surveillance System seemed to have proved suitable in the practical conditions of Vietnam in terms of feasible information collection at commune level.

The results gathered were similar to that of NIN's surveys during the last some years. This proves that the Nutritional Surveillance System's activities and indicators are feasible and reliable.

Through the nutritional surveillance network, the nutrition education and improvement of VAC system at commune level have been disseminating as well as vitamin A deficiency and xerophthalmia control; iron deficiency and anaemia control programmes have been more efficiently integrated.

There is a need to feedback the preliminary results obtained to the grassroot levels and more efficiently used by decision-makers at different governmental levels and agencies.

References

1. Beghin I, Cap M, Dujardin B. Guide to Nutritional Assessment WHO, Geneva, 1988; 80p.
2. How to weigh and measure children. Assessing the Nutritional Status of young children in household surveys. - Preliminary version United Nations Dept. of Tech. New York, 1986.
3. Growth monitoring. Primary Health Care issues. American Public Health Association, Washington, 1981; 70p.
4. Les aspects medico-sanitaires de la reproduction chez les adolescents. - OMS Geneva, 1989; 18p.
5. Health and Mortality of young children in developing countries. International Colloquium. Antwerp, Belgium, 1985; 142p.
6. Ducos M, Faramond E, Desenclos J-C. Guide pour less enquetes nutritionnales dans less situations urgences. Medecines sans frontieres, Paris, France.
7. Development of indicators for monitoring progress. Towards health for all by the year 2000. WHO, Geneva, 1981; 91p.
8. Working Papers Regional Workshop on Nutrition Surveillance programme, WHO. Institute of Nutrition, Mahidol University, Bangkok, Thailand, 1983; 268p.
9. Nutrition and Adjustment. UNICEF, 1988; 23p.
10. Health Status Indicators in Developing Countries. A selective review, 1986; 95p.
11. Food and Nutrition surveillance systems for monitoring the human condition, 1988; 27p.
12. Food and Nutrition surveillance in Indonesia: A case study 1988; 31p.
13. A pionering project for combitting Vit. A deficiency and Xerophthalmia with MSG fortified with Vit. A, 1985; 88p.
14. Applied Nutrition, UNICEF-NIN, Hanoi, 1986; 376p.

Proc 6th ACN 1991; 577 – 582

Monitoring of programmes against iodine deficiency disorders

Michael Gurney

World Health Organisation, South East Asia Regional Office, New Delhi, India

Introduction

Iodine deficiency disorders (IDD) are one of the major debilitating nutritional problems in much of Asia. IDD control programmes have been in existence for some decades with only moderate success in many cases. Recently, confidence that we can control IDD has increased and programmes have picked up a new lease of life.

The technology needed to control IDD is reasonably simple. It is based on the iodation of salt, with possible back-up components using iodised oil or iodine added to drinking water.

The main problem is managerial. The management of IDD programmes needs to be flexible, and the programme manager at each level needs to have authority to be able to respond to changing needs by concentrating resources when, where and how required.

Flexibility of this kind and the appropriate exercise of authority need to be based on knowledge if they are to be effective. This knowledge can come from programme monitoring.

In this presentation I will address, rather briefly, a few important issues in programme monitoring for IDD. You will notice that I am not discussing surveillance of the problem of IDD. I prefer to address the monitoring of successful programmes rather than just measure the size of problems.

The phases of an IDD programme

The first point I would like to make is that it is useful to categorise IDD programmes into four phases (Figure 1).

FIG 1. The phases of an IDD programme

PREPARATORY	ATTACK	CONSOLIDATION	MAINTENANCE
Nationwide programme not started but being planned.	Programme started but IDD prevalence still of public health significance.	1. IDD only exists in pockets,or, 2. IDD under control but permanent measures(eg. salt) not yet in place and/or temporary measures(eg. oil) not yet withdrawn.	IDD no longer a public health problem, and permanent measures are functioning normally

The four phases are technically, managerially and financially very different. Their monitoring requirements are also different. I suggest that the phases could be: Preparatory, Attack, Consolidation, and Maintenance. Some of you will recognise these terms as having been used in the old malaria eradication programmes. I find that they apply very well to IDD control.

During the Preparatory Phase no major efforts will have yet been made to control IDD nationwide. The information needs are to (Figure 2):

- establish a benchmark for evaluating the IDD control programme. This means getting prevalence estimates and mapping the salt system.
- motivate planners and decision makers to communities, service providers at all levels, and central policy makers;
- develop the monitoring system which will start during the attack phase.

FIG 2 – IDD monitoring priorities in each programme phase

PREPARATORY	ATTACK	CONSOLIDATION	MAINTENANCE
Classify areas into grades of severity	Document decline in IDD prevalence in each area	where IDD is still present document its decline as in attack phase	Monitoring that IDD does not reappear
		Monitor that IDD does not reappear as oil is withdrawn	
Map the salt system	Verity progress in salt iodation and other methods in relation to targets	Monitor salt iodation	Monitor salt iodation over a very long period
		Follow-up non-iodated salt along distribution chain	Monitor long-term changes in salt consumption
Develop the M&E system	Refine the M&E system	Simplify the M&E system	Integrate the M&E system
Use data to develop awareness & motivation and t set targets	Use data to manage IDD programme, rectify plans & procedures & maintain informed motivation	Management	Use data to ensure ensure programme continues

During the attack phase the IDD programme gets under way. The phase lasts until the prevalence of IDD drops to a level that is no longer of public health significance. The information needs are to:

- verify the progress in delivery of inputs (e.g. salt, oil);
- identify when modification of a procedure or plan is needed;
- document the decline of IDD prevalence; and
- inform communities, service providers and policy makers of progress.

In the Consolidation Phase the prevalence of IDD is no longer of public health significance. However the final phase of maintenance has not yet been reached for one of two reasons:

- IDD control is not yet nationwide. Some areas are still in the attack phase; or
- IDD prevalence may have dropped but the permanent, long term measures may not have been implemented. For example, there may still be a dependence on iodised oil. This will have to be withdrawn under careful watch.

The information needs are to keep a careful watch as the method of control changes and to simplify the system in preparation for the Maintenance Phase.

The Maintenance Phase starts when the prevalence of IDD reaches a predetermined level such that it is judged to no longer constitute a public health problem and the long term measure (usually salt) is functioning normally.

The information needs are:

- to monitor implementation of the programme for a very long time in as simple a way as possible;
- to monitor for any changes in salt consumption that might necessitate changing the level of iodation;
- to monitor to ensure that there is no resurgence of IDD anywhere in the country.

Principles of programme monitoring

Next, I would like to suggest four principles of programme monitoring. I submit that these principles should guide our choice of IDD programme indicators and trigger levels as well as the use made of them for assessment, analysis and action. The four principles are:

One. Only collect information that really leads to action. Programme managers must resist pressures to collect interesting information that does not help their decision-making. Otherwise the monitoring system will be overloaded and will fail.

Two. Make sure the information collected is seen to be useful to those who collect it. Otherwise they will not do it regularly and conscientiously, and may even fabricate the results.

Three. Act locally on the data. Any programme monitoring information collected that is not useful at local level is probably even less so centrally.

Four. Follow-up the findings. The monitoring system is the principal tool of the manager for assessment, analysis and action.

Monitoring measurements and indicators

Bearing these four principles in mind we should select our monitoring measurements and indicators with care.

Regarding prevalence we have, currently three choices: urinary iodine which reflects dietary iodine, thyroid stimulating hormone (TSH) which indicates the physiological response to

iodine intakes and goitres which indicate the anatomical response.

Urinary iodine estimation requires a special laboratory, an iodine free environment and basic safety precautions. I submit that these constraints make urinary iodine an unsuitable measure for routine monitoring. It may have its uses however in occasional programme evaluations.

TSH can be measured quite cheaply in very specialist laboratories, mostly abroad. I submit that we cannot afford to get outselves locked into such dependency in routine monitoring. Also, the results will be too slow in returning to the potential users.

This leaves us with goitre estimation. The most accurate method is ultra-sound. However, currently, the machine for doing this is bulky, requires electricity and is not cheap.

Visible and/or manual examination for an enlarged thyroid gland is known to show considerable inter-observer variability but is, I suggest, nevertheless the most suitable prevalence indicator we have. I should emphasis here that our aim is not to diagnose individual cases but to estimate community prevalence; a few errors in individual categorisation either way are not all that important.

I suggest that, for routine monitoring there is little to be gained by categorising goitres by grade. What we really need is to monitor a decline in the proportion of the vulnerable population with goitre down to an acceptable level. Ten per cent seems the most appropriate; and then to monitor that it stays below that level thereafter.

During the Attack Phase I do not think that we need any great precision of estimate. I suggest that we define three grades of severity of IDD endemicity as defined by goitre proportions, and aim to see goitre drop by one grade a year during the attack phase.

Table 1 indicates suggested grades: serious - over 50%, moderate - 31-50%; mild 11-30%; and under control - 10% or less.

Using such a system sample sizes can be kept quite small.

We can concentrate our efforts on monitoring the group that shows the quickest change in goitre prevalence in response to changes in iodine availability. That is pre-adolescent school-age boys and girls.

TABLE 1

Grade of severity of IDD as indicated by goitre prevalence

Goitre prevalence	IDD severity
10% or less	Under control
11-30%	Mild
31-50%	Moderate
Over 50%	Serious

It is important to routinely monitor salt iodation at production and retail level. In large countries some salt monitoring may be needed along the distribution channels. But, basically, a failure at the consumer end should trigger a search up the distribution channel for what went wrong.

What is the most suitable method to monitor salt iodation? Iodometric titration of salt in a laboratory takes about 20 minutes per sample, not counting the time taken getting salt to the lab and getting the results out. This method is too clumsy for routine monitoring and too expensive to be widely used.

Simple field tests, taking only a few seconds and useable right in the market-place or shop itself, are now available. This is a breakthrough, not perhaps as momentous as the bifurcated needle was for smallpox eradication perhaps, but in the same league. Communities can now monitor their own salt and can thus put informed pressure on their own shopkeepers, on consumers and on their politicans. The information they collect can be fed into the IDD programme monitoring system.

In consequence, community level demand, stimulated by such local level salt monitoring, can exert a strong pull for iodated salt that was missing in older, less successful, iodation efforts.

Monitoring responsibilities at various levels

This leads to my next, and last, point. It concerns who should collect the monitoring data and who should assess it, analyse its meaning, and decide on and take action.

I submit that the simple system for IDD programme monitoring outlined here enables such assessment, analysis and action to take place at all levels: including the communities, the districts and the centre. All have a role in IDD programme monitoring and management.

During the preparatory and attack phases, the village health committee (helped by health centre staff) can use the IDD programme monitoring data to assess its own problem (Figure 3). This can create awareness and demand. During the maintenance phase such awareness is less important; communities have other priorities.

FIG 3. Monitoring responsibilities at community level

ASSESSMENT	–	Collect data according to methods and sampling instructions from district.
ANALYSIS	–	Construct histograms etc. (designed by IDD control unit) and analyse them.
ACTION	–	Persuade shopkeepers to only stock iodated salt.
	–	Persuade consumers to only use iodated salt.
	–	Decide when to seek help.
		Send to district : consolidated data : report on action : requests for help

FIG 4. Monitoring responsibilities at district level

ASSESSMENT	–	Collate the reports that come in
	–	Remind defaulting communities
ANALYSIS	–	Identify : trouble spots : nature of problems
ACTION	–	Investigate trouble spots ('IDD posse')

The district health team, or the District Committee for Control of IDD, needs to keep an overview of the programme in all parts of the district. It is this level that must send an investigation team (perhaps called an "IDD posse") to further analyse problems indicated by the monitoring system and to suggest action (Figure 4).

The IDD control programme is managed from central level which needs to maintain an overview of how the programme is progressing in different parts of the country (Figure 5). The need is not for raw data but for data consolidated mainly by district.

In summary, I am suggesting that a main bottleneck to eradication of iodine deficiency disorders - perhaps the main bottleneck - is the failure to collect and use data on programme progress at the three levels of implementation: community, district and national. I go on to suggest that it is vital, if the monitoring system is to be functional and sustainable, that: (i) it collects as little data as needed, as infrequently as is practical, (ii) that the data are analysed at the level of collection and (iii) that the collated findings are passed up to higher levels, not the raw data.

FIG 5 Monitoring responsibilities at central level

ASSESSMENT	–	Collate all district reports
	–	Remind defaulting districts
ANALYSES	–	Identify : problem districts : nature of problems
ACTION	–	Respond to identified needs
	–	Modify strategy as needed

Proc 6th ACN 1991; 583 – 585

Nutritional surveillance in the Philippines

[1]Demetria C. Bongga and [2]Florentino S. Solon

[1]Deputy Executive Director, National Nutrition Council, Makati, Philippines; [2]Executive Director, Nutrition Centre of the Philippines, Makati, Philippines

Introduction

Nutritional Surveillance is a system of keeping a close watch on the state of nutrition and on factors that may impinge on nutrition within a locality.

Nutrition Surveillance is important so that certain changes in the environment and people can be detected and can serve as early warning signals of the evolution of impending nutritional problems or worsening of existing ones. Through surveillance it will be possible to:

1. Assess the prevalence of specific nutritional problem in target populations;
2. Monitor possible changes in the nutritional situation of target populations resulting from existing intervention programs;
3. Foster information that may predict occurence of malnutrition within the very near future and those serves as an alert system;
4. Monitor existing intervention programmes and evaluate their effectiveness;
5. Provide a research base for investigating the relationship between certain health conditions/indicators and different levels of nutritional status;
6. Provide data to establish priorities for the allocation of limited funds and resources.

The system requires continous collection of data, their analysis and the dissemination of resulting information to policymakers and program implementors so that they can take necessary actions at minimum loss of time.

In the Philippines, attempts to establish a mechanism for the regular and systematic generation of essential information at the local level that can provide basis for drawing up immediate interventions include such activities as: a) Mass weighing of preschool children nationwide which started in 1975; b) Nutrition surveillance pilot project in Albay province conducted in 1977; c) Index Monitoring by the National Nutrition Council initiated in 1983, and d) The Philippines Food and Nutrition Surveillance System began in 1989.

Operation Timbang (Mass Weighing)

Efforts towards the establishment of a nutrition surveillance system in the Philippines started as early as 1975. While not intended to be part of the surveillance system, community level nutrition assessment through mass weighing of preschool children (so-called Operation Timbang or OPT) has been conducted yearly. Weight and height measurements of school children were also taken as part of their health record upon school entry. These activities serve as basis for identifying

the priority children and areas to be given immediate health and nutrition interventions which include supplementary feeding, nutrition education, micronutrient supplementation, and other health services.

The availability of the OPT results on a yearly basis in many municipalities provide utility in local level nutrition programme planning and evaluation.

The OPT however has certain limitations as a tool for surveillance because: 1) OPT coverage is generally below the required 80% of total preschool population hence may not give an accurate picture of prevalence of undernutrition of preschool children in the area; and 2) OPT results are oftentimes not readily available to the community and to other agencies for their use.

Nutrition Surveillance Pilot Project in Albay

The first attempt to systematically collect local level health and nutrition data on a regular and frequent basis using a community based investigation team was tested by the Nutrition Centre of the Philippines (NCP) in Albay province in 1977.

The framework for the Albay surveillance was formulated based on the WHO Methodology on Nutrition Surveillance, with funding assistance from UNICEF. The activity involved the regular monitoring of changes in nutrition indicators, with deteriorating trend serving as early warning for immediate nutrition intervention. The pilot project monitored indicators such as proportion of newborns with low birth weight, proportion of moderately and severely underweight grade one school children, diarrhoea morbidity rate and prevalence of nightblindness. An upward change in the indicator was a signal to take action.

One significant contribution of the pilot project was the identification of relevant indicators predictive of malnutrition. For example, the age of Grade I school children was found to be positively associated with nutritional status, i.e. the older the child, the higher is the chance of being malnourished.

The Albay surveillance system was not sustained beyond the pilot stage because of too much external input (manpower, material, etc.) from offices of implementing agencies at the national level. Most of the related functions of surveillance were performed by agency personnel, and with little participation from the local government unit or indigenous workers.

Index monitoring

In response to the need for more timely information on the nutrition situation, therefore, the National Nutrition Council (NNC) adopted an index monitoring scheme in 1983. This involved the collection of primary data on nutrition and socio-economic indicators in identified index municipalities such as height and weight of children, morbidity data, occupation of household head, household income and expenditure, food prices as well as data on intervention programmes being implemented at the local level.

The index monitoring system has proved to be viable, less expensive and makes feasible a more frequent data collection. However the manner in which it is currently done still needs some refinement to allow generation of critical information. For one, the sample population may have to be increased for a more detailed analysis of prevalence of malnutrition vis-a-vis critical factors and to allow for a better cross-sectional picture of the prevalence of malnutrition over time. Secondly, the NNC Index Monitoring however, still relies on a number of trained personnel from the National

Level for its operation. In 1989 training and assistance of local workers have been initiated.

All aforementioned mechanisms intended to generate relevant data to assess food and nutrition conditions which include the OPT of DOH, and the Index Monitoring of NNC, are still unable to provide the needed timely information for decision-making and immediate action at the local level, hence a subnational level, area-based food and nutrition surveillance system has been proposed.

Philippines Food and Nutrition Surveillance System

The proposed Philippine Food and Nutrition Surveillance System (PFNSS) is geared towards involving local level constituents in the production and utilisation of information on a more frequent and regular basis, especially those that can warn of nutrition problems (social and economic) in the area. Correspondingly, the system requires harnessing of local skills in analysing and interpreting data in a simple form that may be readily utilised for formulating appropriate local programmes. It is intended to provide relevant and timely information that would improve the nutritional effects of the government policies, plans and programmes.

As an initial activity, a consultative conference was conducted with participants from the different government line agencies at the provincial and municipal levels to identify the type and number of indicators to be monitored.

A nutrition surveillance unit (NSU) at the municipality level, composed of persons who are already involved in collecting data/indicators has been created.

A Manual of Operations has been developed through efforts of data management offices from key sectors to guide the local level implementors in the operationalisation of the system. The Manual describes the procedures for data collection, analysis and interpretation. It contains sample forms to be used in recording findings which can easily be accomplished by auxiliary or volunteer workers. It also suggests probable response mechanisms that may be adopted in the event a nutritional problem breaks up. An important feature of the manual is the simple and visualise step-by-step description of the procedure for collection and analysing data. It also suggests ways of reporting information.

It is envisioned that the establishment/institutionalisation of the Philippine Food and Nutrition Surveillance System will serve as a major step towards more accelerated development and subsequent nutritional improvement among the poorest families.

References

1. Bonded MP, Ramos AC, Blumenfield S. System Operation Timbang. June 1990.
2. Food and Nutrition Research Institute, Department of Science and Technology. Regional Updating of Nutritional Status of Children. 1989-1990.
3. Solon FS, Florentino RF, Adorna C, Jagolino R, Moreno L, Mendoza O. The Nutrition Surveillance Pilot Project, First Phase Albay, Philippines.

   1980.

Proc 6th ACN 1991; 586 – 587

Nutritional surveillance for disaster preparedness and prevention of nutritional blindness: an expansion of distress monitoring to the cyclone affected areas

Martin W Bloem, Menno Mulder-Sibanda, Yaekub Patwary, Rafiquel Islam Chowdhury, Moqbul Hossain Bhuiyan

Helen Keller International, P O Box 6066 Gulshan, Dhaka-1212, Bangladesh

Abstract

Bangladesh is located between South and South-East Asia. The issues of adjustment to nature and to other human groups residing elsewhere in the region are of vital significance for the people of Bangladesh. The country occupies greater part of the Bengal Basin. Eighty years ago, the popultion was less than one-third of what it is today. The high growth rate of the population and the interactions of the peoples of the whole of the Ganges-Brahmaputra-Meghna Basin have created profound problems for the continued progress of the people of Bangladesh. The international media have succeeded in presenting Bangladesh to the world community as a land where natural disasters are endemic. Of these natural disasters the most frequent and devastating to the life and property are floods, cyclones storm surges and tidal bores.

On April 29, 1991 Bangladesh experienced one of the most severe cyclones of the century, resulting in an extensive loss of life an property. An efficient allocation of food aid and relief efforts had to be established to minimise subsequent mortality in the affected areas.

Since October 1989 Helen Keller International (HKI) is coordinating a Nutritional Surveillance Programme for Disaster Preparedness and Prevention of Nutritional Blindness (NSP) in 16 disaster-prone areas in various parts of Bangladesh. The NSP is a collaborative effort by NGOs, the Institute of Public Health and Nutrition (IPHN) and UNICEF, to establish a sentinel surveillance system. The NSP is financially supported by USAID. HKI has extended the Surveillance activities to the devastating cyclone affected areas. A special team was recruited to carry out continuous distress and relief monitoring to provide essential information for establishing an effective allocation of relief and food aid.

Both the June and July Reports showed extremely high levels of severe malnutrition in Post-cyclone upazilas. Almost one-third of children surveyed in these areas had a mid upper arm circumference (MUAC) below 125 mm. This is an extraordinary high level of severe malanutrition even by Bangladeshi standards. As a point of comparison, the April 1991 prevalence of MUAC less than 125 mm was 11% in a sample of nine disaster prone rural areas in Bangladesh. Both the data collected over the past year in the

sentinel surveillance systema and the data periodic nationwide nutrition surveys indicate that the baseline "norm" for rural Bangladesh is in the range of 9-11%. The July-data showed an even greater deteriortion of the nutritional status. The post-disaster findings from almost all ares surveyed document approximately 2.5 times the level of severe malnutrition which is usual in rural Bangladesh.

Based on the June report various meetings with government (Ministry of Relief), United Nations Children's Fund (UNICEF), World Food Program (WFP), and several NGOs (Care, BRAC, Proshika, Concern, e.o.) were scheduled to discuss the situation and remedial actions.

This project shows that nutritional surveillance can create an interactive mechanism for planning, monitoring and evaluating multisectoral relief activities in order to increase their effectiveness.

Proc 6th ACN 1991; 588

Nutrition and health problems arising from dietary imbalances and changing lifestyles

S Kobayashi

The National Institute of Health and Nutrition, Tokyo, Japan

Abstract

For hundreds of years, cereals-mostly rice and vegetables, with small amounts of pulses and fish, have been constituting the traditional Japanese diet. The average Japanese lifestyle was physically active since the majority of them had often been exposed to physical rather than mental stress. As is well-known, the circumstances of Japanese livelihood have made a tremendous change over the last 50 years, which was accompanied not only with a remarkable improvement in the health status of Japanese but also with some newly-arising health problems. To desribe these changes more concretely, it seems pertinent to divide these 50 years into three stages: (1) before, during and several years after World War II, during which time the traditional dietary habit remained unchanged, with significant prevalence of malnutrition or undernutrition and vitamin deficiencies. This period was characterised by a high incidence of pulmonary and gastrointestinal infections, with tuberculosis as the first-ranked killer, (2) economic growth period begining from the late 1950's when intake levels of milk, eggs and meat increased rapidly while those of vegetables, potatoes and algae decreased. Deaths from infectious diseases decreased while stroke became the top killer, (3) after the oil crisis, "westernisation" in dietary habit became more apparent with decreasing salt and increasing fat intake. Inactive lifestyles became far more prevalent. Cancer is now the first-ranked cause of all deaths, with heart diseases as the second. Discussion will be made on casual relationships between the changes in lifestyles and disease pattern, together with a role of recent trend towards a simplification of dietary habit of the Japanese in terms of promotion of health.

Proc 6th ACN 1991; 589 – 592

Changing profile of malnutrition and nutrition deficiency disorders

Kalyan Bagchi

Consultant in Maternal and Child Health,
Eastern Mediterranean Regional Office, World Health Organization,
Alexandria, Egypt

Changing nutrition status

In most parts of the world, nutrition status of the population has improved over the last few decades. Infant mortality rates (IMR) which reflect, to a very large extent, the health and nutrition situation of the child population in a country, has shown downward trend in most countries of the world. In some regions of the world, e.g., the Gulf Region, the countries have reached a level of IMR comparable to those in the industrially developed countries. Saudi Arabia, a West Asian country, with huge oil wealth has a reduction of the level of IMR from 81 in 1978 to 30 in 1989.

Excepting nutritional anthropometric data, reliable information is not available from most countries of the world to pinpoint this trend. Global anthropometric indicators collected by the Nutrition Unit of the World Health Organisation Headquarters at Geneva do indicate the rapid decline in the prevalence of wasting in children in most parts of the world, while prevalence of stunting in children, though showing gradual decline, continues to cause concern.

Among the specific deficiencies disease, three micronutrient deficiencies have been widely prevalent in the last three to four decades. These are vitamin A deficiency, causing xerophthalmia and other ocular disorders, the extreme form of which is keratomalacia and blindness, iron deficiency causing nutritional anaemia, the most widely prevalent nutritional deficiency, and the revamped iodine deficiency disorders. Ad-hoc data from countries with high prevalence of vitamin A deficiency do indicate that the prevalence has come down, but the problem still continues to be a public health problem in many Regions of the world. Unfortunately, the two other nutrient deficiencies continue unabated. Iron supplementation, inspite of being the most widely implemented control measure, has not been able to make any definite impact on the prevalence level. In most countries of Asia today, any ad-hoc survey among women of reproductive age indicate a prevalence of 50-60% . Recent interest is centered around evaluation of existing programmes to ascertain what goes wrong in such preventive programme.

Iodine deficiency disorders, relatively neglected in the past, has attracted considerable interest of the international community in the present decade. The activities of WHO, UNICEF, USAID and the new international body, ICCIDD, have created a global interest for the elimination of

IDD as a public health problem. Though, IDD is under control in many countries of the developed world, it continues to be a dominant public health problem in many countries of the Asian Continent. Renewed interest, political commitments and international assistance in most affected countries are expected to bring down the prevalence level to a large extent. Eradication by the year 2000 AD is, however, not a feasible objective.

Clinical manifestations of protein-energy malnutrition like kwashiorkor is now a rare sight excepting in natural or man-made disasters with most severe food deprivation. Marasmus, however, continues, especially in urban slums and severely food deprived areas. Classical deficiency diseases like scurvy, beriberi and rickets are, however, not causes for concern in most regions of Asia excepting in some foci or in situations of extreme deprivation as in famines.

On the other hand, distinct changes are noticeable among the economically affluent population in Asian countries, especially in West Asia, where oil wealth has made dramatic changes in the socio-economic status of the majority of the population, regarding their dietary consumption pattern and life-style. Increasing wealth and/or better management of health system has produced dramatic changes in their socio-economic standards, leading to rapid improvement of literacy level, provision of safe water, better environmental sanitation and health care facilities. The health indicators like mortality and morbidity patterns and life expectancy are undergoing rapid improvements. Such changes are being equally witnessed among the economically affluent population in less prosperous developing countries in Asia. The dietary pattern and the life-style are of the same pattern as those practiced in the developed world. There are numerous studies to indicate that gradual changes in dietary pattern and life-style are taking place, even among the economically disadvantaged population, especially in urban settings.

Changing patterns of dietary consumption

In general, the following changes in the dietary consumption pattern is noticeable throughout the countries in Asia:

(a) With increasing purchasing power, there is a gradual, sometimes rapid, rise in food energy intake. Average per capita calorie intake in many segments of population is far beyond the expenditure level in most cases. This is a sinister trend, since, most often the energy expenditure goes down due to a change in the life-style with reduction of physical activity. This is marked in West Asian countries and among economic affluent population in most Asian countries.

(b) Consumption of animal foods, animal fat and sugar shows a distinct upward trend. Among the vegetarians, consumption of dairy products and ghee shows a rapid increase.

(c) Consumption of red meat and eggs increased significantly with increased purchasing power. In several West Asian countries, these foods are available to consumers at a subsidized price thus inducing the people to eat these foods more. It is interesting to note that the transition from under to over nutrition. Consumption of impact on health is more rapid and noticeable. Consumption of fish, on the other hand, has not shown increasing trend in these countries and strangely, the consumption of fish has not been supported by Government subsidy. Most of these coun-

tries are either islands or have long coast-line with fishing as a major trade for export outside.

(d) There is a consistent trend towards consumption of "processed convenience foods". This trend is more marked in economically affluent West Asian countries where these foods are either produced under license by food industries of the developed world or are freely imported. In most Asian countries, food industries have shown rapid at strides and increasing amount of these foods are now available. The common trend is the gradual replacement of traditional foods with processed foods, quite often inferior in nutritional qualities leading to unbalanced intake. Traditional dietary practices and foods are fast disappearing among the young population in urban areas in most Asian countries.

Changing pattern of mortality and morbidity

Profound changes are taking place in mortality and morbidity pattern in these countries which have direct relevance to the nutritional pattern of the population. Overall, the following is the general pattern of changes:

(a) Prevalence rates of infectious disease have shown rapid decline in most countries. In West Asian economically affluent countries, infectious diseases in children are fairly under control.

(b) Very few countries now have infectious disease as the first three causes of death among the general population.

(c) Diet-related non-communicable diseases are gradually occupying the first five causes of death in these countries. Coronary heart disease, cerebro-vascular accidents and certain types of cancer (eg, breast and colon cancer) are the common causes of death in many Asian countries.

(d) Non-insulin dependant diabetes and obesity and its complications are important causes of morbidity among hospital patients.

(e) Kwashiorkor and marasmus, almost universally encountered in the paediatric ward of any hospital in 1950s and 1960s in most, if not all, developed countries are now uncommon, excepting in situations where the hospitals caters for population undergoing acute food scarcity or other disaster conditions.

(f) During routine school health examination, wherever such system exists, increasing prevalence of childhood obesity is being noticed especially among well-to-do urban population. In West Asian affluent countries, childhood obesity is already an issue of concern.

Determinants of health and nutritional improvements – changing pattern

It is important for policy and decision makers to explore the major underlying causes for this improvement, slow but perceptible in some Asian countries and remarkably rapid in others as being witnessed in economically affluent West Asian countries. Non of the Asian countries, where available data demonstrate improvements, have a national nutrition policy in operation. In fact, most, if not all, of these countries have watertight sectoral plans and policies in which nutritional objectives are conspicuous by their absence. Each sectoral strategy has its own objectives, which are essential components of the national development plans, e.g., food and agriculture policy, education policy, health policy, etc. Though in a number of Asian countries, efforts are being made for years to formulate an

intersectoral national nutrition policy, in no country such policy has been effectively operationalized.

In other words, the emerging pattern is that the improvement in the health and nutritional status of the population in a country are the effects of well-implemented development policies and programmes, even without nutritional objectives clearly spelt-out. Nutritional objective is certainly not a priority objective in all sectoral policies and strategies thought in many, this is implicitly mentioned in some sectoral plans like food, health, etc.

However, this is not to belittle the importance of a well-formulated and operationalized national nutrition policy. What is stressed is that a country, which can formulate and implement important components of a national development programme will improve the health and nutritional status of its population. For most developing countries with scarce financial resources, there is considerable limitation in starting nutrition programmes and this is one of the reasons for providing low priority for nutrition. The logical task of nutritionists in these countries, if they exist at all, is **not** to insist on direct nutrition programmes, but to see that nutrition is incorporated explicitly or implicitly in other concerned sectoral plans and if this is not possible, to at least review the impact of these plans on nutrition and nutrition-related indicator and monitor their trend.

Proc 6th ACN 1991; 593

Diet-related non-communicable diseases in Japan

Teruo Omae

National Cardiovascular Centre, Osaka, Japan

Abstract

A remarkable change in mortality statistics has occurred in Japan over the last 40 years. Infectious diseases have been reduced, which greatly contributed to a higher life expectancy in the Japanese population. In consequence non-communicable diseases such as cardiovascular diseases and cancer, are now most prevalent, the frequency of which increases in parallel with advancing age.

Mortality and morbidity statistics are greatly influenced by lifestyle including nutritional conditions and health care system. In this communication, the following topics will be discussed:

(1) recent change in dietary habit and lifestyle in the Japanese population,

(2) change in frequency and type of non-communicable diseases, and

(3) the lessons learned from autopsy-based epidemiological study in a rural Japanese community (Hisayama study).

Proc 6th ACN 1991; 594 – 602

Nutrition and physical activity in urbanised societies

Ian Macdonald

Professor Emeritus, Guy's Hospital,University of London, United Kingdom

Introduction

Moving from a more organised rural community to the more self-reliant, even emotionally hostile, environment of a city or town affects, among other things, the ability to be physically active and increases the responsibility of the individual to choose a balanced diet. It has also been suggested that some foods available in the urban situation may contribute to the onset of non-communicable diseases.

The move from a rural to an urban environment can be an abrupt, even traumatic change. The degree of physical activity may suddenly drop and the type of food consumed may be quite different. The loss of traditional organisations, the absence of a family head and the lack of feeling part of a group will, by and large, affect only the first generation of town dwellers. A gradual adaptation leading to reduced environmental risk, or evolution, is a multigenerational process so that the metabolic and biochemical responses to relative inactivity and altered food and eating patterns, may require several generations.

The British were the first to industrialise on a large scale. People from the country flocked to towns where they were paid poorly and were removed from customary and natural sources of food so they filled their stomachs with cheap food to supply the energy for their strenuous work. A century ago in the UK, the rich tended to be fat and the poor tended to be lean. Today, however, fatness has slide down the social scale so that the less well-off are not only more overweight but are more prone to heart disease and cancer. Variants of this pattern are occurring throughout the industrialised as well as the developing world. Until genetic adaptation occurs, if indeed it does, emphasis should be placed on advising the urban immigrant to eat a balanced diet and adopt a lifestyle that does not encourage those conditions associated with a high mortality and morbidity.

Energy output

It has generally been assumed that to obtain the basic requirements for survival in developing countries, where mechanization is very limited, high levels of physical labour are needed. There is, however, evidence to suggest that this may not be so and that the traditional way of life may not be synonymous with high physical activity (1, 2). Hunter-gatherers, in the few remaining primitive societies, appear to meet their materials needs with a rather moderate degree of physical activity, whereas on the other hand those who move from area to area clearing forest or bush for crops, have a higher output of physical energy. The energy output of peasant farmers in non-industrialised farming systems is

on the high side, but it must be remembered that the extreme activity at certain seasons may be matched by periods of relative inactivity. What is not clear is whether the limit of physical activity in pre-industrial society is because of restricted energy availability or because only relatively moderate demands on physical activity are required to meet material needs. There is evidence to support the latter view. For example, Guatemalan farm labourers with an energy supplemented diet spent more time in active physical leisure such as playing football than did an unsupplemented control group, who just sat around or lay down (3, 4). Similarly, energy-supplemented pregnant and lactating Gambian women had a general feeling of well-being and were more inclined to take part in leisure events (5).

Though physical activity is an important factor determining energy intake, the relationship between physical activity and energy intake is not a simple linear one in man, as was first pointed out 35 years ago. This work, carried out in West Bengal, confirmed earlier experiments in animals (6), which found that energy intake increases with activity only within a certain range, below which a decrease in activity is followed, not by a decrease in food intake but, instead, by an increase. Body weight also increased in this sedentary zone, a situation not unlike that often seen in urbanization (7). More recent animal work has shown that there is not a linear relationship between reduced energy intake and the rate of loss of body weight (8).

Can urbanisation increase physical capacity?

In absolute terms, the work performance of rural communities is lower than that in industrial countries (1) but it has been shown that this difference disappears when the results are corrected for body weight. It is accepted that the upper limit of work that can be tolerated over 8-hour shifts corresponds to physical activity of an intensity up to 35-40% of the VO_2 max of the individual (9,10). If the energy cost of any particular task is of a similar order of magnitude, than a malnourished individual will have a reduced output compared to the well nourished because, presumably, of a reduced fat-free body mass. In urbanisation the supply of food is likely to be more plentiful and the choice wider throughout the year, so that undernutrition is more uncommon and unlikely to be seasonal; therefore the potential work capacity of an individual will increase because he or she will not be hindered by undernutrition.

There is evidence to support this reasoning. Newly hired Bantu mine workers in South Africa increased their VO_2 max after the initial months of employment, during which time they received a diet of about 4000 kcal/day (11). After three years of energy supplementation, Guatemalan labourers showed small increases in work capacity, in endurance for a given exhaustive task, and in total amount of work output (3). Similar results were obtained in Colombian sugar cane cutters (12).

If urbanisation results in an increase in the fat-free body mass of an individual, as might be expected owing to the greater availability of and less seasonal variation in the available food, then there is evidence to support the view that there will be greater productivity from that individual. For example, units of productivity among Colombian sugar cane workers were significantly and positively correlated with body weight, stature, fat-free mass and VO_2 max (12). In Kenya, the time road workers needed to complete standard work tasks was related to the men's weight-for-height ratio (13). Likewise, a relationship between work

output and body size was reported in Indian boys engaged in the preparation of safety fuses (14). The fat-free mass of Guatemalan labourers correlated linearly with the amount of coffee beans picked per day, the amount of cut sugar cane loaded, and the time needed to weed a given area (15). On the other hand, it has been reported that there is hardly any correlation in women between work output and body weight or work output and energy intake (16).

In an attempt to explore the relationship between food intake and economic returns from physical work, Leiberstein hypothesized that productivity will increase exponentially with increased food intake over a given range and that beyond this range productivity returns will diminish (17). This assumes that the extra energy consumed by an undernourished person over and above that needed to meet basic requirements will be allocated primarily to work activities. Several studies support this hypothesis but, interestingly, the sharply diminishing productivity returns predicted seem to start at relatively low levels of energy intake.

Thus greater availability of food in urban areas will lead to an increase in physical activity and work only in persons who are undernourished or marginally nourished. But what happens where energy input is greater than energy output, a situation likely to be found in towns where food is more readily available and where public and private transport replace walking and where increased mechanization in the urban workplace and home results in a marked trend towards low levels of energy expenditure compared with those found in the rural environment? When the changes brought about by urbanisation and by modern technology result in a positive energy balance, as it may well be in many individuals, then the importance of regular recreational exercise to maintain overall health status and to the prevention of obesity in particular becomes important.

Of the total daily energy output of a 70-kg man, the energy cost of exercise can vary from 5% in the inactive to 35% in those who engage in strenuous exercies. It is therefore clear that in the urban situation, if body weight is to remain the same, and an increased intake of food is to be enjoyed, then increased physical activity is essential. Of more importance is the tendency found in urban communities in developed countries, for an increasing proportion of energy expenditure to come from recreational activity rather than from the workplace. In fact, the classification of people according to leisure or discretionary activity may be at least as important as classification by occupation (18). In a recent report of a study in a city in Northern Ireland, the major finding was that simple changes in lifestyle can have an important impact on energy requirements. The authors predict that the social and health sequelae of volitional leisure time activity is likely to assume even greater significance in the future as work becomes increasingly sedentary and leisure time increases in tandem together with the trend toward shorter and fewer working days.

A question often posed is whether one of the several advantages of physical activity is an increase in the resting metabolic rate. It seems clear that energy expenditure during exercise is only a portion of the total increase in energy related to muscular work. The current view seems to be that an increase in oxygen consumption can be detected at 12 hr after exercise only if the work intensity is 70% of VO_2, max an effect that, in one study, increased linearly with the duration of the exercise (19).

Two observations relating physical fitness to metabolic rate are of

interest. The first, published in 1985, is that highly physically trained men have a resting metabolic rate that is high for their metabolic size (20). This relationship is observed most often in men with very high levels of aerobic fitness. This high level of basal energy expenditure is doubtless a contributory factor to the low reserves of body fat seen in trained endurance athletes. The second observation relates to the increase in metabolic rate that follows the ingestion of food, the so-called thermic effect of food (TEF). This aspect of energy expenditure is only a small proportion of the 24-hour energy expenditure, but may be quantitatively important in the regulation of energy balance. A recent study found that moderate levels of fitness were associated with the highest TEF, whereas a lower TEF was observed at both extremes of the fitness spectrum (21). If confirmed, this should encourage those who live in towns and who are beginning to put on weight to take part in moderate exercise.

The precise effect of exercise on food intake is not known, but it appears to differ between lean and obese individuals. In relatively long-term studies on non obese subjects, food intake increased with moderate physical activity (22). Obese individuals, on the other hand, either decreased or made no change in energy intake in response to exercise (23, 24). Thus is seems that the food intake of obese persons is less responsive to the effects of exercise than food intake in lean persons, an advantage that should encourage the over-weight to exercise.

Childhood

It has been suggested that activity levels of growing children are important not just for current physical fitness but also because they might affect the potential for exercise in adult life (25) although this has been questioned (26). It could be argued that as the physical activity of young children is largely spontaneous, then no difference would be brought about by their moving from a rural to an urban environment. This, of course, presupposes that in both situations the child is adequately nourished.

But to turn now to aspects of childhood in the urban environment that are not directly related to energy intake and execise output, some interesting reports have been published recently indicating that the nutritional well-being of the mother during pregnancy may influence the disease pattern of the foetus several decades after birth. Also nutriture of the infant may perhaps affect the cause of death when that infant reaches middle age. It may thus be incorrect to ascribe the altered disease pattern of first-generation immigrants to the urban situation to altered food intake or changes in the extent of physical activity, or lack of it in the urban environment. The disease pattern may have been predetermined before moving to the city or town.

Epidemiological studies in the UK have shown that birth weight at one year of age is negatively associated with the incidence of ischaemic heart disease in later life. It is also of interest to note that no such relationship exists for other non-circulatory causes of death, nor is weight at birth associated with risk of heart disease. Low weight at one year of age is also associated with an impaired glucose tolerance (even if adjusted for body mass) at age 59-70 years. The impaired glucose tolerance test and the risk of ischaemic heart disease may, of course have a common aetiological factor (27). The suggestion that a poor infant environment is merely the beginning of an adverse adult environment is unlikely as weight at one year did not show a downward trend through the social classes.

It has also been reported that weight at birth is inversely related to systolic pressure in middle age and that the placental weight/birth weight ratio strongly and positively correlated with later hypertension. The authors speculate that anaemia in the mother may have led to the relatively larger placenta (28). Thus, it could be incorrect to conclude, in first generation urban dwellers, that altered disease patterns are entirely due to environmental changes in later life.

However, these findings are at present, correlations and not cause and effect relationships.

Calcium

If physical activity is relatively low in urban areas or indeed anywhere, what effect could this have on bone and calcium homeostasis, with special reference to osteoporosis, a condition that seems to be becoming more common in developed countries? Although extremely high levels of physical activity cause bone hypertrophy and bed rest and immobilisation cause bone atrophy, the effect of intermediate levels of physical activity on bone mass is less clear. Increased physical activity, however, seems to delay bone loss or even to increase bone mass in young, middle-aged, and elderly subjects. For example, the bone mineral content of the tibia increased 5-10% in military recruits after intense training (29), the bone mineral density of the lumbar spine of postmenopausal women increased with 8-12 months of exercise (30), and the density of the distal radius of osteoporotic postmenopausal women increased 3.8% after 5 months of dynamic loading of the forearm (31). Because decreased levels of physical activity seem to be a feature of urbanization, an increase in the consequences of reduced bone mass is to be expected, unless a conscious effort is made to increase physical activity, in leisure time.

Can an increase in dietary calcium prevent or delay the onset and extent of osteoporosis? Dietary calcium has been implicated in the development of osteoporosis mainly through failure to achieve an adequate peak bone mass during early years. In a study in Yugoslavia two populations of women were studied with different calcium intakes. The one with the high calcium intake (1000 mg/day) had greater bone mass and experienced fewer fractures than the one whose calcium intakes were half that value (32). Because the energy intakes of the two groups were different, it is possible that the high calcium intake group were more active and it has been suggested that this fact accounted for the greater bone mass (33).

The role of dietary calcium may be quite different in those parts of the world where the intake of dairy products is low and because of this the intake of calcium is also low. A recent study of 400 Chinese men and women in Hong Kong with hip fracture and 800 controls found that a higher dietary calcium intake was associated with a lower risk of hip fracture (34). Interestingly, the average calcium intake in Hong Kong was 171 mg/day compared with an average intake in the UK of 689 mg/day. This low intake of calcium in Hong Kong could explain the calcium effect that was found and why it is not seen in the UK in that many of the subjects could have had calcium intakes that were inadequate for their physiological needs.

This highlights the complexity of the calcium intake/osteoporosis relationship, which is further compounded in the urban situation by an increase in alcohol and cigarette consumption, possibly nulliparity and lack of regular exercise.

Heart disease

We have heard about the role of

diet in the causation of heart disease. We also are aware of the prominence given to the Lipid Hypothesis for the aetiology of coronary heart disease, and we have recently learned that factors relating to thrombosis, such as fibrogen and blood viscosity, are more strongly predictive of coronary heart disease than are cholesterol levels (35). The risk of coronary heart disease of individuals in the top quintile of cholesterol levels is twice that of those in the lowest quintile. Using blood clotting measurements, the risk of the highest quintile suffering from coronary heart disease was 4-5 times that of the lowest.

The earliest evidence that physical activity may protect against coronary heart disease was provided some years ago by a classic study among London bus drivers and conductors which found that conductors of double deckers had substantially fewer heart attacks than drivers. Similarly it was found that postmen had fewer heart attacks than telephonists and post office clerks (36). Increased physical activity has also been found to raise the proportion of the protective HDL lipoproteins (37).

The benefits of exercise in heart disease prevention have been disputed and it has been suggested that exercise may play only a minor role compared with the risks of hyperlipidaemia, smoking and hypertension. Some advocate vigorous aerobic exercise (38) whereas another group found an almost linear benefit from increasing energy expenditure, with lower levels of exertion being protective, if sufficient time was spent exercising (39).

The value of exercise receives support from the finding that the incidence of coronary heart disease falls with increasing energy intake and this increase in energy intake is probably a reflection of increased activity, because the effect is independent of age and sex and is not an artifact of not smoking. Futhermore, reduced energy intake seems to result from generally lower food intake overall rather than a reduced consumption of a few specific nutrients of foods (40).

Physical activity and exercise have benefits other than preventing a future coronary event. Walking or cycling to work and using the stairs instead of the lift not only benefit the heart and improve bone mass, but also benefit the environment. The extent of physical activity will largely depend on the use of leisure time. The UK Health Education Authority recently recommended three 20 - minute bouts of vigorous exercise a week.

One of the features associated with living in cities is stress. This is not stress for survival in the physical sense but stress brought about by the urge to achieve. It is known that stress in the office can affect the blood cholesterol level. However, a recent report in the London Times (31 July 1991) cited research finding that corporate fitness programmes aimed at creating lean, mean decision makers are more or less a waste of time and that exercise makes you no more able to resist stress of a psychological nature. This may or may not be true but there can be no doubt that physical activity increases the capacity to resist physical stress if not psychological stress.

Conclusions

Urbanisation and economic development are associated with diminishing occupational physical activity but it seems that the increase in leisure time activity has not been large enough to counterbalance the decreased energy expenditure at work.

Likewise a reduction in energy intake does not seem to match the decrease in occupational and leisure activity so that the adiposity of adults and children has increased. In the former East Germany, for example,

rapidly improving living standards and other social policy changes resulted in a more sedentary lifestyle, overnutrition, and increasing rates of non-communicable disease mortality and morbidity (41). Perhaps more effort should be put into increasing nutrition knowledge and encouraging more leisure time physical activity, especially in the towns and cities.

References

1. Ferro-Luzzi A. Work capacity and productivity in long term adaptation to low energy intakes. In: Blaxter K, Waterlow JC, eds. Nutritional adaptation in man. London: John Libbey, 1985.
2. Norgan NG, Ferro-Luzzi A. Nutrition, physical activity and physical fitness in contrasting environments. In: Parizkova J. Rogozkin VA, eds. Nutrition, physical fitness and health. International Series on Sports Science 7; 167-193. Baltimore: University Park Press, 1978.
3. Viteri FE. Considerations of the effect of nutrition on body composition and physical working capacity of young Guatemalan adults. In: Scrimshaw NS, Altschul AM, eds. Amino acid fortification of protein foods, Cambridge, Mass.; MIT Press, 1971.
4. Viteri FE, Torun B. Ingestion calorica y trabajo fisico de agricolas en Guatemala. Bol of Sanit Panamer 1975; 78: 58-74.
5. Prentice AM. Adaptations to long term low energy intake. In: Pollitt ED Amante P, eds. Energy intake and activity. New York : Alan R Liss, 1984.
6. Mayer J, Marshall NB, Vitale JJ, *et al.* Exercise, food intake and body weight loss in normal rats and genetically obese adult mice. Am J Physiol 1954; 177: 544-8.
7. Mayer J, Roy P, Mitra KP. Relation between calorie intake, body weight and physical work. Am J Clin Nutr 1956; 4: 169-75.
8. Macdonald I. Non-linear relationship between reduced energy intake and rate of weight loss in rats. Ann Nutr Metab 1990; 34: 213-5.
9. Michael ED, Hutton KE, Horvath SM. Cardiorespiratory responses during prolonged exercise. J Appl Physiol 1968; 16: 997-1000.
10. Astrand I. Degree of strain during building work as related to individual aerobic capacity. Ergonomics 1967; 10: 293-303.
11. Wyndham CH, Strydom NB, Morrison JF, *et al.* A test of the effectiveness of acclimatization procedures in the gold mine industry. J Appl Physiol 1966; 21: 1586-8.
12. Spurr GB, Physical activity, nutritional status and physical work capacity in relation to agricultural productivity. In: Pollitt, E. and Amante P, eds. Energy intake and activity. New York: Alan R. Liss, 1984.
13. Brooks RM, Latham MC, Crompton DWT. The relationship of nutrition and health to worker productivity in Kenya. E African Med J 1979; 56: 413-21.
14. Satyanarayana K, Naidu N, Narasinga Rao BS. Nutritional deprivation in childhood and the body size, activity and physical work capacity of young boys. Am J Clin Nutr 1979; 32: 1769-75.
15. Immink MDC, Viteri FE, Flores F, *et al.* Microeconomic consequences of energy deficiency in rural populations in developing countries. In: Pollitt, E, Amante P, eds. Energy intake and activity. New York: Alan R Liss, 1984.
16. Sukhatme PV. Poverty and malnutrition. In: Sukhatme PV, ed. New Concepts in Nutrition and their

Implications for Policy. Maharashtra Assoc. for the Cultivation of Science Research Inst. Punna, India, 1982.

17. Leibenstein H. The theory of underemployment in backward economics. J Political Economy 1957; 65: 91-103.
18. Livingstone MBE, Strain JJ, Prentice AM, *et al.* Potential contribution of leisure activity to the energy patterns of sedentary populations. Br J Nutr 1991; 65: 145-55.
19. Bahr R, Ignes I, Sejersted OM. Effect of duration of exercise on excess postexercise O_2 consumption. J Appl Physiol 1987; 62: 485-90.
20. Tremblay A, Fontaine E, Nadeau A. Contribution of postexercise increment in glucose storage to variations in glucose-induced thermogenesis in endurance athletes. Can J Physiol Pharmacol 1985; 63: 1165-9.
21. Poehlman ET, Melby CL, Badylak, *et al.* Aerobic fitness and resting energy expenditure in young adult males. Metabolism 1989; 38: 85-90.
22. Woo R, Pi-Sunyer FX. Effect of increased physical activity on voluntary intake in lean women. Metabolism 1985; 34: 836-41.
23. Woo R, Garrow JS, Pi-Sunyer FX. Effect of exercise on spontaneous calorie intake in obesity. Am J Clin Nutr 1982; 36: 470-7.
24. Kissileff HR, Pi-Sunyer FX, Segal K, *et al.* Acute effects of exercise on food intake in obese and non obese women. Am J Clin Nutr 1990; 52: 240-5.
25. Astrand PP, Rodahl K. Textbook of Work Physicology. New York: McGraw-Hill, 1986.
26. Weber G, Kartodihardjo W, Klissouras V. Growth and physical training with reference to heredity. J Appl Physiol 1976; 40: 211-5.
27. Barker DJP, Winter PD, Osmond C, *et al.* Weight in infancy and deaths from ischaemic heart disease. Lancet 1989a; II, 577-80.
28. Barker DJP, Osmond C, Golding J, *et al.* Growth in utero, blook pressure in childhood and adult life and mortality from cardiovascular disease. Br Med J 1989b; 298: 564-67.
29. Margulies JY, Simkin A, Leichter I, *et al.* Effect of intense physical activity on the bone mineral content in the lower limbs of young adults. J Bone Joint Surg 1986; 68A: 1090-3.
30. Krolner B, Toft B, Neilson SP, *et al.* Physical exercise as prophylaxis against involutional vertebral bone loss: a controlled trial. Clin Sci 1983; 64: 541-6.
31. White MK, Martin RB, Yeater RL, *et al.* The effects of exercise on the bones of postmenopausal women. Int Orthop 1984; 7: 209-14.
32. Matkovic V, Kostial K, Simenovic J, *et al.* Bone status and fracture rates in two regions of Yugoslavia. Am J Clin Nutr 1979; 32: 540-9.
33. Kanis JA, Passmore R. Calcium supplements of the diet. Br Med J 1989; 298: 205-8.
34. Lau E, Donnan S, Barker DJP, *et al.* Physical activity and calcium intake in fracture of the proximal femur in Hong Kong` Br Med J 1989; 297: 1441-3.
35. Elwood P. Heart disease. The fat debate-time to move on. Chemistry & Industry 1990; 3: 59-62.
36. Morris JN. Exercise versus heart attack. MRC News 1989; 45: 24-5.
37. Hespel P, Lijnen P, Fagard R, *et al.* Changes in plasma lipids and apoproteins associated with physical training in middle-aged seden-

tary men. Am Heart J 1988; 115: 786-92.

38. Morris JN, Clayton DG, Everitt MG, *et al.* Exercise in leisure time: coronary attacks and death rates. Br Heart J 1990; 63: 325-34.

39. Paffenbarger RS, Wing AL, Hyde RT. Physical activity as an index of heart attack risk in college alumni. Am J Epidemiol 1978; 108: 161-75.

40. Elwood PC. Epidemiological studies of cardiovascular disease. Progress report VII. MRC Epidemiology Unit, Penarth, Wales, 1991.

41. Heinemann L, Zerbes H. Physical activity, fitness, and diet: behavior in the population compared with elite athletes in the GDR. Am J Clin Nutr 1989; 49: 1007-16.

Proc 6th ACN 1991; 603 – 607

Meeting the nutritional needs of societies in transition

GM Wilson

Department of Food Science and Technology, University of New South Wales
P.O. Box 1, Kensington NSW 2033 Australia

Introduction

This paper addresses the importance of food processing in meeting this objective, where the term food processing includes all those activities which are necessary to modify raw materials into a stable product. These include post-harvest storage, slaughtering, milling, drying, freezing, canning, chemical preservation, smoking, salting, fermentation and so on. The topic is addressed from the macroscopic viewpoint recognising that although nutrition is more and more recognised as a separate entity it is, and always will remain, multidisciplinary (1), developing the thesis that to supply the requisite nutrients to populations which are both increasing in numbers and also becoming more urbanised, it is necessary not only to improve production, but also to develop effective processing of foods so that they can be stored and distributed safely to the expanding population centres. Much effort is often directed at increasing food production and the establishment of the International Agricultural Research Centres has resulted in enormous benefits not only in relation to production, but also in the area of food science (2). Less emphasis has been devoted to developing food processing and distribution (3). The paper gives some indication of population growth, geographic movements, food requirements, changes which are occurring through food processing as it relates both to extending shelf life of existing products and the introduction of alternative products. Also the impact of all these activities on nutritional status since the nutritional condition of a population and the causes of problems depend on among other things, the environmental characteristics of the community (4).

Population growth trends

The human population is growing rapidly. In the next twenty years it is estimated that the world population will rise from 5,300 million to 7,200 million. This is an increase of 36%. At the same time it is anticipated that the urban population of the world will reach 3,600 million, a rise of 62% from the 2,200 million city dwellers in 1990 (5). In stating these percentage trends, it is nevertheless important to point out that in terms of actual numbers the agricultural population in the region is increasing. The ratio of arable and permanently cropped land to agricultural population has declined from 0.34 ha/caput in 1961 to 0.27 ha/caput in 1987 (6). These figures simply serve to confirm the absolute need to improve both the cropping efficiency and the capability of transforming raw materials into sound products with good shelf-life which are capable

of storage and transportation. The concept of value addition is important to increase income. Also, the need to look to importation of some of the food supply.

Food requirements and availability

In terms of kilocalories per head per day, food availability for the triennium 1984-86 has been compared with the national requirements of countries within the Asia-Pacific region (7). The increase in the weighted average of the kilocalorie availability is an important achievement for the developing countries in comparison with the triennium 1974-76 when the figure was 12% less. Variation however exists, both across countries and within countries.

A published summary by FAO of the dietary position is that the diets of most of the people in the Asia-Pacific region are rich in cereals and/or starchy roots and tubers, fair in fruit and vegetables, low in added fats, animal products and pulses and beans (8). From these proportions it is possible to estimate quantities of different food commodities which must be produced or imported into a country to shift the present focus of food and agriculture planning from mere food self-sufficiency to nutritional adequacy.

In relation to the consumption of these commodities as food products or prepared dishes three points are worth mentioning (3). The first point is that in the country about 50% of food consumed in the home is home produced, whereas in the city it drops to 10%. The second point is that research has shown that when people move from one environment to another they tend to maintain as much of their traditional values of food selection as is possible. This can be very difficult to achieve. An important goal of modern food technology therefore needs to be the development of products which duplicate traditional foods yet provide them in a nutritious and safe form that people can afford. The third point is that people eat to satisfy their wants rather than their needs. Palatability and emotional satisfaction are of primary importance and nutrition of secondary concern.

Food processing industry

As well as its positive influence on maximising the use of raw materials and provision of finished products capable of distribution over large distance, food processing has been identified as a industry which has high potential for boosting the economies of agriculturally-based countries. Some opportunities related to export while others are through tapping internal potential (6).

Agro-industry has traditionally been characterised by the dominance of thousands of small-scale, traditional units. More recently large international companies have made investments. Many techniques have been developed and are in regular use. These include chilling, freezing, heating, dehydration and use of chemicals. In the developed world much controversy exists about the use of food additives to preserve, modify, flavour and enrich foods. There is however little evidence that food additives represent a significant risk to health and they make a useful contribution to the provision of safe nutritious food.

The Asian Productivity Organisation reported the results of a Multi-Country Study Mission on the Food Processing Industry in October 1990 (9). One of the objectives of the study was to assess the current status of the food processing industry in member countries. Many parallels amongst the participants were noted both in terms of opportunities and problems created by food processing.

Traditional foods were found to be diverse. Consumption trends in general

related to socio-economic level in each country and in particular to the family unit. In general as a country develops, a shift from consumption of traditional foods (eg rice and vegetables) to Western-type foods (eg wheat-based products, eggs, meat and milk) is likely to take place.

Most countries represented were still very much an agro-based enterprise. For most, the beginning of the food processing venture centred around the utilisation of domestically available agricultural and fishery raw materials such as rice, vegetables, fruits, tea, sugarine, coconut oil, oil palm and seafoods.

Western-style products such as processed meat, eggs and bread have brought about the need to establish modern processing plants. In turn this has led to an increase in imported raw materials. In traditional factories, processing is generally manual, batch type and with simple equipment designed and fabricated locally. There is little or no Research or Development. Government and/or foreign aid is usually called upon to modernise facilities. In contrast, the majority of modern plants are owned by large companies which use readily available raw materials. Factories are well designed, highly automated and with strict quality control. R & D activities occur, thereby guaranteeing greater product safety and new product innovation. Problems have been generally identified as supply of raw materials, infrastructure, equipment and human resources, particularly shortage of skilled labour.

In relation to Research and Development participants particularly expressed the need for government involvement in this activity. Overall it has been noted that statistical data and information on food processing in the Asia-Pacific region is not well developed and that there is a need to complete this information.

Involvement of University of New South Wales

The University of New South Wales makes a contribution through the provision of some food technologists to the area and some research work done within the region. Many students are from the Asia-Pacific region. While our teaching covers all stages along the food chain, our main research emphasis is in the areas post-harvest storage to usage. Postharvest losses are a basic problem in all countries but particularly in those which are developing their agricultural practices. They can substantially affect food availability and they are estimated to claim at least 10% in grains, legumes and fish and 20% in starchy staples. Within our University, on the fruit and vegetable side, we have a strong post-harvest unit. As well as work within the University, extension activity is performed directly within countries in the region such as assisting in the establishment of post-harvest centres at key fruit and vegetable production centres at agricultural colleges, universities and departments of agriculture. Other activities include developing computer programmes which are capable of adaptation for the optimal storage of a wide range of cereal and nut crops. Problems have been addressed in relation to In-store drying in Malaysia and Drying of Grains in humid tropics including Thailand and Philippines. Processing by drying is necessary to avoid development of potentially carcinogenic mycotoxins by naturally occurring fungi. Another project related to Improved Processing Systems for Dried Fish. It is an example of technology which fits the traditional culture of the society to supply an important part of the essential protein component of the nutrition.

Lessons to be learned

Some of the changes which are

happening, or are likely to happen in countries in transition have already happened in countries such as Japan during the 20th century (10). Since the start of the century when rice was central to agricultural production there has been an adoption of Western-style processed foods, followed by strong urban development, and more recently a drive for health and safety in the food intake. In the last thirty years, trends indicate an increase in fats/oils coupled with an increase in energy. If the figures level off at this point they are very close to the range which is considered to be desirable. The average intake of each nutrient in Japan is fairly good compared with the recommended level, except a little shortage of calcium and iron (11). The present health condition of the Japanese people is fairly satisfactory demonstrating the largest longevity in the world. Clearly countries, where societies are in transition, will watch the trends and through educative processes inform their population of the adjustments to the balance which is occurring so that it approaches the optimum.

Discussion

In 1989 the European Journal of Clinical Nutrition pointed out that the many associations of the Council of the International Union of Nutritional Sciences (IUNS) did not yet include collaboration with a group representing the Food Processing Industry (FPI) (12). Many potential areas for collaboration between the food processing industry and the International Union of Nutrition Sciences were noted and it would certainly be worthwhile revisiting these recommendations.

In preparing the Joint FAO/WHO Framework Paper "Meeting the Nutritional Challenge" the authors rightly point out that to make lasting improvements in nutrition, action will be required by communities, national governments, bilateral agencies, international organisations and the private sector (13). Of the important discussion points this paper has focused on the value of food processing to improve household food security. This involves not only the food industry but all the these groups.

Conclusion

As the impact of population growth and rapid urbanisation continue to bring about significant changes to lifestyles of Asian populations, so greater demands will be placed on global food processing and distribution systems to provide urban consumer with safe nutritious food. This paper has aimed to underline that food research and development needs to be maintained at a high level to ensure that the technical skills are available to improve all stages of the food system. An increased number of trained scientists and technologists within their own countries will lead not only to better food production, but also to advances in storage, processing, preservation and distribution, so as to maximise output from the food system. These steps are all esential to achieve the goal of good health through provision of a good dietery intake which meets all of the body's energy and nutrient needs. However, food processing has to move in harmony with the nutritional needs of the consumers as well as their wants. It is only by there being a close union and a continuing dialogue that the agro/processing industries will produce the required stable products in the appropriate proportions, which both taste good and provide the required nutrients.

References

1. Gabr M. The present status of nutrition worldwide. Food and Nutr Bull 1990; 12(1): 75-7.
2. Bressani R. Food science and technology in developing countries

during the past 50 years. Food Tech 1989; 9: 108-32.

3. Miller SA. Report on the Panel on Food and Agriculture, WHO Commission on Health and the Environment 1990; Section 1.2.5.
4. Gross R, Monteiro CA. Urban nutrition in some developing countries: Some lessons to learn. Food and Nutr Bull 1989; 11(2): 14-20.
5. United Nations World Population Prospects 1990.
6. Hicks PA. Food processing industry in Asia and the Pacific: an overview of principles, policies and strategies. Asian Productivity Organisation Tokyo 1991; 36-68.
7. Qureshi RU. Towards nutritional adequacy in Asia-Pacific region. Proc 14th Intl Congress of Nutrition, Korea 1990; II: 207-8.
8. Qureshi RU. Dietary guidelines for food and agriculture planning. Proc 14th Intl Congress of Nutrition, Korea 1990; II: 205-6.
9. Editor. Summary of findings Food processing industry in Asia and the Pacific. Asian Productivity Organisation, Tokyo 1991; 1-24.
10. Tsutsomi T. Changing dietary intake and processed food consumption. Asia Productivity Organisation, Tokyo 1991; 25-35.
11. Yamagochi N. The progress and problems of diet and lifestyle during the last half century in Japan. Proc 14th Intl Congress of Nutrition, Korea 1990; II: 219-20.
12. Summary. European J Clin Nutr 1989; 43: 733-36.
13. 'Meeting the Challenge' FAO/WHO Secretariat 1991.

Proc 6th ACN 1991; 608 – 611

Basic concepts in nutritional epidemiology

Barrie M Margetts

Department of Human Nutrition, University of Southampton, Southampton S09 3TU UK

Introduction

Nutritional epidemiology is defined as the study of the nutritional determinants of disease, health outcome or nutritional status (broadly grouped and referred to as outcome measures). Classically epidemiological research has three aims:

1. to describe the distribution and size of outcome measure problems in human population;
2. to elucidate aetiology of outcomes, to determine cause-effect relationships between exposures and outcomes; and
3. to provide information necessary to manage and plan services for the prevention, control, and treatment of public health outcomes.

The primary objective in nutritional epidemiology research is to further our understanding about cause-effect relationships. It is not possible to reliably inform the policy makers about the best strategies to prevent illness and improve health, unless the research that is used to make these decisions is of the highest quality: where due consideration is given to all the important design and interpretation factors which influence the validity of the data.

Nutrition is a very complex exposure to measure and to understand the potential for complex interaction that exist within eating patterns and subsequent availability of substrates and co-factors at the level of function at tissues or cells requires an understanding of whole body metabolism. It is also important to consider the wider social, cultural, and economic environment in which the individual meets (or not) his or her metabolic demands. Because diet-disease relationships are so complex it is important that the expertise in nutirion and epidemiology are brought together so that important public health problems related to diet can be studied in the best possible way.

In summary a nutritional epidemiological approach provides:

1. a framework in which research on important public health issues can be undertaken to provide the information necessary to formulate policy;
2. a framework which provides for flexibility to address the changing public health priorities in a country or region; and
3. a practical approach to the design and completion of research.

The approach aims to consider the important theoretical issues in the light of how this affects study design, the validity and reliability of the information which is obtained, and how the data are interpreted in the light of the effects of chance, bias and confounders.

The theoretical difficulties raised in the presentation should be seen in the light of seeking ways to improve what is already being done, rather than saying it is not possible to do it. I believe that the principles of nutritional epidemiology are relevant to the study of problems of both inadequacy and excess, and that whatever the study question the best possible approach should be taken.

Measures of exposure-outcome

In deciding how to approach a particular problem, it is important to set up a clear testable question that the research seeks to address. The more specific this question the more likely that the relevant exposure and outcome of interest can be defined. Exposure measures can be diet assessed at the national, household or individual level, anthropometry, biochemical measures, clinical measures, vital statistics or other individual characteristics. If the exposure of interest is nutritional status it is important to consider that nutritional status can be assessed using dietary, biochemical, anthropometric and clinical measures and in broad terms using vital statistics. The information that each of these measures of nutritional status provides may not be comparable. Anthropometric measures of nutritional status are very commonly used in nutritional epidemiology studies because they are considered to be relatively simple to collect with reasonable precision. Where resources are limited they may be the only measure of exposure that can be obtained. However, because, for example, there are many factors beside food intake that may affect body weight it may be misleading to equate anthropometric measures with measures of food and nutrient intake. The term diet includes food, drink, and non-food items, and the components of food, both nutritional and non-nutritional. The concern may be for example, with food security where the relevant exposure measure is the amount of food available to the household or for example the concern may be with the amount of vitamin A in the diet.

The outcome measure is not always a disease (morbidity or mortality) endpoint, it may be individual diet, comparison with some reference standard such as an RDA, anthropometry, physiological measures (for example, blood pressure) or biochemical measures.

The aim is to measure the exposure and outcome measures of interest with required accuracy. The exposure and outcome measures can be measured in a variety of ways and the selection of an appropriate method and the correct use of that method must be considered at the design stage. It is vital to have a detailed protocol which is followed in the same way in all subjects in the study to avoid differential biases in data collection. If an inaccurate measure of exposure is used then the wrong estimate of effect of that exposure on the outcome of interest will be obtained. Prior to commencing the study the validity and reliability of the measures used, both of exposure and outcome, must be determined.

Confounding and effect-modifiers

In interpreting any exposure-outcome relationship it is important to take account of the other factors which may influence that relationship. If potential confounders and analysis, or considered in the design of the studies it is very likely that misleading exposure-outcome relationships will be inferred. Confounding factors need to be measured with the same accuracy as the key exposure measure; using an incorrect estimate of the confounder will result in an incorrect adjustment for its effect on the exposure-outcome relationship.

Study design

Epidemiological studies can be divided in a variety of ways. I find it most helpful to consider studies as being either observational or experimental and within each of these broad groups studies can either be based on populations or individuals as the unit of study. In observational studies the relationship between exposure and outcome is observed, whereas in experimental studies the investigator alters an exposure and assesses the effect of that change on outcome.

Ecological studies are observational studies conducted using data collected at a national or household level, but not at an individual level. Cross-sectional, case-control and cohort studies are all observational studies where individuals are studied. Observational studies are sometimes divided into descriptive (ecological and cross-sectional studies) and analytical (case-control and cohort) studies.

Experimental studies in populations are called community trials, whereas experiments in individuals are called either field or clinical trials.

Each study design has strengths and weaknesses and the choice of the best study design to use depends on the state of knowledge in the field of study, the question that is being asked and also on practical considerations such as time and money. However, for each type of study there are important specific design implications which need to be considered. It should also be borne in mind that not all types of study design are the same and the strength of causal inferences that can be drawn from ecological studies for example is not the same as that which can be drawn from a well-controlled experiment.

The requirements for measuring diet in these different sorts of studies differ; these issues will be discussed elsewhere in this Symposium.

Interpretation of nutritional epidemiological studies

Having designed and conducted the study in the best possible way and in strict compliance with the research protocol, the investigator has to interpret the information obtained. It is important to consider the effects of chance, bias and confounding on the exposure-outcome relationship that has been found.

In assessing the findings the investigator needs to know whether the results obtained could have occurred by chance alone. This can be tested by hypothesis testing or by reference to confidence intervals. The ability to detect a true relationship is affected by the accuracy of measurements and the number of subjects in the study. If the investigation finds not statistically significant difference it is important to consider whether this is due to there being no effect or because the study design was compromised in some way or because the study was too small.

The potential for bias must always be considered when interpreting studies. There are many potential sources of bias at all stages of the process of completing the research from subject recruitment through to analysis. Of prime concern is differential bias between groups in the study. For example, in a case-control study if diet is assessed more completely in cases than controls a differential assessment of exposure and therefore of the effect of the exposure on the outcome will be obtained. It is also important to consider the effects of potential confounders.

In interpreting the study it is also important to consider whether it is reasonable to generalise from the present sample to other populations.

Summary

A nutritional epidemiological

approach can be a very useful way to address research questions aimed at understanding cause-effect relationships. The design of nutritional epidemiological research starts from a clear definition of the study question of interest, clarification of the study design to use, a clear articulation of the study protocol and the adherence to that protocol. The measures that are taken should be accurate and reliable and the likely error in these measures should be assessed so that the affects of misclassification can be taken into account.

Used carefully, a nutritional epidemiological approach can play an important part in informing public health policy.

Proc 6th ACN 1991; 612 – 615

Reducing measurement error in nutritional epidemiology

Noel W Solomons

Centre for Studies of Sensory Impairment, Aging and Metabolism, Guatemala City, Guatemala, Central America

Introduction

It is important that we discuss together the issue of measurement error in nutritional epidemiology, because understanding it makes us better technically for working in epidemiology, and improves the quality of our final product. The region of Asia and the Pacific is composed of diverse societies and ecosystems, from the highly-industrialised countries of Japan and the Republic of Korea and the enclaves of industry and finance in Singapore and Hong Kong, to the transitional nations of Malaysia and China, to the still largely rural, largely agrarian, and largely poor regions of the Indian subcontinent, of Indo-China and of the archipelago nations of Indonesia and the Philippines. The great majority of the population, however, lives in the latter two regions (transitional and less-developed), characterised by limited resources for health or for the study of health. Thus, the relevance of nutritional epidemiology to the majority is its relevance to resolving the nutritional problems of the poor.

Despite the povery of the Asian countries, its health sciences cannot afford to succumb to the poverty. There is a pernicious proposition in some circles that espouses that almost any level and grade of competence is sufficient for the study of less-developed countries. The syllogism might be stated: "First class science for First World countries; Third class science for Third World countries. We must reject such notions and insist on maximising competence in our epidemiologists and excellence in our epidemiology. Some would argue that we do not have the luxury for high quality epidemiology in less-developed countries; I would argue we do not have the luxury not to have the highest quality. At the least, poor epidemiology will waste money; at the worst, it will result in wasted lives.

On the nature of nutritional epidemiology

There exists a growing debate on the definition and scope of the term: "Nutritional Epidemiology". The debate does not rage so much within the industrialised nations but at the interface of the more affluent and the less previleged nations and populations. In the most generic sense, epidemiology is the study of the origins and the transmission of diseases in populations. Given possibilities for prevention and therapy, it also embraces the monitoring of health-related interventions.

When poor, underdeveloped countries with underprivileged populations are considered, it is not necessary to discard concerns for diet and health,

but rather balance them with the more important problems of nutrition. The priority is logically going to be on nutrient deficiency and nutritional imbalance, rather than on dietary excess. The urgency of the battle to overcome food insecurity and deficiency states supercedes the longer-range objective to reduce the prevalence of chronic and degenerative diseases (1,2).

In addition, one must go beyond the dietary paradigm, per se, when one considers the determinants of nutritional status. It is not only the nutrients not consumed, but the nutrients not absorbed, not retained, not utilised or lost in excessive amounts, that can lead to deficiency states (3). Environmental and psychosocial causes can be at the root of nutrient depletion. Thus, nutrient deficiency syndromes can be rampant where individuals' intakes of the specific nutrients in the diet are apparently adequate to meet ordinary nutritional needs.

Hence, it is in the interest of the solution of problems affecting the less-developed countries of Asia, and the rest of the globe, to maintain a more ample definition of nutritional epidemiology as "epidemiology in service to understanding abnormal human nutrition to find ways of improving human nutriture", rather than the more restrictive (and First World relevant) definition as "diet and health". In this broader context, nutritional epidemiology will pursue issues such as:

1. The description of the prevalence and pattern of abnormal nutrition in populations.
2. The causes and determinants (dietary, environmental, genetic, psychosocial) of altered nutrition.
3. The surveillance of sentinel populations for changes in nutritional status or the factors that influence it.
4. The monitoring of nutritional responses to intervention aimed at improving nutrition directly or at reducing factors that interfere with adequate nutrition in populations.

On the nature of measurement error

Error is an indelible fact of life in all measurements in research and in clinical practice. There is no more an error-free measure or index than there is a "free lunch." Thus, in epidemiology, as in other disciplines, one must come to terms with and come to live with the fact of error (4).

Causal, inference and observational/experimental design

The issue of causality is central to all of epidemiology as the prevention of disease, disability or dysfunction is related to the elements that cause them. In epidemiology, the search for causality traditionally begins with the paradigm of "host, agent, exposure." The host is the individual potentially susceptible to being affected; the agent is the factor of causation; but a sufficient duration and intensity of exposure between agent and susceptible host must occur to cause illness.

Associations are relationships between or among variables which has a probability of occurring in conjunction greater than chance. The fact of an association in no way implies causality i.e, that one variable produced the outcome for the other variable. Three types of planned epidemiological study designs are recognised: (a) cross-sectional study; (b) longitudinal study; and (c) intervention trial.

In a cross-sectional design, variables are measured in a population at a specific point in time for each participating subject and only one set of data are gathered. If multiple measurements are made, they are averaged to provide a single value for the person. It is the least expensive of all studies to under-

take, and the easiest to assure enrolment and compliance, but only the existence or absence of association can be concluded. It is impossible to impute causality based purely on cross-sectional associations.

In longitudinal studies, a cohort of individuals are measured sequentially over time to determine a series of variables. No external changes are applied, but the natural alterations in the variables can be assessed and associations tested for. Since the sequence of relationships is known, the direction of effect can be determined in longitudinal studies. This, however, still does not prove causality, since the longitudinal association may, in fact, be caused by another factor that was not measured in the study.

Finally, an intervention study is a variant of the longitudinal study in which the exposure to an agent is controlled. Ethically, only a potentially protective (therapeutic or preventive) agents can be applied or only a potentially noxious agent, a placebo group or a non-intervened subcohort should be included. This is the most expensive and complex format to maintain, but it is the design that provides the most power to determine causality.

The nature of variables in nutritional epidemiology

In the descriptive aspects of nutritional epidemiology in which prevalence and incidences are of prime interest, any measurable variable related to nutrition (dietary intake, nutritional status, health, function) can be assessed. The demographic (age, sex, ethnicity) and socioeconomic data (income, education) are also conveniently included.

In the search for causal relationships in nutritional epidemiology, the most frequent exposure variables are: (a) dietary intake (of a food, or a nutrient, or a non-nutrient constituent) or (b) nutritional "insults" or status (deficiency; marginal undernutrition; marginal overnutrition; excess). The outcome variables are can be related to other aspects of nutritional status, some aspect of health status, or physiological or cognitive functioning.

Precision and accuracy of measurements

The fundamental considerations in measurement error relate to two important terms: accuracy and precision. Accuracy is the degree to which a measure gets the correct answer, as compared to a "gold standard". Precision is the degree of reproducibility of the measure for getting the same or a similar value repeatedly. For studies of prevalence, accuracy is crucial. For seeking associations, precision is usually the more critical quality of epidemiological.

Consequences of measurement errors

When the error is one of accuracy, a misclassification error is likely to occur (5). When imprecision is the error, an instability of response is likely to be perceived. If the understanding of disease causality or the nature of biology is the goal, both misclassification and instability act against the finding of a true association when a true association exists. For instance, if one is looking at malnourished and well-nourished people in relation to adequate or inadequate nutrient intake as the exposure, there is obvious implication for the reliability of the association test if persons are misdiagnosed as malnourished and vice versa, or if dietary intake estimates over- or underestimate true intake. In such a circumstance, a true association of inadequate intake as an exposure predicting nutrient deficiency may be totally missed.

Conclusion

To be a good nutritional epidemiologist, one must first be a good epidemi-

ologist, with a command for the fundamental principles and the newer applications in epidemiology.

Nutritional epidemiology includes the dietary exposure: chronic disease paradigm, but in addition — especially in the Third World countries — it embraces issues of nutritional deficiency surveillance and intervention programme monitoring.

All measurements in science involve error. In nutritional epidemiology, one must be aware of: (a) sources of error; (b) consequences of error for finding associations; and (c) the tolerance for error of a specific inquiry.

The principal errors to be concerned with in nutritional epidemiology are related to accuracy, i.e. getting the correct answer, and precision, i.e. reproducibility and stability of the measure. For relative risk assessment both types of error are important; for regression analyses, precision is more important than accuracy. Finally, sampling error, i.e. the inclusion of biased and non-representative subpopulations, is another source of errors that influences the ability to uncover true associations.

References

1. Willett W. Nutritional epidemiology: issues and challenges. Int J Epidemiol 1987; 16 (Suppl): 312-3117.
2. Willett W. Nutritional Epidemiology. In: Monographs in Epidemiology and Biostatistics, Vol 15. New York: Oxford University Press, 1990; 272-290.
3. Brown KH, Solomons NW. Nutritional problems of developing countries. Infectious Disease Clinics of North America 1991; 5:297-317.
4. Snedecor WG. Error in measurement in statistics. Technometrics 1968; 10: 637-666.
5. Barron BA. The effects of misclassification on the estimation of relative risk. Biometrics 1977; 3: 414-418.

Proc 6th ACN 1991; 616 – 619

Measuring dietary exposures (including use and problems of biochemical markers) in nutritional epidemiological studies

Barrie M Margetts

Department of Human Nutrition, University of Southampton, Southampton S09 3TU UK

Introduction

From a clear articulation of the study question follows a clarification of the relevant study design and choices for measuring the dietary exposure of interest (1). The measure of dietary exposure needs to be of required accuracy, and the final decision about the method to be used may be influenced by practical as well as theoretical issues. For example, it may be that the investigator would like to know in great detail the vitamin A intake of an individual, and chooses a very detailed dietary history method, but finds that because of the demands of the method on the subject many people do not complete the study thereby compromising the validity of the findings. It may be better for the investigator to use a less rigorous method, but one that can be used by the subjects. Under these circumstances the investigator then needs to consider the effects of the increased measurement error associated with the simpler method and design and interpret the study accordingly. Whatever method that is selected it is important that it is used in the same way in all subjects to avoid bias, and that during the study the validity and reliability of the measure is assessed in the study sample.

In designing studies which seek to understand causality it is important to consider the possible mechanisms by which the diet affects the outcome. It is also important to consider the complexity of the dietary exposure. Diets are eaten as a whole package and the effects of one component in isolation may be quite different from when studied in the whole diet. Nutrients may also interact, or the effective availability may be different at different levels of other nutrients. It also may not be reasonable to equate what is measured in the diet with what is actually available at the functional level; there is a need to consider the bioavailability and bioequivalence. It is also important to consider that the diet that is eaten at present may not be the diet that caused the disease and to understand causality it is the diet that caused the disease that is relevant.

Assessing dietary exposure

In an earlier presentation in this Symposium, I described the different types of study designs that are commonly used in nutritional epidemiology research, and the preferred method of assessing dietary exposure differs in each type of study. The method of assessing diet must be

appropriate for the level of precision required. It may be that the investigator is concerned with ascertaining the group mean estimate and provided the sample is large enough a relatively simple measure of diet (such as a one-day recall or one-day record) will give an accurate estimate of the true sample mean. However, the exact level of intake for each individual will not be accurately determined. The assumption is that on the day of taking the dietary record for example, some people will over-report and others will under-report their usual true intake, but that on average the group mean will reflect the true intake for the group. This means that it is not possible to say at the individual level that an individual's intake is high or low, and therefore it is not appropriate to use that measure to rank that individual in the population. If the investigator wants to ascertain the individual's true intake, a more detailed method will be required, such as a seven-day dietary record, where within subject variability can be assessed.

If the objective of the study is to obtain nutrient intakes from the dietary assessment, the investigator must in some way convert the amounts of foods eaten into levels of nutrients. It is possible to obtain duplicates of meals eaten and directly analyse the nutrient content of the meal. This is expensive and time consuming and in most epidemiological studies the investigator relies on tables of the composition of foods to derive nutrient intakes. The assumption must be made that the food eaten (quality, preparation etc) is similar to that from which the food table values were derived. This may not always be the case, and for some nutrients reliable food tables do not exist. Food tables do not exist for every country, and therefore assumptions must be made about the validity of using for example Indian tables in Bangladesh. While it will be desirable to improve the quality of food table data bases, existing data can be used provided they are used with consideration of the possible weaknesses and providing that within the study sample, there is not likely to be any difference in the validity of the assumption that the tables are appropriate (that is there is no bias).

Specific measure for different study designs

In ecological studies dietary exposure is assessed from data collected at a national or household level, for example using food balance sheets collated by FAO, or in the UK using the household food survey. (2). These measures are then compared with data collected in the same study units such as for example, rates of decayed, missing and filled teeth, or national morbidity or mortality data such as infant mortality rates or rates of colon cancer. Caution is required in drawing causal inferences from these sorts of comparisons. Data collected at national or household level may mask important variation within the sample, and may also miss out important sources of foods. For example in the household food survey in the UK, consumption of foods eaten outside the household are often not included, and there is no allowance for waste of food purchased. Correlation between gross national product and mortality across the study units is often as strong as for food intake and mortality, indicating that there is the possibility that many other factors may account for the association that is reported (ie confounding factors can not generally be assessed and adjusted for in these studies). However, when interpreted with caution, associations seen at an ecological level can provide a useful lead into potentially important causal relationships which warrant further in-depth study.

Cross-sectional (prevalence) studies assess the relationship between exposure and outcome at one point in time.

This approach is very widely used because results can be obtained relatively quickly and cheaply. It is difficult to draw causal inferences from these studies as it is not possible to determine whether the exposure affected the outcome or vice versa, and therefore it is not possible to say that the exposure caused the outcome. It is usually the case that a group mean estimate of diet is the required measure of exposure and thus a one-day recall or record is adequate, provided the sample is large enough to reduce the standard error of the group mean estimate to enable a true difference in intakes to be detected. Food frequency questionnaires and dietary histories are also useful methods of assessing diet in cross-sectional studies.

Case-control studies compare persons with the outcome of interest (cases) to persons without the outcome of interest (controls or referent group). The prevalence of past diet is measured and from this, a risk ratio for the effect of that measure is determined. Ideally the measure of diet should cover the period of time when the diet is believed to cause the outcome to develop. Therefore past diet, not the present diet is the relevant exposure. If current diet is used to estimate past diet it must be assumed that diet has not changed over time, and that if diet has changed that the change is consistent between cases and controls. For many diseases this may not be the case and it is possible that a bias wil occur. Most commonly, diet is assessed by a food frequency questionnaire (asking about patterns in the past) or a one-day recall or record, if current diet is used as a proxy for past diet.

Cohort studies start with defining the exposure of subjects and then follow these subjects up over time. Dietary exposure needs to be measured at baseline and at regular intervals duringthe follow-up period. In large cohort studies, the method of assessing the diet is usually a one-day recall or a food frequency questionnaire. Both methods can be completed by interview or they can be self-administered. If they are self-administered they need to be carefully piloted in the study population to ensure that they can be completed reliably. It is also desirable to assess the validity of the methods in a sub-set of individuals in the same study population.

Experimental studies set out to modify the dietary exposure and assess the effect on outcome. In community trials it is not possible to assess dietary intake at the individual level, and routine data as in ecological studies is often all that is available to assess compliance. It is now becoming more common in community trials to assess compliance in a sub-set of individuals. In clinical or field trials, where individuals are followed in great detail, a very accurate assessment of diet is required at baseline and during the study.

Use of biomarkers to ascertain exposure

Because of the difficulties of measuring diet in epidemiological studies, investigators have increasingly turned to biomarkers of intake. A biomarker may be considered to be any biological material taken from the body in which it is possible to measure a level of a nutrient (or exposure, susceptibility or outcome). The assumption is that the level of a nutrient measured in a tissue sample will be a more objective assessment of intake than what is recorded by the subject. Markers are also used to check on the validity of dietary assessment methods as well as to check on compliance in experimental (intervention) studies.

Most commonly biomarkers are taken from blood, urine, fat and faeces, but other cells and tissues have been used (for example, skin, cheek cells, toe nails, hair, breast milk). Whatever cells

are used it is important to consider that there will be measurement error in any assay that is undertaken, and that there is also potential for bias (for example in response rates where blood samples are required). It is essential, therefore to assess the reliability of the methods used to ascertain the tissue levels. Quality control needs to be considered and reported (present coefficients of variation on repeat measures).

It is also vital to consider the nature of the relationship between the marker and nutrient intake. It is commonly assumed that this is a simple linear relationship, the more in the diet the more in the blood. This may be true for some nutrients, but it is not likely to be true for most. For example blood vitamin A levels do not increase above a certain level of intake. It is therefore important to know the range of intake of the nutrient of interest and determine whether in that range blood levels will be sensitive to differences in intake. It may be that at different levels of intake, different markers may be more appropriate. For example buffy coat vitamin C may be appropriate at low intakes and urinary levels more sensitive at higher intakes.

It is also important to consider whether the turnover of the nutrient under investigation in the tissue being used relates to the relevant time frame for assessing intake. If for example there is a rapid turnover, and a measure of longer term intake is required, the marker may not be appropriate. Further the level of the marker in blood, for example, may be influenced by other nutrients or the physiological state of the subject.

Summary

Dietary exposure can be measured in a variety of ways and the optimal method will depend on the study in question. Different types of study designs require different methods of assessing diet. In all studies, it is essential to have an indication of the validity and reliability of the measures, to assess measurement error and the likely degree of misclassification. Once a study protocol is established, all subjects should pass through the study in the same way.

Biomarkers are a useful support to assessing dietary exposures, but need to be used with caution to ensure that they are relevant to the exposure of interest.

References

1. Margetts BM and Nelson M, eds. Design concepts in nutritional epidemiology. Oxford: Oxford University Press, 1991.
2. James WPT, FerroLuzzi A, Isaksson B and Szostak WB. Healthy nutrition: preventing nutrition-related diseases in Europe. WHO regional publications, European Series No 24, WHO Regional Office for Europe, Copenhagen, 1988.

Proc 6th ACN 1991; 620 – 622

The application of nutritional epidemiology in community nutrition programmes

Goeffrey C Marks

Nutrition Programme, University of Queensland, Brisbane, Australia

Introduction

To address this topic I will look at the field of epidemiology in terms of what it has to offer the practising nutritionist, particularly somebody involved in delivering programmes, or in planning and policy formulation related to nutrition problems in the community.

Epidemiology is defined as the "study of the determinants and distribution of disease in human populations". Nutritional epidemiology applies this to nutritional problems. Textbooks of epidemiology often talk about the uses of epidemiology in terms of descriptive epidemiology, analytic epidemiology and intervention studies.

Descriptive epidemiology is mainly concerned with describing who has the nutrition problem, where they are located, at what time of the year and under what circumstances it occurs. this is central to any nutrition programme where we need to describe the extent of the problem that we are dealing with, define who our target group is, and to set priorities. Often we use clinic data to do this, or routine reports, or special surveys. The epidemiological issues of bias, chance, and confounding apply as much to these types of data as they do to more rigorous studies.

Analytic epidemiology aims to establish whether or not there is a causal link between a particular exposure and an outcome. In the context of policy and planning, for example, we might want to determine whether or not an increase in cash cropping in a province causes a change in diet and subsequently the rate of malnutrition. For program development, we might want to determine the behaviours leading to the development of vitamin A deficiency in children. These normally involve carrying out special studies such as a cohort or a case control study.

Finally, there are intervention studies. These aim to assess the impact or the effect of a programme that has been implemented. Rigorous programme evaluations are becoming more and more important in the current economic environment where we are being asked to justify our programmes and demonstrate to funding agencies that they are not wasting their money.

From this brief overview, it is clear that much of what epidemiology deals with can be directly applied to strengthen the development, implementation and evaluation of nutrition programmes and policies. However, because we are dealing with nutrition there are a few special problems, and this is what helps to define nutritional epidemiology.

The first issue is that nutrition, or nutritional status is difficult to measure directly, and so we use a series of nutritional indicators. The second is that in the course of our work we use these indicators in a variety of ways. The third is that malnutrition, both over- and undernutrition can be the outcome of many factors that operate at the level of the community, or the household, or the individual. As a result nutrition programmes and policies are often inter-sectoral, and nutrition studies inter-disciplinary.

Methods of nutritional assessment

Methods of nutritional assessment in common use include: dietary assessment, laboratory measures, anthropometry, physical activity or fitness, immune response, behavioural assessment, clinical assessment.

Each of these can be used to provide a range of indicators that reflect nutritional status. Dietary assessment, for example, can be expressed in terms of kilocalories or gramess of intake per day, percent adequacy, or a measure of dietary diversity. Biochemical measures can reflect the level of body stores of a nutrient, the level in body fluids or some functional change. Anthropometry, the most commonly used method of nutritional assessment, is the basis for measures of wasting, stunting, underweight, obesity and so on. While these are all indicators of nutritional status, each of the indicators measures different things and, in epidemiological terms, have different validity, reliability, sensitivity and specificity.

Validity refers to how closely the measure reflects what we actually want to measure. For example, to measure the change in nutritional status in the children of a community over a period of several years, height-for-age would be a valid indicator because it reflects long term nutritional status. But weight-for-height would have poor validity because it is very susceptible to short-term changes and so it reflects other things.

Reliability refers to how well the measurement can be repeated. If the reliability is not high there will be a lot of error in the assessment.

Sensitivity refers to how well we can identify those that are truly malnourished — the proportion of those that we call malnourished that are truly malnourished. We want this to be high, particularly if not being given treatment carries a high risk.

Specificity is a measure of how well our indicator or method of assessment identifies healthy people as being healthy. We want this to be high, particularly if the treatment has some risk associated with it, or is particularly expensive.

The characteristics determine how useful the indicators are for use in describing the nutrition problem of a community, selecting people for treatment, for use in programs, in special studies and evaluations.

Uses of the indicators

Taking this a step further, the indicators are also used in various ways. For example:

a. screening individuals to prevent malnutrition, as in growth monitoring — we want the indicator to predict malnutrition;

b. diagnosing malnutrition — we want an indicator to predict risk, or predict some benefit from the treatment;

c. equity — to rank areas according to how far the population is away from some ideal or normal value;

d. for evaluating a treatment or intervention — we want an indicator that will respond to the treatment. For example, weight change would

be a better indicator of short-term changes in protein-energy status in children than is height change.

The "best" indicator will depend on the purpose. The indicator that is most appropriate for identifying those at highest risk may be different than that which is best for defining greatest benefit or response. Thus, there is no single indicator that will be appropriate for all purposes, and one needs an understanding of the characteristics of the indicators in order to choose the best one for a particular purpose. This is an important area in the study of nutritional epidemiology.

Community nutrition activities depend on the nature of the problem

In the context of community nutrition we are presented with some special challenges because of the nature of the nutrition problems. Malnutrition may be a result of shortage of food at the community level, for example, due to agricultural problems. It may be a result of individual households not having access to adequate quantity or quality of food, for example due to poverty. Or it may be a result of the way that food is distributed within the household, or personal choice. The content of our programmes depends on the constraint that is causing the problem.

If we are concerned with predicting malnutrition so that we can take steps to prevent the malnutrition, or to identify those most at risk so that we can target programmes, then it may be that the best indicators to use are not even those that assess nutritional status.

Because of this, nutritional surveillance systems, for example, need to consider a range of indicators, often using information that comes from outside the health sector. Epidemiology gives us a way of assessing the characteristics of these indicators and the sources of the information, and of deciding how useful they are for this purpose.

Finally, nutritional epidemiology needs to be seen in the context of what the nutritionist, planner or policy maker is trying to accomplish — that is, they are trying to reduce the levels of current malnutrition, and to prevent the occurrence of future malnutrition. An epidemiological approach can help to understand some dimensions of the problem — who, where, when and why in quantitative terms, and to evaluate if the programme is working as expected. However, this approach has some limitation when we are talking about the behaviour of the population. This is relevant to some analytic studies where we are trying to establish a causal link between attitudes and behaviours and nutritional outcomes; or for example, in the context of an evaluation where we need to know what factors are influencing compliance in the program, why some people participate and others do not. These types of questions are better addressed by qualitative methods. Consequently, I would argue that while nutritionists have a lot to gain by training in nutritional epidemiology, it needs to be seen in the context of training in a range of approaches to assessing nutritional problems. What is needed is for nutrition workers to be able to choose from a range of approaches and methods for assessing and addressing the problems.

Summary

1. Nutritionists can benefit from better use of epidemiologic principles and methods.
2. Special expertise is needed for applying epidemiology to nutrition issues.
3. Nutritional epidemiology should be seen as one of several approaches to assessing and addressing nutritional problems in the community.

Proc 6th ACN 1991; 623- 625

The application of nutrition epidemiology in developing countries

Asmuni R Ranggasudira, PF Matulessy, IT Angeles, Ratna Djuwita

University of Indonesia, Jakarta, Indonesia

Nature of the problems

The developing countries are faced with nutritional deficiency diseases, such as, PEM, vitamin A deficiency, nutritional anaemia, and IDD. All of these community nutritional states end up to higher infant and child mortality rates, as well as, maternal mortality rate. Apart from these, they cause lower human productivity, higher absentism and increased morbidity rates.

The before mentioned conditions, in the long run, will effect the quality of a nation's health, setting up a vicious circle: lower nutritional status - higher morbidity - poverty states.

Changes of lifestyle from traditional toward westernised and industrial communities, invite new public health nutritional problems, especially in the big cities; among them are obesity, degenerative diseases, and other nutrition-related chronic diseases.

It has been well recognised that community nutritional problems (either over or undernutrition) are caused by complex etiology (multifactorial nature of the disease) rather than one single cause. These multifactors, in many instances, contribute to the complexity of instituting the intervention programme. Therefore, all providers engaged with improving nutritional and health status of the people/community should collect, analyse, and synthesise the information needed for the programme.

Application of nutritional epidemiology

Nutritional epidemiology is used to quantify and describe patterns of nutritional disease or problems of the community. The figures can be in descriptive or rates which indicate magnitude and distribution in relation to person, place and time; it can also be in the shape of analytical result which may come to elucidation of the diet - disease/problem relationship. Any information regarding the community nutrition obtained from the study is needed by any level of prevention (primary, secondary, and tertiary), policy and any level of nutrition management.

Preventive measures

Most of developing countries are engaged in agriculture. The population is young. Mortality rates of infant and preschoolers contribute to a large portion of all deaths which are rooted in protein-energy malnutrition.

In big cities, shifting of agrarian to industrial lifestyle alters the people's disease pattern. Lifestyle or the so called self-created risks by Alan Dever can be divided into 3 elements - leisure activity risks, consumption pattern,

and employment risks - resulting in newly emerging community nutritional problems in developing countries. Example of these are : CHD, obesity, hyperglycaemia, peptic ulcer, hypertension and other concomitant problems. In preventive measures, the role of nutritional epidemiology may be:

a. to define the occurrence, distribution, determinants of nutrition problems of the community so as to provide a basis for planning, monitoring, evaluation, and management of efforts to improve community nutritional status.

b. to promote the utilisation of the nutrition epidemiological concepts in the management of nutrition problems.

Nutrition policy

Nutritional epidemiology information in this field is translated into meaningful and natural (normative) public policy decision. The policy leads to the development of programmes to aleviate the major causes of nutritional deficiencies and to people's productivity yielding national prosperity.

Implementation

The implementation of nutrition policy relates to the management of nutrition programme and services. In nutrition management, the role of nutritional epidemiology is to provide a method, within the planning process (strategic and/or operational planning), collecting health and nutrition information and guiding the implementation of the activities or programmes. By this, expected effective outcome indicators are clearly defined, and the means of operation are set up or created; clear expectation about when, where, and how activities will be conducted are set and in which results are monitored, measured and redirected when deviations are detected.

Present and future needs

The developing countries cannot avoid being influenced by industrial society's lifestyle, while at the same time depend on the agrarian section for national food supplies. Thus, they are faced with complex nutrition conditions which need, in turn, complex solution.

The scarcity of funds, and the lack of other resources necessitate health and nutrition planners to adopt suitable and efficient planning. Programmes and projects should be carefully planned in view of the expediency of the problem. The first activity, therefore, to be conducted is the identification of problems. This is one of the major objectives of nutritional epidemiology, which otherwise, will result in failure and useless efforts.

Logically, there is a real need for the developing countries to apply nutritional epidemiology to their problems. It means training of nutrition and health workers on how to conduct sount assessment of community nutrition and nutrition-related problems; to identify effective and efficient methods to address these problems; to collect valid/reliable informations/data; to analyse and interpret these data; and to utilise them. It should be mentioned, however, that these activities are already existing in our own respective countries, but are we really on the right tract? Are we utilising our resources effectively and efficiently? Are we collecting a valid and reliable data? Are there substantial researches on which some of these activities are based? These are some questions for thoughts in this Symposium.

Training teaching staff of local higher educational institutions on health and nutrition and nutritional epidemiology has been done in Indonesia. Before running the course, some

members of the nutrition and epidemiology staff from University of Indonesia were sent to join a similar course conducted by Southampton University, led by Dr Barrie Margetts.

The Indonesian experience on the said course allows us to recommend it to other countries in the region. Of course, it depends on all of us who are present today as to what should be done.

Proc 6th ACN 1991; 626

Training in nutritional epidemiology at the Nutrition Programme, University of Queensland

Geoffrey C Marks

Nutrition Programme, University of Queensland, Brisbane, Australia

Established in 1979, the Nutrition Programme of the University of Queensland offers postgraduate training in nutrition for professionals coming from health, agriculture, economics, planning and other backgrounds. The primary focus of the Nutrition Programme is on public health issues. Training in nutritional epidemiology is stressed in several courses.

Master of Community Nutrition (MCN)

The MCN is a 12-month coursework degree aimed at professionals involved in the formulation and implementation of nutrition policy and programmes and those who train other professionals to work in the area of nutrition. An interdisciplinary approach to nutrition problems is stressed. Nutritional epidemiology is included amongst the core subjects for the course.

Master of Public Health (MPH)

The MPH requires coursework and a short thesis. Students who major in nutrition undertake course work in nutritional epidemiology and research on a problem related to nutrition. The MPH is normally completed in 18 months (full-time) or can be undertaken part-time.

Research training (MMedSc and PhD)

Research training at the masters and Ph.D levels includes coursework in nutritional epidemiology and further training relevant to the research topic. The masters degree is normally completed in two years of full time study, while the doctorate is normally completed in three years.

Short term training

Short-term training can be arranged both in Australia, or in-country for overseas groups in the areas of nutritional epidemiology, and nutritional surveillance.

Research in the programme

Current areas of research amongst the Nutrition Programme staff include: food and nutrition policy studies; nutritional surveillance; health promotion; evaluation of programmes; agriculture and nutrition; iodine deficiency disorders; recommended dietary intakes; beta-carotene and skin cancer; nutrition and development of non-communicable diseases; nutrition and child morbidity.

The primary focus of the Nutrition Programme is on public health issues and nutritional epidemiology is important to most areas of research and training in the Programme.

Proc 6th ACN 1991; 627

Nutritional epidemiology training in the People's Republic of China

Ge Keyou

Institute of Nutrition and Food Hygiene, Beijing, China

Human nutrition is under the jurisdiction of the health sector in China. Nutritional epidemiology training involves health schools, research institutes and epidemic prevention stations.

Amongst the 128 medical universities/colleges, only three have set up nutrition as a specialty. Nutrition epidemiology is taught as one of the courses. For students of the public health specialties in other 36 universities/colleges, the class hour of nutrition is 40-50 hours, nutritional epidemiology makes only a small portion of it. In 510 vocational health/pharmaceutical schools, there are only 3 schools involved in nutrition specialty training.

There are 5 institutions authorised to confer the master's degree in Nutrition and Food Hygiene. Nutritional epidemiology training is conducted for the post-graduate students.

The Institute of Nutrition and Food Hygiene, Chinese Academy of Preventive Medicine is a unique National Nutrition Research Institution. The Department of Community Nutrition of this Institute has carried out informal nutritional epidemiology training in connection with some large scale nutrition surveillance and intervention programmes.

Epidemic prevention stations at provincial and county levels are the principal institutions for the implementation of community nutrition programmes. The personnel at these stations are the trainees of the informal training mentioned above, and then become the trainers for the local training. About 10,000 local health workers have been trained through this system; basic knowledge on nutritional epidemiology is included in the course.

Nutritional epidemiology is new in China. The training needs in this field are first, international formal programmes for college teachers and trainers; second, workshops for experience exchange between senior professionals.

Proc 6th ACN 1991; 628 - 633

Nutritional epidemiology – research and training in Malaysia

Mirnalini Kandiah

Institute for Medical Research (IMR), Kuala Lumpur, Malaysia

Introduction

Nutritional epidemiology (NE) is the application of the principles of epidemiology to nutritional problems. Just as epidemiology originated in the study of communicable diseases, nutritional epidemiology may be said to originate in the study of famines where large numbers of people were affected. Early studies of nutritional deficiencies such as pellagra, anaemia and scurvy concentrated on the geographic pathology of these conditions. The application of epidemiological principles in the study of nutritional disorders, coincided with the discovery of vitamins in the 1920's.

Nutritional epidemiology is not unknown to researchers in Malaysia. The earliest nutrition studies, which go as far back as 1900, were carried out to investigate the etiology and pathology of beri-beri, in the then Federation of Malaya. This pioneering work carried out at the Institute for Medical Research stimulated interest on other disorders arising from vitamin deficiencies in the diet, such as xeropthalmia, rickets, pellagra and angular stomatitis.

TABLE 1

Nutritional epidemiology - institutions involved

Institution/University
1. Institute For Medical Research (IMR)
– Division of Human Nutrition
2. Malaysian Agricultural Research and Development Institute (MARDI)
– Food Technology Division
3. Public Health Institute (PHI)
– Food and Nutrition Unit
4. Universiti Pertanian Malaysia (UPM)
– Department of Nutrition and Community Health, Faculty of Agriculture
5. Universiti Kebangsaan Malaysia (UKM)
– Department of Food Science and Nutrition, Faculty of Life Sciences.
– Department of Community Health, Faculty of Medicine
6. University of Malaya (UM)
– Department of Social and Preventive Medicine,
– Faculty of Medicine

With the setting up of a Division of Nutrition at the IMR after the war in 1946 and the emergence of the universities in the early 60's and 70's, NE research in the country was extended to cover other areas in nutrition including PEM, nutritional anaemia, nutrition-related infections, nutrition toxicology, nutrition surveillance and intervention. In Tables 1 and 2 are presented the various institutions and departments in the country actively involved in NE research. Several studies in the past have applied epidemiological principles to study nutrition problems in the country. Table 3 shows a list of studies done in the recent 10 years, categorised under various aspects of NE. This list is not an exhaustive one but contains some of the better designed studies.

TABLE 2

Training in nutritional epidemiology

Institution/University	Target groups
1. Department of Nutrition and Community Health, Faculty of Agriculture Universiti Pertanian Malaysia (UPM)	Undergraduates (B.Sc)
2. Department of Food Science and Nutrition, Faculty of Life Sciences, Universiti Kebangsaan Malaysia (UKM)	Undergraduates (B.Sc)
3. Department of Community Health, Faculty of Medicine, Universiti Kebangsaan Malaysia (UKM)	Medical Undergraduates Master of Community Nutrition (MCN)
4. Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya (UM)	Medical undergraduates

TABLE 3

Research areas in nutritional epidemiology (1980-1991)

Research areas	Studies
Assessment of nutritional status	Status of community nutrition in rural villages in Peninsular Malaysia
	Nutritional status in remote villages in Sabah, East Malaysia
	Nutritional status in the elderly
	Nutritional status in adolescents of various ethnic groups

Table 3 (continued)
Research areas in nutritional epidemiology (1980-1991)

Research areas	Studies
	Maternal nutritional status and foetal development
	Prevalence and effects of protein-energy malnutrition in Malaysia
	Nutrition surveillance studies
	Nutritional status of children in an urban squatter community in Malaysia
	Nutritional assessment by comparative growth achievement in Malay children below school age
Nutrition intervention	Nutritional status of pre-school children in two rural areas selected for the SEAMEO Pilot Project for Integrated Community based Human Resources Development
	Nutritional impact of the School Supplementary Feeding Programme
	Impact on growth and iron nutritional status of alternative interventions in anaemias associated with hookworm disease
	Iron status and working productivity of women estate workers Effect and implications of the Applied Nutrition Programme on primary pupils in Sarawak
	Iron supplementation, haemoglobin concentration and birth weight in pregnant Malay women
Infant feeding studies	These are modern times - infant feeding practices in Peninsular Malaysia
	Breastfeeding - A study of 8,750 Malaysian infants

Table 3 (continued)

Research areas in nutritional epidemiology (1980-1991)

Research areas	Studies
	Infant and health practices - A study in three communities
	Infant feeding practices in an urban squatter community
	Determinants of breastfeeding and weaning patterns in Malaysia patterns in Malaysia (Malaysian family and fertility survey)
	Environmental factors in the relationship between breastfeeding and infant mortality: the role of sanitation and water in Malaysia (MFLS)
	Changes in infant feeding practices in Malaysia - a historical review.
Low birth weight (LBW) studites	Incidence of LWB during pregnancy and birth weight
	Dietary intake during pregnancy and birth weight
	Implications of LWB on the growth and nutritional status of children
Deficiency diseases	
1. Anaemia	Iron-deficiency anaemia among pregnant-women, young children
	Folate status in vulnerable groups
	Nutritional anaemia in pregnancy: A study at the Maternity Hospital, Kuala Lumpur
	Etiology of iron-deficiency anaemia during-pregnancy among rural women In Malaysia
2. Vitamin A deficiency	Ecological assessment of vitamin A status of primary school children in Terengganu, Malaysia

Table 3 (continued)

Research areas in nutritional epidemiology (1980-1991)

Research areas	Studies
	Serum vitamin A levels of two rural communities in Malaysia
3. Goitre	Endemic goitre in Kedah, Malaysia
	The prevalence of endemic goitre among various ethnic groups in Sarawak
	Survey of availability of iodine – enriched salt in Sarawak
Dietary studies	Food habits and dietary of pre-school children in rural areas
	Food habits of primary school children in Peninsular Malaysia
	Dietary intakes of a native community in Sarawak, East Malaysia
	Comparative food consumption and pattern in selected new villages, kampungs and estates
	Food intake and factors influencing data accuracy in a rural community
	Determinants of family and preschooler food consumption
	Food intake in selected towns and rural areas of Peninsular Malaysia
	Food consumption and habits in rural-Malaysian villages
Nutrition and infection	Impact of ascariasis and trichuris on growth in early school-age Tamil Malaysian children
	The effect of ascariasis on weight and height gain among Indian primary school children
	Hookworm infection, anaemia and growth retardation
	Malnutrition in malaria-endemic villages in Sabah

Table 3 (continued)

Rsearch areas in nutritional epiddmioloby (1980-1991)

Research areas	Studies
Nutrition and chronic diseases	Coronary heart disease risk factors survey among Malaysian executives
	Relationship of coronary heart diseases with dietary intake, nutrition knowledge and practices
	Association of obesity, serum lipids and lipoprotein levels in male adult Malaysians
	Cardiovascular diseases in Malaysia – A Country Report by the Ministry of Health
	High-density lipoprotein - cholesterol levels and their application in assessing coronary heart disease risk in Malaysia
	Non-hypercholesterolaemic effects of a palm-oil diet in Malaysian volunteers
	Risk factors and the absence of coronary heart disease in the Orang Asli in Malaysia
Nutrition and cancer	Salted fish and nasopharyngeal carcinoma (NPC) in Malaysia
	NPC and dust and smoke in Malaysia with control for dietary variables)
	Aflatoxins and toxin-producing moulds in selected foodstuffs and food consumption patterns, and exposure to aflatoxins and toxin producing moulds in selected population groups

In conclusion, while attention will continue to be given to rural undernutrition, a shift in emphasis will also be seen towards nutritional problems in urban areas as well as chronic degenerative disorders associated with affluence and nutritional excesses, particularly in view of the Government's vision of Malaysia being an industrialised country by the year 2020. Thus NE activities in Malaysia need to be targeted with vision 2020 in mind.

Proc 6th ACN 1991; 634 – 635

Training, research and services in nutritional epidemiology in Thailand

Panata Migasena

Mahidol University, Bangkok, Thailand

Training

Nutritional Epidemiology integrates with the teaching of Epidemiology in the three International postgraduate teaching courses held in the Faculty of Tropical Medicine, Mahidol University as follows:

1. Diploma in Tropical Medicine and Hygiene (DTM&H)
2. Master of Science in Tropical Medicine (M.Sc. Trop. Med)
3. Doctor of Philosophy in Tropical Medicine (Ph.D. Trop. Med)

The faculty has also been conducting yearly a short term 3-weeks' training course in tropical epidemiology as a national programme for Thai physicians.

Nutritional Epidemiology is also integrated with Epidemiology in the following postgraduate courses conducted by the Faculty of Public Health, Mahidol University:

1. Master of Public Health (MPM)
2. Master of Science in Public Health (MSPH)
3. Doctor of Public Health (Dr P.H.)

Associated postgraduate courses in Epidemiology which involve the teaching in the field of Nutritional Epidemiology are:

1. Board certification in Preventive Medicine-Epidemiology (the training programme of 2 years Field Epidemiology Training programme plus MPH).
2. Master of Science in Medical Epidemiology (M.Sc. Med. Epid.) This course is conducted by the Faculty of Public Health, Faculty of Tropical Medicine and the Ministry of Public Health.
3. Asian Short Course in Tropical Epidemiology is conducted yearly in rotation among 4 TROPMED Nation Centres of Thailand, Philippines, Indonesia and Malaysia.

Research

The Department of Tropical Nutrition and Food Science, Faculty of Tropical Medicine, Mahidol University conducts research in the field of Nutritional Epidemiology such as:

(a) Eating habits and defecating habits of the people in the endemic area of liver fluke infection.

(b) Nutritional surveillance in the northeast of Thailand as well as nutrition intervention for the important problems in the community such as iron-deficiency anaemia, protein-energy malnutrition, vitamin deficiencies.

(c) Food-borne carcinogens such as nitrosamines, nitrates, nitrites, aflatoxin.

Service

The Epidemiology Division, Office of Permanent Secretary of the Ministry of Public Health of Thailand is involved with the following services:

1. Publication of a weekly Epidemiological Surveillance Report.
2. Duty in investigation on endemicity or epidemiology of the diseases of public health importance to obtain epidemiological data and to make use of epidemiological tools and methods in prevention and control of such diseases.

National Epidemiology Board of Thailand

This Board consists of 20 distinguished academicians including the President of Mahidol University and 7 Deans of all medical schools in Thailand, 6 top administrators from the Ministry of Public Health including all Director-Generals of the Departments, the Armed Forces Research Institute of Medical Science and other leading medical scientists. An Executive Committee has been appointed in order to ensure the better management and to expedite the processes involved. This committee consists of 9 members of the Board who can meet more often.

There are 3 scientific areas for the National Epidemiology Board of Thailand to operate:

Communicable diseases

At the initial stage, the diseases include malaria, rabies microbial infections acquired during hospitalisation of patients, poliomyelitis, dengue haemorrhagic fever and Aedes mosquitoes, cholera vaccine trial, hepatitis E and hepatitis B studies, sexually transmitted diseases.

Non-communicable diseases

The diseases include diabetes mellitus, hypertension, cancer of liver, lung, biliary tracts, prostate, cervix, breast, etc, accident and injury prevention, drug addiction of amphetamine, heroin, marihuana, vapours, etc, and chronic diseases in the elderly.

Environmental health

The areas include (a) air pollution from motor vehicles in Bangkok, (b) water pollution from wastes of industries in Bangkok and suburb areas, (c) environmental hazards from using pesticides and insecticides in agricultural practice, (d) illness effects in industrial workplaces and ergonomics, and (e) environmental monitoring of toxicological and microbiological contamination of water.

Proc 6th ACN 1991; 636

Nutritional epidemiology training in the Philippines

LB Rabuco

College of Public Health, University of the Philippines, Manila

Prior to 1988, there was no formal course in nutritional epidemiology offered in the College of Public Health, University of the Philippines, Manila. Instead, nutritional epidemiology was incorporated in the various epidemiology course offered by the Department of Epidemiology and Biostatistics and in other nutrition courses. Then the Department of Nutrition instituted several new courses under the Master of Science in Public Health one of which is Nutritional Epidemiology. The course is an application of epidemiological methods on problems in nutrition and nutrition-related diseases and is handled by the Department of Nutrition. The course is open to all graduate students not only in nutrition but other disciplines as well. Additionally, the Clinical Epidemiology Unit of the College of Medicine is also involved in short-term (1-2 days) nutritional epidemiology training to different agencies.

Other agencies involved in epidemiology training include the Field Epidemiology Training Programme Unit (FETPU) of the Department of Health and the Philippine Heart Centre of Asia (PHCA). The FETPU conducts training on epidemiologic investigation of diseases for example, an examination of thiamine deficiency in one province in Southern Philippines. While the PHCA has been conducting researches particularly on the epidemiology of coronary heart diseases. The Food and Nutrition Research Institute and the Nutrition Service of the Department of Health are also actively involved in nutritional epidemiology researches.

Proc 6th ACN 1991; 637 – 638

Nutritional epidemiology training in India

PS Shetty

Nutrition Research Centre, St. John's Medical College, Bangalore, India

The subject of nutritional epidemiology is not new to India. Assessment of nutritional status of different segments of the population particularly in relation to dietary intakes has been one of the important nutrition research activities in India for well over six to seven decades. These isolated or regional studies were carried out by several Institutions and Agencies. It was the Indian Council of Medical Reseach, through one of its intramural Institutions, the National Institute of Nutrition (NIN) which established systematic data collection in many of the States in the country through an extremely well-organised nutritional surveillance system established as early as 1972. This National Nutrition Monitoring Bureau (NNMB) has been carrying out systemic surveys and has also recently conducted a National survey along with the National Sample Survey Organisation (NSSO). Some nutritional epidemiological training has been provided largely by the NIN for the staff of the NNMB in order to enable uniform data collection on nutritional parameters in the form of in-house training. Several nutritional epidemiological studies, mostly longitudinal followup of cohorts has been carried out in the country, more specially to obtain information and to evaluate the impact of intervention strategies in the field of childhood malnutrition and growth patterns of children and adolescents. The recent cohort studies on vitamin A and morbidity are outstanding exmples of such nutritional epidemiological studies being carried out in this country. Other examples include the several reports based on classical epidemic genu valgum in fluorosis belts, epidemics of lathyrism, aflatoxicosis and other similar outbreaks of nutrition related disorders. Despite the excellent record of studies in the epidemiology of nutritional disorders, no concrete and systematised training programme exists for nutritional epidemiology in this country for medical, health and nutrition personnel. Such a training programme becomes even more important with the advent of and the increasing incidence of diseases of Western civilisation such as hypertension,

Coronory artery disease and diabetes which are nutrition related. In a complex socio-cultural milleu and a pluralistic society such as India, both degenerative diseases of industrialised countries and deficiency diseases seen in poor developing countries tend to coexist. Whether one is involved with the concerns of a primary health care centre or with the problems that one addresses in an advanced tertiary care facility one is confronted by an array of nutrition-related disorders that can be prevented. Training in nutritional epidemiology for personnel handling both these extremes is paramount if

India has to prevent the losses imposed on its society by the morbidity resulting from the effects of poverty and affluence at the same time.

AUTHOR INDEX