

SCREENING IN THE EARLY DIAGNOSIS AND PREVENTION OF CARDIOVASCULAR DISEASE

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OLIVER and Stuart-Harris (1965) in their admirable paper on the present position concerning prevention of heart disease, reviewed current views on the aetiology of this condition and listed the 'risk factors' which are, with varying degrees of agreement, thought to contribute to the likelihood of an individual developing coronary thrombosis or the sequelae of hypertension. They also concluded with a plea for screening procedures as a key to early diagnosis and possible prevention.

The Institute of Directors' Medical Centre opened in June 1964 and provides facilities for 'health checks' or executive health examinations on business men of all ages and varying status—from the largest to the smallest companies in this country. At the centre allegedly healthy men are seen by one of the doctors on the staff for a complete environmental and physical examination.

After this, the following routine investigations are carried out: urine tested with haemacombistix; haemoglobin, sedimentation rate and cholesterol; postero-anterior and lateral chest x-ray and straight x-ray of the abdomen and pelvis; lung function test by vitalograph; tonometry and skinfold thickness; electrocardiograph, and exercise cardiograph on those over 50 or with clinical indications. Other investigations are done as clinically indicated.

A continuing relationship with the 'patients' is expected and so far very good follow-up is being obtained. The main aim of these procedures is to try to relate the findings on examination and investigation to the individual's cardiovascular risk. Thus, a thoroughly over-worked, stressed man, who smokes 30 cigarettes a day, has a cholesterol of 320 and ST depression on his cardiograph, is likely to be at hazard.

Clearly, seeing relatively large numbers of men in a high coronary

risk group provides a wide range of information which when followed up over a number of years could indicate the significance of the various risk factors. In this paper, we present the findings on initial examination of the first 2,000 men seen at the centre, with particular reference to the risk factors listed by Oliver and Stuart-Harris.

Description of material presented

The men seen at the centre fell under two main headings: those who came as individual members of the Institute of their own volition and those who came under arrangements made by their company. These latter came as a 'firm group' and were perhaps less selected or biased than were the individuals who could have come because they were unwell or worried about themselves. Roughly 40 per cent of the 2,000 came under the first and 60 per cent under the second heading.

There were minor differences in the findings between the two groups but these are outside the scope of this paper. Here we are merely seeking to present the cardiovascular findings revealed by screening 2,000 business men.

As has been said, each man was seen by one doctor who was thereafter clinically responsible for him. The pathology was carried out independently by Dr Jean Shanks, the cardiographs and lung function tests were done by technicians and all the cardiographs were independently reported on by a visiting cardiologist; similarly, the x-rays were all reported on by the radiologist in charge of the department.

In the light of what was found, the individual doctor came to his own conclusions and communicated them to the patient's general practitioner on whom rested the final decision about initiating treatment. The centre, however, does have a policy about many aspects of preventing cardiovascular disease so that there is in practice considerable uniformity of recommendation. To achieve further uniformity, the analysis presented here was all done by Dr Pincherle who had seen only a small number of the patients clinically.

Results

Age and weight

Table I gives the age and weight distribution of the group. Weights were taken stripped or in minimal clothing; heights (not quoted here) were without shoes. In computing over- and under-weight, the Metropolitan Life Insurance figures were used. Nearly a quarter of the men were under 40 years old and 60 per cent were under 50. We do not yet know the extent to which it is possible to prevent or reverse the pathological changes which finally lead to ischaemic heart disease but it is presumably of greater value to pick these up

in the younger rather than the older men. For this, if for no other reason, it is important to include the under 40's in any cardiovascular screening procedure.

The table also shows that 20 per cent were between ten per cent and 19 per cent over-weight and ten per cent were 20 per cent or more over-weight. Life insurance experience suggests that mortality rates go up with obesity and that most, but not all, of this is due to hypertension. There is currently a feeling that perhaps obesity is not quite so important a cause of morbidity and mortality as was thought ten years ago. But it is undoubtedly of considerable significance if only because it is relatively easy to treat. Control of weight is often in practice the simplest method of reducing blood pressure and cholesterol.

Over-nutrition is obviously a prevalent condition in this group although an equal number (ten per cent) were ten per cent or more under-weight.

TABLE I
AGE DISTRIBUTION AND WEIGHT BY AGE

<i>Age</i>	<i>Under 40</i>	<i>40-49</i>	<i>50-59</i>	<i>60 or over</i>	<i>Total</i>
	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>
Number	465 100	722 100	647 100	166 100	2000 100
10 per cent or more under-weight ..	50 11	72 10	66 10	20 12	208 11
Average weight ..	286 61	454 63	404 63	81 49	1225 61
Between 10 per cent and 20 per cent over-weight	92 20	133 18	117 18	36 22	378 19
More than 20 per cent over-weight	37 8	63 9	60 9	29 17	189 9

Nearly 30 per cent of each age group is 10 per cent or more over-weight
Expected weight based on the tables of the Metropolitan Life Insurance Co.

Blood pressure

Blood pressure was taken with the patient lying down, using a mercury sphygmomanometer. Opinions differ both as to the significance and accuracy of casual blood pressure readings and as to what constitutes a significant elevation above normal, either for the individual or the population. Clearly for this and other reasons, it

is unwise to place too much significance on minor elevations of blood pressure but if a doctor is convinced that a patient's pressure is raised, and particularly if there are other signs indicating a reduced prognosis, it is unfair to the patient to neglect an elevation of the diastolic pressure.

Hamilton (1966) recently indicated that hypertensive patients were likely to benefit from early treatment and there is a growing feeling that individuals with a raised diastolic pressure should at least be closely watched, after further investigation to exclude obvious pathology like renal disease.

Table II shows the blood pressure findings in relation to age. This shows that 14 per cent of the total and eight per cent of the under 40's had a diastolic pressure of 91-100 and a further three per cent of the younger group and eight per cent of the total group had pressures of over 100.

TABLE II
BLOOD PRESSURE BY AGE

<i>Age</i>	<i>Under 40</i>		<i>40-49</i>		<i>50-59</i>		<i>60 or over</i>		<i>Total</i>	
	<i>No.</i>	<i>Per-centage</i>	<i>No.</i>	<i>Per-centage</i>	<i>No.</i>	<i>Per-centage</i>	<i>No.</i>	<i>Per-centage</i>	<i>No.</i>	<i>Per-centage</i>
Number	465	100	722	100	647	100	166	100	2000	100
Normal B.P. (systolic 150 or less and diastolic 90 or less) ..	390	84	541	75	379	59	69	42	1379	69
Diastolic 90 or less	416	89	586	81	451	70	104	62	1557	78
Diastolic 91-100	37	8	81	11	120	19	41	25	279	14
Diastolic over 100	12	3	55	8	76	11	21	13	164	8

Table IV shows the relationship between weight and blood pressure. This bears out the traditional concept of hypertension being related to weight but it is worth noting that men with normal weights and even those who are appreciably under-weight do sometimes have raised blood pressures.

Many question the significance of a single raised blood pressure reading, be it at a life insurance examination or elsewhere. But it cannot be denied that the man whose pressure goes up under any specific circumstances is likely to be a worse risk than the man whose pressure remains low under similar provocation. Finding a high

pressure is, at least, an indication for further supervision.

Cholesterol

Raised cholesterol is currently one of the most popular predictors of increased coronary risk, since long term studies have shown that those with levels over 270 do tend to be more coronary prone (Kannel *et al* 1961). This matter has additionally become of more importance since the introduction of drugs like atromid S which not only lower cholesterol but also reduce coagulability. In view of the possibilities and possible benefits of treatment, it is certainly worth screening vulnerable groups to identify these high risk cases.

Table III shows cholesterol levels in relation to age and table IV in relation to weight. As with blood pressure, a single cholesterol reading, taken more or less randomly during the day, may be suspect but at least it gives an indication of the overall level and can easily be repeated for confirmation. If high cholesterol levels are related to over-nutrition and an 'expensive' diet, the figures tend to bear out that this group at any rate tends to be over-indulgent: 14 per cent have levels of 270-300 and 11 per cent over 300. Again, 17 per cent of the under 40's and 29 per cent of the over 50's have levels above 270.

TABLE III
BLOOD CHOLESTEROL BY AGE

<i>Age</i>	<i>Under 40</i>	<i>40-49</i>	<i>50-59</i>	<i>60 or over</i>	<i>Total</i>
	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>
Number	465 100	722 100	647 100	166 100	2000 100
Cholesterol 270 or less mg. per cent	387 83	544 75	458 71	116 70	1505 75
Cholesterol 270-300 mg. per cent	41 9	99 14	92 14	36 21	268 14
Cholesterol 300 or more mg. per cent	37 8	79 11	97 15	14 9	227 11

Table IV shows that there is no significant difference in the number of patients with raised cholesterol levels between the normal weight and the over-weight group. The under-weight group appear to be at an advantage although even in this group 16 per cent had a cholesterol over 270. Thus adiposity is not the only determinant of cholesterol level. It could also be that our concepts of optimum

weights are too high. The optimum weights which the Metropolitan Life Insurance Company originally calculated before the importance of cholesterol was recognized, are certainly well below the usual average figures (Wright 1963).

TABLE IV
WEIGHT BY CHOLESTEROL AND BY BLOOD PRESSURE

<i>Weight</i>	<i>10 per cent or more under- weight</i>	<i>Average weight</i>	<i>Between 10 per cent and 20 per cent over- weight</i>	<i>More than 20 per cent over- weight</i>	<i>Total</i>
	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>	<i>Per- No. cent- age</i>
Number	208 100	1225 100	378 100	189 100	2000 100
Cholesterol over 270 mg. per cent	34 16	306 25	106 28	49 26	495 25
Raised blood pres- sure (systolic over 150, diastolic over 90 or both) mm. of Hg.	50 24	337 28	147 39	87 46	621 31
Diastolic pressure over 100 mm. of Hg.	10 5	70 6	48 13	36 19	164 8

Expected weights based on the tables of the Metropolitan Life Insurance Co.

Cholesterol levels can also be shown in relation to blood pressure: 15 per cent of those with levels of 271–300 and 16 per cent with levels of over 301 had diastolic pressures between 91 and 100; six per cent of those with diastolic pressures of over 100 had cholesterol levels of 271–300 and 12 per cent had levels of more than 300. These people, particularly if they are cigarette smokers, would appear to constitute the most coronary-prone group.

Table V shows a relationship between smoking and cholesterol; heavy smokers having significantly higher levels than non-smokers. This could be a direct casual relationship between smoking and ischaemic heart disease; it could also reflect a common behavioural factor like stress and tension. It is certainly something that warrants further investigation.

Cigarette smoking

There is now increasing agreement that the cigarette smoker is

more likely to get coronary heart disease than the non-smoker. It is also becoming apparent that there are marked and immediate benefits from stopping smoking; not least perhaps from the removal of the stimulus caused by cigarettes, to raising blood pressure and cholesterol.

Thirty-three per cent of the total and 40 per cent of the under 40's said they had never smoked cigarettes. A further 19 per cent of the total and 12 per cent of the younger groups had previously smoked. This is a high proportion of non-smokers but it is borne out by similar figures from other sources that we have recently obtained. (*The Director*, 1966 and in process of publication). Overall, 48 per cent were current cigarette smokers; this agrees very closely with two independent results of 47 per cent in similar socio-economic groups (Meadows, Wood and Schilling 1965, College of General Practitioners 1961). Of the smokers, 22 per cent of the total smoked 1-19 cigarettes a day and 26 per cent smoked 20 or more. In these groups, there was no difference with age. It is worth noting that a quarter of the group were heavy smokers.

TABLE V
CHOLESTEROL BY SMOKING

	<i>No. of patients</i>	<i>Mean* cholesterol</i>	<i>Standard* error</i>	<i>Percentage with cholesterol over 270</i>
1 Never smoked cigarettes	677	236.2	±1.92	19
2 Given up cigarettes ..	388	246.0	±2.53	28
3 1-19 cigarettes per day ..	424	239.2	±2.42	24
4 20 or more cigarettes per day	511	249.4	±2.20	30
TOTAL	2000	242.1	±1.11	25

For the difference between groups 1 and 4 $t = 4.52$ $P < 0.0001$

*mg. per cent

Obviously, we do our best to discourage smoking and we are conducting a follow-up to measure our success in this field. We do, however, find that in this intelligent and highly motivated group, the display of figures relating smoking and cardiovascular disease and chest disease—not necessarily lung cancer—can be a major factor in persuading them to stop.

ECG changes

It is not yet possible to assess the prognostic significance of minor

ECG abnormalities but growing experience (Higgins, Kannel and Dawber 1965) suggests that minor abnormalities, previously thought to be unimportant, do turn out to be of poor prognostic significance. So far there has been little attempt to evaluate the findings in 'healthy people' in this country and only prospective studies such as we are envisaging will do this.

In our group, 22 per cent of the total (five per cent severe and 17 per cent minor changes) had some possibly significant ECG changes. The proportion rose from 13 per cent in the under 40 group to 45 per cent in the over 60's. The nature of these abnormalities will be described in more detail elsewhere as will the effect of exercise cardiographs on revealing otherwise latent ischaemia. But clearly the cardiograph (we do the 12 standard leads as a routine) is a useful and relatively easy screening procedure.

X-ray findings

Apart from looking for bone and soft tissue disease in the chest and abdomen, our x-ray reports comment on cardiac enlargement, distortion or enlargement of the aorta and calcification in the pelvic blood vessels. We would make the point here that routine chest x-ray, particularly if it includes a lateral view, may be more useful in measuring and creating a baseline for heart size than it is for finding treatable lung disease. On this basis, 15 per cent had x-ray abnormalities of the cardiovascular system, varying from five per cent in the under 40's to 38 per cent in the over 60's.

Conclusions and summary

In this paper, we present some of the findings resulting from the detailed environmental and physical examination of 2,000 business men whose ages ranged from 28-70. In terms of the causative and productive factors listed by Oliver and Stuart-Harris, an appreciable proportion were over-weight (29 per cent), hypertensive (eight per cent), hyperlipaemic (11 per cent); 25 per cent were heavy cigarette smokers and 15 per cent had significant x-ray and five per cent significant ECG changes.

Attention is drawn to the appreciably high proportion of positive or significant findings in the under 40 group. Atherosclerosis is a process in which thrombosis or infarction is an event. In terms of prevention, it is probably going to be better to halt or reverse the process than it is to treat the event. We do not yet know the points along the line of its natural history at which the disease can be either halted or reversed but, on *prima facie* grounds, it would seem more important to screen the young than the old. There is probably a watershed, soon after 50, which may determine survival. The older age group, having passed the danger point, are more likely to survive

into their 70's. It is the under 50's, who still have a contribution to make, who may require most screening and supervision. That screening produces a rich yield of treatable clinical disease cannot be doubted from the figures presented, particularly if these are viewed in relation to the yields from mass radiography, diabetic surveys or cervical smear campaigns (Smith, Ruskell and Earson 1965).

If the figures presented are re-analysed by age into those under and those over 50, new ischaemic heart disease was found (by ECG) in 1.1 per cent of under 50's and 3.4 per cent of the over 50's. Other new cardiovascular disease was found in 1.8 per cent of the under and 3.8 per cent of the over 50 age group. 5.6 per cent of the younger and 11.9 per cent of the older group had diastolic pressures over 100 and 9.6 per cent of the younger and 13.6 per cent of the older group had cholesterol levels over 300 mg. per cent.

In addition to the findings discussed in detail, a vast amount of other clinical, environmental and behavioural information was obtained. Something clinical or physical was found in over a third of the people seen. This is a high and rewarding yield for any screening procedure. It fits in well with other surveys that have been made in general practice and the municipal screening clinics. (Logan 1963). From the results of all these, it is inescapably clear that there is a vast reservoir or 'iceberg' of undiagnosed disease in all our allegedly healthy population.

If we are ever to reduce the toll of cardiovascular and other chronic disease, it can only be by presymptomatic diagnosis and screening of vulnerable groups in the population. This may mean altering priorities in the health service as a whole. But there is abundant evidence to suggest that if this can be achieved and the various factors accurately evaluated, preventive medicine has an exciting and immensely useful future.

Even if all our patients were selected in terms of coming because they felt unwell or knew they were failing—which was not in fact the case—the yield in terms of the early diagnosis of potentially treatable disease was still appreciable. We would conclude by supporting Oliver and Stuart-Harris in their demand for screening centres for the early diagnosis of cardiovascular disease.

Acknowledgements

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MIDWIFE'S OATH—SEVENTEENTH CENTURY

"You shall swear, first, that you shall be diligent and faithful and ready to help every woman labouring with child as well the poor as the rich; and that in time of necessity you shall not forsake the poor woman to go to the rich.

"Item. You shall neither cause nor suffer any woman to name or put any other father to the child, but only him which is the very true father thereof indeed.

"Item. You shall not suffer any woman to pretend, feign, or surmise herself to be delivered of a child who is not indeed; neither to claim any other woman's child for her own.

"Item. You shall not suffer any woman's child to be murdered, maimed, or otherwise hurt, as much as you may; and so often as you shall perceive any peril or jeopardy either in the woman or in the child, in any such wise as you shall be in doubt what shall chance thereof, you shall thenceforth in due time send for other midwives and expert women in that faculty, and use their advice and council in that behalf.

"Item. You shall not in any wise use or exercise any manner of witchcraft, charm or sorcery, invocation or other prayers that may stand with God's laws and the King's.

"Item. You shall not give any counsel or minister any herb, medicine, or potion, or any other thing, to any woman being with child whereby she should destroy or cast out that she goeth withal before her time.

"Item. You shall not enforce any woman being with child by any pain or by any ungodly ways or means to give you any more for your pains or labour in bringing her to bed, than they would otherwise do.

"Item. You shall not consent, agree, give, or keep counsel that any woman be delivered secretly of that which she goeth with, but in the presence of two or three lights ready.

"Item. You shall be secret and not open in any matter appertaining to your office in the presence of any man, unless necessity, or great urgent cause do constrain you so to do.

"Item. If any child be dead-born, you yourself shall see it buried in such secret place as neither hog nor dog nor any other beast may come unto it; and in such sort done as it be not found nor perceived, as much as you may; and that you shall not suffer any such child to be cast into the jaques or any other inconvenient place.

"Item. If you shall know any midwife using or doing anything contrary to any of the permisses, or in any otherwise than shall be seemly or convenient, you shall forthwith detect, open, or show the same to me or my Chancellor for the time being.

"Item. You shall use yourself in honest behaviour unto the woman, being lawfully admitted to the room and office of a midwife in all things accordingly.

"Item. That you shall truly present to myself, or my Chancellor, all such women as you shall know from time to time to occupy and exercise the room of a midwife within my aforesaid diocese and jurisdiction of without any licence and admission . . .

English Midwives their History and Prospects. J. H. AVELING, M.D.
London, J. & A. Churchill, 1872. Pp. 90,