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Chemical Studies on Aortic Intima in Nigerians

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Summary. The chemical composition of aortic intima, obtained from 103 adult Nigerian Africans dying from a variety of diseases, is described. The relationship between the lipid components and the pattern of aortic atherosclerosis in Nigerians is discussed. The mean values for the dry weight and total lipids in the intima are slightly higher in males than in females. The mean values for ash and phospholipids are significantly higher in males than in females but the mean value for triglycerides is significantly higher in females than in males. There is no significant difference in the mean value for total and free cholesterol and the total/free cholesterol ratio between the two sexes. There is significant correlation between the dry weight of intima, total cholesterol and age. Correlations between the various chemical components estimated and with various factors including age, sex, ash and intimal dry weight are also presented.

Résumé. On décrit ici la composition chimique de lintima aortique obtenue de 103 Adultes Nigerians mourant d'une variété de maladies. On parle aussi des rapports entre les constituants lipeides et la nature de l'atherosclérose aortique découverte dans les Nigérians. Les valeurs moyennes pour le poids sec et les lipides totales dans les intimas sont légérement plus grandes dans les mâles que dans les femelles. Les valeurs moyennes de la cendre et phospholipide sont considerablement plus grandes dans les mâles que dans les femelles mais, la valeur moyenne des triglycerides est considérablement plus grande dans les femelles que dans les mâles. Il n'existe pas de différence significative entre la valeur moyenne du cholestérol total et libre, et le rapport total/libre du cholestérol des deux sèxes. Il n'y a pas de corrélation significative entre le poid sec de l'intima du cholestérol et l'âge. Les corrélations entre les différents constituents chimiques évalués et avec des facteurs diverses, y compris l'âge le sèxe, la cendre et du poids sec d'intima sont aussi exposées.

Although there are anatomic studies on the geographic variations of atherosclerotic lesions among different population groups and races, there are very few studies on serum lipids or the lipid content of the vascular intima in different races including the African (Scott *et al.*, 1963; Taylor, 1971; Meyer, Meyer & Pepler, 1971; Bronte-Stewart, Keys & Brook, 1955; Williams, 1971; Scott *et al.*, 1961). There is sufficient evidence that the present day African

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inhabiting his native land, is less susceptible to severe atherosclerosis of the coronary arteries (Williams, 1971; Scott *et al.*, 1965; Brock, 1965; Robertson, 1959; Miller, Spenser & White, 1962; Strong, Wainright & McGill, 1959), aorta (Strong *et al.*, 1959; Williams, 1969) and cerebral arteries (Williams, Resch & Loewenson, 1969; Resch *et al.*, 1970; Baker *et al.*, 1967; Osuntokun, Odeku & Adeloye, 1969). There is however, a lack of studies on the quantitative and qualitative analysis of the lipid composition of the vascular intima of the African (Meyer *et al.*, 1971; Anderson *et al.*, 1959). Comparative studies of the chemical composition of aortic atherosclerosis between Bantus and Causasian subjects, living in South Africa have shown true differences and certain similarities (Anderson *et al.*, 1959). The present study primarily describes the chemcial composition of the aortic 'intima' (for this study it is the vascular layer internal to the tunica media of the aorta) of Africans living in Nigeria and secondarily attempts to obtain further information on the relationship of the chemical components to the pathogenesis and pattern of aortic atherosclerosis. The results obtained from this study also provides baseline chemical data from a population known to have relatively low amount of atherosclerosis in general (Williams, 1971; Williams, 1969; Osuntokun *et al.*, 1969). Furthermore, comparisons can be carried out in the future when the severity and frequency of atherosclerosis increases in the population as it is expected to do with improved standards of living.

MATERIALS AND METHODS

One hundred and three complete aortas (fifty-eight from males and forty-five from females) were studied from consecutive unselected necropsies of adult Nigerian patients, between the ages of 15 and 70 years, at the University College Hospital, Ibadan, a general teaching hospital with about 550 beds.

The aorta from the aortic valve to the bifurcation was removed, opened longitudinally along the anterior aspect and stretched out on cork mats. The intimal surface was rinsed under running tap water and then graded roughly using visual estimation by one worker (A.O.W.). All the aortas were within grades 0 and 2 using the grading technique of Anderson *et al.* (1959). The intima was removed by scraping the aortas with a clean scalpel blade and histological sections were taken to ensure complete removal. Materials obtained were stored in polythene containers at $-20°C$ until chemical analyses were carried out a few weeks later. Occasionally, it was necessary to pool two or three samples if these were too small for separate analysis. The samples obtained were lyophilized and stored in a desiccator under vacuum. Each dried specimen was weighed and the total lipids extracted according to the method of Folch *et al.* (1957). The defatted residue was incinerated at a temperature of 500°C for 14 h cooled in a desiccator overnight and weighed. The lipid fraction was dissolved in a known volume of chloroform and aliquots were taken for estimation of the different lipid components. Total and free cholesterol, phospholipids and triglycerides were estimated according to the methods of Ferro & Ham (1960), King & Wootton (1956), van Handel & Zilversmit (1957) respectively. Values for total lipids were obtained from total cholesterol, phospholipids and triglycerides.

RESULTS

Effect of grading

The method of grading severity of atherosclerosis, as employed in previous studies

(Williams, 1971; Strong *et al.*, 1959) was unsuitable for this study. Since the severity of aortic atherosclerosis was evidently minimal in this population, and complicated lesions were very seldom encountered, it was perhaps permissible to employ visual estimates for this study. In fact, the majority of the aorta (95%) were grades 0–1.

Effect of sex

The mean values for total dry weight and total lipids were higher in the males than in the females but the differences were not significant (Table 3). The mean values for ash and phospholipids for all age groups were higher in males than in females ($P<0{\cdot}05$) and ($P<0{\cdot}01$)

TABLE 1. Intima dry weight, ash, and lipids in the males (mean+SEM)

Age group (years)	Dry weight per subject (mg)	Ash (mg/g)	Phospho-lipids (mg/g)	Total cholesterol (mg/g)	Free cholesterol (mg/g)	Free/total cholesterol	Trigly-cerides (mg/g)	Total lipids (mg/g)	No. of subjects
15–20	65·99	30·54	24·82	26·33	21·48	0·50	13·37	82·88	6
	12·34	1·21	1·60	5·60	2·20	0·06	1·76	10·73	
20–25	124·83	37·47	18·23	17·07	9·32	0·58	7·05	42·34	6
	13·09	3·59	2·22	2·23	0·32	0·09	1·39	2·52	
25–30	137·00	26·60	26·07	28·00	18·69	0·51	7·82	71·36	7
	9·63	4·99	4·41	7·45	4·12	0·02	0·99	15·12	
30–35	122·21	38·95	21·49	25·71	14·81	0·60	7·38	54·60	3
	8·30	6·75	2·40	3·41	2·73	0·10	2·44	3·27	
35–40	168·32	30·69	21·92	15·55	8·63	0·58	6·74	57·90	5
	32·10	4·90	4·44	1·33	0·29	0·08	0·74	17·10	
40–45	245·27	23·55	29·96	44·80	21·01	0·36	11·58	126·81	6
	33·70	3·67	4·12	1·57	1·04	0·07	3·62	18·76	
45–50	190·37	31·65	38·97	14·75	16·78	0·48	6·96	120·41	3
	14·38	6·10	12·63	2·31	0·69	0·01	1·18	26·04	
50–55	107·24	33·49	31·15	41·48	19·26	0·46	9·69	82·33	5
	10·08	6·64	2·04	5·25	3·16	0·03	1·83	5·77	
55–60	248·29	29·38	36·87	31·93	22·82	0·50	9·33	94·41	5
	33·41	2·87	4·32	4·41	5·39	0·06	1·90	19·56	
60–65	224·15	35·42	38·83	36·90	14·08	0·59	7·22	115·57	7
	18·96	2·52	6·34	8·89	3·83	0·11	1·85	18·39	
65–70	343·15	27·97	44·21	58·30	25·70	0·58	13·63	136·87	5
	100·90	5·76	5·85	13·65	4·88	0·07	3·05	21·19	

respectively. The mean triglycerides in the females were significantly higher ($P<0{\cdot}02$) than in the males. There was no significant difference in the total cholesterol, free cholesterol and the ratio of free cholesterol to total cholesterol in both sexes (Table 3).

Dry weight

The mean values for the total dry weight for the male subjects were higher than those for the females but the observed difference was not statistically significant (Tables 1–3). Correlation co-efficients, probability values for dry weight against, age, ash and lipid fractions in both sexes are presented in Table 4. In the males, there was significant correlation between the dry weight and age, phospholipids, total and free cholesterol and also total

TABLE 2. Intima dry weight, ash, and lipids in females (mean ± SEM)

Age group (years)	Dry weight per subject (mg)	Ash (mg/g)	Phospho-lipids (mg/g)	Total cholesterol (mg/g)	Free cholesterol (mg/g)	Free/total cholesterol	Trigly-cerides (mg/g)	Total lipids (mg/g)	No. of subjects
15–20	66·31	31·38	27·16	27·80	16·48	0·55	9·97	64·95	5
	10·26	5·90	2·44	3·14	5·16	0·12	1·98	4·95	
20–25	60·23	19·24	16·36	23·82	9·74	0·50	16·42	78·19	6
	8·10	4·92	2·78	4·47	1·40	0·07	3·10	11·05	
25–30	69·39	20·52	13·20	23·88	9·50	0·42	13·88	49·30	4
	12·16	5·06	0·63	4·53	1·67	0·06	4·10	7·50	
30–35	86·43	27·00	28·80	44·79	17·65	0·62	9·46	88·65	6
	12·99	4·29	5·44	7·80	5·05	0·09	2·45	15·19	
35–40	100·89	18·75	20·16	24·44	15·24	0·54	10·81	54·58	5
	16·74	5·18	5·01	3·46	4·82	0·07	1·83	7·37	
40–45	258·67	24·70	24·20	41·64	21·90	0·56	10·93	76·78	4
	47·69	3·49	4·54	8·69	3·39	0·07	2·19	14·49	
*50–55	287·07	24·83	24·46	31·37	18·31	0·46	11·63	75·05	4
	7·91	3·07	3·83	4·12	3·78	0·03	2·66	7·79	
55–60	150·80	33·41	18·36	30·73	18·11	0·59	15·75	88·64	4
	20·60	4·13	3·63	8·02	5·68	0·04	3·59	24·78	
60–65	228·90	35·73	22·67	39·54	18·95	0·37	14·74	96·54	3
	24·64	1·85	3·50	9·30	3·04	0·06	1·07	15·61	
65–70	330·76	29·80	42·33	76·97	37·93	0·50	13·28	132·58	4
	76·22	3·80	4·23	14·35	6·63	0·07	2·07	15·82	

* No female patients in the 45–50 years age group during the period of study.

TABLE 3. Mean intima dry weight, ash and lipids in males and females

	Males			Females			
	Mean	SE	*n*	Mean	SE	*n*	*P* values
Dry weight	188·75	18·35	37	149·99	18·63	35	>0·05
Ash	30·99	1·52	40	26·15	1·64	36	<0·05
Phospholipids	30·72	1·92	42	23·57	1·68	36	<0·01
Total cholesterol	31·24	2·84	31	35·78	3·31	35	>0·05
Free cholesterol/	17·64	1·37	35	17·92	1·82	34	>0·05
Total cholesterol	0·52	0·03	40	0·50	0·03	32	>0·05
Triglycerides	9·36	0·74	41	12·54	0·90	38	<0·02
Total Lipids	90·10	7·21	40	79·90	5·42	38	>0·05

SE, standard error of Mean; *n*, number of subjects.

lipids but there was no correlation between age and triglycerides and the free/total cholesterol ratio. In the females, there was significant correlation with age, phospholipids, total cholesterol, free cholesterol and total lipids but not with ash, triglycerides and the free/total cholesterol ratio (Table 4).

TABLE 4. Correlation between intima dry weights, age, ash and lipids

	Males			Females		
	r	*P*	*n*	*r*	*P*	*n*
Dry weight vs age	0·655	<0·001	37	0·726	<0·001	35
Dry weight vs ash	−0·378	<0·05	34	0·201	>0·05	35
Dry weight vs phospholipids	0·611	<0·001	36	0·363	<0·05	32
Dry weight vs total cholesterol	0·529	<0·01	28	0·391	<0·05	33
Dry weight vs free cholesterol	0·355	<0·05	32	0·404	<0·05	31
Dry weight vs free/total cholesterol	0·155	>0·05	34	0·061	>0·05	32
Dry weight vs triglycerides	0·139	>0·05	36	0·035	>0·05	33
Dry weight vs total lipids	0·584	<0·001	34	0·369	<0·05	33

r, Correlation coefficient; *P*, probability value; *n*, number of subjects.

TABLE 5. Correlations between aortic intima ash, age, dry weight and lipids

	Males			Females		
	r	*P*	*n*	*r*	*P*	*n*
Ash vs age	−0·003	>0·05	38	0·016	>0·05	35
Ash vs dry weight	−0·378	<0·05	34	0 210	>0·05	34
Ash vs phospholipids	−0·206	>0·05	39	0·391	<0·05	33
Ash vs total cholesterol	0·021	>0·05	28	0·402	<0·05	32
Ash vs free cholesterol	−0·147	>0·05	32	0·507	<0·01	32
Ash vs free/total cholesterol	0·087	>0·05	37	0·384	<0·05	34
Ash vs triglycerides	−0·225	>0·05	38	−0·008	>0·05	34
Ash vs total lipids	−0·321	>0·05	37	0·438	<0·02	35

r, Correlation coefficient; *P*, probability value; *n*, number of subjects.

Ash

The mean values and the standard error of the mean for the different age groups are presented in Tables 1 and 2. The mean values for ash for all the age groups were significantly higher in the males than in the females (Table 3) ($P<0·05$). There was a significant negative correlation between ash and dry weight in males (Table 4) but no correlation between ash and the different lipid fractions (Table 5). In females, however, there was

significant correlation between ash and phospholipids, total cholesterol and total lipids. There was no significant correlation with age, dry weight and triglycerides (Table 5).

Phospholipids

Table 3 shows that the mean value for males was significantly higher than in females ($P<0.01$). There was significant correlation between phospholipids and age, dry weight, total and free cholesterol, triglycerides and total lipids but not with ash and free-total cholesterol ratio in the male subjects. In the females, there was also significant correlation with dry weight, ash, total and free cholesterol and total lipids but not with age, triglycerides and free/total cholesterol ratio (Table 6).

TABLE 6. Correlations between aortic intima phospholipids, age, dry weight, ash and other lipids

	Males			Females		
	r	*P*	*n*	*r*	*P*	*n*
Phospholipids vs age	0·373	<0·02	42	0·006	>0·05	35
Phospholipids vs dry weight	0·611	<0·001	38	0·363	<0·05	32
Phospholipids vs ash	−0·206	>0·05	39	0·391	<0·05	33
Phospholipids vs total cholesterol	0·656	<0·001	30	0·765	<0·001	33
Phospholipids vs free cholesterol	0·599	<0·001	34	0·736	<0·001	34
Phospholipids vs free/total cholesterol	0·250	>0·05	39	0·184	>0·05	36
Phospholipids vs triglycerides	0·513	<0·001	40	−0·046	>0·05	35
Phospholipids vs total lipids	0·864	<0·001	40	0·721	<0·001	36

r, Correlation coefficient; *P*, probability value, *n*, number of subjects.

Total cholesterol

There was no significant difference in the mean values obtained for both sexes (Table 3). In the males, there was significant correlation between total cholesterol and age, dry weight, phospholipids, free cholesterol and total lipids, but there was no significant correlation with ash, triglycerides and ratio of free/total cholesterol. In the females, there was significant correlation between total cholesterol and age, dry weight, ash, phospholipids, free cholesterol and total lipids but not with triglycerides and free/total cholesterol ratio (Table 7).

Free cholesterol

There was no significant difference in the mean values for both sexes (Table 3). In the males there was no significant correlation between free cholesterol and ash and the ratio of free/total cholesterol. In the females, there was also no significant correlation with age and triglycerides. However, in the males, there was significant correlation between free cholesterol, and age, dry weight, phospholipids, total cholesterol triglycerides and total lipids. In

TABLE 7. Correlations between intima total cholesterol, age, dry weight and other lipids

	Males			Females		
	r	*P*	*n*	*r*	*P*	*n*
Total cholesterol vs age	0·360	<0·05	34	0·462	<0·01	33
Total cholesterol vs dry weight	0·529	<0·01	28	0·391	<0·05	33
Total cholesterol vs ash	0·210	>0·05	28	0·402	<0·05	32
Total cholesterol vs phospholipids	0·655	<0·001	30	0·765	<0·001	33
Total cholesterol vs free cholesterol	0·907	<0·001	28	0·873	<0·001	32
Total cholesterol vs free/total cholesterol	−0·089	>0·05	29	0·034	>0·05	33
Total cholesterol vs triglycerides	0·252	>0·05	30	0·067	>0·05	34
Total cholesterol vs total lipids	0·855	<0·001	29	0·932	<0·001	34

r, Correlation coefficient; *P*, probability value; *n*, number of subjects.

TABLE 8. Correlations between intima free cholesterol, age, dry weight, ash, and other lipids

	Males			Females		
	r	*P*	*n*	*r*	*P*	*n*
Free cholesterol vs age	0·345	<0·05	35	0·075	>0·05	34
Free cholesterol vs dry weight	0·355	<0·05	32	0·404	<0·05	31
Free cholesterol vs ash	−0·147	>0·05	32	0·507	<0·01	32
Free cholesterol vs phospholipids	0·599	<0·001	34	0·734	<0·001	34
Free cholesterol vs total cholesterol	0·907	<0·001	28	0·873	<0·001	32
Free cholesterol vs free/ total cholesterol	−0·027	>0·05	34	0·389	<0·05	34
Free cholesterol vs triglycerides	0·395	<0·05	34	0·035	>0·05	33
Free cholesterol vs total lipids	0·750	<0·001	32	0·806	<0·001	34

r, Correlation coefficient; *P*, probability value; *n*, number of subjects.

the females there was significant correlation between free cholesterol, and dry weight, ash, phospholipids, total cholesterol, ratio of free/total cholesterol and total lipids (Table 8).

Free/total cholesterol ratio

No significant difference was observed in the mean values for both sexes (Table 3). There was no significant correlation between this ratio and age, dry weight and also the other lipid fractions in males but there was significant correlation between this ratio and the ash and free cholesterol in females (Table 9).

TABLE 9. Correlations between intima free/total cholesterol ratio, age, dry weight, ash and other lipids

	Males			Females		
	r	*P*	*n*	*r*	*P*	*n*
Free cholesterol/total cholesterol vs age	0·004	>0·05	38	−0·027	>0·05	37
Free/total cholesterol vs dry weight	0·016	>0.05	34	−0·061	>0·05	32
Free/total cholesterol vs ash	0·087	>0·05	32	0·384	<0·05	34
Free/total cholesterol vs phospholipids	0·250	>0·905	39	0·184	>0·05	36
Free/total cholesterol vs total cholesterol	−0·089	>0·05	29	0·034	>0·05	33
Free/total cholesterol vs free cholesterol	−0·027	>0.05	34	0·389	<0·05	34
Free/total cholesterol vs triglycerides	0·076	>0·05	38	−0·144	>0·05	36
Free/total cholesterol vs total lipids	0·082	>0·05	38	0·049	>0·05	3

r, Correlation coefficient; *P*, probability value; *n*, number of subjects.

Triglycerides

This is the only lipid fraction in which the mean value for the female subject was significantly higher ($P<0·01$) than in the male (Table 3). In the males there was significant correlation between triglycerides and phospholopids, free cholesterol and total lipid, but there was a lack of correlation of triglycerides with the other chemical components in the females (Table 10).

Total lipids

The mean value for total lipids appears to increase with morphological grading in males (Table 1) but not in females (Table 2). In both sexes, there was significant correlation between total lipids and dry weight, phospholipids, total cholesterol and free cholesterol. There was no correlation between total lipids and the total/free cholesterol. In the male, there was significant correlation between the total lipids with age and triglycerides, but this was not

observed in females. However, there was significant correlation between total lipids and ash in females but not in males (Table 11).

TABLE 10. Correlations between intima triglycerides, age, dry weight, ash and other lipids

	Males			Females		
	r	*P*	*n*	*r*	*P*	*n*
Triglycerides vs age	0·116	> 0·05	41	0·144	> 0·05	38
Triglycerides vs dry weight	0·139	> 0·05	36	0·036	> 0·05	35
Triglycerides vs ash	−0·225	> 0·05	38	−0·008	> 0·05	33
Triglycerides vs phospholipids	0·513	< 0·001	40	−0·046	> 0·05	35
Triglycerides vs total cholesterol	0·252	> 0·05	30	0·067	> 0·05	35
Triglycerides vs free cholesterol	0·395	< 0·05	34	−0·035	> 0·05	34
Triglycerides vs free/ total cholesterol	0·076	> 0·05	38	−0·144	> 0·05	33
Triglycerides vs total lipids	0·612	< 0·001	40	0·136	> 0·05	37

r, Correlation coefficient; *P*, probability value; *n*, number of subjects.

TABLE 11. Correlations between intima total lipids, age, dry weight, ash and other lipids

	Males			Females		
	r	*P*	*n*	*r*	*P*	*n*
Total lipids vs age	0·521	< p·001	38	0·292	> 0·05	38
Total lipids vs dry weight	0·584	< 0·001	34	0·369	< 0·05	33
Total lipids vs ash	−0·321	> 0·05	37	0·348	< 0·02	35
Total lipids vs phospholipids	0·864	< 0·001	40	0·721	< 0·001	36
Total lipids vs total cholesterol	0·855	< 0·001	29	0·932	< 0·001	34
Total lipids vs free cholesterol	0·750	< 0·001	32	0·806	< 0·001	34
Total lipids vs free/ total cholesterol	0·082	> 0·05	38	0·049	> 0·05	37
Total lipids vs triglycerides	0·612	< 0·001	38	0·136	> 0·05	37

r, Correlation coefficient; *P*, probability value; *n*, number of subjects.

Effect of age.

In the males, there are positive correlations between age and dry weight of intima per subject, phospholipids, total cholesterol, free cholesterol and total lipids, but in the females, there are only correlations between age and dry weight and total cholesterol (Table 12).

TABLE 12. Correlations between age, intima lipids and ash in males and females

	Males			Females		
	r	*P*	*n*	*r*	*P*	*n*
Age vs dry weight	0·665	<0·001	37	0·762	<0·001	35
Age vs ash	0·003	>0·05	38	0·016	>0·05	36
Age vs phospholipids	0·373	<0·02	42	−0·006	>0·05	36
Age vs total cholesterol	0·360	<0·05	34	0·462	<0·01	33
Age vs free cholesterol	0·345	<0·05	35	0·075	>0·05	35
Age vs free/total cholesterol	0·004	>0·05	38	0·027	>0·05	37
Age vs triglycerides	0·116	>0·05	41	−0·144	>0·05	38
Age vs total lipids	0·521	<0·001	38	0·292	>0·05	38

r, Correlation coefficient; *P*, probability value; *n*, Number of subjects.

DISCUSSION

The pathogenetic role and importance of intimal lipids in atherosclerosis and its sequence remain poorly understood (Holman *et al.*, 1958, Galindo *et al.*, 1961; Restrepo & McGill, 1959). Although, there is evidence that dietary intake of fats influences serum cholesterol and other lipid fractions (Scott *et al.*, 1963) the relatively low levels of serum lipids observed in the Nigerian (Taylor, 1971) and in the Masai of East Africa (Biss *et al.*, 1971) may influence the qualitative and quantitative aspects of aortic atherosclerosis in these populations. It will be of interest to know if the various lipids deposited in the arterial intima is influenced simply by their relative concentrations in the serum or if other factors in the artery come into play. It is tempting to suggest that, in view of the 'low serum cholesterol low atherosclerosis association' in some African population groups and the converse in certain European groups, atherosclerosis appears to be considerably influenced, amongst other factors, by the serum cholesterol levels. It has been shown that the serum triglyceride level in the adult Nigerian female is significantly lower than in the male counterpart, thus confirming similar observations made in South African Bantus (Anderson *et al.*, 1959). The role of serum triglycerides however requires further evaluation. The present study shows the opposite of what obtains in the serum because the aortic intima triglyceride level was significantly higher in the females than in the males. It could be argued that there is indirect relationship between serum and aortic intima triglycerides, although for this study, the serum triglycerides was not measured in the patients whose aortas were examined. A unifying hypothesis to explain the present observation may be that the higher the serum triglycerides the lower the intimal level and conversely. Local factors in the architecture of vessels may also

be of importance but this alone will be inadequate to explain the vast differences between the severity of atherosclerosis between different population groups.

In this study, the dry weight of the intima increased with age in both sexes and the intimal total cholesterol also increased with age in both sexes. These observations confirm the previous morphologic findings that atherosclerotic lesions in general, increase with age (Antonis & Bersohn, 1960; Meyer *et al.*, 1971; Williams, 1971; Strong *et al.*, 1959; Anderson *et al.*, 1959). It is noteworthy that two aortas may appear similar not only on grading but also in cholesterol and weight measurements but the quantity of other chemical components may differ considerably (Anderson *et al.*, 1959). We were able to confirm this observation. It would appear that the chemical composition of the intima does not strictly correlate with morphological estimates irrespective of the method used for the latter.

There is a relatively high mean value for free cholesterol, triglycerides and total lipids in males between 15 and 20 years (Table 1). This may partly explain the steep rise in aortic fatty streaks seen in Nigerian males in early life and the relative drop in the third and fourth decades observed in this population (Williams, 1969). The bimodal pattern of intimal lipid content is also observed in the female but only in respect of free cholesterol and phospholipids (Table 2). In the males, there is a striking increase of total cholesterol content over the age of 65 (Table 1) and there is also a marked rise in total content over the age of 40. This corresponds with the quantitative rise observed in an earlier study (Anderson *et al.*, 1959). In the females there is a moderate increase of phospholipids, total cholesterol and total lipids over the age of 65 years. Triglycerides are constant in both sexes and the free/total cholesterol is relatively constant in both sexes in all age groups.

It is interesting to note certain marked sex differences in the degree of correlation with particular reference to ash and triglycerides. Ash was significantly correlated with phospholipids, total cholesterol, free cholesterol, ratio of free total cholesterol, and total lipids in the females whereas in the males ash was only correlated with the dry weight of intima (Tables 5 and 10). Triglyceride level in the female showed lack of correlation with any other parameter while in the males, triglyceride level was significantly correlated with phospholipids, free cholesterol, and total lipids.

The levels of dry weight per subject, and total cholesterol were the only intima components which correlated fairly well with age in both sexes. Since these components can be estimated relatively easily, we are of the opinion that these could be useful indices for evaluating the effect of age on the aortic intima. It is therefore suggested that these two factors be adopted for comparative chemico-epidemiological studies on atherosclerosis.

In view of the differences in technics employed for chemical analyses, it is not strictly permissible to compare our data with other studies. However, it will appear that the levels of the different lipid fractions found in the aortic intima of Nigerians without advanced lesions, is relatively low. This data will provide a baseline for comparative studies provided similar technics are employed. It is likely that when this study is repeated in this environment some years later, there may be significant changes in the severity and extent of atherosclerosis which may be reflected in the chemical composition of the intima. These changes may be correlated with improved socio-economic standards, change of dietary habits and serum lipids.

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