scribed combination test enables us to reject the hypothesis that the fish simply swims forward on sound. Directional hearing has been shown at least for the coarse discrimination of bearings 180° apart. This ability alone has (already) biological meaning. It is quite probable that the orfe possesses a much better angular resolution. We did not test this directly owing to the risk of another act of willful hindering[15] in the field.

Von Frisch and Dijkgraaf[19] and Reinhardt[20] have been unable to show acoustic localization in Ostariophysi, except when the fish were within a dm range from the sources. We tentatively attribute their negative results to inadequate qualities of the applied sound fields (too few low-frequency components?). Since in our experiments there was no correlation between the polarity of the acoustic pressure at the onset of the sounds and the location of the sources, we conclude that the discrimination cannot be based on detection of the initial polarity of the acoustic pressure: a sensory ability demonstrated by Piddington[21] for goldfish. We think that in our experiment a phase analysis between acoustic pressure and particle displacements as shown for cod[22] explains the discrimination of oppositely travelling waves.

1 The authors gratefully acknowledge the efforts of Mr M. Kleisma in the conduction of preliminary laboratory and field experiments. We thank Dr J. Ringelberg for making available to us the field facilities of the Limnological Laboratory, University of Amsterdam. Dr E. Meelis, Institute of Theoretical Biology, Leyden, has checked the applied statistics.

2 D. R. Nelson and S. H. Gruber, Science *142*, 975 (1963).
3 D. R. Nelson, Bull. Mar. Sci. *17*, 741 (1968).
4 A. Banner, Bull. Mar. Sci. *22*, 251 (1972).
5 A. A. Myrberg, Jr, S. J. Ha, S. Walewski and J. C. Banbury, Bull. Mar. Sci. *22*, 926 (1972).
6 A. A. Myrberg, Jr, C. R. Gordon and A. P. Klimley, in: Sound reception in Fish, p. 209. Elsevier, Amsterdam 1976.
7 A. Schuijf and A. D. Hawkins, Sound reception in fish. Elsevier, Amsterdam 1976.
8 O. Sand and P. S. Enger, in: J. Schwartzkopff, Mechanoreception, p. 223. Ed. J. Schwartzkopff. Abh. Rhein.-Westf. Akad. Wiss. *53* (1974).
9 A. Schuijf, J. W. Baretta and J. T. Wildschut, Neth. J. Zool. *22*, 81 (1972).
10 A. Schuijf and M. E. Siemelink, Experientia *30*, 773 (1974).
11 K. Olsen, in: Sound reception in Fish, p. 259. Elsevier, Amsterdam 1976.
12 A. Schuijf, J. comp. Physiol. *98*, 307 (1975).
13 O. Sand, J. exp. Biol. *60*, 881 (1974).
14 R. J. A. Buwalda and J. van der Steen, Experientia (in press).
15 The observations stopped abruptly after our subject had disappeared being exchanged by someone, otherwise we certainly would have decided to make additional observations, particularly with tail stimulations.
16 J. Oosterhoff, Math. Centre Tracts 28. Math. Centrum, Amsterdam.
17 $\mu = \sum_{i=1}^{4} m_i C_i / N_i$ $\quad \sigma^2 = \sum_{i=1}^{4} m_i n_i C_i (N_i - C_i) / \{N_i^2 (N_i - 1)\}$
18 Let the value of p_i and p_i' under H_o be π_i. If we accept H_1 then we have $p_i > \pi_i > p_i'$. The expected number of correct choices is $mp_i + n(1-p_i') > m\pi_i + n(1-\pi_i)$.
19 K. von Frisch and S. Dijkgraaf, Z. vergl. Physiol. *22*, 641 (1935).
20 F. Reinhardt, Z. vergl. Physiol. *22*, 570 (1935).
21 R. W. Piddington, J. exp. Biol. *56*, 403 (1972).
22 A. Schuijf and R. J. A. Buwalda, J. comp. Physiol. *98*, 333 (1975).

High density lipoproteins in ischaemic heart disease[1]

I. C. Ononogbu[2]

Department of Biochemistry, University of Nigeria, Nsukka (Nigeria), 21 December 1976

Summary. High density lipoprotein cholesterol concentrations were significantly lower in ischaemic heart disease patients than in healthy subjects when age and sex-matched. This difference was, however, not observed in the older age group (> 60 years).

Ischaemic heart disease due to coronary atherosclerosis (obstruction of the coronary artery as a result of lipid deposition in the arterial wall) is a major world problem at the present time[3,4]. There are many risk factors for ischaemic heart disease. Hypercholesterolaemia[5,6] and hypertriglyceridaemia[7] are known to be associated with ischaemic heart disease. The role of lipoproteins in the aetiology of ischaemic heart disease has, however, not been fully explored. Recently it has been indicated that high density lipoprotein is an antiatherogenic agent[8]. The mode of action of high density lipoprotein as an antiatherogenic agent is not, however, completely understood. Suggestions have, at any rate, been made as to the means by which high density lipoprotein could act as an antiatherogenic agent. One of these[9] believes that high density lipoprotein has the ability to solubilize exogenous cholesterol in addition to its own cholesterol content, thus preventing influx of cholesterol into the arterial wall. The localization of ApoA-1 in atherosclerotic lesions[10] may also indicate that high density lipoprotein has the ability to transport lipids from the arterial wall to the plasma.

Another mode of action of high density lipoprotein is believed[11] to be due to its ability to inhibit uptake and degradation of low density lipoprotein, and depress net increment in cell sterol content. Low density lipoprotein is the main carrier of cholesterol and inhibition of its degradation may prevent accumulation of cholesterol in the arterial wall.

Material and methods. Healthy subjects. These were made up of 99 white British-born men and women between the ages of 20 and 69 years living in the London area. Subjects were selected on the basis of absence of clinical or ECG

1 Acknowledgment. This investigation was supported by a grant from University of Nigeria, Nsukka.
2 I am grateful to Prof. Barry Lewis, St. Thomas Hospital Medical School, London, for his expert advice.
3 A. Keys, Atherosclerosis *22*, 149 (1975).
4 B. Lewis, Lancet *1*, 141 (1974).
5 W. B. Kannel, T. R. Dawber, G. D. Friedman, W. E. Glonnon and P. M. McNamara, Ann. int. Med. *61*, 888 (1964).
6 E. Nikkila and A. Aro, Lancet *1*, 954 (1973).
7 L. A. Carlson and L. E. Bottiger, Lancet *1*, 865 (1972).
8 G. J. Miller and N. E. Miller, Lancet *1*, 16 (1975).
9 S. L. Hsia, Y. Chao, C. H. Hennekens and W. B. Reader, Lancet *2*, 1000 (1975).
10 H. F. Hoff, C. L. Heideman, R. L. Jackson, R. J. Bayardo, H. Kim and A. M. Gotto, Circulation Res. *37*, 72 (1975).
11 T. E. Carew, T. Koschinsky, S. B. Hayes and D. Steinberg, Lancet *1*, 1315 (1976).

evidence of ischaemic heart disease (IHD) from history or clinical examination. Subjects were excluded on grounds of cirrhosis, renal failure, clinically evident endocrine disease, congestive heart failure and malignant disease.

Ischaemic heart disease patients. Those were made up of 50 white British-born men and women (20–69 years) who were ischaemic heart disease patients who were attending the cardiac clinic at Hammersmith Hospital, London.

Fasting (12–14 h) blood samples were collected from the 2 groups of subjects. Serum was separated by low speed centrifugation.

High density lipoprotein separation by precipitation and cholesterol and triglyceride analyses by Technicon Autoanalyser were done by the methods described in an earlier paper[12].

Table 1

		HDL cholesterol (mg/100 ml)	HDL triglyceride
Males			
Control	n = 57	56 ± 12 (mean ± SD)	13 ± 5
Ischaemic heart disease	n = 35	46 ± 11	16 ± 5
T-value		4.01	2.64
p-value		< 0.001	n.s.
Females			
Control	n = 42	70 ± 22	14 ± 6
Ischaemic heart disease	n = 15	51 ± 21	15 ± 7
T-value		2.99	0.82
p-value		<0.01	n.s.

Table 2

		HDL cholesterol (mg/100 ml)	HDL triglyceride
Age 20–29			
Control	n = 16	58 ± 17 (mean ± SD)	13 ± 4
Ischaemic heart disease	n = 4	43 ± 10	14 ± 9
T-value		2.3	0.55
p-value		<0.05	n.s.
Age 30–39			
Control	n = 16	65 ± 12	11 ± 4
Ischaemic heart disease	n = 10	51 ± 14	15 ± 6
T-value		2.78	2.18
p-value		<0.05	n.s.
Age 40–49			
Control	n = 18	60 ± 15	13 ± 4
Ischaemic heart disease	n = 13	43 ± 15	15 ± 6
T-value		3.01	1.08
p-value		<0.01	n.s.
Age 50–59			
Control	n = 30	63 ± 23	14 ± 8
Ischaemic heart disease	n = 15	43 ± 12	16 ± 6
T-value		3.81	1.02
p-value		<0.001	n. s.
Age 60–69			
Control	n = 19	64 ± 19	13 ± 5
Ischaemic heart disease	n = 8	62 ± 14	16 ± 6
T-value		0.30	1.19
p-value		n.s.	n.s.

Results. High density lipoprotein cholesterol and triglyceride concentrations in the ischaemic heart disease patients and in the healthy controls compared for the 2 sexes are given in table 1. In table 2 is presented the comparison of high density lipoprotein cholesterol and triglyceride concentrations in the 2 groups for the different age groups. Among the men, the ischaemic heart disease patients had lower high density lipoprotein cholesterol concentrations than the healthy controls ($p < 0.001$). There was no statistical difference in high density lipoprotein triglyceride in the 2 groups. The ischaemic heart disease female patients also had lower high density lipoprotein cholesterol than the female healthy controls, with a lower statistical difference, however ($p < 0.01$). There was also no statistical difference in high density lipoprotein triglyceride concentration in the 2 groups. In the age groups of 20–59 years, the ischaemic heart disease patients had lower high density lipoprotein cholesterol concentrations than their healthy counterparts (20–29, $p < 0.05$; 30–39, $p < 0.05$; 40–49, $p < 0.01$; 50–59, $p < 0.001$). High density lipoprotein triglyceride concentration showed no statistical difference. In the age group of 60–69 years, there were no statistical differences in high density lipoprotein cholesterol concentrations, or in high density lipoprotein triglyceride concentrations in the 2 groups.

Discussion. The diminution of high density lipoprotein concentrations in the ischaemic heart disease patients is of interest since it has been shown that high density lipoprotein plays a role in atherosclerotic cardiovascular disease[8]. The finding of decreased high density lipoprotein cholesterol concentrations in ischaemic heart disease patients is in agreement with previous reports[13,14]. Women are known to have a lower incidence of ischaemic heart disease than men. A higher concentration of high density lipoprotein found in women than in men might be one of the factors that protect them from ischaemic heart disease. It is known, however, that there is a higher HDL_2 fraction in women than in men[15]. It may be possible that in ischaemic heart disease patients there is a decrease in the proportion of the HDL_2 fraction in the HDL molecule. Some ischaemic heart disease patients often have high HDL concentrations (unpublished observation). The antiatherogenic property of HDL may possibly reside in the HDL_2 fraction. Data from the present study also suggest that high density lipoprotein (HDL) may be more effective as an antiatherogenic agent in the younger age groups (< 60 years) than in the older age groups (> 60 years).

12 I. C. Ononogbu and B. Lewis, Clin. chim. Acta *71*, 397 (1976).
13 C. L. Gulbrandsen, G. G. Rhoads and A. Kagan, Circulation *50*, Suppl. 3, 100 (1974).
14 K. Berg, A. Borresen and G. Dahlen, Lancet *1*, 499 (1976).
15 M. Barclay, R. K. Barclay and V. P. Skipski, Nature (Lond.) *200*, 362 (1963).