tested individuals from Table IV of Glynn *et al.* (1959). The Liverpool series is not significantly different from its control with regard to the incidence of non-secretors but does show a non-significant excess of them. The statistical analysis shows that on combining the results from the two investigations there is no heterogeneity between them, and there is a significantly increased incidence of the disease in those who are non-secretors.

Discussion

It will be seen that in the Liverpool results there is a significant association between the disease and the ABO blood groups, whereas the excess of non-secretors, though present, is not significant. The converse is the case with the Taplow investigation; but there is no heterogeneity between the two series, and the combined result is significant for both characters. Even so, the levels of significance do not approach those needed before such an association can be regarded as well founded, because of the difficulty of getting adequate control series. Thus the need for large numbers in this field of research is again emphasized, and it is to be hoped that the data presented in this paper will be augmented by workers elsewhere. Should this result in convincing proof of these associations with rheumatic fever, it would be the first demonstration of an association between blood groups and a bacterial disease since the finding of Struthers (1951) in pneumonia in infancy. In addition, further data would enable a definite conclusion to be drawn about an interesting feature (though one not significant with present numbers) of both the Liverpool and Taplow series. This is that the percentage of non-secretors is particularly high in the patients of groups A and B (Liverpool group O=25.7% and group A=31%; Taplow, group O=25.5% and group A=30.1%).

If the reactions of the haemolytic streptococcus are affected materially by the secretor status of the host, it might be possible to demonstrate differences in virulence or growth rate depending on the amount of water-soluble blood-group substances present in the culture media. This investigation is now being carried out. Finally, it would be interesting to know whether or not the blood-group and secretor differences present in rheumatic fever are also present in series of patients with uncomplicated streptococcal throat infections and in those who develop acute nephritis.

Summary

Data are presented of a series of 263 Liverpool patients suffering from rheumatic carditis. They show a significant reduction in the incidence of blood group O and a non-significant increase in non-secretors compared with controls. There is no heterogeneity between our results and those from Taplow (Glynn, 1959, personal communication) in where there is a significant excess of non-secretors and a non-significant deficiency of group O. On combining the results of the two investigations there is a significantly increased incidence of the disease both in those who are not group O and in those who are non-secretors.

The levels of significance are suggestive of there being a relationship between rheumatic fever and the ABO blood-group antigens, but the collection of further data is indicated, not only of rheumatic fever but also of uncomplicated streptococcal throat infections and acute nephritis.

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PRACTICAL DIETS FOR LOWERING SERUM LIPIDS

A LONG-TERM STUDY ON OUT-PATIENTS WITH ISCHAEMIC HEART DISEASE

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The effects of dietary fats on blood lipids have aroused considerable interest in recent years in view of the probable relationship to coronary heart disease. Morrison (1955), in a controlled study of patients with myocardial infarction, reported that life could be prolonged by taking a low-fat diet; the serum cholesterol, total lipids, and neutral fat were all reduced. Lyon *et al.* (1956), with a larger series, showed similar effects on survival accompanied by a lowering of low-density lipoproteins. A fall in blood lipids can also be produced by the isocaloric replacement of saturated fats by unsaturated oils (Kinsell *et al.*, 1952; Ahrens *et al.*, 1954, 1957; Bronte-Stewart *et al.*, 1956), but there have been few studies showing that a regimen containing unsaturated fats can be used by patients in their home surroundings and may be effective over long periods (Groen *et al.*, 1952; Malmros and Wigand, 1957).

For the past 18 months we have been studying the long-term effects of various treatments in men with ischaemic heart disease. Data are now available showing the effect on the blood lipids, and in this paper we report the relation of a low-fat diet and of an unsaturated-fat diet to lipid levels. It is too early for comment to be made on any effect on the disease process.

Procedure

The patients were first classified into three diagnostic groups: (*a*) Myocardial infarction, with abnormal Q waves, or a history of pain for more than one hour at rest with major electrocardiographic changes. (*b*) Angina of effort with electrocardiographic changes at rest or on exercise, but no abnormal Q waves. (*c*) Angina of effort without electrocardiographic changes.

They were further subdivided according to age, and then randomly allocated to five treatment groups: (1) Phenindione to give a single-stage prothrombin time between two and three times normal. (2) Phenindione 1 mg. as control. (3) Unsaturated-fat diet. (4) Unsaturated-fat diet with a lower phenindione dose to give a single-stage prothrombin time of one and a half times normal. (5) Low-fat diet.

For analysing the lipid changes, groups 1 and 2 are referred to as the "anticoagulant group," groups 3 and 4 as the "unsaturated-fat diet," and group 5 as the "low-fat diet"; this is justifiable, since the anticoagulants did not lower blood lipids. The anticoagulant group served as a control for the dietary groups. Dietary histories were taken before and during treatment.

Methods

20 ml. of blood was taken at three-monthly intervals, when the patients attended after their usual breakfast. The following lipid estimations were then made: (*a*) Total cholesterol (Abell *et al.*, 1952). (*b*) Low-density lipoprotein; a modified ultracentrifugal method (Lindgren and Gofman, 1957) using refractive index increment 1.51×10^{-3} per g. per 100 ml. (Hanig and Shainoff, 1956). The following estimations were made after the study had progressed several months, but no pre-treatment data are available. (*c*) Total cholesterol in low-density fraction. (*d*) Calculations of concentration of molecules Sf 0-12 and Sf 12-400, using *b* and *c* in regression equations (Lindgren and Gofman, 1957).

Low-fat Diet.—This diet contained no dairy produce except skimmed milk, and one egg or ¾ oz. (21 g.) of cheese a day. Lean meat and fish were each allowed once a day; fruit, vegetables, and other non-fatty foods were allowed in unlimited quantity. This diet stipulated 20 g. of fat, but in practice 20–30 g. was eaten daily.

UNSATURATED-FAT DIET

	FOODS NOT ALLOWED	FOODS ALLOWED
FATS	Butter, margarine, dripping, lard, and *all other fats and oils*. See footnote	*Only* the oil permitted.* It is important to use 3–4 oz. (8 tablespoonfuls) daily, i.e., in frying (not to be reused for frying) and in place of other fats in cooking, e.g., for cakes and pastries etc.
EGGS	Egg yolk	Egg white—e.g., (1) for meringues (stiffly beaten), puddings, and cakes; (2) for binding in cakes and batters where whole eggs are normally used.
MILK	Whole milk, condensed or evaporated milk, powdered whole milk, and cream	Skim-milk. Condensed skim-milk (tinned). Powdered skim-milk
CHEESE	Cheese made from whole milk, or containing cream	Cottage or curd cheese made from skim-milk (home-made by letting skim-milk sour and hanging curds in a muslin bag)
MEAT		All lean meat now permitted
FISH		All fish, fresh or tinned, or shellfish
FRUIT AND VEGETABLES		All fruits and vegetables
SOUPS	Made with meat stock, whole milk, or fat	Vegetable soup, cream soup made with skim-milk and oil. Fish soup
MISCELLANEOUS SUGARY AND STARCHY FOODS	Ice cream, chocolates, toffee, fudge	Nuts, sugar, sweets, jams, honey, bread, Matzos, cereals, cakes, and biscuits made *without* egg yolks, butter, cream, or cooking fat. N.B.—These sugary and starchy foods should be cut down if weight needs reducing
3 MONTHS LATER		¼lb. (113 g.) of a relatively unsaturated margarine per week

*Unsaturated oils permitted: soya, maize, safflower, sunflower.

Unsaturated-fat Diet.—All dairy produce, except skimmed milk, was eliminated from a meat-free diet. Fish and vegetables were allowed without restriction, and the unsaturated fat was supplied in the form of soya oil (90 ml. daily). The soya oil had an iodine value between 130 and 135.

After six months restrictions were relaxed and lean meat was allowed. Later, up to ¼ lb. (113 g.) weekly of a relatively unsaturated margarine was also permitted.

Results

Table I shows that in both dietary groups there was a marked drop in the blood-level of cholesterol and low-density lipoproteins; this reduction has persisted ($P<0.01$). The unsaturated-fat diet produced the greatest mean reduction, while patients receiving only anticoagulants showed no significant change.

During treatment it was noted (Table II) that concentrations of Sf 0–12 lipoproteins and of Sf 12–400 lipoproteins were significantly lower on both diets, as compared with the anticoagulant group ($P<0.01$). Comparison of the effects of the diets, moreover, showed that while there was a similar reduction of Sf 0–12 lipoproteins, a significantly greater drop of Sf 12–400

TABLE I.—*Mean Serum Lipids (mg./100 ml. ± 1 Standard Deviation) in Different Treatment Groups*

Treatment Group	No. of Patients	Serum Cholesterol		Low-density Lipoprotein		Duration of Treatment in months
		Before Treatment	During Treatment	Before Treatment	During Treatment	
Anticoagulants	23	288 ± 34	294 ± 38	902 ± 156	931 ± 161	12·5 ± 6·4
Unsaturated-fat diet	23	287 ± 54	210 ± 33	838 ± 141	624 ± 113	13·7 ± 3·3
Low-fat diet	12	296 ± 43	219 ± 34	849 ± 180	680 ± 150	13·5 ± 5·1
Standard error for blind duplicates		8·3 mg.		22·6 mg.		

lipoproteins occurred in those patients taking the unsaturated-fat diet ($P<0.01$).

Table III refers to the composition of the diets, and Table IV compares the weight changes. Patients in the anticoagulant group gained slightly, those on the unsaturated-fat diet lost slightly, and those on the low-fat diet lost considerably. It seems reasonable to explain this by caloric differences.

TABLE II.—*Mean Estimated Concentration of Molecules Sf 0–12 and Sf 12–400 (mg./100 ml. ± S.D.) During Different Treatments*

Treatment Group	Sf 0–12	Sf 12–400
Anticoagulants	464 ± 63·8	422 ± 108·7
Unsaturated-fat diet	345 ± 54	263 ± 84
Low-fat diet	359 ± 19·8	318 ± 103·2

TABLE III.—*Composition of Diets Taken During Treatment Calculated from Histories (Protein Values Obtained by Difference)*

Treatment Group	Calories per day	Carbohydrates (g. day)	Fat (g. day)	Protein (g. day)
Anticoagulants	2,040	235	80	95
Unsaturated-fat diet	1,875	240	75	60
Low-fat diet	1,425	240	25	60

TABLE IV.—*Mean Weight*

Treatment Group	Before Treatment		During Treatment	
	lb.	kg.	lb.	kg.
Anticoagulants	164 ± 19·7	74·4 ± 8·9	168 ± 18·1	76·2 ± 8·2
Unsaturated-fat diet	160 ± 9·5	72·6 ± 4·3	156 ± 11·5	70·8 ± 5·2
Low-fat diet	159 ± 15·2	72·1 ± 6·9	147 ± 13·1	66·7 ± 5·9

Discussion

These findings agree with previous reports on the efficacy of fat restriction and of the substitution of unsaturated for saturated fats; further, they show that a lipid-lowering diet is a feasible and attractive proposition.

Nichols *et al.* (1956) found in isocaloric experiments that the serum level of Sf 0–12 lipoproteins (rich in cholesterol esters) is established by saturated fats, while that of Sf 12–400 lipoproteins (rich in neutral fat) is determined by the carbohydrate content of a diet. Walker *et al.* (1957) have shown that the Sf 12–400 level is also influenced by the calorie balance. This implies that Sf 0–12 lipoprotein, and therefore the serum cholesterol level, can be lowered by removing saturated fat from the diet. This can be done isocalorically by replacing the saturated fat with carbohydrate, when the level of Sf 12–400 lipoprotein and neutral fat will rise. Alternatively, unsaturated fats which do not raise this lipid class can be given. In isocaloric experiments the unsaturated fat diet is the more effective (Nichols *et al.*, 1956; Ahrens *et al.*, 1957). The drop in cholesterol and Sf 0–12 lipoprotein in our patients is explained by the removal of saturated fats from their diets. The drop in Sf 12–400 lipoprotein levels in patients on the low-fat diet can be explained by the considerable loss of weight. The still greater reduction of this class of lipid in patients on the unsaturated-fat diet demands a different explanation: it is suggested that unsaturated fats can lower the level of Sf 12–400 lipoprotein directly. It should be stressed, however, that too much ought not to be read into dietary histories, and this explanation must therefore remain open to question.

Throughout, our patients have co-operated well. Those on the unsaturated-fat diet find it much more palatable, and have eaten enough to maintain weight. When the patient has shown that he has co-operated effectively he is allowed a ¼ lb. (113 g.) of a relatively unsaturated margarine weekly, and as it is no longer necessary to exclude lean meat the menu is made more attractive, so that such a diet presents no hardship to a patient living at home.

These diets do not necessarily influence the prognosis of ischaemic heart disease, and much more extensive trials must be carried out before a definite conclusion can be drawn about ultimate benefits. Indeed, it is of interest in this respect that Oliver and Boyd (1959) have presented data showing that the lowering of serum cholesterol and lipoprotein levels by oestrogens produces no change in mortality.

It is our intention merely to indicate that a satisfactory and practical way to lower serum lipids, as a group, is by an unsaturated-fat diet.

Summary

Serum cholesterol and low-density lipoproteins have been effectively reduced by dietary means in out-patients with ischaemic heart disease over a period of more than one year.

The unsaturated-fat diet is more efficient than the low-fat diet; it achieves, without loss of weight, lower levels of serum cholesterol, low-density lipoprotein, and Sf 0–12 and Sf 12–400 lipoproteins, the last significantly so.

The unsaturated-fat diet, being less monotonous, is better tolerated. The diet sheet now supplied to our patients is included.

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