# Screening for risks of cardiovascular disease in children. A preliminary report

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1. The results obtained for 236 Viennese schoolchildren between 11 and 12 years of age indicated that 38 % of children had an increased concentration of cholesterol in their serum and 3 % had an increased serum triglyceride concentration.

2. The results of the preliminary study suggested that, by extending the dimensions of the screening, further problems, for example the correlation between different 'risk' factors and the significance of nutritional habits, might be studied.

Our laboratory is screening 11–12-year-old schoolchildren for cardiovascular disease 'risk' factors (Rudas, Widhalm & Marktl, 1973; Widhalm, Rudas & Auerswald, 1973; Marktl, Rudas & Widhalm, 1974). Recently the problem of screening children has been discussed extensively (Kannel & Dawber, 1972; Mitchell, 1973) but few studies have been done and to our knowledge only one has been undertaken in Europe (Uppal, de Haas & Arntzenius, 1974). It seems therefore to be of interest to report briefly the results obtained for 236 children from one school. These children represent the first group studied in our project, which involves screening a total of about 2000 Viennese children.

## METHODS

The first and second classes of a secondary school ('Gymnasium') were selected. Of 272 parents contacted, 241 consented and 101 boys and 135 girls were actually examined.

The parents received a short communication about the purpose of our study and a questionnaire about: (1) the medical history of the family (diabetes, infarct, stroke, atherosclerosis); (2) the nutritional habits of the child. About twelve children/d were examined in the study period between 1 December 1973 and 1 March 1974.

After asking briefly about previous illnesses or present complaints, a short clinical examination was made. The height and weight of the children was measured using the routine measuring equipment available in the school; for these measurements the children wore only underpants. Their height was measured in the standing position against a firm wall with a fixed scale, and they were weighed using a beam-type balance. Blood pressure was measured using a Riva-Rocci sphygmomanometer (Erkameter; Kalmeyer, Bad Tölz, Germany).

*Analytical procedures*

A blood sample was taken from a cubital vein, after a 12–14 h fast. The sample was centrifuged, the serum was removed and within 36 h the amounts of glucose, cholesterol, triglycerides, phospholipids, uric acid and total protein were determined. Glucose concentrations were determined by the peroxidase–glucose oxidase (POD–GOD) method (Schmidt, 1963; Werner, Rey & Wielinger, 1970); cholesterol by a modified Liebermann–Burchard procedure (Zöllner, 1959; Watson, 1960), triglyceride concentrations by the method of Eggstein & Kreutz (1966) as modified by Schmidt & Dahl (1968) and phospholipid concentrations were estimated by measuring phosphatide-phosphorus levels (Zilversmit & Davis, 1950; Zöllner & Eberhagen, 1965). Uric acid concentration was estimated enzymically (Kageyama, 1971; Thefeld, Hoffmeister, Busch, Koller & Vollmar, 1973) and total protein by the Biuret method (Weichselbaum, 1946; Josephson & Gyllensvärd, 1957). These determinations were done using 'Biochemica Test Combinations' (Boehringer GmbH, Mannheim, Germany): Precilip for cholesterol, triglyceride, phospholipid and uric acid; Precinorm for glucose and total protein (Boehringer GmbH) served as quality controls to check the accuracy of our determinations. The coefficients of variation for the analytical procedures ranged between 2·6 and 5·1. For the serums in which cholesterol levels exceeded 5·95 mmol/l and for an appropriate number of control samples, lipoprotein electrophoresis on cellulose-acetate strips was done using the method described and modified by Kohn (1961), Chin & Blankenhorn (1968), Grabner, Gronauer, Berg & Bergner (1970) and Ziegler (1972).

These procedures will be used also in the continuing studies, which will be made in secondary schools of different types situated in various districts of Vienna. In this way we will attempt to include in our project as many socio-economic groups (classified according to Strotzka (1969)) as possible.

RESULTS AND DISCUSSION

Table 1 gives the mean values and SD obtained for physical and chemical measurements made during the screening of 11–12-year-old Viennese schoolchildren.

The results were also grouped according to sex and body-weight. No significant differences were found between boys and girls and the results have not been given separately.

The standard 'weight-for-height' was calculated using the formula of Karlberg, Permain & Iggbom (1959) and using the classification described by Mellbin & Vuille (1973), the children were divided into four groups. Significant ($P < 0.05$) differences found between the groups are given in Table 2. It appeared that the concentrations of triglycerides and uric acid in serum were increased in children who were 'overweight'.

The results were also grouped according to the nutritional habits of the children (preference for sweets and 'fattening' food) and to their family medical history (diabetes and atherosclerosis), but no statistically significant differences were found for any of the measurements made in this preliminary study.

Table 1. *Results of the physical examinations and of chemical determinations for serum samples obtained during the screening of 236 11–12-year-old Viennese schoolchildren for cardiovascular disease 'risk' factors*

(Mean values and standard deviations)

|  | No. of children | Mean | SD |
|---|---|---|---|
| Physical measurements |  |  |  |
| Height (m) | 236 | 1·492 | 0·0773 |
| Body-wt (kg) | 236 | 40·4 | 8·25 |
| Blood pressure: |  |  |  |
| Systolic (mm Hg) | 231 | 120·0 | 15 |
| Diastolic (mm Hg) | 231 | 75·0 | 10 |
| Chemical measurements |  |  |  |
| Cholesterol (mmol/l) | 236 | 4·93 | 0·93 |
| Triglycerides (g/l) | 230 | 0·84 | 0·34 |
| Phospholipids (g/l) | 234 | 2·35 | 0·41 |
| Glucose (mmol/l) | 236 | 5·29 | 0·64 |
| Uric acid (mmol/l) | 233 | 0·24 | 0·05 |
| Total protein (g/l) | 235 | 75·0 | 6 |

Table 2. *Serum triglyceride content and serum uric acid content of 11–12-year-old Viennese schoolchildren grouped according to body-weight (Mellbin & Vuille, 1973), during screening for cardiovascular disease 'risk' factors*

(Mean values and standard deviations)

| Group† | Triglycerides (g/l) | | | Uric acid (mmol/l) | | |
|---|---|---|---|---|---|---|
|  | No. of determinations | Mean | SD | No. of determinations | Mean | SD |
| Underweight | 30 | 0·77 | 0·29 | 31 | 0·23 | 0·05 |
| Normal | 126 | 0·82 | 0·34 | 126 | 0·23 | 0·05 |
| Overweight | 40 | 0·85 | 0·23 | 40 | 0·26* | 0·06 |
| Obese | 34 | 0·98* | 0·46 | 34 | 0·27* | 0·06 |

\* Values significantly different from those in the normal group and the underweight group: $P < 0.05$.
† The distribution of the 236 children in the different 'weight groups' was: underweight 31, normal 128, overweight 42, obese 35.

The primary aim of our study has been to determine the incidence of high blood lipid levels in 'healthy' children. Although we studied only 'healthy' children (assessed by questionnaire and physical examination), 38% of them had cholesterol levels above 5·18 mmol/l and 3% had triglyceride levels above 1·50 g/l. In a survey done in 1973 in the Netherlands (Uppal *et al.* 1974) about 33% of the children had cholesterol levels above 5·18 mmol/l. Since the results in both countries were unexpected the importance of screening children seems apparent and furthermore, when the parents of children with 'high' lipid levels were contacted, many unsuspected cases of hyperlipidaemia among close relatives were found (Marktl, Rudas & Swoboda, unpublished results).

The importance of uric acid as a 'risk' factor has not yet been firmly established nor

have we authentic 'normal' values, particularly for children. Thus the mean value + 2 × SD found in the present study (Table 1) which set the upper limit at 0·35 mmol/l, i.e. lower than the values for adults, are of interest. In 2·6% of the children this limit was exceeded.

The correlation between various 'risk' factors has not been analysed in this preliminary study.

There has recently been general agreement about the necessity for using glucose tolerance tests for reliable diabetes screening. The single determination of fasting serum glucose merely helped to exclude subjects with overt diabetes. Total serum protein concentration was estimated in order to obtain additional information about the general nutritional status of Austrian children, and the phospholipid values obtained in this study will be correlated with cholesterol levels when more results are available.

Measurements of height and weight, and of blood pressure are an essential part of studies associated with cardiovascular disease. As it was one of the intentions of the present study to find out how practical it was to screen Austrian children in school, more detailed studies (e.g. measurement of skinfold thickness and circumferences, measurement of blood pressure more than once) were not attempted. It is, however, important to decide whether sufficient information can be obtained by a few simple tests.

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