

A COMPARISON OF THE LEVELS OF TOTAL SERUM CHOLESTEROL (1974-1984) AND ITS RELATIONS TO ISCHAEMIC HEART DISEASE IN SINGAPORE AND THE UNITED STATES OF AMERICA

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SYNOPSIS

We compared the differences in the levels of serum cholesterol between two studies on patients with myocardial infarction in 1974, and strokes in 1984. As there is no linear study over this period of 10 years of the levels of serum cholesterol, the differences in the levels between these two years were taken as the projected rise over this period. The average rise in serum cholesterol was 14.4% and this was related to the rise in deaths due to coronary heart disease of 9%. Although there was no rise in the deaths in the age group below 50 years, nevertheless they showed the highest rise of 22.5% in the level of serum cholesterol.

The cause of this rise in serum cholesterol and deaths due to coronary heart disease was related to the increase of the gross domestic product (GDP) of Singapore which had averaged 9% per year over the past several years. The study shows that the deaths due to coronary heart disease paralleled the rise in the GDP. While we have a rise of 0.9% per year of deaths due to coronary heart disease, the United States of America is showing a 0.6% fall per year of this disease. The differences in the levels of serum cholesterol between the nationals of Singapore and the United States and the causes for these differences are discussed in relation to the differences of the percentage deaths per year of the respective countries.

A change in the life style of the Singapore citizen is mandatory if a halt and a reversal of this rise of death due to coronary heart disease is to be achieved.

SING MED J. 1988; 29:6-10

INTRODUCTION

Ischaemic heart disease (IHD) is a major cause of morbidity and mortality in Singapore. Over the past 15 years there has been a steady increase in the mortality from ischaemic heart disease (Fig. 1), while deaths from infectious diseases have declined with better health measures. The magnitude, extent and cause of the increase in IHD mortality is examined, discussed and contrasted with that seen in the United States where a precipitous decline in mortality from IHD was observed over the past 15-20 years (1). This paper especially seeks to address the role of cholesterol as a main contributing factor in the rise of mortality associated with IHD in Singapore.

In 1974, Lim et al., (2) studied 142 patients admitted to the coronary care unit for management of acute myocardial infarct. The profiles of these patients were measured with regard to all the known risk factors amongst which were serum cholesterol, triglyceride, and uric acid (Table 1). In 1984, Chew et al (3) conducted a relatively similar exercise to study the profiles and risk factors of 80 stroke patients. Again in this study, attention was paid to the levels of serum cholesterol, triglyceride, uric acid and high density lipopro-

tein of these patients, in addition to other risk factors (Table 2).

A review of these two papers indicates that there was a significant rise in the level of total serum cholesterol for all ages over the past 10 years ($P < 0.05$). As no serial study of serum cholesterol in the general population of Singapore has been made, liberty is taken to assume that this rise represents the national average rise (Table 3). Although both the studies looked at different diseases, and suffered from some dissimilarity in statistical analysis e.g. age grouping of patients, nevertheless, the basic pathology under consideration was atherosclerosis, to which the total serum cholesterol is much related.

Although other risk factors such as cigarette smoking are important contributions to IHD, their roles in its pathogenesis are not compared here as they have been stated in previous papers (2, 3). The Southern Chinese in Kwangchow are heavy cigarette smokers and suffer from a high incidence of cancer of the lung, but only about 50 people were admitted annually for acute myocardial infarction to a 600 bed hospital there (4). Compared to our hospital, the Alexandra Hospital, with an almost similar bed capacity, (568 beds), there were 273 admissions for acute myocardial infarction in 1984. The main diet of these Chinese in Kwangchow is rice gruel, vegetable and fish. It is not known what their serum cholesterol levels are, but it is likely to be low. Heavy cigarette smoking does not seem to be a factor that predisposes these Southern Chinese in Kwangchow to IHD when the diet is low in cholesterol coupled with low incidence of hypertension through low salt intake. In Singapore, a survey in 1974 among persons aged 20 years and above showed a prevalence of hypertension of 14% (5). We have not included the risk of hypertension in this study.

The association between plasma cholesterol and atherosclerosis is well established and angiographic

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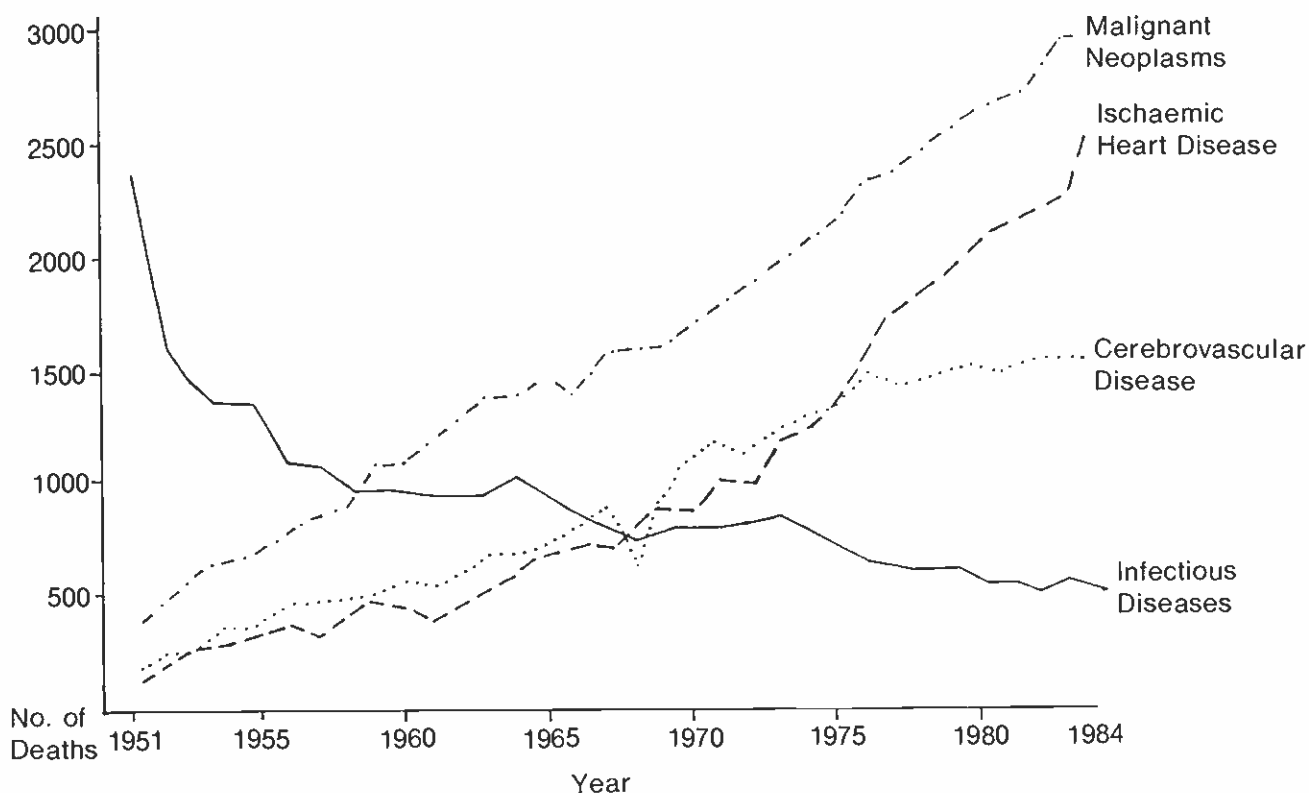


Fig. 1: Deaths by Selected Causes, 1951–1984 Ministry of Health, Singapore

TABLE 1
MEAN SERUM CHOLESTEROL, TRIGLYCERIDE AND URIC ACID VALUES
AT VARIOUS AGE GROUPS
(Lim et al 1974)

Age Group	No.	Cholesterol mgm % Mean ± S.D.	Triglycerides mgm % Mean ± S.D.	Uric Acid mgm % Mean ± S.D.	Age (Mean) (years)
Below 40	10	222.50 ± 38.17	128.10 ± 57.72	6.24 ± 1.96	34.80
41 – 50	34	216.68 ± 45.56	141.35 ± 46.00	6.19 ± 1.35	45.91
51 – 60	55	219.60 ± 90.33	157.58 ± 91.79	6.34 ± 1.53	55.13
61 – 70	39	216.32 ± 46.48	148.32 ± 76.96	6.77 ± 1.16	64.82
70 & above	4	227.00 ± 36.50	212.40 ± 69.09	7.86 ± 2.09	73.20
All ages	124	218.49 ± 65.68	151.07 ± 76.39	6.46 ± 1.47	54.72 ± 9.76

TABLE 2
MEAN CHOLESTEROL, TRIGLYCERIDE, HDL-CHOLESTEROL AND CHOLESTEROL:
HDL RATIO AT VARIOUS AGE GROUPS
(Chew et al 1984)

AGE	Mean ± SE (mg/dl)			Cholesterol HDL
	Cholesterol	Triglyceride	HDL-CH	
All Patients				
Below 50	267 ± 26	155 ± 18	38 ± 4	7.0
50 – 59	247 ± 8	149 ± 10	41 ± 3	6.0
60 – 69	254 ± 12	148 ± 11	38 ± 3	6.7
70 – 79	246 ± 12	124 ± 10	45 ± 3	5.5
80 & above	236 ± 18	135 ± 26	46 ± 9	5.1
Total	250 ± 6	141 ± 6	41 ± 2	6.1

TABLE 3
PERCENTAGE INCREASE IN CHOLESTEROL LEVEL
FROM 1974-1984

Age group	Cholesterol level		Percentage increase
	*1974	†1984	
Below 50	218.00	267	22.5
50 - 59	219.60	247	12.5
60 - 69	216.32	254	17.4
70 & above	227.00	241	6.2
Total	218.49	250	14.4

*C.H. Lim et al
†W.L.S. Chew et al

information suggests that progression is related to the level of hypercholesterolaemia. The Multicentred Lipid Research Clinic Coronary Prevention Trial (LRC-CPPT) in the United States and Canada addressed itself to the lowering of hypercholesterolaemia with cholestyramine (6). Both the cholestyramine and the placebo groups received advice on dietary fat modification to lower serum cholesterol. Follow up averaged 7.4 years. The cholestyramine group averaged considerably greater decrease in plasma cholesterol than the control subjects. Correspondingly, the cholestyramine group had a 19% lower rate of non-fatal myocardial infarction and coronary deaths ($p < 0.05$) the trial primary end point.

Besides many other favourable end points of lowered serum cholesterol e.g. reductions in angina, and new positive exercise test, men with greater reductions in serum cholesterol and low density lipoprotein cholesterol had much greater reductions in coronary incidence than men with lesser decrease.

With this background information of hypercholesterolaemia and of atherosclerosis, we began to look at the causes of death in Singapore (Fig 1). Deaths from IHD have shown a dramatic rise over the past 15 years with cerebrovascular diseases also showing a steady increase. While deaths from infectious diseases have shown a steady decline and stayed low in comparison, that from IHD and cerebrovascular diseases, both strongly associated with hypercholesterolaemia and atherosclerosis, have increased dramatically. In 1974, IHD accounted for 14% of all causes of death in

TABLE 4
PERCENTAGE CHANGE IN AGE-SPECIFIC DEATH
RATES PER 100,000 POPULATION DUE TO IHD
FROM 1974-1984

Age group	Age-specific death rate		Percentage Change
	1974	1984	
30 - 39	8.9	7.4	- 16.9
40 - 49	60.0	58.3	- 2.8
50 - 59	205.7	248.8	21.0
60 - 69	344.3	604.7	75.6
70 & above	779.8	1406.2	80.3
Total	152	228	50.0

Singapore, but in 1984, this has risen to 23%. Correspondingly, deaths from cerebrovascular diseases have risen 1% (from 10% to 11%) Fig. 2. We are unable to obtain in absolute figures the number of people admitted for non-fatal myocardial infarction and strokes for comparison between these years as statistics for such events were not kept in 1974. But it can be surmised that with a 9% rise in deaths due to IHD despite better coronary care, there must be a considerably greater number of people admitted for the treatment of IHD in Singapore.

In the United States, IHD is the major cause of disability and death. It is a fact that IHD alone is responsible for more deaths in the United States each year than all forms of cancer combined (1). However, in contrast to findings in Singapore, there has been a precipitous decline in mortality from IHD observed over the last 15-20 years. This has been seen and claimed as an important, auspicious and major health event (1) Fig 3. In 1968, cardiovascular diseases in the United States accounted for 47% of total deaths (IHD = 36%), but in 1982 this had fallen to 36% (IHD = 28%). Over a 14 year period, deaths from IHD in the United States have fallen by 8% (Fig 3) a fall of 0.6% every year (Fig 4). In contrast, in Singapore, over the last 10 years there has been a 9% rise in deaths due to IHD — a 0.9% increase every year.

The increase in the serum cholesterol between the periods 1974 and 1984 are shown in Table 3. There is a corresponding increase in serum cholesterol in all

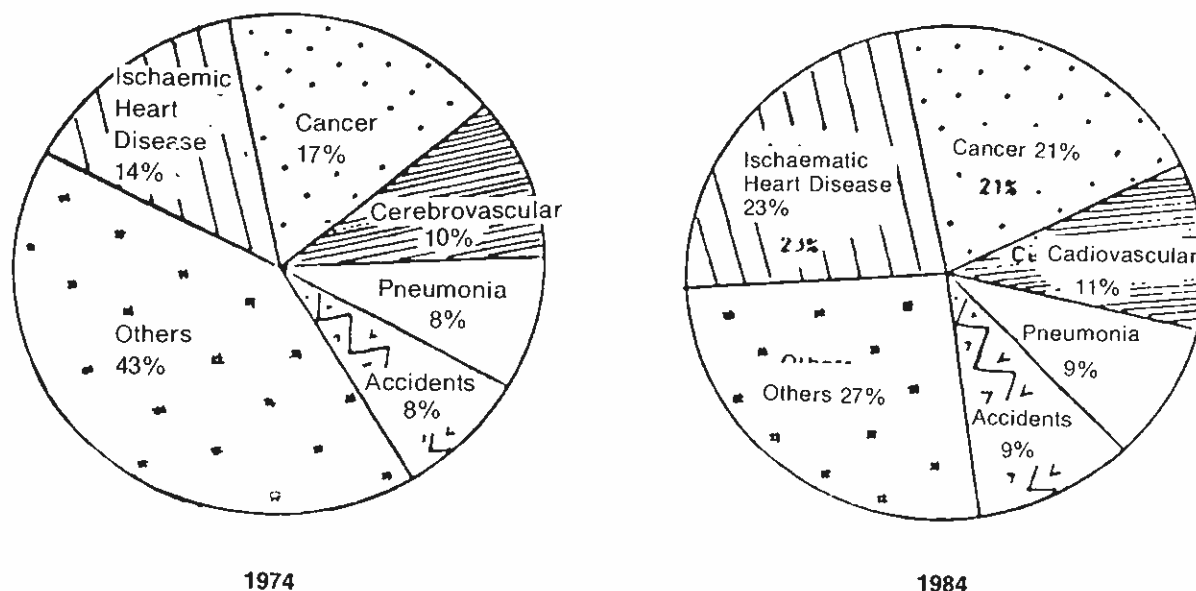
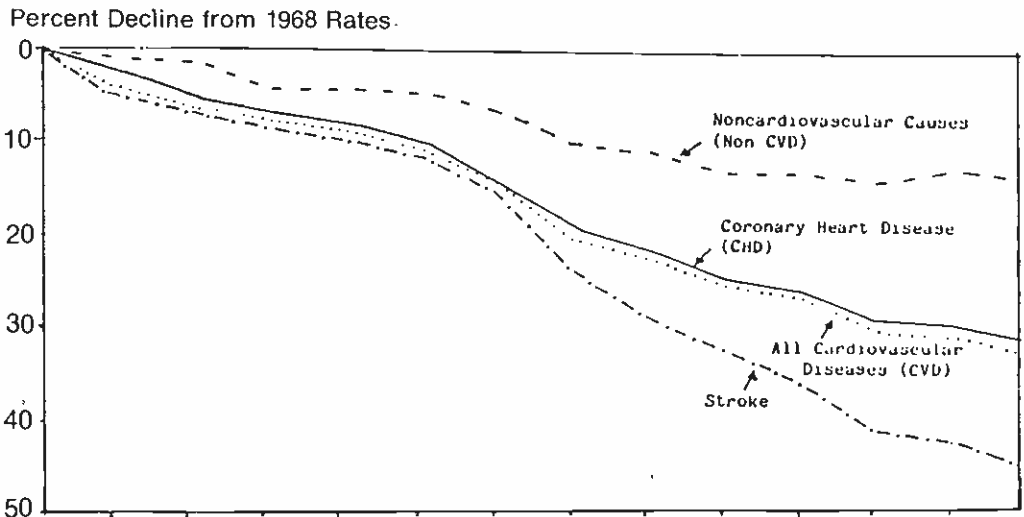


Fig. 2: Distribution of the Main Causes of Death, 1974 and 1984 Ministry of Health, Singapore



1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981.
Percent decline in age-adjusted death rates, United States, 1968 to 1981 = provisional data

Fig. 3: Trends in Mortality for Cardiovascular Disease and Noncardiovascular Causes of Death

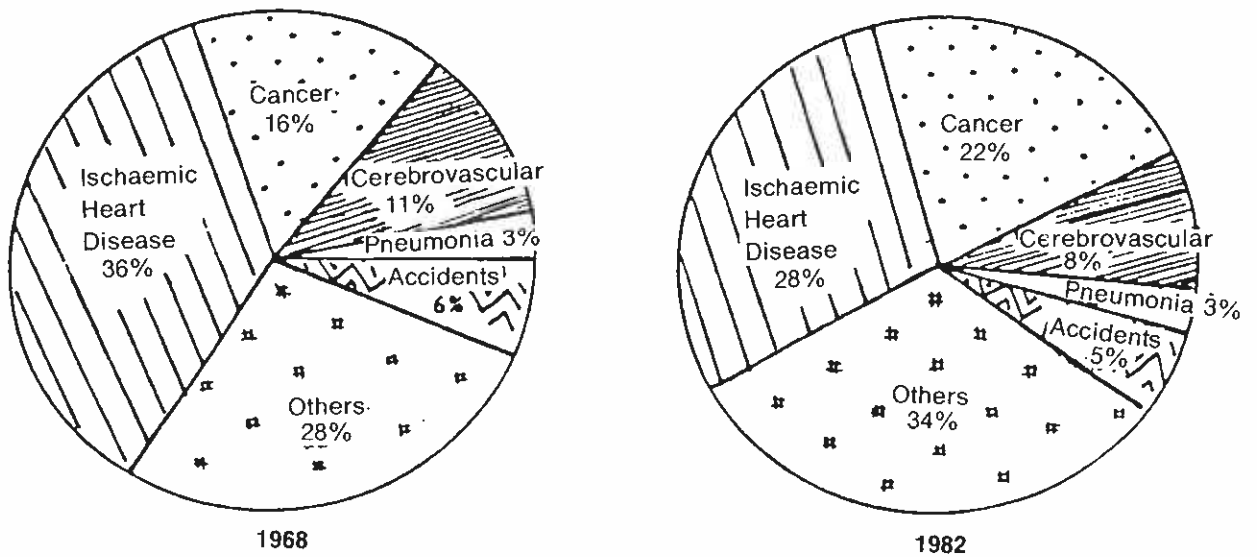


Fig. 4: Deaths by Cause as Percentage of Total Deaths: United States, 1968 and 1982

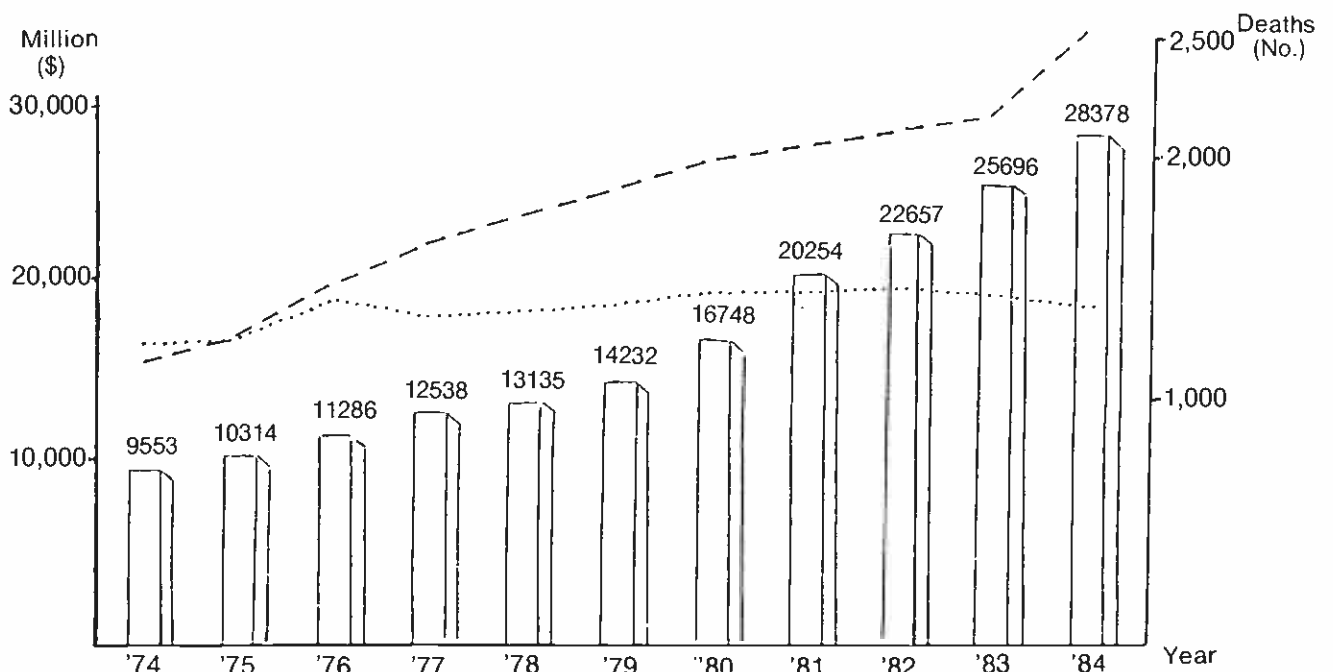


Fig. 5: Indigenous Gross Domestic Product, Singapore, 1974-1984. With Superimposed Deaths from Ischaemic Heart Disease and Cerebrovascular

the age groups with the highest percentage increase in those under 50 years. This overall increase in the total serum cholesterol, especially in the younger-aged patients must indeed be alarming. Even though there is a negative percentage change in age specific death rates per 100,000 population due to IHD in the age group 50 years and below (-9.9%), there is a dramatic and sudden increase in percentage change of IHD in those aged 50 years and above (+58.9%) (Table 4). The fact that there is a negative percentage change in the age specific death rate of patients under 50 years, however, does not mean that there are less patients from this age group suffering from IHD, for if the incidence of IHD increases and the case fatality falls, then the mortality falls. Our recent study of acute myocardial infarction for patients below 50 years admitted to Alexandra Hospital over a period of one year confirmed our impression that there is an increasing number of younger patients being admitted for management of this disease (7).

While our mean serum cholesterol and triglyceride in the various age groups showed an increase between 1974 and 1984 (Table 3), that in the United States has declined from about 235-240 mg/dl in the 1950s and early 1960s to 210-215 mg/dl in the 1970s (8), and continues to fall to account for the dramatic decline of IHD.

Cornfield (9) estimated that for each 1% rise in serum cholesterol, the incidence of IHD increased from 2% to 3%. The percentage rise of serum cholesterol between 1974 and 1984 is 14.45, but fortunately, for us, the corresponding rise in mortality is only 9%. This is no ground for complacency as atherosclerosis takes years to develop before occlusion of the blood vessel occurs. Statistics show that heart disease as a cause of premature mortality in the United States is gradually being reduced. Reasonable predictions are that by the end of the decade, heart disease will no longer be the major cause of death for those under 65 years (1). This happy message cannot be forecast for our population unless drastic measures to control risk factors, especially the arrest and the reversal of the rising trend of serum cholesterol is made.

What in the life style of our Singapore citizen accounts for this rise in IHD? In Fig. 5, we have superimposed the deaths due to IHD and strokes over the gross domestic product (GDP) of Singapore. Over the past two decades, the GDP of Singapore has averaged an approximate 9% rise per year. The people now enjoy the third highest per capita income in Asia (10). (Brunei which has lots of oil and few people number 1 followed by Japan). With this increase in wealth in this a small island Republic, coupled with a great fondness of the people for food, it is expected that what must follow is a corresponding increase in serum chole-

sterol from dietary cholesterol. This increase in serum cholesterol between that of 1974 and 1984 must be due to the diet of the people that comes with increased personal wealth, industrialization and urbanisation.

If then the mortality of IHD and strokes is to be reduced, it must begin with a change in the diet. The recent fall in the GNP (1985) to a minus 2% would not make any impact as the people have accumulated considerable savings to continue their eating styles. Implications from the LRC-CPPT trials are that reduction of serum cholesterol will reduce the incidence of IHD (6). A broader interpretation of the Trial results are, when extrapolated to a large segment of the population, a fall in morbidity and mortality of IHD must come with the fall in the serum cholesterol that follows in the diet of the people. An overall reduction of approximately 10% of the serum cholesterol can be expected with a change in the diet.

We have noticed in our previous studies (2, 3, 7) that the serum cholesterol in our study population is not high and many are in the normal reference range of our laboratory. However, if we look at the total serum cholesterol: HDL lipoprotein ratio, these are all well above 4.5. It is advised, through the Framingham studies (11), that subjects with a ratio of total serum cholesterol: HDL lipoprotein that exceeds 4.0, should be treated to reduce this ratio to 4.0. It is estimated that half the women and two thirds of the men in the United States have ratios above 4.0. We are of the opinion that the HDL lipoprotein levels of our patients with strokes and IHD are low. Unfortunately, we do not know what the national average levels are. Are the levels of HDL lipoprotein or apoprotein A genetically low in these patients who develop strokes and IHD? We hope to seek answers to these questions in a later study.

While we discuss with great detail the dangers of high serum cholesterol, low HDL lipoprotein, and diets rich in saturated fats and cholesterol, we must not detract from the basic issue which is that a total change in our life style with a reduction of all risk factors is mandatory, today, if morbidity and mortality from IHD and strokes in our society is to be reduced. The general public in the United States has indicated readiness to follow a clear lead from health professionals, voluntary and other agencies. Eating habits have changed, millions have stopped smoking, millions have become devotees of leisure time exercise, and the proportion of hypertensives detected, treated and controlled has risen from a low 10-15% in the early 1970s to well over 50% in 1980s (8). We have no alternative but to follow this lead in the pursuit of health shown by the people of the United States if we are to reverse the rising morbidity and mortality of IHD and strokes in our population.

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