Reappraisal of cardiovascular surveys in Jamaica

Use of submaximal exercise tests for clinical investigation

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Assertions that idiopathic cardiomegaly or an obscure form of ischaemic heart disease are common in Jamaica have been based on a high prevalence in community surveys of unexplained electrocardiographic abnormalities and of positive responses to a questionnaire for ischaemic heart pain. Thirty-one men, aged 42-62 years, in whom these abnormalities had been found in a previously surveyed rural community, were recalled for clinical examination and exercise tests and compared with 18 control subjects. No clinical abnormalities were found. The heart rates during standard work and maximum oxygen uptake of subjects and controls were similar, and indicated, on average, excellent exercise performance consistent with their heavy physical activity in daily life. None complained of chest pain at near maximal exertion, and the previous diagnosis of angina pectoris was judged to have been mistaken. Most of the electrocardiographic abnormalities at rest were minor or isolated and did not change on exercise. Significant changes in exercise occurred in 4 subjects, in whom inverted T waves and ST depression became less obvious than at rest, but the cause of these abnormalities was not found. Though idiopathic cardiomegaly and ischaemic heart disease do occur in Jamaica, their incidence is not known but there is no evidence that they are as widespread as has been previously asserted. Interpretations of answers to questionnaires and of electrocardiograms obtained in population surveys should be made with caution. From this study we have no evidence on whether the electrocardiographic changes were related to ethnic or environmental factors.

A cardiovascular survey of a rural community in Jamaica was reported as showing an unexpectedly high prevalence of electrocardiographic abnormalities and of positive responses to a questionnaire for ischaemic heart pain (Fodor *et al.*, 1964). These observations were thought to indicate that a type of myocardial disease with features of ischaemia is common in this population, but lack of any clear relation between the abnormalities and age and the rarity of myocardial infarction in rural Jamaica led to the suggestion that the condition differs from the ischaemic heart disease seen in more affluent societies.

Other workers in Jamaica (Stuart and Hayes, 1963; Stuart and Bras, 1971; Campbell *et al.*, 1971) have suggested that the same

findings indicate a high prevalence of early idiopathic cardiomegaly, a condition or group of conditions characterized in later stages by cardiac dilatation and hypertrophy, congestive cardiac failure, and sometimes by sudden death. In clinical examples of this condition there may be a mild angina pectoris and electrocardiographic abnormalities which resemble those of ischaemia (Stuart and Bras, 1971). However, hospital studies do not accord with the belief that idiopathic cardiomegaly is common in Jamaica. From 1960 to 1965, only 30 (4.1%) of 738 diseased hearts seen at necropsy at University Hospital had unexplained enlargement (Summerell, Hayes, and Bras, 1968). The detailed studies of Stuart and Hayes (1963) and Campbell *et al.* (1971) recorded only 50 patients with unexplained cardiomegaly over an 18-year period.

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In view of the uncertainty about the meaning of the epidemiological findings, and of the discrepancy between hospital and community experience, we have re-examined some of the men seen on the original surveys who were said to have had angina and electrocardiographic changes with no obvious cause or association, in order to determine whether they might be suffering from ischaemic heart disease or idiopathic cardiomegaly. Particular attention was given to cardiac performance during exercise because this was likely to be a more sensitive test for early cardiac disease than measurements made at rest.

Subjects and methods

One of the communities surveyed was that of Lawrence Tavern, a rural area situated in hill country 16 miles north of Kingston, the capital. The people are predominantly African in origin. The first surveys were carried out on a random sample of men and women aged between 35 and 64 years in 1962 (Fodor *et al.*, 1964) and 1963, and they were followed up five years later in 1967 and 1968. Since we were proposing to impose the stress of exercise on subjects considered by some to have good evidence of heart disease, the present investigation was confined to men who were between 40 and 59 years at the time of follow-up, and therefore between 42 and 62 years when the present study was undertaken in 1970. Women were not asked to participate, but their survey findings were similar to those for the groups studied and presumably were of the same nature.

Of the 286 men in the selected age group examined in 1967 and 1968, 86 had either responded positively to the questionnaire for ischaemic heart pain (described hereafter as having 'angina') or had electrocardiographic abnormalities of interest, or both. Since the main purpose of the study was to examine those with 'angina' or electrocardiographic changes of no known cause or association, subjects with hypertension (systolic pressure greater than 160 mmHg or a diastolic pressure greater than 95 mmHg), diabetes mellitus, valvular heart disease, or any other disorder likely to interfere with assessment of the heart such as kyphoscoliosis or marked airways obstruction, were excluded. Eighteen men found on the same surveys to have normal electrocardiograms and no 'angina' were investigated as controls.

Each subject was selected for exercise studies after satisfactory completion of a questionnaire for past medical history and present state of health and after a clinical examination. Measurements of height, weight, thigh circumference and four skinfold thicknesses (biceps, triceps, subscapula and suprailiac) were made according to the recommendations of the Human Adaptability Subcommittee of the International Biological Programme (Weiner and Lourie, 1969). Lean body mass was calculated from weight and summed

skinfold thicknesses at four sites by the method of Durnin and Rahaman (1967).

Forced expiratory volume and forced vital capacity were measured with a dry spirometer by a standard technique (Cotes, 1968) and a resting electrocardiogram was recorded. A posteroanterior chest radiograph was taken at full inspiration and the cardiothoracic ratio (CTR) expressed as a percentage was calculated from the transverse diameter of the heart and the maximum internal thoracic diameter.

An assessment of each subject's level of customary activity was made using a standardized questionnaire which inquired about occupational and recreational activities and the usual mode of travel. In addition, daily energy expenditure over one week was derived indirectly in 5 control subjects from the daily heart beat count obtained with a SAMI (socially acceptable monitoring instrument) heart rate integrator (Baker, Humphrey, and Wolff, 1967). The recording cells had been previously calibrated and checked for stability and were changed every 24 hours. The daily average cardiac frequency was calculated and the equivalent oxygen consumption derived from the subject's heart rate: oxygen intake relation which had been determined in the laboratory during the exercise study described below. In another study (Miller *et al.*, 1972), repeat measurements on submaximal exercise at the higher temperature of Lawrence Tavern, confirmed the appropriateness of the relationships. A diary account of activities was made over the week of study.

Exercise was performed on a cycle ergometer (Monark) in an air-conditioned laboratory (temperature range 24–26°C, humidity 70%), while the work load was increased at 3-minute intervals up to the maximum which the subject could tolerate. A full electrocardiogram was first recorded with the subject seated on the ergometer at rest; the electrocardiogram during exercise was monitored at chest lead V₅ or V₆. All leads of interest were repeatedly recorded during recovery. Each test was preceded by a short period of exercise and lasted 12 minutes on average. Subjects inhaled air through a dry gas meter (Parkinson and Cowan, CD4) mouthpiece and low resistance valve box, and exhaled to atmosphere through a gas mixing chamber from which mixed expired air was continuously sampled and drawn through a paramagnetic oxygen analyser (Servomex) and an infrared CO₂ analyser (Hartmann and Braun). The accuracy of gas analysis was repeatedly checked with gas mixtures previously analysed with a Scholander apparatus. Data for submaximal exercise were used to obtain the relation between cardiac frequency and oxygen uptake, and cardiac frequency at an oxygen uptake of 1.5 l. min⁻¹ (CF_{1.5}) was estimated. The expected maximum cardiac frequency (CF max) of each subject was predicted from the relation CF max = 200 – 0.63 age in years (SD 12) found in this laboratory for men in rural Jamaica, and the maximum oxygen uptake ($\dot{V}O_{2, \text{max}}$) was then estimated by extrapolation (World Health Organization, 1971).

Results

The numbers of subjects with 'angina' and electrocardiographic abnormalities in 1967 and 1968, those with hypertension, other associated disease, and those with unexplained findings examined in the present study are summarized in Table 1.

Angina Fifteen men were said to have responded positively to the questionnaire for ischaemic heart disease, but 4 were hypertensive and one had chronic airways obstruction. Of the 10 men without associated disease, 8 were investigated. Of these 8, 1 had incomplete right bundle-branch block, 1 had atrioventricular conduction delay, and 3 had Q wave abnormalities.

Ventricular conduction defects Two men had complete right bundle-branch block but 1 was hypertensive; the other was not examined. One man with incomplete right bundle-branch block and also with 'angina' was examined.

Atrioventricular conduction delay One subject with complete heart block was excluded because he was known to have suffered from conduction disturbances for at least 15 years. No case of second degree heart block had been seen. Fifteen men had PR (PQ) intervals ranging between 0.22 and 0.24 sec in one or more limb leads, but one had chronic obstructive bronchitis. Of the 14 remaining subjects, 7 were examined, including one who also had 'angina'.

Atrioventricular conduction acceleration

Fifteen men had PR intervals ranging between 0.10 and 0.12 sec in all beats in any two limb leads. One had evidence of airways obstruction and 4 men were hypertensive. Of the remaining 10, 6 were studied, including one subject who also had frequent extrasystoles.

Q wave patterns Q wave patterns codable according to the Minnesota code (Rose and Blackburn, 1968) were present in 18 men. Five were hypertensive, 1 had aortic incompetence and 1 had conspicuous airways obstruction. Of the 11 men remaining with unexplained Q wave abnormalities, 10 were investigated: in 9 men, the Q wave changes were confined to lead aVL, the duration of Q being between 0.03 and 0.04 sec with R wave amplitude of 3 mm or more; 3 of these men also gave a history of 'angina'. In one man changes were restricted to the absence of R waves in chest leads V₁ and V₂.

T wave inversion Eight subjects had a T wave negativity of 1 mm or more without ST segment depression in the leads defined by the Minnesota code. Five were hypertensive and 2 had severe kyphoscoliosis. The remaining person with unexplained T wave inversion was studied.

ST depression with T wave inversion

Twelve subjects had ST segments which were horizontally depressed or downward sloping, displaced at least 0.5 mm, and associated with T wave changes as defined above. All but 2

TABLE 1 *Relation of hypertension and other associated diseases with 'angina' and electrocardiographic abnormalities in men examined in community surveys*

Survey findings	Number in 1967-1968 surveys (286 men examined)	Number with associated disease		Number without associated disease	
		Hypertension	Other*	Total	Number examined in present study
'Angina'	15†	4	1	10†	8†
Ventricular conduction defects	3	1	0	2	1
AV conduction delay	16	0	2‡	14	7
AV conduction acceleration	15§	4	1	10§	6§
Q wave abnormalities	18	5	2	11	10
T wave inversion alone	8	5	2	1	1
ST depression and T wave inversion	12	10	0	2	2
Frequent extrasystoles	5	2	0	3	2
Total number of subjects	86	31	8	47	31

* Valvular heart disease, diabetes mellitus, kyphoscoliosis, airways obstruction.

† Subjects with 'angina' included one with incomplete right bundle-branch block, one with AV delay, and three with Q wave changes.

‡ One man had long-standing complete heart block.

§ One man also had frequent extrasystoles.

of the 12 subjects were hypertensive and both were studied.

Frequent extrasystoles Five men had frequent extrasystoles defined as occurring in 10 per cent or more of recorded QRS complexes. Two had hypertension and of the remaining 3, 2 were studied, 1 of whom also had atrioventricular conduction acceleration.

In summary, 'angina' or electrocardiographic abnormalities had been found in 86 of 286 men in the follow-up surveys (Table 1). Five men had both angina and electrocardiographic changes and 1 subject had more than one electrocardiographic abnormality; 39 men had hypertension or some other condition but the findings were unexplained in 47 men; 31 men in the group of 47 were examined in the present study together with 18 controls.

Clinical examination was normal in all 49 men. None volunteered any significant complaint and all were working full time, mainly as peasant farmers. No significant electrocardiographic changes had occurred since the previous survey recording. Chest radiography showed borderline cardiac enlargement in some subjects and in some controls but otherwise no abnormalities were seen.

Table 2 presents the means with standard deviations and the ranges for age, height, body weight, lean body mass (LBM), and cardiothoracic ratio, and shows that, in general, values for those with angina and electrocardio-

graphic abnormalities were similar to those of controls.

Cardiac frequencies at rest, in standardized submaximal exercise ($CF_{1.5}$) and at maximal exercise (CF_{max}), are summarized in Table 3, together with the estimated maximum oxygen uptakes ($\dot{V}O_2 \max$) for the groups. Mean resting heart rates were about 62 min^{-1} and were similar for all groups and controls. No significant differences between the groups were found for $CF_{1.5}$, CF_{max} or $\dot{V}O_2 \max$. All groups had exercised to peak heart rates which were, on average, 90 per cent of the predicted maximum.

No subject complained of symptoms suggestive of angina pectoris at any time during exercise. Interesting electrocardiographic changes on exercise occurred in 4 subjects who are therefore presented in more detail. All 4 were working full time as farmers.

C. 264 57 years. Electrocardiogram showed left axis deviation of the QRS complex and large inverted T waves in chest leads V_2 - V_4 at rest. On exercise the T waves flattened but inverted again during recovery. Cardiothoracic ratio was 58.3 having been 57.0 in 1962. Blood pressure was 140/70 mmHg. During exercise $CF_{1.5}$ was 132 min^{-1} and $\dot{V}O_2 \max$ 2.07 l.min^{-1} . Lean body mass was 57.9 kg.

D. 220 48 years. Marked ST segment depression and T wave inversion in leads I, II, III, aVF, V_5 , and V_6 , with high amplitude R waves at rest.

TABLE 2 Anthropometric data of subjects with 'angina' and electrocardiographic abnormalities and of controls

Group	No.	Age (yr)	Stature (cm)	Weight (kg)	Lean body mass (kg)	Cardiothoracic ratio
		Mean $\pm$ SD and range	Mean $\pm$ SD and range	Mean $\pm$ SD and range	Mean $\pm$ SD and range	Mean $\pm$ SD and range
'Angina'*	8	52.3 $\pm$ 5.2 42-57	172.4 $\pm$ 6.7 160.8-182.9	63.3 $\pm$ 3.9 55.9-67.7	57.2 $\pm$ 3.1 51.9-61.4	49.8 $\pm$ 4.4 42.4-56.2
Incomplete right bundle-branch block	1	48	175.3	55.9	51.9	53.4
AV conduction delay	7	50.3 $\pm$ 6.3 42-59	176.1 $\pm$ 3.2 170.8-179.9	66.7 $\pm$ 6.4 55.7-76.1	59.9 $\pm$ 6.7 50.9-72.0	49.5 $\pm$ 3.3 45.6-53.9
AV conduction acceleration†	6	51.7 $\pm$ 6.8 42-61	166.8 $\pm$ 4.6 160.0-172.4	57.8 $\pm$ 5.3 49.5-65.9	51.8 $\pm$ 4.3 44.9-58.1	49.0 $\pm$ 5.2 44.4-57.0
Q wave abnormalities	10	50.2 $\pm$ 6.8 42-61	167.6 $\pm$ 6.6 157.6-179.7	61.6 $\pm$ 6.8 46.8-67.7	56.1 $\pm$ 5.9 43.9-62.6	52.5 $\pm$ 2.7 50.4-54.9
ST and T wave changes	3	56.0 $\pm$ 7.5 48-62	165.4 $\pm$ 5.7 159.9-171.3	56.9 $\pm$ 4.0 53.9-61.4	53.4 $\pm$ 3.9 50.9-57.9	54.0 $\pm$ 5.2 48.2-58.3
Frequent extrasystoles	2	1) 60 2) 61	176.5 172.4	65.7 56.8	61.2 53.1	54.7 57.0
Controls	18	53.9 $\pm$ 5.5 42-62	169.2 $\pm$ 6.2 160.2-184.5	60.1 $\pm$ 8.4 51.4-83.2	54.3 $\pm$ 6.5 46.7-70.7	50.5 $\pm$ 4.7 43.3-56.9

* Including one subject with incomplete right bundle-branch block, one with AV conduction delay, and three with Q wave abnormalities.

† Including one subject with frequent extrasystoles.

TABLE 3 Heart rates and maximal oxygen consumption on exercise of subjects with 'angina' and electrocardiographic abnormalities and of controls

Group	No.	Resting heart rate, min ⁻¹	CF 1.5*	Maximum heart rate achieved, min ⁻¹	Estimated maximum oxygen uptake, l.min ⁻¹
		Mean $\pm$ SD and range	Mean $\pm$ SD and range	Mean $\pm$ SD and range	Mean $\pm$ SD and range
'Angina'†	8	59.6 $\pm$ 10.8 44-76	118.6 $\pm$ 14.8 96-138	146.8 $\pm$ 18.7 130-185	2.43 $\pm$ 0.44 1.94-3.20
Incomplete right bundle-branch block	1	54	107	130	2.34
AV conduction delay	7	60.3 $\pm$ 8.7 48-72	109.3 $\pm$ 13.5 95-125	154.7 $\pm$ 19.4 125-168	2.81 $\pm$ 0.34 2.52-3.37
AV conduction acceleration‡	6	58.7 $\pm$ 18.3 36-90	127.2 $\pm$ 15.2 113-154	142.7 $\pm$ 20.1 120-170	2.24 $\pm$ 0.38 1.70-2.70
Q wave items	10	62.1 $\pm$ 12.1 46-82	126.3 $\pm$ 19.8 99-160	153.8 $\pm$ 18.0 140-186	2.40 $\pm$ 0.62 1.80-3.44
ST and T wave changes	3	61.7 $\pm$ 11.9 48-70	126.7 $\pm$ 12.9 112-136	155.0 $\pm$ 7.2 147-162	2.21 $\pm$ 0.37 1.94-2.63
Frequent extrasystoles	2	(1) 78 (2) 42	118 135	132 138	2.95 1.98
Controls	18	65.1 $\pm$ 12.0 42-90	122.1 $\pm$ 11.5 107-150	146.3 $\pm$ 17.7 120-175	2.55 $\pm$ 0.43 1.93-3.46

* Heart rate at an oxygen uptake of 1.5 l.min⁻¹.

† Including one subject with incomplete right bundle-branch block, one with AV conduction delay, and 3 with Q wave abnormalities.

‡ Including one subject with frequent extrasystoles.

The ST and T wave abnormality became less obvious during exercise but reappeared on recovery. Cardiothoracic ratio was 55.5, having been 56.0 in 1963. Blood pressure was 125/70 mmHg. CF_{1.5} was 112 min⁻¹ and $\dot{V}O_2$, max 2.63 l.min⁻¹. Lean body mass was 51.4 kg.

D. 224 62 years. ST segment depression and T wave inversion in leads II, III, aVF, V₄, and V₅ at rest, but T waves became upright and peaked and ST segments upward sloping on exercise. Cardiothoracic ratio was 48.2 compared with 51.0 in 1963. Blood pressure was 114/72 mmHg. On exercise CF_{1.5} was 136 min⁻¹ and $\dot{V}O_2$, max 1.94 l.min⁻¹. Lean body mass was 50.9 kg.

C. 382 61 years. Supraventricular ectopic beats comprised about 10 per cent of all QRS complexes at rest with a pulse rate of 42/min⁻¹. Extrasystoles persisted at low work loads, disappeared as the heart rate increased, and returned on recovery. Cardiothoracic ratio was 57.0 compared with 50.0 in 1962. Blood pressure was 112/87 mmHg. During exercise CF_{1.5} was 135 min⁻¹ and $\dot{V}O_2$, max 1.98 l.min⁻¹. Lean body mass was 53.1 kg.

In 5 men studied by the SAMI technique the mean daily average energy expenditure of 4500 calories was high. Individual ranges of daily expenditure were large and the overall daily range for the group was from 2900 to 5200 calories. This variation in expenditure agreed well with the diary accounts of activity, and the men often rested the day before or the day after a strenuous day of work.

Discussion

The principal object of the investigation was to examine in detail all men seen in a survey carried out 2 to 3 years previously who were said to have given a history of 'angina' or who had electrocardiographic signs of conduction defects, ischaemia or cardiac irritability not explained by any known pathology and which had been taken as evidence for the presence of an obscure cardiac ischaemia or of idiopathic cardiomegaly. These unexplained items had been found in 47 men of the 286 subjects who were seen on surveys and of these 47, 31 were examined. The 16 subjects who were not examined were unable to attend because of their work, and inquiries by field workers, together with inspection of the records of the local health clinic, provided no evidence that they were in poor health. The exclusion of women and older men who were seen in the original surveys would be unlikely to affect the validity of the investigation because the survey findings were similar in these groups to those for the men in the age range studied.

The exercise performances of men with 'angina' and with electrocardiographic changes were similar to those of controls. In each group the heart rate during standard exercise was similar to that observed for 12 healthy young men (20-30 years) in the same community (cf. Miller *et al.*, 1972). When sub-maximal heart rate was related to lean body

mass (cf. Cotes *et al.*, 1969), as in the Figure, 9 (19.4%) of the men had heart rates lower by more than 2 standard deviations than that predicted for young men. Of these 9 men, 3 had 'angina' (2 of whom also had Q wave items), 2 had AV conduction delay, 1 had ST depression (D.220), and 3 were controls. Cotes *et al.* (1971) have shown that when the level of habitual activity increases, as in competition athletes, exercise performance improves and heart rate at a standard submaximal oxygen uptake is reduced. Thus the evidence suggested that, as a group, the older men had better cardiac responses to exercise than the younger men, and that some of those with angina or electrocardiographic abnormalities had excellent exercise responses. In contrast to the submaximal exercise responses, maximum oxygen uptakes ($\dot{V}O_2$, max) cannot be compared between young and older men because of the physiological fall in maximum heart rate with age (Astrand, 1960). The values for $\dot{V}O_2$ max quoted here may be slightly less than the true value since they do not allow for the asymptotic relation between heart rate and oxygen uptake at maximum heart rates.

The majority of men had been born in this mountainous area and had been cultivators since boyhood. Plots of land must be cleared, planted, and reaped by hand on hillsides so steep that footholds must be cut in some

places. The produce must then be carried along the trails in head baskets weighing with their contents up to 45 kg. Most subjects, including those with ST segment and T wave changes, were still cultivating and all groups were as active as the controls. This type of work was associated with high levels of energy expenditure as confirmed by the SAMI technique. The training effect of a lifetime of difficult agricultural work on the older men probably explained their superior exercise performance and may also have contributed to the high prevalence of electrocardiographic evidence of left ventricular hypertrophy (Fodor *et al.*, 1964) and the low resting heart rates in this population, both of which are known to occur with increased physical activity (Van Ganse *et al.*, 1970). The 9 men with above average exercise performances had a mean resting heart rate of 52 min^{-1} (range 44–64).

Although the methods used to assess cardiac performance appeared to exclude many possible disease states, exercise performance is not necessarily limited by the presence of heart disease. For example, sudden unexplained cardiac death is said to occur in trained athletes. However, there is good reason to believe that the stress of near maximal exercise is likely to be a sensitive indicator of ischaemic heart disease. Reviewing the present status of exercise electrocardiography, Simonson (1970) stated that the best method for the detection of coronary heart disease was a progressive exercise test in which the heart rate was taken to 85 per cent of the maximum. Failure to provoke either angina or ischaemic ST segment and T wave changes in exercise or recovery with this test suggested that subjects did not have ischaemic heart disease. Concerning idiopathic cardiomegaly, Bengtsson and Lamberger (1966) found that $\dot{V}O_2$ max was frequently reduced in patients who had been left with residual myocardial fibrosis after recovery from acute myocarditis, so that it seems likely that exercise performance is impaired in idiopathic cardiomegaly, even in early stages. More elaborate and 'invasive' laboratory investigations of cardiac function were not thought to be justified in men who were apparently in good health and in whom the only evidence of disease were electrocardiographic items or of answers to questionnaires of doubtful significance.

The absence of chest pain or significant ST and T wave changes or near-maximal exercise in all the 8 men considered during past surveys to have 'angina' raises serious doubts as to the validity of this diagnosis. The failure of the questionnaire would not be surprising for

FIG. Relation between lean body mass and the cardiac frequency at an oxygen uptake of 1.5 l.min^{-1} (CF, 1.5) for the 49 men studied. The regression line is that pertaining to young healthy men from the same community, $\pm 2SD$ (cf. Miller *et al.*, 1972).

it was designed by Rose (1962) for different cultural circumstances. In our experience, Jamaicans sometimes responded positively because they had interpreted the questions in a manner different from that intended by the interviewer. Further informal probing into the history usually revealed that effort pain characteristic of cardiac ischaemia was not present. A spontaneous history of angina is rarely given in clinical practice in rural Jamaica.

The presence of radiographic cardiac enlargement in two subjects (C. 264, D. 220) with unexplained ST and T wave changes and in one man with ectopic beats (C. 382) might suggest early idiopathic cardiomegaly. However, the cardiac enlargement was not great and the absence of symptoms, the satisfactory exercise performance, and lack of progression of the electrocardiographic changes over several years of observation did not suggest heart disease. Furthermore the negative T waves became upright during exercise or in recovery. This phenomenon has been recorded previously (Blackburn *et al.*, 1966; Master and Rosenfeld, 1967), but its significance, and whether or not it is pathological, is not understood. Only continuing observation will determine whether these men have ischaemic heart disease or cardiomyopathy.

Other evidence put forward as indicating that idiopathic cardiomegaly is common in Jamaica is that an unexpected number of subjects with apparent cardiac enlargement were seen on a survey involving mass radiography (Stuart and Hayes, 1963). However, it is well recognized that geometric enlargement of the heart shadow can be produced by mass radiographic techniques. Full-sized chest radiographs were subsequently taken in a community survey and compared with similar radiographs from Wales by Ashcroft and Miall (1969). The mean cardiothoracic ratio was greater in Jamaicans than in the Welsh as a result of the mean thoracic diameter being less in the presence of a similar cardiac diameter. Though a general shift towards higher values of the cardiothoracic ratio was seen in the Jamaican population, the frequency distribution of cardiothoracic ratios did not suggest that the proportion of cases with cardiac enlargement was any greater in Jamaica than in Wales. The apparent radiographic appearance of larger hearts in Jamaicans may be partially explained by ethnic differences in anthropometry, people of African origin having narrower thoracic diameters than Caucasians. This difference may lead to over-estimation of the prevalence of cardiac enlargement in African communities because

usual standards are based on measurements of Caucasians.

Thus the results of chest radiography, like those of the electrocardiogram and the questionnaire for ischaemic heart pain, afford no evidence that idiopathic cardiomegaly is common in Jamaica, and generalizations such as 'idiopathic cardiomegaly is more widespread in Jamaica than hospital experience indicates and a large proportion of the population, now without symptoms, is already affected' (Stuart and Hayes, 1963), are not justified. Cases of idiopathic cardiomegaly do occur in hospitals but its incidence in Jamaican communities is not accurately known. In our opinion both ischaemic heart disease associated with coronary atheroma and idiopathic cardiomegaly are relatively rare and most heart disease in adults in Jamaica is hypertensive in origin. Summerell *et al.* (1968) reported that hypertension was responsible for 340 (46%) of 738 diseased hearts found at necropsy of adult Jamaicans. The next most common causes of cardiac pathology were atherosclerosis (14%), cor pulmonale (10%), rheumatism (7%), and syphilis (6%).

The nature of the electrocardiographic changes in the community studied remains uncertain, but may be related to ethnic factors or high levels of customary activity. Bartel *et al.* (1971) have shown that the electrocardiogram of the black American man in Evan's County, Georgia, is remarkably similar to that of the rural Jamaican man. As in this study, they concluded that, in contrast to the white man, increased QRS voltages with ST changes, prolonged PR intervals, and bundle-branch block in the black man were benign and did not indicate coronary artery disease. Cassel *et al.* (1971) concluded that in general the physical activity of the black man was higher than that of the white man in this part of America.

This study has shown that conclusions from the use in a population survey of a questionnaire for ischaemic heart pain and of the Minnesota code in analysing electrocardiograms agree poorly with conclusions from more detailed investigations. Interpretation of survey data should be made with caution and in the light of other clinical information. The submaximal exercise test, when the responses related to oxygen intake and analysed in terms of body muscle, may be useful in interpreting findings in clinical and community investigations of cardiac and respiratory disorders.

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