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Risk factors of CHD in children – a retrospective view of the Westland study

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Summary

Routine medical examinations have been carried out in children for many years, but more recently paediatricians have broadened their outlook to consider not only the health of the child until the age of 14 or 16 years but also his future health as an adult. Screening for risk factors for coronary heart disease (CHD) in children raises problems of normal values by sex and age, expecially for serum cholesterol and blood pressure.

The results of a study of CHD risk factors in school children in Westland, Holland, are described. Although further information is needed it is concluded that in future paediatricians should accept a greater responsibility for preventive cardiology.

AFTER World War II, the term 'risk factor' has gradually come into use as a new concept in medical terminology, originating from a deeper insight in the epidemiology of non-infectious diseases. In spite of this in most countries many older and younger physicians have not yet become familiar with the meaning of this new concept, as epidemiology takes up only a modest, instead of a dominant, place in undergraduate and postgraduate medical education.

The traditional physician receives patients who ask to be relieved of pain or discomfort. Even if the patient comes to his doctor for a general check up he wants tc know whether he has a silent disease which has not yet come to the surface, rather than whether his way of life needs correction on the grounds of risk factors which may threaten his health in later life. Moreover curative and preventive medicine of infectious diseases taught us that a disease has a special cause. Tuberculosis cannot exist without the tubercle bacillus, but the presence of tubercle bacilli as such is usually not enough to bring about the disease in a given person. A decrease in general resistance is nearly as important. In one way or another most infectious diseases are multifactorial, although this has often remained unrecognized in the past.

It is easier to understand that chronic diseases are multifactorial in origin, although there are a few exceptions.

One of the greatest achievements in modern medicine is the discovery of a complex of factors which are responsible for the development of coronary heart disease (CHD) in adults. Although one factor may be more important than another, most probably there is not one single factor which is absolutely indispensable in the origin of CHD, as is the case in the origin of infectious diseases. However, it may be that there is a certain level of serum cholesterol beneath which CHD is very unlikely to occur. Hyperlipidaemia, hypertension and smoking are generally considered to be the major risk factors of CHD, while obesity, physical inactivity, diabetes and some other factors, such as stress rank second.

The concept of risk factors of CHD, as developed for middle-aged and older adults, has been extrapolated to children, neglecting the fact that a child is a growing individual whose phases of life – from birth to adolescence – show special characteristics which are quite different from those of adult life.

Screening for risk factors of CHD has been carried out much more extensively in adults than in children, but in industrialized countries, screening for other types of risk factors, such as diminished hearing or seeing was already in general use in maternity and child health centres and in school-health services, long before screening for CHD of adults came into practice.

In principle, screening for CHD risk factors in children, therefore, is not a new element in social (preventive) paediatrics, but in practice it is a new shoot from an old stem. It originates from the idea that paediatrics should broaden its outlook by giving attention to the child not only until 14 or 16 years of age, but also to his future health in adulthood.

Preventive measures must be adapted to the age-group concerned. The basic question: "What are normal levels by sex and age?" is still more difficult to answer for children than for adults since (a) the borderline between normal and raised values is smaller, (b) not much is known of the quantitative relationship between the levels of the risk factors in childhood and the implications in adulthood, and (c) the period between the start of prevention and the

TABLE 1. Survey of Westland schoolchildren 1973–1974 (from Uppal, 1974)

Device
Seeds of atherosclerosis are sown in the early years of life
Aim:
Dutch feasibility study and WHO pilot study, standardization of methods,
to get to know the risk profile around 10 years of age.

Population
2388 schoolchildren { 1214 boys / 1174 girls
Age 9–12 years, mean 10 years and 9 months
9 years: 15% 11 years: 37%
10 years: 45% 12 years: 3%
Region: horticultural region between two large cities (Rotterdam and The Hague)
Social class: lower and higher middle class

Methodology
Planning of protocol.
Consultation of family doctors and school health officers.
Instruction of parents, teachers and children.
Postal questionnaire to parents.
Training and evaluation of team members.
Standardization of (laboratory) methods.
Local arrangements.
Notification of results to parents and family doctors.

Results
Response rate: 97½%.
Venepuncture success rate: 98% of children examined.

Cholesterol
Huang method (9% higher than Abell–Kendall method)
In spring
Mean: boys 188 mg% (4·9 mmol/l)
girls 191 mg% (5·0 mmol/l)
Cut-off point: 220 mg% (mean+1 s.d.).

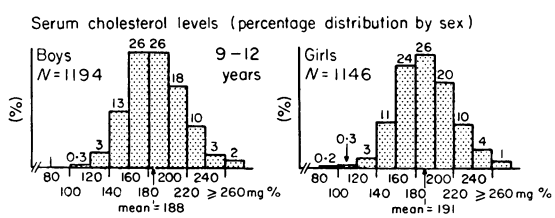
mg%	mmol/l	boys (%)	girls (%)
⩾200	5·2	33	36
⩾220	5·7	14	16
⩾240	6·2	4	6

Rescreening of 119 children (5%) whose serum cholesterol values exceeded 240 mg% at baseline screening.
In winter.
Cholesterol – triglycerides – paper electrophoresis.
21% of families (children) changed diet spontaneously without advice.

Cholesterol
40% remained above 240 mg% and 60% declined.
Mean declined from 261 to 235 mg% (s.d. 36).
(Regression towards the mean?)

Triglycerides
Method of Eggestein – fasting.
Mean boys 91 mg%, girls 108 mg%
⩾150 mg% 10%

Fredrickson typing
Normal 7% type 2A 25%
type 2B 17%
Borderline 50% type 4 1%

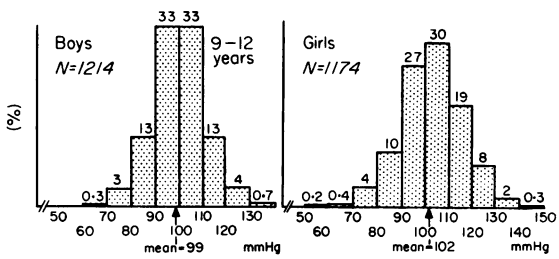


Blood pressure
Random zero sphygmomanometer
Mean: boys 99/56 mmHg } low compared with other
girls 102/56 mmHg } studies
Cut-off points: 110 and/or 70 mmHg (mean+1 s.d.)

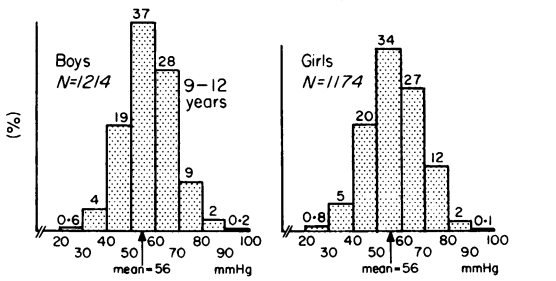
	mmHg	boys (%)	girls (%)
Systolic	⩾110	18	29
	⩾120	5	10
Diastolic	⩾70	11	14
	⩾80	2	2

Only 6 children above 140 and/or 90 mmHg.
No children with extreme hypertension.

Systolic blood pressure (percentage distribution by sex)



Diastolic II blood pressure (percentage distribution by sex)



Other risk factors
Smoking of cigarettes according to parents (underestimated):
Boys and girls: 2%.
Unknown: 3%.
Physical activity: 6% mildly active.
Obesity (triceps skin-fold and weight for height): 2½–5%
Diabetes – urine not examined.
Plasma glucose levels: nearly 0·5% of 2300 children above 220 mg% (one hour after 50 g glucose *per os*).
Re-examination (GTT) of these nine children: not a single child with a diabetic curve.

International comparison
Blood pressure and cholesterol values
Chaos as regards protocol, methodology, and standardization.
With these restrictions: compared with international data
(1) blood pressure low,
(2) cholesterol high,
(3) obesity middle scale.

Implications
International and national co-operative studies (under the auspices of WHO) in children admit of no delay.
Meanwhile primary prevention of CHD (in childhood) should be propagandized.

outbreak of CHD is 50 years or more, against half of that time-span in adults, which makes evaluation of preventive measures rather complicated.

What are normal or optimal values of serum cholesterol and other risk factors such as triglycerides, plasma glucose, systolic and diastolic blood pressure, height/weight ratio, skin fold thickness, etc. in children by sex and age?

While in some countries we know a great deal about averages and means by sex, age, region, and socio-cultural class, most data are not suitable for international comparison, as standardization of methods is still poor. The nutrition pattern and ECG are generally not studied in surveys in children. Results of studies as far as available, have been differentiated by chronological age, neglecting the fact that for these age groups biological age is more important.

Against the background of these views we will look back at the results of our feasibility study of CHD risk factors in schoolchildren in Westland, a horticultural region between Rotterdam and The Hague. The study was carried out by Dr Uppal, under the guidance of Professor Arntzenius of Leiden University and the present author, in 1973, and published as his M.D. thesis in 1974 (Uppal, 1974; Uppal, de Haas and Arntzenius, 1974).

The Westland study was a feasibility study. As such it was a success with nearly 100% response rate.

As far as international comparison is permitted, in the Westland study the average cholesterol level seems high, blood pressure low and obesity intermediate. As long as we do not know the optimal levels by sex and age, which are definitely lower than the averages in industrialized countries, the conclusion seems justified that in schoolchildren and probably also in pre-schoolchildren, elevated or borderline serum cholesterol is the most important risk factor for atherosclerosis. This is the more true as epidemiological and experimental studies suggest that hypertension accelerates atherogenesis only if hyperlipidaemia is present. A cumulative effect is also evident in cigarette smoking and hyperlipidaemia.

The first step to reach so-called 'normal' or optimal values should be to strive for values midway between the averages of poor and rich countries. At preschool age this amounts to a serum cholesterol level of about 140 mg% (3·6 mmol/l). At present nearly all Dutch schoolchildren show higher values.

Similar problems arise when in search for the optimal blood pressure in children. If in schoolchildren 105 mmHg systolic and 65 diastolic are chosen as cut-off points, these being the averages of the surveys in different industrialized countries, borderline or elevated values are rather common. What are normal and what are optimal blood pressure levels in schoolchildren, and is it possible to aim at lower values?

Medical logic suggests that the decrease of the high values of the two major risk factors of CHD – serum cholesterol and blood pressure – in childhood, if continued in adulthood, will lower the risk for premature CHD in later life and will do no harm at an early age. The mathematical proof cannot be given, as it is not possible to organize prospective studies during 50 years or more. In the practice of public health it is not always possible to wait for a 100% scientific confirmation.

As regards the third major risk factor, smoking, the message to schoolchildren and to their parents is clear: Stop if you are smoking; don't start if you are not.

Studies on risk factors of CHD in children in different countries have to be co-ordinated and integrated into existing child health services, using standardized methods to make comparison of results possible, and trying to get to know optimal values. Not only does one need to gather more reliable data on risk factor levels at paediatric ages, but also one needs to find out (a) if the children who at one period appear to be in the higher part of the distribution curve of a variable, will again score high in the following years, (b) if the risk pattern in children is changing for the better under the influence of health education, and (c) if in children a cholesterol level under 140 mg% (3·6 mmol/l) is compatible with general good health. To reach this goal, the marriage of preventive cardiology and maternal and child health will stand no delay.

References

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