5. SUMMARY

5.1. The incidence of mortality from myocardial infarction in South Africa, Fiji and England is high among those of Asian origin when compared to those of European and African descent. In India, the incidence of coronary mortality is higher among South Indians; earlier workers have found that the increased use of rice (over wheat) as the main cereal runs parallel to the increased CHD mortality among the railroad workers in the different regions of India. However, dietary surveys are very incomplete, and hence this study.

5.2. The possibility of a relationship between diet and CHD among middle class (with respect to income, education and occupation), town-dwelling South Indians was studied by a diet survey in 350 households in the city of Madras and the Department of Atomic Energy (DAE) Township at Kalpakkam, 50 km South of Madras city on the east coast of South India. The sample studied consisted of 215 children (aged 3-12 years) and 942 adolescent and adult subjects (aged 13 - >50 years).

5.3. To collect dietary data, a Diet History - Interview Schedule was specially formulated to meet the objectives of this study. This instrument of data collection was pretested on a population similar to the test populations and then validated against a 3-day Weighed Inventory of dietary intake assessment in a subsample of the test population.

5.3.1 Information on the different foods consumed was recorded as amounts consumed in one month, (an average of the previous three months), by an entire
household. Individual food intake was arrived at by using consumption units
developed for Indians by the National Institute of Nutrition (NIN) and Indian Council
of Medical Research (ICMR). Nutrient intake was computed using food tables
compiled for Indian foods by the NIN, ICMR. Foods were analysed for vitamin E,
cholesterol, selenium and manganese content and the intake of these nutrients
was also computed.

5.3.2 Data on foods intake included cereals, pulses (legumes), milk, meat
(including egg, fish and fowl), green leafy vegetables, roots and tubers, other
vegetables, nuts and oilseeds, sugar and oil.

5.3.3 Nutrients studied included net energy, protein, carbohydrate, fat (visible
and invisible), cholesterol, calcium, phosphorus, iron, copper, zinc, manganese,
selenium, carotene, retinol, vitamin A, vitamin E, vitamin C, thiamine, riboflavin and
niacin. Data on the consumption of non-nutrient components - oxalate, phytate and
total dietary fibre is also presented. Fatty acid intake based on visible fat intake
was also computed.

5.4 The trend of risk of coronary mortality in the South Indian population
studied was assessed by the medical history and the plasma lipid and lipoprotein
profile of 342 men, over 40 years of age in Madras and the DAE township in
Kalpakkam. For the 342 men, Coronary Risk Index (CRI - Total Cholesterol/HDL-c)
WAS 4.5 ± 0.5, 26.3% had hypertension, 24.3% had a history of diabetes mellitus
13.2% had a history of CHD and 44.7% had CRI above 4.5, 14.6% had total
cholesterol above 240 mg/dl. These results confirm that the incidence of CHD in
the population is high.
5.4.1 Blood assays were also made on miscellaneous parameters such as glucose, haemoglobin, urea, uric acid, creatinine, SGOT, SGPT, free radical scavengers - vitamin A, E, C and GSH; antioxidant enzymes - SOD, GPx, CAT, plasma and erythrocyte lipid peroxidation and the trace element selenium in plasma and erythrocytes.

5.4.2 Antioxidant deficiencies were seen only in subjects with CHD. Those having CRI above average, but without CHD, showed borderline values for free radical scavengers - vitamin E, C and GSH and also for SOD activity. The values of the other blood parameters were normal except for selenium, which falls in the lower ranges worldwide but, not as low as in Keshan's disease.

5.5 Food and nutrient intake is presented in terms of age, sex, food habits: lactovegetarian (vegetarian including lactovovegetarian), omnivore (non-vegetarian), and income (upper middle-income [Group A] and lower middle-income [Group B]). Children, male and female adolescent and adult subjects are classified according to sex and food habits into the age groups 3-5, 6-9 and 10-12; 13-18, 19-24, 25-34, 35-49 and >50; 13-19, 20-29, 30-39, 40-49 and >50 years respectively.

5.6 Significant dietary findings were: vegetarians consume more fat than omnvores; visible fat intake is generally lower than invisible fat intake; fat derived calories are lower than 30%; cholesterol intake is lower than 250 mg/d; % unsaturation with respect to fatty acids in the visible fat consumed is >60%; protein derived calories are very constant between 10 - 13% and carbohydrate derived calories are between 60 - 65%; Income A Categories have greater fat intake than
Income B Categories while Income B Categories consume more cereals and less of the protective foods, like milk other vegetables, than the Income A Categories.

5.7 The RDA for vitamin A is met by a combination of carotene (from plant foods) and retinol (from animal foods). The major source of vitamin E is the vegetable oils with 55% and 58 - 67% of the adult and adolescent subjects respectively, meeting the US RDA. Only 44% and 38% of the children aged 3-12 years meet the US RDA for vitamin E. Vitamin C intake is adequate with respect to the ICMR RDA, except for children of 3-5 years. Riboflavin intake in all the categories are significantly deficient; only 23% and 26% of the male and female adult subjects respectively, 13% and 11% of the boys and girls respectively and 0.5% and 12% of the adolescent boys and girls respectively meet the ICMR RDA. Thiamine and niacin intake are adequate in some groups and borderline deficient in others.

5.8 The strikingly deficient minerals that were in the diet are selenium, iron and zinc. Copper intake is adequate in some groups and borderline in others. Calcium, phosphorus and manganese intake are adequate. Dietary selenium intake in the population studied falls in the lower ranges of intake observed worldwide.

5.9 Selenium intake, (for which ICMR has not provided any RDA), in the population is significantly low and 58% of the adult subjects consume less than half the US RDA. The selenium content in the local foods was analysed and it was seen that wheat, milk, fish and legumes were the chief sources of the element, while polished rice, the staple food, was a poor source.
5.10 The possible role of dietary wheat as a source of dietary selenium in the rice-based diets of the south Indian population was studied. First, the relationship between dietary selenium and wheat intake of 877 adult male and female subjects was analysed. Subsequently, the relationship between frequency of dietary wheat intake and plasma and red cell selenium content in 65 male subjects was studied. A higher wheat intake is related to increased selenium intake as seen in the entire adult population; subjects who consumed wheat more frequently had higher plasma and erythrocyte selenium content. The effect of a 3-month supplementation of selenium from wheat by partial substitution of rice in the habitual rice-based diets of 12 normal healthy South Indians was analysed. After the 3 month wheat supplementation period, it was observed that both plasma and erythrocyte selenium levels were raised, the increase in plasma being more significant. The activities of the antioxidant enzymes were also raised the increase being significant for GPx. The concentrations of the four antioxidant scavengers were significantly raised and both plasma and erythrocyte (untreated) lipid peroxidation had decreased, the decrease being significant in the erythrocytes. CRI was also lowered in the subjects.

5.11 The results of this study indicate that right from childhood, the fat content of the middle-class South Indian diet is below the levels considered as favourable for the development of CHD. However, the South Indian diet is very varied as seen from the vitamin and mineral intake. The four nutrients which are much below the RDA are selenium, iron, zinc and riboflavin. Selenium is associated with the etiogenesis of CHD, chiefly due to its role as an essential part of the antioxidant enzyme - glutathione peroxidase. A favourable change in almost all the blood
parameters after selenium supplementation indicates that, selenium from wheat is effective in delaying the asset of CHD.

5.12 It can be concluded that the higher incidence of CHD in South Indians may be related to the sustained dietary deficiencies with respect of selenium and riboflavin. No outward signs of any nutrient deficiency are noticed in the population studied.

5.13 CHD is strongly related to the diet of any population. In this population, inclusion of wheat as a regular part of the rice-based diets may have far reaching effects in lowering the incidence of CHD as seen from various results. The role of selenium in the etiology of CHD among South Indians has to be studied further. The role of zinc, iron and riboflavin deficiency in the etiology of CHD among South Indians needs further investigation.