Studies of atherosclerosis determinants and precursors during childhood and adolescence*

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At a Meeting of Investigators on Epidemiological Studies of Atherosclerosis Determinants and Precursors, which was held in Geneva on 7–9 November 1983, representatives from 26 countries reviewed the current status of epidemiological studies in this area. Particular interest was shown in the following determinants of cardiovascular disease: blood pressure, blood lipid levels, body weight, pathological studies, and tobacco use. Working papers on each determinant were prepared, and recommendations were made on areas for research, and on the need for prevention programmes and pathological studies. This article summarizes the work of the meeting.

INTRODUCTION

The concept of atherosclerosis as a paediatric problem, which was first proposed more than 20 years ago (*1*), is based on two findings. Firstly, autopsy studies have shown that in populations aortic and coronary atherosclerosis start early in life. For example, the WHO Five Cities Study (*2*) demonstrated that in certain European countries about 10% of boys and girls aged 10–11 years already had atherosclerotic plaques in their coronary arteries. Secondly, cross-sectional and prospective studies have identified a number of largely environmental factors

related to the development of clinically manifest coronary heart disease. It is likely that these factors, when present in young children, often continue into adult life, thus both promoting the formation of early morphological lesions in the child and acting as precursors of clinical coronary heart disease in later life. In view of the overwhelming public health importance of coronary heart disease, the study and, prevention of the childhood precursors of clinical coronary heart disease is of major importance (*3*).

The WHO descriptive study on atherosclerosis precursors in children

In 1974, the WHO Collaborative Study of Atherosclerosis Precursors in Children was initiated, and a protocol for data collection established.[a] This was followed in 1977[b] by a meeting which reported that studies of atherosclerosis and hypertension pre-

cursors had begun in various parts of the world. The WHO protocol was then offered to various research institutions to promote consistency of reporting and to stimulate international cooperation. A working group of investigators of atherosclerosis precursors met in 1979[c] and recommended widespread adoption of standard (or at least comparable) research methods. Permanent collaboration between workers using the WHO protocol and enhanced efforts to exchange scientific information on a worldwide basis, were also proposed.

Between 1977 and 1982 requests for the WHO protocol were received from 145 different institutions and researchers. In April 1983 a questionnaire was sent to those who had received the protocol, and responses indicated that 45 studies had used either the methods described therein or comparable methodology. Twenty-eight of these studies were conducted in Europe. Altogether, approximately 92 000 children and adolescents were surveyed, roughly 53 300 of them by studies that followed the WHO protocol. Subjects ranged in age from infants to those in their twenties, the majority being 6–16 years old.

Since 1974, between four and ten studies on precursors of atherosclerosis have been initiated each year, and, of these, 56 included a longitudinal follow-up of the study cohorts or planned to do so, while 27 reported that a more or less systematic intervention was included. Three studies were designed to assess the feasibility of intervention.

The WHO Meeting of Investigators on Epidemiological Studies of Atherosclerosis Determinants and Precursors in 1983 reviewed the status of epidemiological studies of atherosclerosis determinants and precursors in youth, including the results of risk factor intervention studies. Further topics discussed included epidemiological and statistical methodology, comparison of results, and the need for further studies, especially longitudinal investigations of previously studied populations. As shown in Table 1, 36 studies from 26 countries were discussed at the meeting. The factors most frequently investigated were blood pressure, concentration of serum cholesterol and other lipids, body weight, height, smoking habits, and physical activity.

The WHO Intervention Study

In 1978, the WHO Regional Office for Europe initiated the Health Promotion in Youth — International Cooperative Project. A common protocol specified a two-year multifactorial intervention for children in two or more schools. Baseline and two-year follow-up surveys of these children and of control children in matched reference schools were carried out. The aims of the study were to obtain epidemiological information about established risk factors for major noncommunicable diseases as well as related behavioural and environmental factors among youth; to develop comprehensive educational intervention programmes to cover these risk factors and evaluate the feasibility of implementing them in schools; and to test the effectiveness of the interventions to reduce and prevent development of risk factors for cardiovascular diseases.

By 1982, three studies had been completed: the North Karelia Youth Project, in Finland (4–6); the Oslo Youth Study, in Norway (7–9); and the Intervention Study in School Children in Zwickau, German Democratic Republic.[d] All three studies reported successful implementation of the intervention programmes and data collection in the schools. In North Karelia and Oslo the intervention groups had lower smoking onset rates than the controls. Some favourable influence on eating habits was observed, and in Oslo the intervention group had a smaller increase in consumption of alcoholic beverages and a larger increase in exercise frequency compared to controls. In Oslo and in Zwickau the intervention group showed a net reduction in body weight relative to the controls. Only in Zwickau was there a reduction in blood pressure levels in the intervention group, but all three studies observed some favourable changes in blood lipid levels.

Other studies

A considerable number of other studies have used methods similar to the WHO atherosclerosis precursors study, and in many respects the results obtained are comparable. Examples of such studies in the USA are the Bogalusa Heart Study (10), the Muscatine Study, and a study in Minnesota (11); the Zoetermeer (12) and Zutphen (13) studies in the Netherlands; as well as studies participating in the International "Know Your Body Program" (14).

SPECIFIC ISSUES CONCERNING RESEARCH AND PROGRAMME DESIGN

Ethnic factors

The extent to which genetic and environmental factors interact to account for similarities and differences in the levels of risk factors among different ethnic groups in the same environment has

Table 1. Parameters surveyed in the studies discussed at the meeting

Country: study location	Weight	Height	Body mass index	Skinfold Triceps	Skinfold Subscapular	Total cholesterol	HDL cholesterol	TG[a]	Sexual maturity	Systolic blood pressure	D4[b]	D5	Cigarette smoking	Alcohol intake	Physical activity	Eating habits	Data from parents
Australia: Adelaide	X	X	X	X	X	X	X	X		X	X				X		
Newcastle	X	X		X	X	X	X	X			X				X		X
German Democratic Republic: Zwickau	X	X	X		X	X									X		X
USA: Bogalusa	X	X	X	X		X	X	X	X	X			X	X	X	X	X
New York	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X
Muscatine	X	X	X	X		X		X		X	X	X					X
Finland: Multicentre	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
North Karelia	X	X	X	X		X	X		X	X	X		X	X	X	X	X
Cuba: Havana	X	X	X	X		X		X	X	X	X		X				
Havana	X	X								X			X				
Canada: Newfoundland	X	X	X	X		X	X	X	X	X	X		X		X	X	X
Norway: Oslo	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X
Czechoslovakia: Prague	X	X	X	X	X	X	X	X	X	X					X	X	X
Israel: Jerusalem	X	X	X			X	X	X		X		X	X		X		X
Tel Aviv	X	X	X			X	X			X		X	X		X		X
Switzerland: Geneva	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Italy: Cittadella	X	X	X	X	X	X	X	X		X	X				X		X
Modena	X	X	X	X	X	X		X	X	X	X		X		X		X
Naples	X	X	X	X		X	X		X	X			X		X		X
United Kingdom: Southampton	X	X	X		X	X	X	X		X			X	X	X	X	
Japan: Shizuoka	X	X				X									X		X
Federal Republic of Germany: Düsseldorf	X	X	X	X		X	X	X		X	X		X		X		X
Philippines: Metro Manila	X	X	X		X	X	X		X	X	X	X	X		X		X
Argentina: Buenos Aires	X	X	X			X	X	X		X	X	X	X	X	X		X
France: Nancy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
USSR: Moscow	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X
Kaunas	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X
Netherlands: Epoz	X	X	X	X		X	X		X	X	X	X	X	X	X		X
Wageningen	X	X	X	X		X	X				X					X	
Belgium: Liège	X	X	X	X		X				X							X
Austria: Vienna	X	X				X				X							
Ghana: Accra	X	X	X	X	X	X	X			X					X	X	
Spain: Madrid	X	X				X		X		X	X		X		X	X	X
China						X		X		X						X	
Yugoslavia: Novi Sad										X							
Romania: Bucharest										X							

[a] TG = triglycerides.
[b] D4 and D5, respectively, are diastolic blood pressure phase 4 and 5.

been investigated. The Geneva Study of children of Swiss or Italian origin indicated a major environmental effect on risk factor levels,[e] while the Düsseldorf Study of German and Japanese children drew a similar conclusion (*15, 16*). In the Bogalusa Heart Study, clear differences in risk factor levels between black and white children were found (*10*). Conversely, persons of the same ethnic background living in different environments may show differences, suggesting a predominant environmental influence. This finding is also consistent with the results of studies conducted in China[f] and in regions of Finland (*17*) and Italy (*18, 19*).

Development and maturation

The influence of biological development and sexual maturation on the level of risk factors and their change with age is important. The levels and rate of change of risk factors during childhood and youth are not only dependent on chronological age but on the rate of growth (developmental age) and/or stage of sexual development (*20–22*). Thus, assessment of the significance of a given biological risk factor must take development and maturation into account, since it is likely that these variables influence not only individual risk factor levels in the same population but contribute to inter-population differences. Apart from the effect of growth and maturation on age-specific risk factor levels, chronological age has independent significance (*20, 21*).

Sociocultural and behavioural issues

Sociocultural and behavioural influences contribute decisively to the determination of risk factor distributions in populations. These include individual living habits: for example, eating, exercising, sleeping, cigarette smoking, and alcohol consumption; the prevailing social and behavioural norm; economic circumstances; availability of and access to health care services; administrative attitudes and practices at the local and national levels of government; the influence of the media and advertising; working conditions; leisure-time opportunities; and factors leading to or protecting against emotional stresses and strains. All these aspects need to be further studied to examine the potential for preventive action.

BLOOD PRESSURE

Arterial hypertension is a major health risk in virtually all populations of the world. Although high blood pressure can be successfully controlled, to some extent, by medication, the ultimate goal in general and for WHO programmes is its primary prevention (*23, 24*).

Synopsis of results

Of the 27 studies discussed during the meeting, 16 reported mean blood pressures by age and sex; most of these were performed in accordance with the WHO protocol. There was wide variation among the mean blood pressures of the different study populations.

Up to 10 years of age, there were essentially no differences in the blood pressure levels of males and females; however, in those between 10 and 20 years the systolic blood pressure increased more in boys than in girls. The rate of increase of diastolic blood pressure was similar for both sexes, though by 20 years of age significant differences were observed in this respect in all populations.

For both sexes there was an accelerated rate of blood pressure increase at puberty. Clearly, changes occurring during sexual maturation are important, but the contribution of pubescent acceleration of body growth and the direct effects of hormonal and dietary changes have not yet been fully assessed.

The wide range of blood pressure levels recorded in the different studies may partly be a reflection of methodological differences, but the consistency of age and sex differences indicates that genetic and environmental influences have important effects on blood pressure change.

Implications for prevention of elevated blood pressure

Since the value of blood pressure levels in childhood for predicting levels in later life is not clear, childhood levels cannot be used to detect future hypertensives. This underscores a need for further research directed towards early detection of future hypertensives, and suggests that emphasis should be placed on studies of the possibility of preventing increase in blood pressure in the whole population of young people.

Elevation of blood pressure with age during childhood is the result of interaction between genetic and environmental factors. Of the environmental factors that have been implicated, the following may have potential as intervention foci for primary prevention of this elevation: body weight, sodium and fat intake, and level of physical activity.

Conclusions and recommendations

To facilitate comparing the results of various studies of blood pressure in children and adolescents,

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[e] MASIRONI, R. & ROY, L. *Cigarette smoking in young age groups. Geographic prevalence.* Unpublished document (WHO/SMO/82.3).

[f] See footnote *d* on p. 596.

more detailed measuring guidelines should be developed (24). Data on blood pressure in childhood should include the following information: device used to make the measurement, cuff-size, arm on which the reading was made, definition of diastolic blood pressure used, patient's position, period of rest before making the measurement, room temperature, season, time of day, and number of readings on which the results are based.

Further comparative analyses may be useful to better differentiate genetic and environmental influences. There is a need to study more diverse populations, particularly those with no or a low prevalence as well as those with a high prevalence of hypertension in adult life. Although screening of large populations of children for high blood pressure is not recommended at this time, routine measurement of blood pressure in children as part of school health care and by general practitioners and paediatricians should be encouraged.

Intervention studies on the effect on blood pressure of prevention of obesity, restriction of sodium intake, and physical activity are recommended before major public health actions are implemented. The putative role on blood pressure in childhood of dietary fat and fibre, alcohol consumption, intake of trace elements and minerals, as well as psychosocial factors needs further investigation.

BLOOD LIPIDS AND LIPOPROTEINS

The level of blood lipids and lipoproteins is a predictor of atherosclerosis and coronary artery disease. Since the onset of atherosclerosis is generally held to begin in childhood (3), the levels of serum lipids and lipoproteins are likely to be major predictors of its early development.

Synopsis of results

The most dramatic changes in the level of serum lipids and lipoproteins occur in the first year of life. Serum total cholesterol begins rising shortly after birth from 1.5–1.8 to 2.7 mmol/l at 24–48 hours after birth. By 6 months the concentration in the Bogalusa Heart Study increased to 3.5 mmol/l, and by 1 year values of 3.8 mmol/l were reported (10).

The concentrations of both total cholesterol and high-density lipoprotein (HDL) cholesterol are low in populations in developing countries, intermediate in Mediterranean countries, and high in countries of northern Europe and North America. This is illustrated by the levels measured in 7–8-year-old boys from 16 countries (25). In this study, samples were collected and analyses were carried out under standardized conditions. Similar results were obtained in a subsequent study performed in five countries (26); in most instances the ratio of HDL-cholesterol to total cholesterol for children aged 7–9 years was 0.30–0.32, although in the Philippines values between 0.24 and 0.27 were reported.[g]

The total cholesterol and HDL-cholesterol concentrations reported from Canada[g] and Israel[g] were similar to those for Western Europe and North America. The ratio of HDL-cholesterol to total cholesterol for Argentina was relatively low[g] and was approximately the same as that for the Philippines. In comparison, the ratios reported from Japan[g] and China (27) were relatively high (0.34–0.50). The effect of non-genetic factors, especially diet, on total serum cholesterol and HDL-cholesterol levels is clearly shown in studies on Japanese children living in Düsseldorf in the Federal Republic of Germany, whose lipid profiles are similar to their native-born German counterparts (16).

There have been several cross-sectional studies and a few incomplete longitudinal studies of the changes in lipoprotein lipids during puberty (4, 5, 20–22). Although data are incomplete, the results so far indicate a relationship with other biological changes occurring at this age.

When data are pooled, the general trend is for total serum cholesterol levels to increase slightly during childhood until the age of 9–10 years. The reported mean values vary from 3 to 5 mmol/l, the highest levels being from northern industrialized countries; the differences are attributed mainly to dietary factors. At the onset of puberty, which generally occurs after the age of 10 years, the serum total cholesterol and HDL-cholesterol levels decrease both in boys and in girls, the decrease in HDL-cholesterol levels being more marked and more permanent in boys than in girls. Total serum triglyceride levels are relatively low in childhood, the mean values being less than 1.0 mmol/l. However, above the age of 10 years the levels begin to rise, first in girls and then in boys, but the values reached after puberty are higher in boys than in girls (20–22).

Data from a number of countries show that at the age of 18 years and above, the level of total HDL-cholesterol is slightly higher in females than males. Serum total cholesterol levels in 18-year-olds vary widely in different countries, and for triglycerides there are no consistent global differences in levels between the sexes among 18-year-olds.

Implications for prevention

Although the "ideal" and optimum levels of serum lipids and lipoproteins are still subjects of debate, there is clear evidence that the populations of

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[g] See footnote d on p. 596.

industrialized countries run a higher risk for the development of, or an earlier onset of, atherosclerosis and its consequences. The development of atherosclerosis is influenced, to a large extent, by a high level of blood lipoproteins and lipids from early infancy, and this has prompted recommendations to modify on a community basis those life-style factors (including diet) that are known to increase serum cholesterol levels. WHO guidelines on recommended changes in dietary habits have appeared previously (3).

Conclusions and recommendations

Methods for the determination of serum cholesterol that involve variations of the Liebermann-Burchard reaction produce the most reliable results. However, since enzymatic methods offer advantages over the use of the Liebermann-Burchard reagent, their use is recommended where appropriate.

Concentrations of total cholesterol and of HDL-cholesterol can be obtained reliably using non-fasting serum samples. For triglycerides, however, analyses should be performed on fasting serum samples. Venous blood samples should normally be used, but capillary blood has advantages for studies on neonates, infants, or young children. Analysis of lipids and lipoproteins in capillary serum are precise and reproducible; however, the concentration of these substances is approximately 9% lower in capillary than in venous blood serum.

The concentration of serum lipids and lipoproteins may be subject to both diurnal and seasonal variations (28–30). Accordingly, multiple observations of these lipid values are required if "true" values of lipid levels for individuals are required (31).

BODY WEIGHT

Obesity is recognized as a predisposing factor for cardiovascular disease, particularly via its role in the development of other risk factors, such as elevated blood pressure, glucose intolerance, and high levels of blood lipids.

Synopsis of results

Interpopulation comparison of age-specific values of body weight, height, and body mass index (weight/height^2) indicates similar results for Caucasoids, and these parameters increase with age for both sexes. For boys, the greatest heights at 15 years of age were recorded in Iowa City, USA,[h] and Zwickau, German Democratic Republic; while at 12

years of age the lowest heights were reported in Mar del Plata, Argentina.[h] For both sexes, the prevalence of obesity found by various investigators varied between 3.7% and 32.8% in Caucasoid populations aged 5–15 years, but, because of the different definitions used in the studies, comparison of results is difficult.

Implications for prevention

Prevention of obesity is desirable, and children and adolescents defined as obese by any criterion should follow educational and hygiene programmes aimed at reducing body weight or preventing a further increase in body fat.

Conclusions and recommendations

There is no ideal value for body mass that can be used globally. However, since the WHO protocol suggests the use of body mass index (kg/m^2), it is recommended that this be used to report data on children and adolescents until a better factor is available for evaluating body mass (body fatness). Further research should be aimed at establishing proper indices for body mass to improve the definition of obesity in children and adolescents, and to ensure comparability between studies. Based on an evaluation of the data for children aged 6–15 years presented at the meeting, it was agreed that the following cut-off points for body mass index are useful broad guidelines for defining obesity in both sexes:

— 14 years and younger: 19–20 kg/m^2
— 15 years: 25 kg/m^2
— 16 years and older: 28 kg/m^2

Nevertheless, population-specific cut-off points based on national data should be produced.

PATHOLOGICAL STUDIES

The need for further investigation of the geographical distribution of atherosclerotic lesions during the first decades of life was stressed in the report of the 1974 WHO meeting on atherosclerosis.[i] Collection of autopsy material in countries where examinations of schoolchildren and young adults are carried out would have many advantages, especially for correlation between risk factor levels and the extent of lesions.

Methodology

The most suitable post-mortem specimens for collection are the thoracic and abdominal aorta and

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[h] See footnote d on p. 596.

[i] See footnote a on p. 595.

the coronary arteries (preferably all three, but at least the left anterior descending and/or the right coronary artery). The aortic samples should preferably be in one piece. All arterial specimens should be cleaned from adventitious fat, flattened on cardboard, and fixed in neutral formalin for at least 24 hours. They should then be placed in a transparent plastic bag with an identification number and made ready for shipment to a central laboratory for further preparation and evaluation (32).

Conclusions and recommendations

An international pathological study of arterial specimens, mainly aorta and coronary arteries, obtained at autopsy from subjects aged between 5 and 30 years in different sociocultural and environmental settings is being supported by the International Society and Federation of Cardiology. A protocol has been prepared which is available on request,[j] and WHO is now in the process of identifying potential participating centres.

TOBACCO USE

The harmful consequences of cigarette smoking have been clearly recognized by WHO (33, 34), and the rationale for preventing the onset of smoking in adolescents is well established.

Synopsis of results

The prevalence of cigarette smoking among young people in different regions has been previously reported by WHO.[k] At the present meeting, 14 studies reported on cigarette smoking. Comparison of results from these studies is difficult, because of the different definitions of smokers used, e.g., number of cigarettes smoked per day, per week, etc., different age groups studied, the practice of combining several age groups for the analysis, and inconsistency of analysis strategy.

Most studies found that boys start experimenting with tobacco at an earlier age than girls. By adolescence, however, girls smoked more than boys in Canada,[j] Norway (7, 9), Switzerland,[j] and in the USA.[j] This was not the case in Cuba,[j] Finland (6), Italy,[j] the German Democratic Republic,[j] or the USSR.[j] The highest prevalence of smoking was reported for 16-year-old males in the USSR, with 47% smoking at least three cigarettes per week. Approximately 40% of 16-year-old females in Bogalusa, USA,[j] and in Oslo, Norway, reported that they smoked cigarettes.

Implications for prevention

The results of the studies reported here, as well as others, indicate that cigarette smoking remains a health problem of youth. Many antismoking programmes in the past have concentrated on providing education about the health hazards of smoking. These campaigns, however, have usually had little or no effect on adolescent smoking habits. Recent research on smoking prevention based on psychosocial models has produced more promising results, indicating that smoking onset rates can be significantly reduced by school-based smoking prevention programmes during early adolescence (35). Although the underlying mechanisms for the onset of smoking are not well understood, models attempting to explain why young people start to experiment with cigarettes are now being developed.[l]

Methodology

Self-reporting is an acceptable method for determining the level of cigarette smoking, especially when subjects are previously informed that their answers can be corroborated by biochemical indicators, such as carbon monoxide levels in expired air or thiocyanate and cotinine levels in saliva and serum, respectively (36). Validation of self-reports is especially important if they are used in the evaluation of intervention programmes.

Conclusions and recommendations

An inter-population comparison of cigarette smoking habits should be carried out using data from studies that have followed the WHO protocol on atherosclerosis precursors.[m] More information is needed on factors that influence the onset of smoking in different cultures. Although in industrialized countries the smoking behaviour of peers and parents has considerable influence on children's smoking habits, this needs to be investigated in other cultures. Research should be intensified on defining what types of programme strategies are most appropriate for various population subgroups, including those in high-risk environments and low socioeconomic and ethnic groups.

Since programmes based on psychosocial models seem to be the most effective, the meeting recommended that this approach be included in smoking prevention programmes. However, because this has been demonstrated only under controlled situations,

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[j] See footnote d on p. 596.
[k] See footnote b on p. 595.

[l] MITTELMARK, M. B. ET AL. Adolescent smoking transition states over two years. Paper presented at the *American Psychological Association Meeting, California, USA, August 1983.*
[m] See footnotes a and b on p. 595, and c on p. 596.

large-scale projects are needed to investigate how such programmes can be implemented.

THE NEED FOR PREVENTION PROGRAMMES

The need for programmes aimed at children and adolescents to lower their risk of cardiovascular diseases later in life has been stressed by WHO (3, 23). This was prompted by evidence of the early onset of cardiovascular disease and of the adoption of habits leading to elevated risk characteristics, as well as by the fact that unhealthy habits are probably easier to avoid than to abandon.

Synopsis of earlier research

So far, there are only a few intervention studies in children from which results are available. In Europe, these are the WHO (EURO) coordinated studies in Finland (5, 6), the German Democratic Republic,[n] and Norway (8, 9). Other studies have been reported from Australia (38) and the USA.[n] These studies demonstrate that it is possible to favourably influence health behaviour and risk factors of youth; however, the degree to which these encouraging results are generalizable has yet to be fully determined.

Ethical considerations

The participants at the meeting concluded that promotion of healthy life-styles among children is ethical and safe. The main approach has been to advocate health promotion life-styles that would prevent cardiovascular risk among all children. However, the results of several intervention studies indicate that, along with the teaching of healthy life-styles, children can be informed, without obvious adverse psychological consequences, about their behavioural and biological risk factor status (5, 9, 37). In the Finnish study (5), self-reported psycho-somatic symptoms of the children were found to be lower after the two-year intervention, and in a study in the USA no increase in anxiety was found after risk factor screening and health education (37).

Intervention strategies and settings

The theoretical basis of major approaches to prevention of cardiovascular diseases in youth should be elaborated. This calls for strong cooperation between medical and social and behavioural sciences. Much of the earlier work was based on teaching health knowledge; however, more emphasis should be put on teaching practical skills, on providing social

[n] See footnote d on p. 596.

support, and on promoting environmental changes (e.g., production and marketing of healthier foods, smoking regulations and policies, and sports facilities).

Because behaviour related to risk factors is closely associated with everyday living and with the social and physical environment of a child, intervention programmes should involve not only individual children, but also schools, homes, and the entire community. Interventions should initially consist of comprehensive programmes for creating and supporting positive forms of health behaviour and also focus on reducing already elevated risk factors. In addition, programmes should pay special attention to characteristics of target populations, emphasize positive health education methods, and promote initiatives and participation by the children themselves.

Conclusions and recommendations

The need to prevent cardiovascular disease risk factors in childhood and adolescence is urgent. The main task is to promote in youth life-styles that prevent the development of risk factors and promote health in general. More intervention programmes with strong evaluation components are needed to test the feasibility and effects of various preventive measures.

There is a need for standardized, repeatable, and valid measurement tools of health behaviour in children. While cardiovascular disease outcomes cannot be measured in children's studies, attempts should be made to assess general health-behaviour outcomes (positive or negative).

It was recommended that reference groups should be included in all intervention studies. Inclusion of reference groups is ethically acceptable provided they are not deprived of treatment considered efficacious by present scientific and medical knowledge.

Further to promoting international cooperation in intervention studies in childhood and adolescence, it was suggested that particular attention should be given to the following:

— standardization of endpoints and measurements of variables;
— exchange of information between the centres involved in these types of studies;
— coordination within and between different WHO regions;
— coordination between cardiovascular studies in youth and other WHO programmes.

The meeting recommended that health promotion and prevention of risk factors in youth should be an essential part of the intensified programme for the prevention of cardiovascular diseases.

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RÉSUMÉ

ÉPIDÉMIOLOGIE DES DÉTERMINANTS ET DES PRÉCURSEURS DE L'ATHÉROSCLÉROSE AU COURS DE L'ENFANCE ET DE L'ADOLESCENCE

Une réunion sur l'étude épidémiologique des déterminants et des précurseurs de l'athérosclérose s'est tenue à Genève en novembre 1983. Son objectif principal était d'analyser les études épidémiologiques sur les déterminants et les précurseurs de l'athérosclérose chez l'enfant et l'adolescent, notamment les études d'intervention sur les facteurs de risque. Trente-six études provenant de 26 pays ont été examinées, les facteurs les plus fréquemment étudiés étant la tension artérielle, les taux sériques de cholestérol et d'autres lipides, le poids, la taille, l'usage du tabac et l'exercice physique. Trois pays (la Finlande, la République démocratique allemande et la Norvège) avaient utilisé avec succès le protocole d'intervention de l'OMS (EURO), et certains effets bénéfiques ont été observés dans les groupes étudiés.

Les participants à la réunion ont recommandé d'étudier tout particulièrement chez les enfants et les adolescents les questions suivantes: développement et maturation, c'est-à-dire l'influence du développement biologique et de la maturation sexuelle sur l'ampleur des facteurs de risque, et leurs modifications avec le temps; les facteurs ethniques, c'est-à-dire dans quelle mesure les facteurs génétiques et environnementaux interagissent et rendent compte des similitudes et des différences observées dans l'ampleur des facteurs de risque chez différents groupes ethniques vivant dans le même environnement, ou chez des personnes d'une même origine ethnique vivant dans des environnements différents; et enfin, les influences socio-culturelles et comportementales sur la distribution des facteurs de risque dans les populations, c'est-à-dire les habitudes individuelles, les normes sociales et comportementales, les conditions économiques, l'existence et l'accessibilité de services de santé, ainsi que les possibilités de loisirs.

Les participants à la réunion ont formulé des recommandations sur la normalisation des méthodes d'enregistrement et de notification des mesures de la tension artérielle, de la lipidémie, du poids, du tabagisme, des résultats d'études pathologiques, et sur la nécessité de prévenir les maladies cardio-vasculaires. Ils ont également préconisé l'élaboration de directives plus précises pour la mesure de la tension artérielle afin de faciliter les comparaisons entre études, et souligné la nécessité d'une présentation plus uniforme des données. La cholestérolémie doit être de préférence analysée sur des échantillons de sang veineux par des méthodes enzymatiques. A l'exception des triglycérides, les lipides sériques peuvent être correctement analysés sur des échantillons non prélevés à jeun. Puisque les lipides et les lipoprotéines sériques peuvent être sujets à des variations diurnes et saisonnières, il peut s'avérer nécessaire d'effectuer des observations multiples. Pour évaluer la masse corporelle (ou corpuleuse), il est recommandé d'utiliser l'indice de masse corporelle (kg/m^2) pour notifier les données relatives aux enfants et aux adolescents.

L'OMS envisage d'étudier des échantillons de sang artériel, provenant principalement de l'aorte et des artères coronaires, prélevés lors d'autopsies de sujets âgés de 5 à 30 ans, suivant un protocole préparé par la Société et Fédération internationale de Cardiologie. Les participants ont également recommandé d'étudier dans différentes cultures les facteurs qui déterminent le tabagisme. Il faudrait intensifier les recherches sur les types de stratégies d'intervention les plus appropriés pour différents sous-groupes de population, notamment ceux vivant dans des environnements à haut risque et à faible développement socio-économique, et pour les différents groupes ethniques. Parce qu'il est urgent de s'employer à prévenir les facteurs de risque des maladies cardio-vasculaires au cours de l'enfance et de l'adolescence, les participants ont recommandé de faire une place essentielle à la promotion de la santé et à la prévention des facteurs de risque chez ces jeunes, dans le programme intensifié de prévention des maladies cardio-vasculaires de l'OMS.

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