*Arh. hig. rada toksikol.*, **30** *(1979) suppl. pp. 1765–1771.*

# RISK FACTORS CONTRIBUTING TO ISCHAEMIC HEART DISEASE AMONG MIDDLE-AGED INDUSTRIAL WORKERS IN EGYPT – AN EPIDEMIOLOGICAL STUDY

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**ABSTRACT**

This study was carried out in the Delta Industrial Company which is concerned with the manufacture and assembly of refrigerators and washing machines. The aim of the investigation was to determine the possible factors responsible for the occurrence of ischaemic heart disease (IHD) among middle-aged workers in the heavy and light industries. The investigation method involved questionnaire, medical histories, physical examinations, blood pressure determination, electrocardiography and laboratory examinations including blood cholesterol and B lipoproteins concentrations determinations.

Evidence derived from the study suggested that an abnormal elevation of systolic and diastolic blood pressure, elevation of serum cholesterol, an elevated B lipoproteins concentration, sedentary type of work, competitive drive, emotional stress, and a high intake od saturated animal fat, were the main risk factors. It was also concluded that the higher the social class, the more frequent the occurrence of IHD, of which a retrosternal dull pain or tightness in the chest is the main symptom. The results further suggested that workers with the blood groups A, B and AB are more likely to develop IHD, while workers of the 0 group are much less prone to it.

Ischaemic heart disease (IHD) is the end effect of complex interrelated disease forces centered in the heart; it is defined as hypoxia in the absence of mecrosis and in the presence of a reduced oxygen supply to the myocardium[4]. It is one of the chronic diseases that nowadays dominate medical practice in industrialized sociclies, where the conquest of malnutrition, infections and parasitic diseases has increased the population's life expectancy, and where improved medical services make it possible to diagnose a greater number of cases than before[11].

Many countries of the eastern Mediterranian region have shifted from pastoral life to a high-speed industrial age with all its dangers of a rising tide of IHD[18]. The risk factors (or IHD – promoting factors) include those abnormalities which are demonstrable in persons free from clinical ischaemic heart disease. These persons are known to face significantly increased risks of

developing the disease in subsequent years. The respective factors include hypercholesterolaemia, hyper B lipoproteinaemia, hypertension, obesity, cigarette smoking, emotional stress and physical inactivity[11,15,17].

The aim of the investigation was to study IHD in middle-aged industrial workers and to investigate in detail the various risk factors that may determine the occurrence of this disease.

## SUBJECTS AND METHODS

The field of the study was the Delta Industrial Company "Ideal" – Almaza Factory which in 1975 employed 1607 workers, 245 of them of middle age (45–64 years old).

Our study was confined to men in the middle-age group. Every worker in this age group was examined using a questionnaire, his medical history, physical examinations and blood pressure determinations. The same workers were subjected later to more detailed examinations including electrocardiographic test without exercise, and blood tests.

The workers were examined in the morning after a rest of at least fifteen minutes. Blood pressure was measured with a mercury sphygmomanometer by the auscultatory method, with the subject in the sitting position. Subscapular skinfold thickness was measured with a Pondera skinfold caliper to the nearest millimetre on the bare chest, just below the angle of the scapula, with the shoulder and arm relaxed. A Cardiopan ECG, Philips-Twelve lead machine was used in this study, and the machine was calibrated before each tracing. The standard recording speed used was 25 mm per second.

For determining the total cholesterol in the blood we applied Sackett's method modified by Harold[9]. The separation of lipoproteins by paper electrophoresis was achieved within 16 hours at 210 volts in veronal buffer, pH 8.6, and the paper was stained with Sudan Black B. The coloured components were quantitated by elution, and were read photometrically at 590 nm against a blank tube[10]. The A, B and 0 blood groups were determined by the tile method for each worker.

## RESULTS

For the sake of comparison, the middle-aged workers were divided into two groups according to the ECG findings using the Minnesota code for ECG at rest[7,14].

The group with normal ECG tracing included 218 workers, with no abnormalities detected in their ECG records. The group with abnormal records consistent with IHD included 27 workers. This classification made it possible to study different variables which may have accounted for the development of IHD in the studied workers.

The frequency of workers with normal tracing was 89%, while that of workers with abnormal records consistent with IHD was 11%.

The mean value of total blood cholesterol of the workers with IHD is 5.90 mmol/l as compared with 5.03 mmol/l in the group of workers with normal tracing (Table 1); the difference is statistically significant ($t = 5.360$, $P<0.001$).

TABLE 1
Frequency distribution of total blood cholesterol in workers of the two groups.

| Total blood cholesterol (mmol/l) | Normal tracing | | IHD | |
|---|---|---|---|---|
| | n | % | n | % |
| 3.36–3.87 | 6 | 2.7 | – | – |
| 3.88–4.39 | 19 | 8.7 | – | – |
| 4.40–4.90 | 90 | 41.3 | 1 | 3.7 |
| 4.91–5.42 | 58 | 26.6 | 9 | 33.7 |
| 5.43–5.94 | 14 | 6.5 | 7 | 25.9 |
| 5.95–6.46 | 21 | 9.6 | 3 | 11.1 |
| 6.47–6.97 | 8 | 3.7 | 4 | 14.8 |
| 6.98–7.49 | 2 | 0.9 | 1 | 3.7 |
| 7.50–8.02 | – | – | 2 | 7.4 |
| Total | 218 | 100 | 27 | 100 |
| $\bar{X} \pm$ S.D | 5.03 ± 0.27 | | 5.90 ± 0.89 | |

The mean value of B lipoprotein in the group of workers with IHD records is higher than the mean B lipoprotein concentration of the group of workers with normal tracing (Table 2); the difference is statistically significant ($P<0.001$, $t = 4.70$). There was a highly significant correlation between the total blood cholesterol and B lipoprotein concentration among the workers studied ($r = +0.570$).

TABLE 2
Frequency distribution of B lipoprotein concentration of the studied workers according to ECG findings.

| B lipoprotein (g/l) | Normal tracing | | IHD | | Total | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| 1.0–1.9 | 65 | 29.8 | 1 | 3.7 | 66 | 26.93 |
| 2.0–2.9 | 117 | 53.7 | 11 | 40.7 | 128 | 52.24 |
| 3.0–3.9 | 22 | 10.1 | 8 | 29.7 | 30 | 12.23 |
| 4.0–4.9 | 9 | 4.2 | 5 | 18.5 | 14 | 5.7 |
| 5.0–6.0 | 5 | 2.2 | 3 | 7.4 | 7 | 2.9 |
| Total | 218 | 100 | 27 | 100 | 245 | 100 |
| $\bar{X} \pm$ S.D | 2.45 ± 0.86 | | 3.35 ± 1.025 | | 2.55 ± 0.88 | |

The mean value of systolic blood pressure of the workers in the group with IHD was higher than that of the workers in the group with normal tracing (Table 3), and the difference is statistically significant ($P<0.001$, $t = 5.80$).

TABLE 3
Frequency distribution of systolic blood pressure in mm Hg among the studied workers.

| Blood pressure (mm Hg) | Normal tracing | | IHD | |
|---|---|---|---|---|
| | n | % | n | % |
| 100–109 | 9 | 4.1 | – | – |
| 110–119 | 7 | 3.2 | – | – |
| 120–129 | 55 | 25.2 | – | – |
| 130–139 | 65 | 29.8 | 3 | 18.5 |
| 140–149 | 37 | 16.9 | 6 | 22.2 |
| 150–159 | 15 | 6.9 | 8 | 29.7 |
| 160–169 | 12 | 5.5 | 7 | 25.9 |
| 170–179 | 9 | 4.2 | 1 | 3.7 |
| 180–189 | 7 | 3.3 | – | – |
| 190–199 | – | – | – | – |
| 200 210 | 2 | 0.9 | – | – |
| Total | 218 | 100 | 27 | 100 |
| $\bar{X} \pm$ S.D | 139.2 ± 18.55 | | 152.4 ± 16.6 | |

The mean diastolic blood pressure of the workers in the group with IHD was higher than that of the workers in the group with normal tracing (Table 4); the difference is statistically significant ($P<0.001$, $t = 4.80$).

TABLE 4
Frequency distribution of diastolic blood pressure in mm Hg among the studied workers.

| Blood pressure (mm Hg) | Normal tracing | | IHD | |
|---|---|---|---|---|
| | n | % | n | % |
| 70– 79 | 5 | 2.3 | – | – |
| 80– 89 | 125 | 57.3 | 3 | 11.1 |
| 90– 99 | 46 | 21.1 | 14 | 51.8 |
| 100–109 | 33 | 15.2 | 9 | 33.3 |
| 110 120 | 9 | 4.2 | 1 | 3.8 |
| Total | 218 | 100 | 27 | 100 |
| $\bar{X} \pm$ S.D | 91.1 ± 9.15 | | 97.96 ± 7.28 | |

The percentage of workers in the social classes I and II 5 (i.e. in leading, non-manual jobs) in the group with IHD records was found to be higher than that in the group with normal tracing; it was also established that a retrosternal

dull pain or tightness in the chest are the main symptoms which affect 100% of the group with IHD records as compared to 48.6% of the workers with normal tracing.

As regards emotional stress, sedentary work, competitive drives, a high intake of animal and diary saturated fat as risk factors for the development of IHD, it was found that the percentage of workers with these risk factors in the group with IHD records exceeds the respective percentage in the group with normal tracing.

However, the mean subscapular skinfold thickness in cm in the group with IHD records was found to be 1.47 in comparison with 1.36 in the group with normal tracing, yet the difference is statistically insignificant ($P > 0.05$). Smoking as a risk factor was also investigated and it was found that the percent frequency of smokers in the group with IHD is higher than the percent frequency of smokers in the other group with normal tracing.

Lastly in 27 workers with IHD records blood groups A, B and AB exceeded those with group 0.

## DISCUSSION

The objective of the present study was to investigate in detail the various risk factors that may determine the occurrence of IHD in middle-aged workers.

The mean blood cholesterol of workers with IHD was 228.1 mg/100 ml, while the mean blood cholesterol of the group of workers with normal tracing was 194.6 mg/100 ml. The difference was statistically significant (Table 1). These results agree with those of Friedberg[5], Gordon and co-workers[8] and Turner and Ball[17] who in population studies recorded a significant relationship between IHD and an abnormal elevation of cholesterol, because once plasma cholesterol accumutates in the intima, it appears to trigger off a series of "sclerotic" reactions which increase the risk of a number of cardiovascular diseases.

In the present study the mean B lipoprotein concentration in the group of workers with IHD was found to be 3.35 g/l, and in the group with normal tracing 2.45 g/l; the difference was statistically significant (Table 2). This result agrees with other authors[12,16] who reported an elevated B lipoprotein concentration in IHD patients. The increased B lipoprotein concentration is an accepted atherogenous indicator suggesting an increased liability to atherosclerotic changes[13].

The present study also points to certain correlation between total blood cholesterol in mg/100 ml and B lipoprotein concentration: $r = 0.570$, $P < 0.001$. This conclusion is similar to that of Scott[16] according to whom epidemiological studies seem to show that, at any rate for IHD, the severity of atherosclerotic damage is related to the blood cholesterol level, and when this is high, the B lipoprotein fractions are elevated.

The mean value of systolic blood pressure of workers in the group with IHD was found to be 152.4 mm Hg. This value was higher than that for the group with normal tracing, and the difference was found to be significant. Mean

diastolic blood pressure in the group of workers with IHD was established as 98.0 mm Hg, and that in the group with normal tracing as 91.1 mm Hg. The difference was found to be significant (Table 4).

Thus it may be concluded that both diastolic and systolic blood pressure are risk factors for the development of IHD. This is in accordance with the findings of Dr Williamkannel, who, studying the population of a small town (Framingham, Massachusetts) established a linear relationship between the elevation of systolic and diastolic blood pressure levels and morbidity from IHD, and drew the conclusion that both diastolic and systolic pressure are significant risk factors[3].

This result is in agreement with Morris[11] who stated that the higher the social class, the less physical activity at work and hence the more frequent the occurrence of IHD.

Our study also showed that the main symptom of workers with IHD records is a retrosternal dull pain or tightness in the chest. This result confirms the findings of Saheta[15] who regards this to be the main symptom in the history of IHD.

Particularly noticed was a connection between emotional stress among the studied workers and the development of IHD. This is in agreement with Turner and Bull[17], who in many workers found a connection between IHD and emotional stress, the respective effects being regarded to be due to catecholamine secretion.

As regards physical inactivity, our result is identical with that of Morris[11] who stated that men in sedentary jobs are more liable to IHD. Brunner and co-workers[2] also showed that the incidence of IHD during a 15-year period, studied in 5 288 men aged 40–64 in Israeli collective settlements, was 2–4 times higher among sedentary male workers than among non-sedentary ones.

The difference in the percentage of workers with competitive drives between workers with IHD and workers with normal tracing is statistically significant. This is in conformity with Turner and Bull[17], who stated that over the years, a competitive way of living may lead to IHD. It was also found that a high intake of animal and dairy saturated fat is another risk factor for the development of IHD. This is in accordance with the findings of Morris[11] who stated that there is a low incidence of IHD among people with a poor nutrition, in particular with a low intake of animal and dairy saturated fat.

In the present study we found that the mean value of subscapular skinfold thickness in workers with IHD records is higher than that in workers with normal tracing, but the difference is statistically insignificant. However, Rose[14], Morris[11], and Bondy[1] showed that the subscapular skinfold is in a positive correlation with IHD in men.

Since smoking is known as a causative factor of IHD, it was essential to establish whether the two groups of workers studied were similar as regards smoking habit. It was found that the difference between the percentage of smokers among workers with IHD records and among workers with normal tracing is insignificant statistically.

This result is not in agreement with the findings of Gordon and co-workers[8] who studied middle-aged men in Framingham, Honolulu and Puerto Rico. They found that there is a positive connection between cigarette smoking and subsequent IHD incidence. This may be attributed to the fact that in our country, because of the high prices of cigarettes, smokers do not smoke many cigarettes.

Finally, it was found that IHD records occur in workers with blood groups other than 0. We could conclude that among 27 workers with IHD records A, B and AB groups exceeded the 0 group. This is in accordance with Gertler and White[6] who reported and excess of A nad B over 0 in 81 cases of IHD.

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