Zeitschrift: Bulletin der Schweizerischen Akademie der Medizinischen Wissenschaften = Bulletin de l'Académie suisse des sciences médicales = Bollettino dell' Accademia svizzera delle scienze mediche

Herausgeber: Schweizerische Akademie der Medizinischen Wissenschaften

Band: 13 (1957)

Heft: 1-4: Symposium über Arteriosklerose = Symposium sur l'artériosclérose = Symposium on arteriosclerosis

Artikel: The effect of a diet rich in fat, unsatureted fatty acids, phospholipids and vitamin B on the blood-cholesterol levels

Autor: Meyknecht, E.A.M. / Bloem, T.F. / Handel, E. van

DOI: https://doi.org/10.5169/seals-307328

D.C. 616.13-002.2:612.123:612.39

Hospital St. Antoniushove, Voorburg (Holland)

The Effect of a Diet Rich in Fat, Unsaturated Fatty Acids, Phospholipids and Vitamin B on the Blood-Cholesterol Levels

by **T. F. Bloem**, M.D., Physician, **E. van Handel**, Ph.D., Chemist, and **H. Neumann**, Ph.D., Biochemist, Amsterdam

communicated by **E. A. M. Meyknecht**, M.S.A. Wageningen

A study of atherosclerosis suggests that in "Western" populations the incidence of the disease is much higher than in "non-Western" populations. From this observation a relationship between atherosclerosis and food is plausible. Though the literature on the problem of atherosclerosis is both confused and controversal, in one respect the studies on the subject concur, viz. that it is characterized by lipid-deposits, chiefly of cholesterol, and that the blood lipids are generally raised.

As regards the aetiology, two main theories can be distinguished, one of which is based on the hypothesis that a dietary excess and the other that a dietary deficiency is playing a part.

The first theory suggests that an excess of cholesterol in the diet, a high fat content—especially fat of animal origin is suspected—or a high caloric intake causes atherosclerosis. *Groen* (1), *Keys* (2).

The deficiency theory suggests that preventive factors—especially phospholipids, including some components such as choline, essential fatty acids and the vitamin-B-complex—have been partially or entirely discarded from the food and that the pattern of the fatty acids is playing a significant rôle.

Atherosclerosis could be induced by a disturbed lipid metabolism or a disorder of fat transport: *van Handel* (3), *Sinclair* (4), *Kinsell* et al. (5), *Beveridge* et al. (6), *Bronte-Stewart* et al. (7).

Last year one of the authors, *van Handel* (l.c.), postulated the deficiency theory, followed by *Sinclair* (l.c.) this year. *Kinsell* et al. (l.c.) and also *Beveridge* et al. (l.c.) stated that a large intake of vegetable fat, especially liquid oils, in fact depresses the serum cholesterol.

Bronte-Stewart et al. (l.c.) make the suggestion, based on the results of short term experiments, that certain discrepancies in the dietary-fat

Table 1
Patients not previously treated with low fat diet

Sexe, age, disease			Days	Cholesterol mg%	Serum-lipid phosphorus mg%
♂	20	nephrosis	0	512	14.4
			42	260	9.9
			85	200	9.7
			320	133	8.2
♀	53	coronary insufficiency	0	300	12.5
			30	235	10.3
♂	60	coronary insufficiency	0	235	10.3
			30	223	8.6
♂	57	coronary insufficiency	0	325	11.2
			72	188	9.6
♂	46	functional complaints	0	260	10.1
			40	253	9.4
			120	205	8.2
♀	28	infectious hepatitis	0	300	11.6
			120	207	8.6
			210	231	9.4
♀	55	coronary insufficiency	0	314	12.8
			45	277	10.9
			80	255	10.4
			110	227	10.4
♀	58	coronary insufficiency	0	275	11.2
			80	223	9.2
			200	215	9.0
♂	73	coronary insufficiency	0	235	10.0
			30	235	9.6
♂	44	coronary insufficiency	0	160	7.0
			60	152	6.8
			100	160	6.5
♀	55	coronary insufficiency	0	350	12.1
			60	300	11.3
♂	48	coronary insufficiency	0	193	7.7
			60	195	7.6
			90	195	8.1
			180	211	8.8
♂	62	coronary insufficiency	0	210	10.1
			150	232	11.6
♂	58	coronary insufficiency	0	240	10.3
		myocardial infarction	60	185	–
		multiple sclerosis	120	250	10.5
			270	224	10.4
♀	60	diabetes	0	500	17.2
			65	345	12.5
			150	385	16.7

Sexe, age, disease			Days	Cholesterol mg%	Serum-lipid phosphorus mg%
♂	59	coronary insufficiency	0	290	11.2
			60	225	10.4
♂	47	myocardial infarction	–200	307	–
			0	300	10.1
			50	230	9.2
			100	220	9.6
			200	220	9.1
			332	232	9.6
♂	73	coronary insufficiency	0	265	10.6
			60	225	9.0
♂	68	myocardial infarction	0	215	10.7
			150	241	9.8
			210	165	10.7

theory on the aetiology of coronary heart-disease may be explained by variations in the nature of fatty-acid composition.

Two of the authors (8) tried choline therapy on some cases of oedema with success. The results may be explained by the effect of choline on the ratio between phosphatide and phosphatid acid and therefore on the permeability of the cellular wall, which, according to the theory of *Bungenberg de Jong* (9), contains a tricomplex of phosphatide.

Based on the above-mentioned theories, different diets have been applied.

It is known that the "rice and fruit" diet of *Kempner* may result in a lowering of the serum cholesterol; *Keys* (l.c.) reports a similar effect on the serum cholesterol following a low fat diet (20 cal.%) and an increase if he administered more fat; but while he maintains that animal and vegetable fats produce the same effect, the findings of *Kinsell* (l.c.) and *Beveridge* (l.c.) were controversial.

Groen (l.c.) reports a lowering of serum cholesterol following a cholesterol-free diet.

It is noted however that the diets of *Kempner*, *Keys* and *Groen* are in effect essentially "deficiency-diets" and may result in mental depression and physical weakness. A considerable part of the fat intake of the "non-Western" population is derived from vegetable fats--fatty seeds such as peanuts, soy beans, sesame seeds, all of which are rich in essential fatty acids and phospholipids, the diets being supplemented with whole wheat and unpolished rice, which provides vitamins of the B-complex and large amounts of trace minerals such as manganese, magnesium and copper. The fat intake of the "Western" population, on

Table 2
Patients previously treated with low fat diet

Sexe, age, disease			Days	Cholesterol mg%	Serum-lipid phosphorus mg%
♂	62	coronary insufficiency	–270	295	–
			0	235	8.8
			55	172	7.2
♀	38	adipositas	0	170	7.6
			30	175	8.4
♂	51	coronary insufficiency	0	400	15.2
			30	350	11.7
			45	310	11.0
			75	260	10.6
			100	240	10.0
♂	54	coronary insufficiency	0	250	11.2
			30	230	9.8
			120	241	14.9
♂	66	coronary insufficiency	–300	200	–
			0	220	10.6
			40	197	8.4
			150	193	8.4
			210	197	9.6
♂	70	coronary insufficiency	–150	189	–
			0	235	8.7
			60	225	10.0
♀	68	coronary insufficiency	0	305	11.0
			90	229	10.9
♂	58	coronary insufficiency	0	243	10.2
			50	220	11.0
♂	45	polycythaemia	0	160	7.2
			30	180	7.0
♂	58	myocardial infarction	0	315	13.2
			60	270	10.3
			150	280	10.5
			240	288	12.3
♂	51	myocardial infarction	0	335	14.2
			70	237	11.0
			220	292	12.3
♀	57	coronary insufficiency	–180	200	–
			0	270	10.6
			60	210	9.6
			220	225	11.3
♂	7	nephrosis	0	390	12.8
			30	295	12.1
			50	260	11.0
			140	288	11.0
			230	303	12.9
			380	283	

Sexe, age, disease			Days	Cholesterol mg%	Serum-lipid phosphorus mg%
♂	62	coronary insufficiency	0	247	11.0
			120	199	11.1
♂	68	myocardial infarction	0	243	11.0
			90	283	11.0
♀	55	coronary insufficiency	0	325	13.5
			150	307	15.0
♂	54	heart decompensation	0	240	10.0
			60	220	10.0
			210	224	9.1
♂	35	nephrosis	0	410	16.6
			60	364	14.4
			120	260	11.6
			360		
♂	67	coronary insufficiency	0	257	10.5
			30	190	7.6
			120	223	9.1
♂	49	myocardial infarction	0	250	10.3
			30	240	10.0
			60	240	11.6
			120	285	11.2
			210	251	11.2
♀	44	coronary insufficiency	−300	284	
			0	260	11.6
			55	233	9.5
♀	41	hepatic cirrhosis	0	205	9.8
			60	200	9.8
♂	50	coronary insufficiency	−300	220	
			0	215	9.5
			50	215	9.6
			120	210	8.4
♂	36	myocardial infarction		317	11.0
				250	10.6
♂	60	myocardial infarction	0	190	8.3
			60	175	7.2

the other hand, consists largely of animal fat, hydrogenated fat, meat, supplemented with white bread, all of which are poor in essential fatty acids, phospholipids and vitamins B. In order to estimate the value of this "non-Western" type of feeding, a number of patients were put on a diet rich in vegetable fats, essential fatty acids, phospholipids and vitamins B. The effect on the blood cholesterol and the serum-lipid phosphorus was recorded at regular intervals. Since we have no means of measuring the extent of atherosclerosis in our patients, we could do no better than estimate this by subjective investigation.

Material

The study includes 48 persons, 26 had not previously been treated with a low fat diet; 18 had already been treated with the *Keys* low fat diet, and 4 were normals. Of particular interest is the group of patients (Table 2) who, in spite of prolonged treatment with low fat diets, had maintained high serum cholesterol levels. Patients who, on a low fat diet (less than 20% of total calories) had reacted by a considerable drop in cholesterol, were not included in this study.

The diet

Daily: 50 g soy bean flour, 50 g peanuts, 50 g peas or beans, 3 g soy bean lecithin (to account for the approximate amount lost in the degumming of vegetable oils).

Not allowed. Lard and other animal fats, shortening, white bread and degerminated flour and cereals.

Restricted: Butter and margarine restricted to 25 g daily. The hospitalized patients, about half of the total, used butter, a part of the outdoor-patients margarine.

Allowed

Whole wheat bread, unpolished rice, etc. Liquid soy bean oil as a source of cooking fat. The use of meat, milk, cheese, and eggs was not restricted.

Estimation of blood-lipids

2 ½ ml serum was mixed with alcohol-ether (3:1), brought to the boiling point of ether in a beaker with warm water, cooled, made to 50 ml and filtered.

Table 3
Control

Sexe, age, disease			Days	Cholesterol mg%	Serum-lipid phosphorus mg%
♀	20	functional complaints	0	188	9.6
				197	
♂	56	ulcus duodeni	0	240	10.3
			220	174	10.2
♂	37	observation	0	160	7.2
			150	134	8.3
♀	20	goitre (normal B. M. R.)	0	208	9.2
			360	207	

In the filtrate we estimated the cholesterol according to *Fidler* and phosphorus lipid according to *van Handel.*

Results and Discussion

Table 1 indicates that with this type of diet a significant decrease of blood-cholesterol was achieved in the majority of cases where the level of lipids was initially high. It could be observed that when the level of the phospholipids, measured as lipid phosphorus, was high it decreased, in practically no case did the ratio cholesterol/phospholipid increase, it was either maintained or fell. Little or no change was observed in patients where blood lipids were essentially normal. A number of patients who had failed to react to low fat diets responded to this type of diet. In no case did the relatively large amounts of oil after the previous low fat intake lead to a rise in serum cholesterol.

Patients who failed to follow the diet were excluded from this report.

As in most studies, little information was gained of the fluctuations in high blood-lipids. However, as most patients were followed for a period of more than 6 months, the possibility of a spontaneous fall of blood-lipids can probably be excluded. Our results agree with the findings of *Kinsell* (l.c.), *Beveridge* (l.c.), and *Bronte-Stewart*, who reported a lowering of the blood-cholesterol in diets containing large amounts of fats of vegetable or marine origin. In our experiments, evidently the intake of butter, milk, cheese, and eggs did not raise the serum-cholesterol.

As regards the mental depression and physical weakness, which were shown by patients with low fat diet, it can be mentioned that on the diets tested a considerable improvement took place.

Therefore in those cases where caloric restricted diets are indicated, it seems to be essential to include natural sources of vitamin B, choline, inositol, and trace minerals as provided by soya beans, wheat germs, sesame seed, nuts, etc. If, however, fat restriction is indicated, the source of fat should be carefully selected and it is suggested that the fats should be as rich as possible in those fatty acids which cannot be synthesized by the human body e.g. the essential fatty acids. In this way the diet resembles much more closely the diet of the non-Western peoples where atherosclerosis is rare.

As early as 1937, *Brouwer* (10) directed attention to the negative correlation between the content of unsaturated fats and the content of short-chain, saturated fatty acids in nearly all natural fats. It is not to be precluded beforehand that in some respects a lack of some unsaturated fatty acids can be compensated by short-chain acids. Especially in coconut-, palm-kernel-oil and milk fat the content of the latter is high,

however, in milk fat the percentage of fat with the lowest chains is highest.

Summary

The effect of a diet, which might be of value in the treatment of atherosclerosis, is shown to reduce high blood cholesterol and phospholipid levels, without excessive restriction in fat (including milk fat) or calories.

The report includes 44 patients and 4 normals. 26 showed a fall of blood-cholesterol; 17 who had normal values at the onset showed no change; 1 failed to react. In no case was there an increase of blood cholesterol values in this relatively high fat diet.

Zusammenfassung

Es wird die Wirkung einer Diät auf die Senkung des hohen Blutcholesterin- und Phospholipidspiegels gezeigt, die, ohne stärkere Einschränkung der Fette (einschließlich der Milchfette) oder der Kalorien, einen Wert in der Arteriosklerosebehandlung haben könnte.

Der Bericht betrifft 44 Patienten und 4 gesunde Personen. 26 zeigten eine Senkung des Blutcholesterins, weitere 17, die beim Beginn der Diät normale Werte hatten, zeigten keine Veränderungen. Ein Fall blieb unverändert. In keinem Fall war aber ein Ansteigen der Blutcholesterinwerte bei dieser relativ fettreichen Diät nachweisbar.

Résumé

Il s'agit d'un régime qui, sans être trop restreint en graisses (y compris les graisses du lait) ou en calories, est capable d'abaisser une cholestérolémie élevée et qui pourrait être utile dans le traitement de l'artériosclérose.

L'étude comprend 44 patients et 4 sujets normaux. Chez 26, on constate une chute de la cholestérolémie; chez 17 sujets, dont les valeurs étaient normales au début du régime, on ne note aucun changement. Un sujet n'a pas montré de réaction. Dans aucun cas, il n'a été constaté une augmentation de la cholestérolémie par ce régime relativement riche en graisses.

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