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THE COMMUNITY-BASED STRATEGY TO PREVENT CORONARY HEART DISEASE: Conclusions from the Ten Years of the North Karelia Project

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INTRODUCTION

Cardiovascular Disease as a Public Health Problem

Cardiovascular diseases (CVD) are a major cause of mortality in the world, although great variability exists in the death rates in different regions of the world. In the developed countries approximately half of the deaths, nearly one third of the permanent disability, and a high proportion of health service utilization are due to CVD (65).

During the last hundred years the industrialized countries have shown a major change in public health: the impact of infectious diseases has been dramatically reduced owing to general social and hygienic or specific preventive and therapeutic measures. Chronic diseases, especially CVD, have emerged as the main new public health problem. Analysis of data from several industrialized countries shows that the greatest potential impact on longevity among the adult population is from control and prevention of CVD (16). Thus, new advances in public health are dependent on our achieving control of cardiovascular and related noncommunicable health problems.

The current high mortality and morbidity from CVD is not only a result of the aging of the population. In many developed countries, around 40% of all deaths in the middle-aged population are caused by CVD. About three fourths of these deaths are due to coronary heart disease (CHD), mainly acute myocardial infarction (AMI). Since the Second World War the mortality from CHD among middle-aged people increased considerably, making it one of the worst worldwide epidemics of all times.

There are considerable differences in CVD and CHD rates, even between the industrialized countries, as has been shown repeatedly with mortality statistics (e.g. 37, 38). According to the World Health Organization's (WHO) statistics in 1975, Finnish males had the highest CHD mortality rates in the world, followed by the USA, Australia, England, and Canada (Table 1).

The regional differences in the CVD mortality rates have been confirmed by the Seven Countries Study (25), which surveyed and followed middle-aged male population samples in different parts of the world, and by a WHO-coordinated AMI registration study (67). Both studies found the highest rates in Finland. Already in the 1950s, mortality statistics showed, and later the Seven Countries Study and the AMI register confirmed, that within Finland the CVD rates were higher in the east than in the west.

The impact of CVD and other noncommunicable diseases (NCD) in Finland on premature mortality is further illustrated by the observation that out of ten deaths in middle-age, about five are due to CVD, two to cancer, one to non-neoplastic respiratory disease, one to violent causes, and one to all other causes together. This situation is not very different in many other industrialized countries. According to the WHO-coordinated register study, in the beginning

Table 1 Age-standardized mortality rates from ischaemic heart disease per 100,000 population in 1975 (40–69 year age group)

Males		Females	
Finland	673	202	UK: Scotland
UK: Scotland	615	193	Israel
UK: Northern Ireland	614	189	UK:Northern Ireland
New Zealand	545	180	Australia
Australia	534	171	United States of America
United States of America	528	168	Ireland
Ireland	508	167	New Zealand
UK: England and Wales	498	143	Canada
Canada	473	142	Finland
Czechoslovakia	410	138	UK: England and Wales
Denmark	400	129	Czechoslovakia
Norway	398	125	Hungary
Israel	370	114	Denmark
Sweden	368	110	Bulgaria
Netherlands	363	102	Sweden
Hungary	328	89	Austria
Federal Rep. of Germany	325	87	Netherlands
Belgium	312	86	Norway
Austria	308	84	Belgium
Bulgaria	237	81	Federal Rep. of Germany
Poland	229	70	Yugoslavia
Italy	226	64	Romania
Switzerland	226	63	Italy
Yugoslavia	180	56	Poland
France	152	50	Switzerland
Romania	146	37	France
Japan	69	29	Japan

of the 1970s the annual incidence rate of AMI (per 1000 population) among the 40- to 59-year-old population was 18 in North Karelia (eastern Finland), 9 in Helsinki, 7 in Dublin, 6 in Perth (Australia), 5 in London, 4 in Heidelberg (West Germany), 3 in Prague, and 2 in Bukarest. Mortality statistics also showed that the lung cancer rates of Finnish men were high, and within Finland the rates in eastern Finland were the highest.

History and Organization of the North Karelia Project

These statistics raised the awareness and concern of the Finnish public. The people of North Karelia in eastern Finland, where the Seven Countries Study was initiated in the 1950s, were particularly concerned. The statistics showing the high disease rates confirmed the people's own observations. In the beginning of the 1970s, among the county's total population of 180,000, some 1000 myocardial infarctions took place annually, and about half of them were among

men below 65 years of age. About 40% of these cases were fatal. In 1972, among people aged 45–59 in North Karelia, 27% were pensioned due to disability, about one third of those because of CVD (45).

On January 12, 1971, the Governor, all North Karelian members of the national parliament, and representatives of many official and voluntary organizations in the area signed a petition for national aid to reduce the cardiovascular problem in North Karelia. The petition noted the very high frequency of CVD in the area and proposed that national authorities and organizations concerned "should urgently undertake efficient action to plan and implement a program which would reduce this greatest public health problem of the county." Simultaneously, related public health questions were discussed nationally. In 1972, a new Public Health Act reorganized primary health care, and the University of Kuopio (including a medical school) was started in eastern Finland.

In response to the North Karelian petition, a panel of Finnish experts, international experts provided by WHO, Finnish health authorities, and North Karelian representatives met to outline the scope of the work that was needed and to recommend further action, including the establishment of the Project organization.

Based on the recommendations, the North Karelia Project, a major community-based preventive cardiovascular study, was formulated and launched. From the very beginning, the project was to be a planned, action-oriented program with evaluative and other research. Simultaneously, the project would work in close collaboration with national health authorities and the WHO as a major pilot or demonstration project to test the usefulness of this approach for national and international purposes.

Almost concurrently with the Finnish project, an analogous study, the Stanford Three Community Study, was planned and launched in the USA (15). The two projects later developed mutually beneficial scientific exchanges, and the developments in Finland and in the USA pioneered the work in community-based prevention of CHD (see below).

After the initial organization of the North Karelia project had been established, the intervention program and its evaluation were planned. Since the importance of the baseline measurements were appreciated and the community was pressing for action, the initial work of the project team was to establish proper baseline measurements and disease surveillance methods for the evaluation. In doing so, the project used WHO and other international recommendations and established contacts with a number of Finnish experts and key North Karelian representatives.

Once the baseline survey was launched (spring 1972), the project team had more opportunity to plan the intervention activities. The project field office was established within the county health department, and local project advisory

boards were set up with participation from various community agencies. Numerous contacts were initiated for community organizing, initial awareness campaigns were launched, materials and action plans were developed, and local training activities were started.

North Karelia is the most eastern of the eleven Finnish counties. The area is 18.000 km^2 (nearly 300 km from south to north), with great forests, lakes, hills, small farms, small towns, and numerous small villages. The population was 180,000 in 1972, and the population density thus relatively low. The area can further be characterized, relative to other areas of Finland, as having low socioeconomic status, high unemployment, an income based on farming and forestry, and scarce medical and other services.

The North Karelia project was thus started in spring 1972 to carry out a planned, comprehensive community program in all of North Karelia for control of CVD, especially CHD, in respond to the petition of the population. The program was aimed at the county's total population, but with special reference to middle-aged men, whose disease rates were especially alarming. Evaluations were designed to assess the feasibility, effects, process of change, costs, and other consequences related to this program. The original project was set up to carry out this program and to evaluate it for a five-year period from 1972 to 1977. Because this experience was an encouraging one, it was decided to continue the program (45). In spring 1982 a major ten-year survey was carried out (44).

The aims of this report are (*a*) to describe the theoretical framework of the project, its intervention and evaluation; (*b*) to review and discuss the main results obtained so far; (*c*) to relate the North Karelia project to other studies that have been carried out or are underway in other parts of the world.

THE THEORETICAL FRAMEWORK

General Principles

The historical background of the project in North Karelia led the way to adoption of the community approach. Also, because CVD was a widespread health problem and its precursors were present in a major proportion of the population, a community-wide scale was necessary. Accordingly, the project principle was to approach these diseases in the entire community in a manner appropriate to any epidemic.

The community approach assumes that the magnitude and nature of the problem precludes a simple, externally initiated solution. Instead, the program has to be integrated with the existing social and health service structure of the community. Since the problem relates closely lifestyle, the population itself has to make the decision to organize itself to solve the problem, with the help of the project experts. A community program for control of CVD (and related noncar-

diovascular diseases) assumes that existing scientific knowledge can be applied to serve the population (or that the community can be helped by having better access to use of the existing knowledge).

Although continuous efforts for new medical and technological advances are still needed, it is obvious that major control of CVD and related diseases is possible with existing knowledge if it can be effectively applied in the population. Although a full consensus on causal links between health habits and disease are lacking—as it may always be—we have to act on the best currently available knowledge. This point is further reinforced by the magnitude of the problem and the realization that doing nothing is also a decision. A decision to await "final proof" cannot help the great number of people in our society who suffer premature death or major disability. In spite of the gaps in our knowledge, we understand few other noncommunicable diseases as well as we do CHD and stroke.

The history of public health is full of examples of successful actions that are not based on full knowledge of the pathogenesis and etiology of the disease concerned. Success has been often based on effective intervention on some parts of the causal chain that lead to the severe manifestations. Carefully evaluated community programs form an important link between basic laboratory and clinical research and the large-scale application of public health programs in society. These programs can thus diminish our uncertainty concerning the effectiveness of such action, inform us about effective use of the existing resources (service and other community resources), and tell us about other possible consequences associated with such interventions. Therefore, carrying out a carefully evaluated community program like the North Karelia Project serves not only its target area, but serves also as a "pilot," "demonstration," or "model" for testing the approach in wider applications.

The field nature of a community program denies the experimental control of many variables. The researcher is therefore not able to test specific epidemiological or behavioral hypotheses rigorously. Rather, a community study tests a complex yet practical program based on previous theory and of such a nature that it could be applied elsewhere, if the results demonstrate success. Thus the limited "internal validity" is compensated by greater "external validity" of the results, i.e. validity for use in real-life circumstances.

A key feature of the "demonstration" or "pilot" program is that the intervention is well conceived and implemented as a planned, systematic program. The program contents are determined by existing medical, epidemiological, behavioral, and social knowledge applied intelligently and adopted to the local community setting. Evaluation includes both continuous monitoring and formative evaluation to guide the program, and comprehensive summative evaluation to assess the overall results.

Figure 1 describes a model of the precursors and stages in the natural course

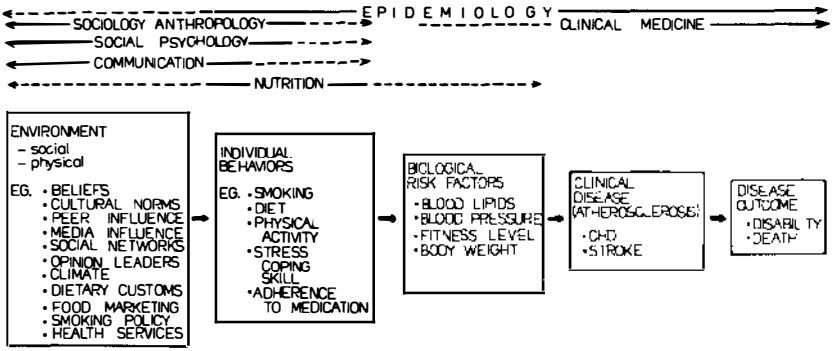

Figure 1 Precursors and sequence of factors leading to cardiovascular disease (coronary heart disease and stroke). The major disciplines needed for effective community-based research in cardiovascular disease (CVD) are listed above. The traditional scope of each discipline is given in the *solid portion of the line*. The *dotted portion of the line* depicts the less common extension of the particular discipline to broader aspects of the related components.

of developing cardiovascular disease. The disease outcomes are preceded by their environmental and behavioral origins through biological factors (modified by individuals' genetic predisposition) to clinical disease manifestations. A key feature of the community program is that it simultaneously applies *medical and epidemiological* knowledge to identify the health problems and to prioritize in selecting health objectives, and *behavioral and social* knowledge to design the actual program contents and activities. This implies an interdisciplinay approach both in planning and implementation and in the evaluative research.

The Medical and Epidemiological Framework

The petition and the historical background of the North Karelia Project guided the adoption of the main objectives. Accordingly, the program's main target was the major CVDs responsible for the greatest excess of premature mortality among that population, especially among men. It was realized that success would lead to achievement of broader public health aims, since (*a*) CVD alone was responsible for nearly two thirds of all deaths among the middle-aged population, and (*b*) reductions in the target risk factor would also probably have beneficial effect for some other NCD and for health in general.

The main medical goal, control of the CVD epidemic, implies all possible action to reduce the burden of the disease, including primary prevention, treatment, rehabilitation, and other secondary prevention and related research. However, major success in controlling a chronic disease can be based only on primary prevention, since intervention after the clinical stages have been reached will have only a limited impact. The greatest potential in control of

CVD thus lies in primary prevention: the "mass epidemic" should be tackled by "mass prevention."

A great deal was already known about the precursors and risk indicators for CHD when the North Karelia Project was originally petitioned. Research had proceeded from desriptive epidemiological studies on populations at high and low risk and from retrospective studies among CHD patients to prospective follow-up studies, the first major one being the Framingham study in the USA (7). A summary of the results of several other prospective studies initiated in the USA in the 1950s and the 1960s was published as the final report of the Pooling Project (39). Results from a major international prospective study, the Seven Country Study (25), were available. First results from the Swedish "Men born in 1913" study became available in the late 1960s (59). All these studies indicated that a few factors—notably smoking, elevated serum cholesterol, and elevated blood pressure—predict a major part of subsequent CHD risk, independent of other potential factor studied. Results from basic biochemical studies, as well as results from a few experimental and quasi-experimental studies on the different risk factors, have also long been available: for smoking cessation (8), for cholesterol-lowering diets (62), and for blood pressure treatment (63).

By the beginning of the 1970s these studies had already lead to a number of excellent reviews (e.g. 3, 11, 56, 57). Several expert groups had published recommendations for further studies or national applications of preventive activities. In 1970, a WHO expert group proposed that preventive trials should concentrate on combined intervention of smoking, hypertension, raised serum cholesterol level, and physical inactivity (64). In the same year the Report of the Inter-Society Commission for Heart Disease Resources (47) in the USA recommended that primary preventive efforts should be aimed at elimination of smoking, change of diet to reduce the serum cholesterol levels, and treatment to lower high blood pressure, with special emphasis on the combination of these risk factors.

As the likely major risk factors came to be identified and the multifactorial origin of the CHD became obvious, several centers started to plan multifactorial trials. A few trials with the classical design of randomizing individuals or groups to experimental and control groups were initiated in the beginning or during the 1970s. However, the problems involved with such trials soon became obvious; namely, the great number of people and many years needed to test the hypothesis, and the close link between risk factors and the community lifestyles and environment. An alternative approach, i.e. one involving an entire community to modify its risk factor profile in a planned and well-evaluated intervention, had obvious merits and was the choice of the North Karelia Project.

The choice of the main risk factors to be intervened upon was relatively easy. The international work had highlighted the obviously important role of smok-

ing, serum cholesterol (related to dietary habits), and blood pressure. It was already well known that the levels of these risk factors were high in the Finnish and especially in the North Karelian population. Furthermore, some other possible risk factors, like physical inactivity, obesity, or type A behavior, were not prevalent in the area.

The validity of the focus of the intervention was further supported by the results of a separate follow-up study in the North Karelia Project (53). A random population sample of some 3800 men initially aged 30 to 59 years and free of obvious CVD was followed for seven years. A multiple logistic function analysis showed that, in addition to age, smoking, serum cholesterol, and blood pressure were the strongest independent predictors of subsequent AMI. Out of a number of other variables included, only physical inactivity (negative) and self-reported alcohol consumption (positive) had some additional independent predictive power. It was also found that these factors were also good predictors of overall mortality.

Once the risk factors have been agreed upon in a program, choices still need to be made concerning the intervention strategy. The "high risk" (or "clinical" or "focused") approach attempts to identify those people with high risk factor levels and to intervene on these. The "community" (or "total population" or "public health") approach attempts to modify the general risk factor profile of the whole population.

Although an individual's risk of CHD increases with increasing risk factor levels (a fact of obvious relevance for clinical practice), it is critical to realize

Table 2 Standardized coefficients of variables predicting the risk of AMI and death in multiple logistic analysis and during a seven-year follow-up of 3811 men aged 30–59 years in 1972 and with no AMI, angina pectoris, or stroke at the outset

	Standardized coefficient	
Variable	AMI	Death
Age	.68[a]	.71[a]
Serum cholesterol	.42[a]	.22[a]
Smoking	.35[a]	.34[a]
Diastolic blood pressure	.25[a]	.23[b]
Physical inactivity (at work)	.19[b]	.24[b]
Alcohol use (self-reported)	−.17[a]	−.04
Educational level	−.06	−.26[a]
Familial history of CVD	.09	.00
Relative weight (BMI)	.07	−.16
Psychosocial stress	−.04	−.04
History of diabetes	−.03	.03

[a] = $p < .001$.
[b] = $p < .01$.
[c] = $p < .05$.

that high risk individuals produce only a small proportion of the disease cases that occur in the community. Many cases arise among people with only moderate elevations, but usually in several risk factors. Because the people with moderate risk outnumber the few really high risk individuals, and because the simultaneous occurrence of several risk factors has a synergistic impact, major reduction in the number of disease cases in the community can occur only if the general risk factor levels can be modified in this great majority—in practice, the whole population.

The clearly greater potential of the community approach compared with the high-risk approach in reducing the CHD rates in the community has been demonstrated by modeling the different approaches and using the data from the North Karelia Project (27). This point has also been well described by Rose using the Framingham data (50). The North Karelia Project results also show that lifestyle changes in the community are not well predicted by people's initial risk factor levels, hence further reducing the usefulness of the high-risk approach (53). Thus, from the epidemiological point of view, major reductions in the disease rates in the community can be achieved only by widespread reduction in the levels of the multiple risk factors. This implies community-

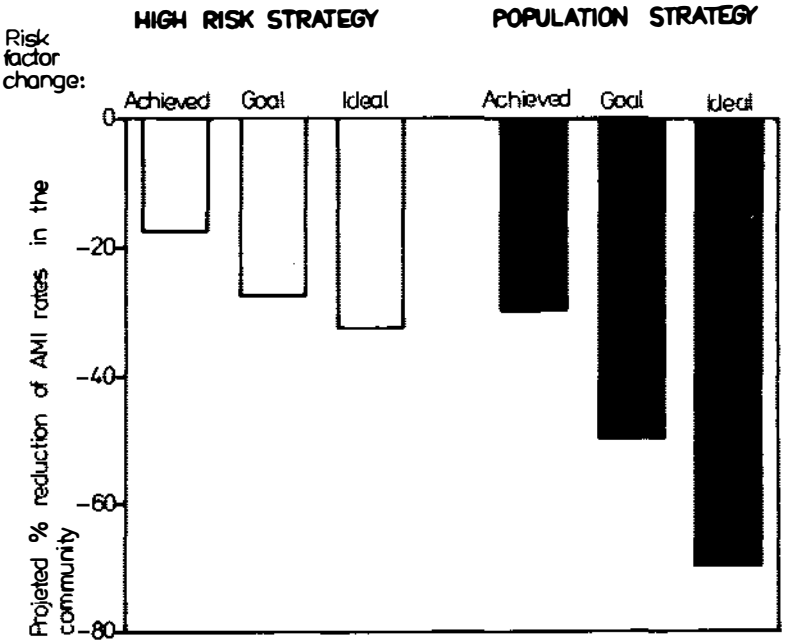

Figure 2 Projected effects of different prevention strategies on reduction of AMI rates in the community: North Karelia Project data. *Achieved* and *Goal* refer to experiences in recent studies (see Ref. 27).

wide effort to promote lifestyles that are likely to reduce the risk of CVD. Such lifestyle changes are also likely to be beneficial for prevention of several other NCD, to be safe and to promote health in general.

The Behavioral/Social Framework

Once the aim of the program has been defined to influence lifestyles and risk factor changes in the whole community, the task enters the realm of the behavioral and social sciences. Medical practice has long been based on the assumption that after identification of the behavioral agents leading to diseases, merely informing the subjects (giving them information) is enough to change the situation. Numerous studies and everyday practice show that this is seldom the case. Behavior is embedded in a complex way in the social and physical environment.

Here we cannot help making reference to the old wisdom of public health: Consider the totality of host, agent, and environment. Much of the work concerning prevention of chronic diseases has concentrated on the link between the agents (risk factors) and the host (man). But actually, many, if not most, of the great achievements in public health have involved major emphasis on the environment. This linkage to the environment applies to control of CVD and is a major rationale behind the community approach. The agents (behaviors/risk factors) of heart disease are largely determined by social forces and other environmental factors. Any major progress in influencing the disease rates has to deal with the environmental forces and structures. The natural, most effec-

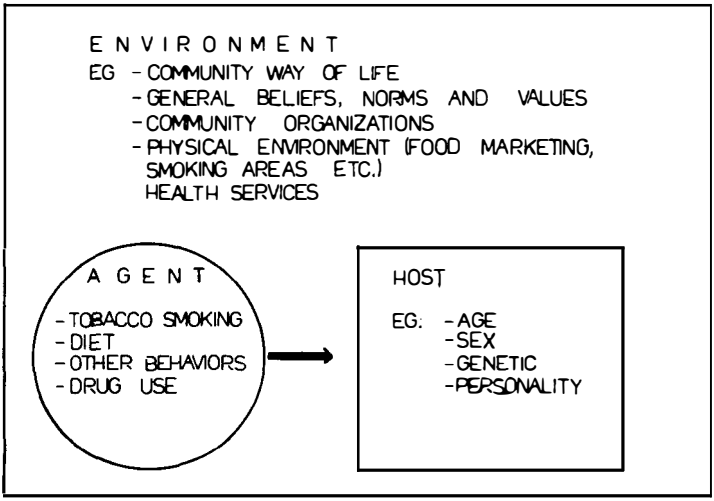

Figure 3 Classical epidemiological agent-host-environment model as applied to noncommunicable diseases.

tive way of changing a population's risk factor levels is to work through the community: the community should be the major target rather than its individuals.

The task of influencing people's behaviors and lifestyles is in the domain of social and behavioral sciences. Still, a major problem has been the lack of a unifying theory to serve as a guide. Program- and action-oriented people often feel frustrated by the inability of behavioral and social scientists to tell them what they should do. In spite of this we feel strongly that there are sound behavioral and social science principles to guide our way in planning, implementing, and evaluating community-based health programs. We refer to the old wisdom, "There is nothing so practical as good theory."

In the following we describe briefly four theoretical, somewhat overlapping, frameworks for behavioral change. Finally we present a model that unifies these approaches in a community-based health program.

THE BEHAVIOR CHANGE APPROACH This social psychological approach deals with the determinants of an individual's behavioral changes, and is based on Bandura's work on the process of learning. New behaviors tend to originate, at least on trial bases, from chance exposure to powerful models; external and self-enforcement and cognitive control are the consequent determinants of continued new behaviors (2). This approach also includes elements of the classical field theory of Lewin (29) and the behavioral intention model of Fishbein (17).

In a previous paper we presented a framework compatible with this approach, using examples from the various activities in North Karelia (32). The relevance of this approach in different cultural situations gets support from the recent work of Kar (23), who has shown that in different cultures the main factors predicting health behavior (e.g. contraceptive use) are intentions, social support from significant others, and accessibility of knowledge and services.

Our model emphasizes that program planning and evaluation should include the following key steps to help individuals to modify their behavior:

1. Improved preventive services to help people to identify their risk factors and to provide appropriate attention and services.
2. Information to educate people about the relationship between behaviors and their health.
3. Persuasion to motivate people and to promote the intentions to adopt the healthy action.
4. Training to increase the skills of self-management, environmental control, and necessary action.
5. Social support to help people to maintain the initial action.
6. Environmental change to create the opportunities for healthy actions and improve unfavorable conditions.

7. Community organization to mobilize the community for broad-ranged changes (through increased social support and environment modification) to support the adoption of the new lifestyles in the community.

Concerning persuasion, one of the key steps in the model, the North Karelia Project emphasized the credibility of the message source (WHO, government, academic expert opinion, health motives etc), various "affective" aspects (reference to the petition, "county pride," international interest, etc), and contents of the message that anticipated the counter-arguments and that matched with the local culture. As a whole, the aim was to inspire "community action for change" in which people would participate not necessarily for their own sake but for the sake of North Karelia and the Project that had become familiar and close to the people (thus emphasizing incentives other than those related to their long-term disease risk). An often used slogan was, "I am in the Project."

As in the Stanford "Three Community Study" (15), the North Karelia project placed great emphasis on various efforts to teach practical skills for change; for example, smoking cessation techniques and ways of buying and cooking healthier foods. In the latter regard, close cooperation with the local housewives' association (MARTTA association) proved most valuable. Various activities were carried out simultaneously to provide social support, to create better environmental possibilities (e.g. production and marketing of healthier foods), and ultimately to organize the community to better meet these needs.

THE COMMUNICATION-BEHAVIOR CHANGE APPROACH The task of introducing new behaviors in the community is basically achieved by communication: mass communication and interpersonal communication. A project communicates its messages through mass media to the population, in addition to its direct communication to various community leaders. In addition to Bandura's social learning theory (2), the classical communication-persuasion model of McGuire (33), its modification by Flay et al (18), and the belief-attitude-intention model of Ajzen & Fishbein (1) provide well-documented theoretical background for this approach.

The North Karelia Project has developed a model, especially in connection with the national TV health education programs of the project (42, 46), that recognizes the various steps of behavioral change, from exposure and attention, through comprehension and persuasion, to action and maintainance of new behaviors. Furthermore, the model takes into account the factors that relate to the communicated message on one hand and to the community-related factors on the other hand that influence the various steps of behavioral change (see figure). By carefully observing these aspects in the planning of the message and by paying attention or even trying to influence these factors in the community (e.g. increased social interaction) accordingly, the likelihood of positive results increases.

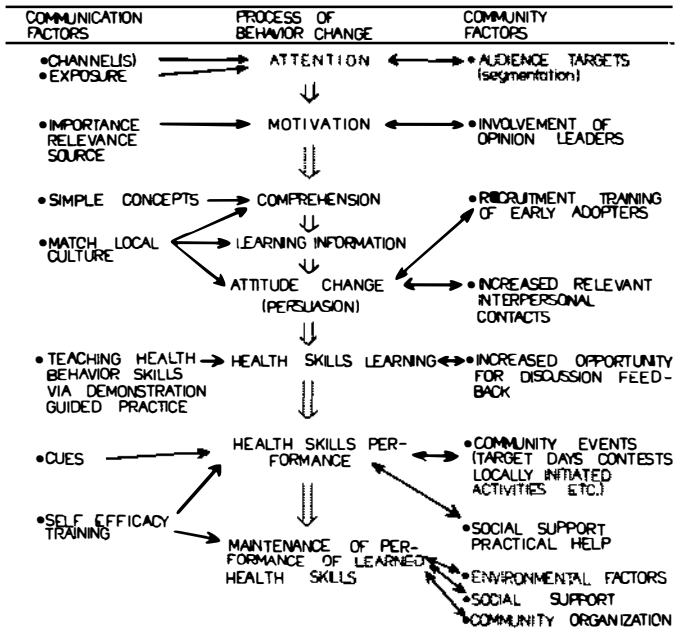

Figure 4 Model of the communication process in community intervention to induce behavioral change, as used in the North Karelia Project.

The task of influencing behavior through mass communication is extremely difficult due to the complex process involved. The danger is that with many, often conflicting, communication messages, people basically tend to maintain their well established habits. However, with the several TV programs of the North

observed. For example, a national survey two to three months after the start of the 1982 TV series showed that approximately 25% of the population had seen at least two sessions and that 1–2% of the smokers in the population reported having stopped smoking with the program and approximately 5% of the population reported actual dietary changes (42). These rates represent considerably high absolute numbers. Compared with other possible methods, TV coverage has proven to be a cost-effective and certainly a useful element in the overall program. Detailed descriptions of this type of planned use of the mass media are published, both in regard to the Finnish TV programs (40, 42, 46) and the programs of the Stanford Three Community Study (31).

THE INNOVATION-DIFFUSION APPROACH New lifestyles are innovations that diffuse with time through the natural networks of the community to the members of the given social system. This diffusion, causing social change,

occurs through communication over time. The innovation-diffusion theory argues that mass media are more effective in creating knowledge of innovations and are useful for "agenda-setting" purposes, while interpersonal channels are more effective in actually changing attitudes and behaviors. The innovation process occurs in four stages (note the similarity to the previous approach): (*a*) knowledge, (*b*) persuasion, (*c*) decision, and (*d*) confirmation.

The innovation-diffusion theory classifies people on the basis of their innovativeness as innovators, early adopters, early majority, late majority, or laggards. The social structure has several norms (system effects) that have a strong influence on the rate of diffusion. Early adopters and a greater diffusion rate are more likely to occur in modern rather than traditional community norms. The early adopters usually have the greatest social influence in the community and are thus in key positions to influence a wider adoption of the innovation. An agent of change is a professional who attempts to influence this innovation-decision process. Three main types of *innovation decisions* have been suggested: (*a*) optional decisions (made individually), (*b*) collective decisions (made by concensus), and (*c*) authority decisions (made by a superordinate power).

These central principles of innovation-diffusion theory have been developed mainly by Rogers (48). The theory is well supplemented by the classical idea of the two-step flow of new ideas and attitudes through opinion leaders (24). This simplified model holds that new ideas, often originating from mass media, are mediated and modified by certain opinion leaders, and most people are then influenced mainly by interpersonal contacts with these opinion leaders. Opinion leaders can be identified through their particular expertise or position, or they can be informal and undistinguishable by formal criteria. Opinion leaders can either favor or resist the innovation-diffusion process.

The innovation-diffusion principles are of great relevance for many community programs. A health project is based on certain health innovations that the project's change agents try, through communication, to spread through the social network to the members of the community. The diffusion time is an essential element of the approach. Diffusion can be facilitated by the skillful use of theoretical principles of the communication process. The degree of community resistance (systems effect) also has an obviously important role.

The central project team of the North Karelia Project tried to observe several of the well-known principles of being a successful change agent: e.g. understand the needs of the community, and diagnose the problems, represent a credible source, establish a close relationship and empathy, create the intent to change in people and show ways to translate intention into action. From its inception the Project worked closely with the various formal opinion leaders (municipal leaders, voluntary organization leaders, health personnel, mass media and business leaders etc). Later, the Project systematically identified

informal opinion leaders in order to communicate the innovations through the county via this network (35, 41).

THE COMMUNITY ORGANIZATION APPROACH Broad-ranged changes in the community can be achieved ultimately only through the existing community structures. Every community has a complex network that exercises great influence over individual behavior and lifestyle. The community organization approach emphasizes efforts to influence individuals through changing organizations to meet the desired ends. The concept of community organization involves both community self-development (the community initially detecting a problem, and organizing itself to cope with it) and the outside influences needed to promote the reorganization.

The community petition that initiated the North Karelia Project provided a favorable subjective climate for community reorganization. However, the Project team provided the external impetus and resources for change in the community. In doing so, the principles of persuasion and of the change agent's role have been of central importance. The impact depends largely on the degree to which the existing community organizations find the proposed actions to fit with their particular needs. It is therefore important for success in community self-development that the program offer incentives for the proposed collaboration.

The North Karelia Project team tried throughout the program (but with greatest intensity in the beginning) to have close contact with a great many representatives of community organizations. The team worked intensively with the representatives of the mass media (newspapers, radio), with people of health and other services (administrators, doctors, nurses, teachers, social workers, schools, teachers etc), with business leaders (dairies, sausage factories, bakeries, groceries, etc), with key persons of voluntary organizations (heart association, housewives' organization, labor organizations, sports organizations, etc), and with local political decision makers (county and municipal leaders). The team tried to show these organizations practical, feasible ways to collaborate, while recognizing each organization's particular needs. The aim obviously was that the changes so initiated would ultimately influence behavior in the community.

A UNIFIED MODEL The approaches described above have been unified in Figure 5 to show the behavioral/social model of community intervention that we found to be most relevant to the North Karelia Project. The external input from the project affects the community both through mass media communication to the population at large (where its effect is mediated through interpersonal communication) and even more so through formal and informal opinion leaders acting as change agents to influence various aspects of community

organization. This two-pronged emphasis is aimed at increasing knowledge, at persuasion, at teaching practical skills, and at providing the necessary social and environmental support for the performance and maintenance of these health skills in the population. The acquisition and maintenance of new behaviors ultimately leads to a more favorable risk factor profile, reduced disease rates, and improved health.

THE MAIN PROJECT COMPONENTS

The practical framework of the North Karelia Project, like any similar project, consists of three components: (*a*) planning, (*b*) intervention program implementation, and (*c*) evaluation. Although they usually occur sequentially, as listed, in time, in many cases these elements take place simultaneously as the project proceeds (Figure 6).

Planning

The major elements in the project planning are (*a*) definition of objectives, (*b*) community analysis, (*c*) establishment of the project organization, and (*d*) the preparatory steps.

The main objectives of the program are usually set by the objective and/or perceived health needs of the community. In North Karelia these were both met. The intermediate objectives are designed on the basis of the available medical/epidemiological knowledge concerning how to influence the health problem(s). The practical objectives and actual intervention measures should then be based on careful analysis of the community and on understanding of the strategic determinants of the intermediate objectives (Figure 7).

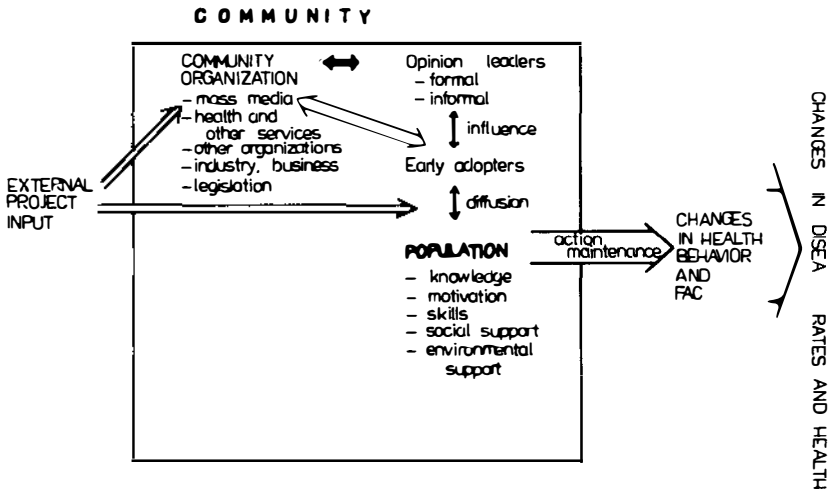

Figure 5 Model of community intervention, as used in the North Karelia Project.

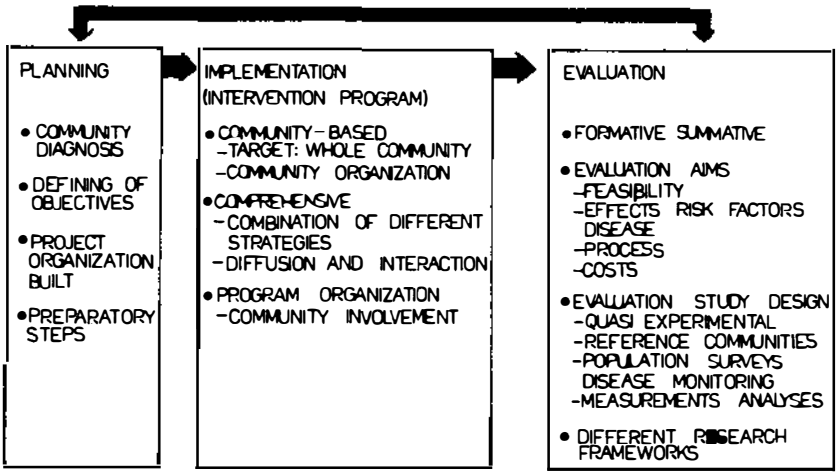

Figure 6 Model of elements in the community-based project, as used in the North Karelia Project.

To the greatest extent possible, the community analysis ("community diagnosis") should provide a comprehensive understanding of the situation at the start of the program. It should provide the basis for selecting priorities and appropriate methods for the intervention, and indicate how continuous follow-up should be carried out to help guide the activities. Background information of the community was collected in North Karelia along these lines (45, 60). Already existing data from previous studies, statistics, and expert opinions were collected and reviewed at the planning seminars. Later on, the results of the baseline survey were used to complement the picture.

Important information for the community analysis included epidemiological information from the area: the mortality and morbidity rates of the different

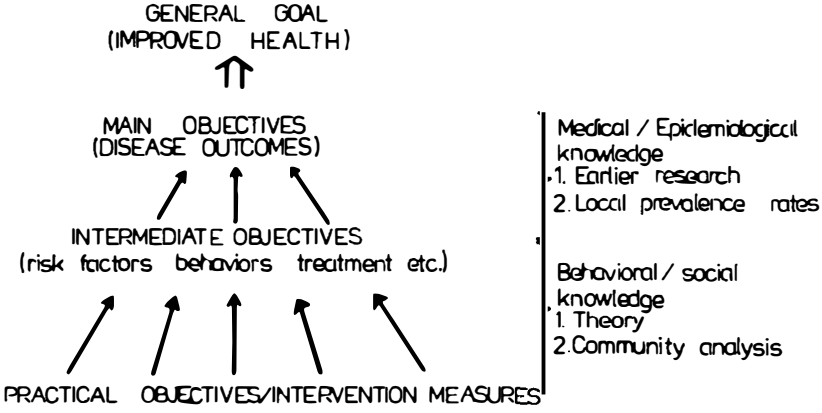

Figure 7 Establishment of the hierarchy of objectives in a community-based health program.

possible health problems of the total population and various subgroups, the prevalence rates of the possible factors influencing these diseases in the target population. Features of the geography, demography, and the socioeconomic factors of the community were reviewed. Information was obtained about the various lifestyles related to the risk factors, about the various community features influencing these behavior complexes, about the community leadership and social interaction/communication channels, and about other factors relevant to the behavioral/social framework.

Because much of the success of a program depends on the support of the population, information was obtained on how people and their representatives saw the problem and how they felt about the possibilities of solving them. Because the program would depend on the cooperation of the local decision-makers and the health personnel, these groups were also surveyed at the outset (43). The community resources and service structure were also considered before deciding on the actual forms of program implementation.

The historical formation of the project organization and the preparatory steps for launching the program are described above. The project organization comprises a principal investigator (project director), co-principal investigators, a steering committee, and a coordinating center: the Department of Epidemiology of the National Public Health Institute (earlier at the University of Kuopio). This central project organization coordinates the field activities in North Karelia, the research activities (National Public Health Institute, University of Kuopio, other), and the national/international activities. The field office of the project in North Karelia is located at the county department of health (and social affairs). A local project advisory board serves to enhance the community participation and feedback.

Implementing the Intervention Program

The goal was systematically to implement the program according to its aims and principles. Within the overall framework of the program, its actual implementation was sufficiently flexible to adjust in response to opportunities in the community. After the needed measures were defined, the formal support was ensured and community resources were identified to accomplish the tasks.

Integrating the program into the community social organization was necessary because in so doing the participation of the community and the availability of community resources were ensured. Thus the Project set the objectives and developed the general framework, while the activities were carried out mainly by the community. The Project catalyzed this work by providing materials, training, necessary official support, mass media support, and follow-up.

The program activities were simple and practical in order to facilitate enactment in the larger community. Instead of highly sophisticated services to a few people, simple basic services were provided to the largest possible

population. This eased information dissemination and personnel training. Integration of the comprehensive measures not only saved the project resources, but avoided duplication and overlapping activities as well, and thus meant better use of the community resources.

To identify and mobilize community resources, the Project worked closely with official agencies and voluntary organizations. As an official pilot program, the new health service activities initiated by the Project became part of formal public health activities in the area. Thus participation in these activities formed part of the regular work of the health professional, not simply an extra job or hobby. In this way the Project activities were based on authority decisions, in addition to training and motivation. Close personal contacts between the Project team and the local health personnel were emphasized to help motivation and compliance.

The use of the large network of other organizations and opinion leaders encouraged population participation. For the most part these organizations appreciated being able to contribute to the success of an important project. Numerous personal contacts were made, local problems were discussed, and possibilities for practical contributions were reviewed. The population's interest and support generated by the activities and mediated by the mass media made it easier to establish further intervention activities.

Since the motivation and support of the general population formed a cornerstone for the project intervention, much of the practical "project work" was carried out by lay people and voluntary organizations. The well-trained and motivated public health nurses maintained the systematic basic health center activities and the necessary administrative framework (e.g. hypertension dispensaries, smoking cessation courses, rehabilitation groups, disease registers etc). The doctors acted as medical experts within this framework.

The program activities of the North Karelia Project can be divided into the following groups:

1. media-related and general educational activities,
2. training of local personnel and other active groups,
3. organization of health services (primary health care, other),
4. other community organization activities,
5. project activities for monitoring the development for management and feedback.

The media activities involved cooperation with the local newspapers and radio, production of various health education materials, and support to various community meetings and campaigns. Training extended to doctors, nurses, social workers, teachers, representatives of voluntary organizations, etc. Later on in the project informal opinion leaders were identified and trained in a systematic way (35). Most of training was organized in cooperation with county administration and/or with other organizations.

The necessary reorganization of health services was carried out through formal decisions, training, demonstrations, provision of guidelines, and materials. Major activities were the reorganization of hypertension control in the area (hypertension clinics, and a hypertension register) and organization of the follow-up and secondary preventive activities for myocardial infarction patients (36, 45).

Other community organization activities concerned a large number of voluntary organizations (heart association, housewives' association, sports clubs, etc), the food industry (dairies, sausage factories, bakeries, etc), and grocery stores. Using and developing various information systems (surveys, registers, statistics, etc), the project monitored the progress for the continuous management and feedback.

A detailed description of the intervention activities can be found in the WHO monograph on the North Karelia Project from 1972–1977 (45).

Evaluation

PRINCIPLES Evaluation can be divided into internal and formative vs external and summative evaluation. *Internal evaluation* is carried out during and within the program to give rapid feed-back to the program workers and management. An overlapping concept is *formative evaluation,* which provides data during the program about the experience with the various program components and thus helps further to develop ("formulate") the program. This section concerns the *summative evaluation* of the program over a given time that assesses the overall effects and other results, usually by an expert group in some way *external* to the daily community work.

The evaluation aims can be divided into assessment of the program

1. feasibility
2. effects (behaviors, risk factors, disease rates)
3. process
4. costs
5. other consequences.

Feasibility The program feasibility evaluation assessed the extent to which it was possible to implement the planned activities, i.e. what actually happened in the community. This concerned the amount of resources that the project had available, how they were used in the community, and how well the activities reached the target populations. A feasibility evaluation is especially important in a large and comprehensive program, like the one in North Karelia, where the community itself carries out the activities in a large geographical area. Before the question of effects can be meaningfully addressed, the actual intervention must be defined. Results of the feasibility assessment in the North Karelia project were based on survey and other data (project statistics) collected during and after certain program periods.

Effect Program effect evaluation was carried out to assess whether and to what extent the main and intermediate objectives were achieved. Thus indicators of the different objectives were defined and these measured in the community at the outset and after the given program period. The effect assessment should especially answer the two questions: 1. Did the program cause changes in target behaviors and risk factors (and other possible indicators of intermediate objectives)? And if so, 2. Were these changes associated with changes in CVD (or other disease) rates?

Since the program target was the whole community, information was collected to represent the whole population. For prevalence data (behaviors, risk factors), a representative population sample was examined at the outset (the baseline survey in 1972) and at the main summative evaluation points: after five years (in 1977) and after ten years (in 1982). Independent, cross-sectional population samples were used so that the baseline measurements or selective loss at follow-up would not influence the findings of the subsequent follow-ups.

The samples were drawn from the national population register. Men and women were included and a broad age range used to give a comprehensive picture about the changes. The sample sizes were large to detect changes in risk factor means that would be small for individuals but meaningful for the population as a whole. Large sample sizes also enable some interesting subgroup analyses.

Comparison of baseline and follow-up survey results revealed the changes that took place in the target community during the program period. However, the changes during this period of several years could well partly or completely be due to reasons other than the intervention program. Thus a reference area was used. A reference area should be as similar to the program area as possible ("matched"), but without the input of the program. In case of the North Karelia Project, the county of Kuopio, continuous with North Karelia on the west, with 250,000 inhabitants, was chosen. This study design can be called "quasi-experimental," since it represents the situation in which the study can control the experimental intervention and the choice of the reference area, but not the allocation of units to experimental and reference ones.

The baseline and follow-up surveys were carried out simultaneously in the reference area and in North Karelia with strict adherence to identical methodology and sampling procedures. Survey results concerning changes in the reference area represent changes occurring without the program ("national changes," "secular trends," "spontaneous changes"). Thus, the program effect was considered the observed change in the program area (North Karelia) minus the observed change in the reference area (the so-called *net change*).

A problem concerning the reference area is that a major national pilot program is likely to have an impact also in the reference area. And after the first

five-year period the North Karelia project was obliged to help national intervention measures (like the national TV programs). A special feature in the county of Kuopio was the establishment of a new university (with medical school) in the same year as the project started. These factors that would tend to influence health behavior and risk factors in the reference area were not taken into account in the formal effect evaluation. Thus the given results can be considered as conservative estimates of the effects.

Mortality rates were collected by disease category and analyzed for North Karelia and the reference area (and also all other counties of the country). Age- and sex-specific rates were used. Regression-based trends were calculated to eliminate the random annual variation. Additional information for the assessment of disease changes concerned hospital discharge data that are available from a national register, and data from the national cancer register. Special AMI and stroke registers were established in North Karelia following WHO criteria to monitor the respective incidence rates. Since these registers were thought to be powerful intervention tools and part of the comprehensive program to be evaluated, no permanent new registers were established in the reference area. Thus these registers served the process evaluation and validation of the other mortality and morbidity data.

Process The process evaluation concerned both the change trends with time during the program and changes in the intervening variables. The former examined when the changes actually took place during the period. The latter aspect related to the behavioral/social framework adopted and definition of the intended intervening (independent) variables. Measurement of these factors gave a picture of how the change process in the community led or did not lead to the desired behavioral and risk factor changes.

Cost The cost evaluation assessed the total project resources and how they were allocated (especially for intervention and evaluation purposes, respectively). In addition, efforts were made to assess the community costs. This concerned both total community costs, or specifically the extra costs involved for the community. In addition to the direct community costs, attempts were be made to estimate the indirect community costs. These costs may also be negative, i.e. the program may well lead to several types of savings (more efficient health care, reduced hospital needs, reduced disability payments). This information for the North Karelia Project was collected using statistical data sources, project surveys, and other data (45).

Other consequences In a major national pilot program, attempts should be also made to assess consequences of the program other than those intended. If the program involves the community deeply and leads to changes in lifestyle, it

is quite possible that this process may lead to other changes as well. For example, non-CVD health effects may occur. Positive or negative consequences may take place in people's symptoms and subjective health. Socioeconomic, social, and emotional consequences, either positive or negative, may appear. Some of these aspects were assessed in the North Karelia Project, using especially data from the population surveys.

Figure 8 gives a summary of the main evaluation study design in the North Karelia Project. A more detailed discussion of the various evaluation principles and issues can be found in some other publications (5, 12, 68, 70). These issues concern e.g. the number of communities, the sizes of communities, the length of the program/observation period, the number and the type of surveys, the sample sizes, the selections of communities, the time-lag assumptions, and the methods of analyses, etc.

MATERIALS AND METHODS OF THE MAIN EVALUATION A baseline survey for assessment of the risk factor changes was carried out in spring 1972 in North Karelia and the reference area. A random 6.6% sample was drawn from the populations of the two counties by using the national population register. The sample included men and women aged 25–59 years (born in 1913–47). In 1977, exactly five years later, another cross-sectional survey, the five-year follow-up survey, was carried out in the two areas. The survey methods were the same as those in the baseline survey. An independent, 6.6% random sample was used that included both men and women aged 30–64 years (i.e. the same birth cohort).

In spring 1982, exactly ten years after the start of the program, a third survey, the ten-year follow-up survey, was carried out in the two areas. An independent

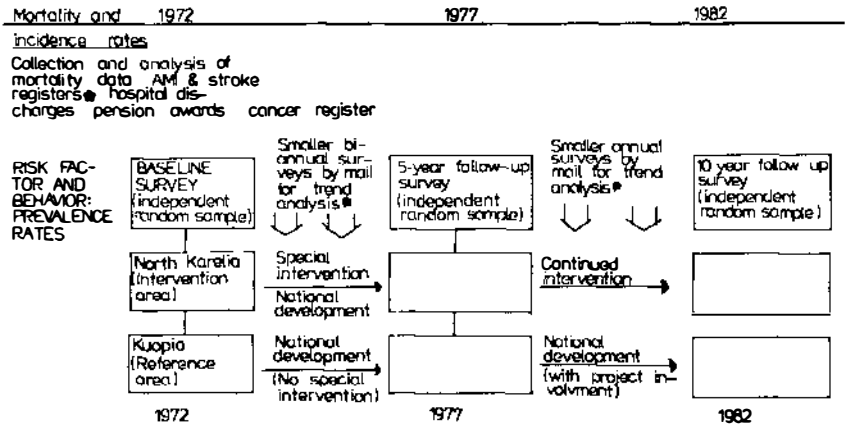

Figure 8 The main evaluation study design in the North Karelia Project. *Refer to North Karelia only (AMI register in the reference area in 1977 and since 1982).

random sample was again drawn. This time the sample was drawn for the age group 25 to 64 years and stratified so that for each sex and ten-year age-specific group the sample size would be approximately 500. This procedure was done to comply with the protocol of the WHO-initiated MONICA project, since this survey also formed the baseline survey for the Finnish participation in the international MONICA project (68).

The surveys included a questionnaire answered at home (on general background, socioeconomic situation, medical history, health behavior, etc) and examination of height, weight, and blood pressure. A venous blood specimen was taken for the determination of serum cholesterol. Casual blood pressure was measured in a sitting position according to the standardized technique. The fifth phase was recorded as the diastolic pressure (44, 45).

Each survey in 1972, in 1977, and in 1982 followed the same methods as much as possible, and in each survey the two areas were treated in an exactly similar way, e.g. the blood samples from the two areas were analyzed in mixed order. Serum cholesterol was determined in 1972 and 1977 from frozen samples and in 1982 from the fresh serum samples in a central laboratory, standardized against the international WHO references.

The participation rate in the baseline survey was 94% in North Karelia and 91% in the reference area (from approximately 6% of these subjects, only questionnaire data were available), and in the 1977 survey 89% in North Karelia and 91% in the reference area, and in the 1982 survey 80% in North Karelia and 82% in the reference area. For the results reviewed here, the age range of 30 to 59 years is used for all three surveys samples (Table 3).

For the analysis of the mortality changes, the data on deaths by the disease category were obtained from the central statistical office of Finland for the years 1969 to 1979. These were stratified into three age groups (35–44, 45–54,

Table 3 Numbers of men and women studied in the three cross-sectional surveys in North Karelia and the reference area

Sex and age (years)	North Karelia			Reference area		
	1972	1977	1982	1972	1977	1982
Men						
30–39	588	640	420	891	954	490
40–49	699	607	371	1024	885	364
50–59	547	538	459	750	777	343
Total	1834	1785	1250	2665	2616	1197
Women						
30–59	598	595	222	879	928	340
40–49	716	616	423	1003	903	293
50–59	659	634	440	887	925	358
Total	1973	1845	1285	2769	2756	991

and 55–64) and by sex. The diagnoses on the individual death certificates had been reviewed according to WHO guidelines. The eighth ICD revision, adopted in Finland in 1969, was used for the disease classification for the entire period of study. The population data for 1970 were based on the census, and those for other years were based on registration of births, deaths, and migration.

The mid-year populations were used as denominators in computing the annual mortality. Death rates were standardized for age by the direct method, using the population distributions of men and women in the whole country in 1969 as the standard. Regression slopes were tested for significance. For analysis of coronary mortality, the ICD codes from 410 to 414 were used.

The difference in the change in the slope of age-standardized mortality between North Karelia and the other ten counties of Finland was estimated and tested for significance with multiple time series regression analysis. The slopes were compared for the time intervals 1969–1973 and 1974–1979. Because the program was started in 1972, data for the years 1969 to 1973 were used to reflect the situation before the program and data for 1974–1979 to reflect the possible effects (54).

REVIEW OF THE MAIN RESULTS

Main Program Effects

HEALTH BEHAVIOR AND RISK FACTORS In 1972, 52% of the men aged 25–59 years in North Karelia were smokers. This rate reduced to 44% in 1977 and further to 38% in 1982. Among women, changes in smoking rates were small, with some increase in the 1978–1982 period.

Table 4 shows the amount of reported daily smoking (daily number of cigarettes, cigars, and pipefuls per subject) in North Karelia and the reference area, as given by the three major surveys in 1972, 1977, and 1982. Among men, smoking clearly declined in North Karelia; among women smoking increased somewhat. During 1972–1977, a net reduction in North Karelia in smoking was observed for both men (14% $p<0.01$) and for women (11%, n.s.). From 1977 to 1982 a further reduction took place among men, more so again in North Karelia than in the reference area. Thus the net reduction in North Karelia for the full ten-year period was 27% ($p<0.001$). Among women the net reduction in North Karelia from 1972 to 1982 was 14%.

To validate the self-reported smoking data, thiocyanate was determined in all serum samples of the 1982 survey. The age-adjusted partial correlation between reported daily amount of smoking and serum thiocyanate among men was 0.72 in North Karelia and 0.67 in the reference area. Among women it was

Table 4 Mean amount of reported daily smoking in North Karelia and the reference area in independent baseline (1972), 5-year (1977), and 10-year (1982) follow-up surveys

	Men		Women	
Year	North Karelia	Reference area	North Karelia	Reference area
1972	10.0	8.5	1.1	1.2
1977	8.5	8.5	1.1	1.3
1982	6.6	7.8	1.7	1.9
% net change in North Karelia				
1972–1977	15[a]		12	
1972–1982	28[b]		14	

[a] $p < 0.01$.
[b] $p < 0.001$.

0.69 and 0.70, respectively. In 1982 the mean serum thiocyanate of men was 71 mmol/l in North Karelia and 79 mmol/l in the reference area ($p<.001$), and for women 54 mmol/l and 57 mmol/l, respectively ($p<.01$).

Dietary changes were assessed in the surveys by standard questions on dietary habits. The results showed that there were considerable favorable self-reported changes in several dietary habits related to the program objectives in North Karelia. This concerned especially reduction of fat intake. Some favorable changes were observed also in the reference area, reflecting national changes, but these were in general smaller than in North Karelia.

During 1972–1977 the program had a highly significant overall effect on mean serum cholesterol concentrations ($p<0.01$). Analyzed by sex the effect was significant among men (4%; $p<0.001$) but not in the whole age range of women (1%). During 1977–1982 the serum cholesterol concentrations showed

Table 5 Mean serum cholesterol concentrations in North Karelia and the reference area in independent baseline (1972), 5-year (1977), and 10-year (1982) follow-up surveys

	Men		Women	
Year	North Karelia	Reference area	North Karelia	Reference area
1972	7.1	6.9	7.0	6.8
1977	6.7	6.8	6.6	6.5
1982	6.3	6.3	6.2	6.0
% net change in North Karelia				
1972–1977	4[a]		1	
1972–1982	3[a]		1	

[a] $p < 0.001$.

Table 6 Mean systolic and diastolic blood pressure levels in North Karelia and the reference area in independent baseline (1972), 5-year (1977), and 10-year (1982) follow-up surveys

	Men				Women			
	North Karelia		Reference area		North Karelia		Reference area	
Year	SBP	DBP	SBP	DBP	SBP	DBP	SBP	DBP
1972	149	92	146	93	153	93	148	92
1977	143	89	146	93	142	87	144	89
1982	145	87	147	89	142	85	144	85
% net change in North Karelia								
1972–1977	3[a]	3[a]			5[a]	4[a]		
1972–1982	3[a]	1[b]			5[a]	2[b]		

[a] $p < 0.001$.
[b] $p < 0.05$.

an almost parallel reduction in North Karelia and the reference area, giving for the full ten-year period 1972–1982 a net reduction of 3% among men ($p<0.001$) and 1% among women (n.s.).

The mean systolic and diastolic blood pressures decreased in 1972–1977 in North Karelia, more so than in the reference area. No further decrease in systolic blood pressure was observed in either areas in 1977–1982. Thus the net reductions in systolic blood pressures in men and women remained virtually the same for 1972–1982 as for 1972–1977 (both sexes $p<0.01$). For diastolic blood pressure the means in 1982 were lower than in 1977. The net reduction in North Karelia became smaller during 1977–1982, but for the whole period 1972–1982 it remained significant for both sexes ($p<0.05$).

Table 7 summarizes the net reductions in risk factor means in North Karelia.

Table 7 Relative net reductions (± SD) in North Karelia in risk factor means in men and women aged 30–59 years in 1972–1977 and 1972–1982. Values are percentages from the baseline value in North Karelia.

	Men		Women	
	1972–1977	1972–1982	1972–1977	1972–1982
Daily smoking	15(10)[a]	28(11)[b]	12(27)	14(38)
Serum cholesterol	4(1)[b]	3(2)[b]	1(2)	1(2)
Systolic blood pressure	3(1)[b]	3(1)[b]	5(1)[b]	5(1)[b]
Diastolic blood pressure	3(1)[b]	1(1)[c]	4(1)[b]	2(1)[c]

[a] $p < 0.01$.
[b] $p < 0.001$.
[c] $p < 0.05$.

As a whole, the favorable program effect observed during 1972–1977 increased for smoking and was maintained for serum cholesterol concentrations and systolic blood pressure during the second five-year period (1977–1982) of the program.

CORONARY MORTALITY For the assessment of CHD mortality, comparable data were available from 1969 up to 1979. During the period, CHD mortality among the middle-aged (35–64 years) male population declined 24% in North Karelia. Most of the decrease in North Karelia took place after the initiation of the program. Thus for the 1974–1979 period, the reduction in age-standardized male CHD mortality was 22% in North Karelia. During this same period the respective reduction was 12% in the reference area and 11% in all Finland less North Karelia ($p<0.05$) when compared with North Karelia.

CHD mortality also decreased among women in North Karelia, significantly more than in the rest of the country. Because the absolute number of CHD deaths was much smaller among women than among men, the decline in actual number of deaths was much greater among men than among women. For total and cardiovascular mortality the differences between North Karelia and the rest of Finland were similar as for CHD mortality but smaller. A multiple cross-county time series regression analysis indicated a greater acceleration of the decline in mortality from CHD ($p<.05$), CVD ($p<.001$), and all causes ($p</001$) from 1969–1973 to 1974–1979 in North Karelia than in the other counties of Finland (54).

Process Aspects

CHANGE TIME TRENDS IN NORTH KARELIA For smoking, a sharp reduction among men took place during the first year. Thereafter, further decline took place only after 1978, possibly associated with the several antismoking TV

Table 8 Average annual regression based decline in age-standardized CHD mortality in 1974–1979 and 1969–1979 in North Karelia, the reference area, and Finland less North Karelia (± 95% confidence intervals) and estimate for 1969 mortality

	CHD mortality rate in 1969 (per 100,000)		Annual % decline			
			Men		Women	
Area	Men	Women	1974–1979	1969–1979	1974–1979	1969–1979
North Karelia	663	140	3.7 ± 1.5	2.2 ± 1.1	2.2 ± 3.4	4.3 ± 1.4
Reference area	606	125	1.9 ± 2.3	1.9 ± 1.3	1.8 ± 1.4	3.1 ± 1.0
Finland less North Karelia	501	103	1.7 ± 2.2[a]	1.1 ± 0.9[a]	1.2 ± 2.4	2.2 ± 1.0[a]

[a]Difference from North Karelia in relation to random variation $p < 0.05$.

programs produced by the project. For women, changes in smoking rates were small throughout the period.

The dietary changes took place gradually throughout the project period. Major changes in government price policy were reflected in these trends. The serum cholesterol levels in North Karelia fell in a linear way from 1972 to 1977 and to 1982.

The frequency of blood pressure measurements increased in the area during the first couple of years of the intervention. After 1974 some 80% of the population had their blood pressure measured at least every two years. The proportion of men under antihypertensive treatment increased from 3% in 1972 to 10% in 1975 and among women from 9% to 14%. These new levels remained throughout the rest of the period. In the population's blood pressure levels, little change took place after 1977.

For other "possible" risk factors, which were not actual targets of the intervention, like physical activity, relative weight, or perceived social stress, observed changes were small during the project period.

The AMI register covering whole North Karelia showed a plateau of AMI incidence rates of men in 1972–1975. Thereafter a gradual decline took place. The CHD mortality showed an increased decline after 1974. Among women similar patterns were observed, but because of much smaller absolute numbers, these changes are less meaningful. Stroke registration in the area showed a sharp decline in incidence among men around 1974. Among women a more gradual decline was observed.

CHANGES IN SUBGROUPS Changes in risk factors were generally greater among men than among women, which was in accordance with project efforts. A breakdown by age indicated that the observed changes in North Karelia were usually somewhat greater among older than younger people. Since changes among the younger people in the reference area compared to those in North Karelia were smaller for men but rather equal among women, the relative net changes in North Karelia were greatest among both younger and older men, but for women among middle or older age groups.

The health behavior and risk factor changes were also analyzed according to socioeconomic subgroups. The general finding was that the changes did not markedly concentrate in some subgroups but took place rather generally throughout the community. Smoking among men dropped somewhat more among lower educated than higher educated men; this difference was observed also for the net reduction. Urban-rural differences in smoking changes were small. Also, dietary changes and serum cholesterol and blood pressure changes took place rather evenly in the different socioeconomic groups.

Changes in health behavior were analyzed also in relation to the initial estimated CHD level. The change in the behavior had no consistent relation to

the preprogram risk level. It was again concluded that the change in health behavior in the population was based on common lifestyle changes in the area.

A survey among formal opinion leaders (medical doctors, public health nurses, and municipal council members) in 1972 and 1977 showed that smoking declined markedly among doctors and public health nurses in North Karelia, while little change occurred in the reference area. Smoking among local decision makers changed little during this period in either county.

CHANGES IN INTERVENING VARIABLES The surveys in 1972 and 1977 indicated that knowledge related to the risk factors increased somewhat during this period, but this increase was only slightly greater in North Karelia than in the reference area. Various health attitude measures showed no major changes during the period and little difference between the areas.

During the program, various health education materials were distributed by the project through health centers and other channels. A survey of the local newspapers showed that there were three to four times more CVD prevention and control related articles in North Karelia than in the reference area in 1972–1977. Training of local personnel groups by the project was frequent. The survey of local health personnel showed that the North Karelian health personnel was more active in health education measures than their counterparts in the reference area. The population surveys showed that there was little difference between the areas in frequency of health behavior related discussions at home or at worksite. Somewhat more people in North Karelia had participated in organized health education meetings. Smokers had received advice from doctors to stop smoking equally frequently in the two areas, but from nurses twice more often in North Karelia than in the reference area.

The population surveys showed that attempts to stop smoking increased clearly more in North Karelia than in the reference area from 1972 to 1977. Evaluation of the TV programs after 1977 indicated that greater attempt rates lead also to greater success rates. Later on, less difference was found in the attempt rates but greater difference in maintenance rates in North Karelia.

The doctors and public health nurses had generally been clearly more active in North Karelia than in the reference area in contacts with various community organizations concerning health promotion activities. The local decision makers had received advice from health personnel to stop smoking and to change dietary habits twice as often in North Karelia as in the reference area. Beginning in 1975 informal lay opinion leaders were identified and trained in a systematic way in North Karelia. Approximately 800 people were trained. A survey in 1983 showed that about half of them had remained active. This evaluation indicated that the lay-leader work had obviously been a useful component of the intervention.

The increase in blood pressure measurements and antihypertensive treatment is discussed above. The hypertension care system in North Karelia was reorganized by the project so that patients were registered and followed at special hypertension dispensaries in a systematic way. The number of hypertensives registered and followed by the new system reached nearly 17,000 by the end of 1976. Thereafter the number of prevalent cases remained much the same. Blood pressure measurements, drug treatment, and health personnel contacts increased somewhat also in the reference area. A more systematic follow-up and greater compliance obviously contributed to the hypertension control results in North Karelia.

Patients with acute myocardial infarctions in North Karelia were recruited to special secondary preventive groups after the attack. Since 1975 more than half of the AMI survivors participated in this program. Such a rehabilitation and secondary prevention activity was much less common in the reference area. AMI patients in North Karelia had after their attack more favorable risk factor changes than in the reference area.

CHANGES IN CARDIOVASCULAR DISEASE PATTERNS In spite of the decline in coronary mortality and incidence, no changes were observed by the AMI register in 28-day case fatality rates in 1972–1977. There was a trend of reduced mortality one year after the acute myocardial infarction among patients with recurrent AMI in 1972–1977 in North Karelia. No significant changes were observed in three-week or one-year fatality rates for stroke cases during this period. The relative decrease in AMI incidence rates in North Karelia was greater in the younger than in the older age groups in North Karelia for both sexes.

The reduction in coronary incidence rates among men was somewhat greater for recurrent than for the first infarctions. When the cases were classified by WHO criteria into "definitive" and "possible" myocardial infarctions, the decline was due to decline in the category "definite" only. The finding that "possible" AMI cases did not decrease may be a consequence of patients with less severe symptoms reporting more often to the hospitals because of increasing awareness and increased services in the community.

In the surveys in 1972, 1977, and 1982, people were asked in the self-administered questionnaires whether they had suffered from angina pectoris diagnosed and/or treated by a doctor during the year preceding the survey. The prevalence of angina pectoris among men aged from 50 to 59 years changed in 1972–1982 from 10.4% to 5.6% in North Karelia and from 6.1% to 6.2% in the reference area.

Other Consequences and Cost Aspects

DISABILITY AND OTHER MORBIDITY Since 1972, both the surveys and the statistics of the National Social Security Institution showed a more favorable

trend in disability pensions in North Karelia compared with the reference area. According to the surveys the proportion of all disability pensions increased 16% in North Karelia and 25% in the reference area from 1972 to 1977. This more favorable trend was largely attributable to CHD, but also partly to respiratory diseases. Age-adjusted prevalence rates since 1968 for CVD-related disability were calculated from the national disability statistics. From 1971 to 1977 the net reduction in North Karelia was 27% for men and 12% for women.

According to the surveys in 1972 and 1977 the proportion of people who had suffered from any chronic disease during the previous year changed in North Karelia from 51% to 53% and in the reference area from 46% to 51%. The respective changes for respiratory disease were from 8.8% to 9.4% in North Karelia and from 7.7% to 10.1% in the reference area. Analyses among subgroups showed an association between net changes in smoking and in cough symptoms. Preliminary findings from the national cancer register show a more favorable lung cancer trend in North Karelia compared with other areas.

The mean self-reported days of illness during the preceding year changed among men from 1972 to 1977 in North Karelia from 32 to 25 and in the reference area from 27 to 24. The respective changes among women were from 17 to 14 and from 14 to 15.

COST ASPECTS The project budget was used for the extra input to intensify cardiovascular prevention and care in North Karelia. For the period of 1971 to 1977 (with evaluation up to 1979) the direct project budget was 1.75 million US dollars. Out of this budget 0.73 million dollars went for intervention expenditures and 1.02 million for evaluation costs. It was possible to keep the budget so modest because many of the actual costs involved were covered by the university or other institutions.

The intervention effort was aimed at improved cardiovascular preventive activity in the area by the existing community resources. The health care and other community resources naturally increased during the project period in North Karelia. But this increase was of at least the same magnitude in the reference area. Furthermore, a new medical school with a university hospital was established in the reference area in 1972 and has developed gradually since then.

In North Karelia the primary health care system provided most of the project-related systematic services. The estimated costs suggested that there was no major difference in resources devoted to CVD in primary health care between North Karelia and the reference area. The estimated difference corresponded to a net cost of 2 million US dollars for the program in 1972–1977. Concerning hypertension care, most of the cost increase was related to an increase in antihypertensive modification. A more systematic service structure with the use of nurses resulted in savings.

Within primary health care about 25%, and for total health service costs about 20%, could be attributed to CVD-related reasons. The direct Project costs were only 1% of the total general health service operation costs and 4% of similar CVD-related costs in North Karelia during the period 1972–1977.

During the same period the reduced numbers of AMI and stroke cases resulted in a saving of 2 million US dollars. A substantial relative reduction in CVD disability pension, specific for North Karelia, took place since 1972. The savings in these pension awards were 4 million dollars during the period 1972–1977.

SUBJECTIVE HEALTH AND PERSONAL EXPERIENCES The survey questionnaires included standard precoded questions that were used to assess psychosocial consequences of the program. In 1972, people in North Karelia reported themselves to be in poorer health than did the people in the reference area. After ten years, in 1982, people tended to report their health status more often as "very good" or "good" than people did in 1972. This improvement in subjective health status was significantly greater for North Karelia than for the reference area ($p < .005$). A similar pattern was present with perceived risk of heart disease; the decline in North Karelia was again greater than in the reference area ($p < .01$).

In addition to these two variables, the survey questions dealt with measures of psychosocial stress, social interaction, psychosomatic symptoms, somatic symptoms, subjective fitness, days of illness, etc. Out of 20 variables (altogether 56 questions) dealing with emotional or psychosocial symptoms or problems, among men 11 showed a net decrease, 3 a net increase and 6 no net changes during 1972–1977. For females the respective figures were 12, 6, and 2.

In a grand score of these complaints, a decrease occurred in both localities. But the decrease was greater in North Karelia, resulting in a net decrease of 6%

Figure 9 Changes in subjective health. Differences in responses to the question: "What do you think of your present state of health?" in the surveys in North Karelia and the reference area between 1972 and 1982. The changes for "very good" or "good" were significantly greater in North Karelia: $p < .005$.

for men ($p < .05$) and 10% for women ($p < .001$). A net decrease in the psychosomatic symptoms index was observed also when the analysis was restricted to people with high risk factor levels in the two surveys.

These findings exclude the possibility of any general unwanted emotional consequences of the preventive program. They rather suggest a general positive effect of the intervention in terms of subjective health and quality of life.

The 1977 survey of local doctors, public health nurses, and local decision-makers asked these people how they felt about various CVD prevention and control related activities in their own community. For all these activities and all these groups the degree of satisfaction was clearly greater in North Karelia than in the reference area. For other types of activities there was little difference between the areas in the responses. (Table 9). The given results and the personal experiences of the project team clearly indicate a broad general satisfaction among the population in North Karelia toward the preventive program initiated and coordinated by the Project. People participated well in the activities; cooperation with various community organizations and opinion leaders was good; and the activities were obviously associated with general positive consequences, including subjective ones.

DISCUSSION OF THE PROJECT RESULTS AND EXPERIENCES

General

The North Karelia Project was founded as a response to the burden of heart disease in North Karelia. Since this problem was not much different in other parts of Finland and in many other countries, the Project was also to be a "pilot" or "demonstration" program for wider application. And since the prevention

Table 9 Opinions of health personnel and local decision makers about the sufficiency of the local CVD control activities in North Karelia (NK) and the reference county (Ref.)

	Consider the activity to be sufficient in the local health center, %					
	Physicians		Public health nurses		Local decision makers	
CVD control activity	NK	Ref.	NK	Ref.	NK	Ref.
CVD control in general	52	18	49	7	20	7
Antismoking	45	30	34	19	28	18
Nutritional education	35	13	31	18	24	10
Hypertension control	79	42	90	47	45	31
Heart disease patients' rehabilitation	52	13	44	9	21	8
Health examinations	59	35	49	23	28	22

and control of CVD involved many unsolved scientific questions, careful evaluative research was linked with the program. Both the background of the project and the nature of the problem led to adoption of the community approach as the main strategy.

Public health decisions on risk factor reduction and CHD prevention must be based on broad information about the overall expected favorable and harmful consequences of such activity. Community studies investigate several questions relevant to prevention and community health in a real life situation. Thus, besides assessing risk factor and disease changes, the North Karelia project has yielded information about the feasibility of the prevention program and demonstrated other positive findings, such as reduced disability payments, fewer reported general health complaints and emotional problems, and popular satisfaction with the program.

It should be noted that, although the main project features and the evaluation design were clearly decided upon during the initial planning phase, many of the theories relating to community intervention were understood and developed only during the actual work. Thus the theoretical framework was only partly outlined at the outset. We have aimed here to put the project implementation into a theoretical perspective to help guide similar activities, and for evaluative purposes.

The intervention activities of the North Karelia Project have been described here only to a very limited extent. A complete description of these can be found in the monograph on the five-year results (45). Most of the results reviewed and discussed here have been previously published in a number of articles partly cited here. Because the initial five-year period (1972–1977) has been evaluated much more thoroughly thus far, many of the process evaluation results mentioned here refer to this period. However, the main epidemiological "hard" effect type of evaluation results include the latest findings of the ten-year follow-up survey (in 1982) and the continued mortality follow-up.

Program Effects

HEALTH BEHAVIOR AND RISK FACTOR CHANGES The major questions of the evaluation are naturally whether it is possible to influence the risk factor levels in the population and, if so, whether such changes lead to respective changes in CHD rates. A quasi-experimental study design was used to measure this effect. Changes in the North Karelian population were compared with respective changes in a matched reference area to give the net change during the study period. This estimate of effect is a conservative one, because the project probably also influenced the reference area. Independent repeated random sample surveys with standardized and similar questionnaires were used to assess the risk factor changes in the whole population. The participation rates were high.

Overall, the reductions in risk factor levels observed in North Karelia during the ten years of the program were substantial: for men, 36% in smoking, 11% for mean serum cholesterol concentration, and 5% for mean diastolic blood pressure. The changes in biological risk factors (serum cholesterol and blood pressure) were much smaller than in smoking, which is to be expected. The changes of this magnitude in risk factors may be considered small for an individual, but they represent mean changes for the whole population and should thus be important for population disease rates. The changes in biological risk factors among women were similar to those among men, but the results for smoking differed because of the small initial smoking rates among women.

Risk factor levels also declined somewhat in the reference area, as was observed already during the first five-year period. During the second five-year period the net difference in favor of North Karelia further increased for smoking, remained quite similar for serum cholesterol concentration and systolic blood pressure, and lessened for diastolic blood pressure. Thus the results in 1982 were further evidence of the effects of the intervention program in North Karelia.

Influencing health-related behaviors and risk factors is not an easy task. Even when the health hazards are well known, many interventions have met with but limited success. We consider the results and experiences presented here an encouraging indication that, at least in favorable conditions, a comprehensive, determined, and well-planned activity can indeed lead to substantial improvements in risk factor patterns.

Similar risk factor changes as reported for ten-year results in North Karelia occurred within the Stanford Three Community Study reported for two years and three years (15, 19, 68). Further comments on this study follow in a later section. Given the analogies in underlying theory and in their application to total communities as a multifactor CVD risk reduction study, the Finnish North Karelia Project and the American Stanford Three Community Study can be seen as replications demonstrating the feasibility and indicating a beginning or partial generalizability of these types of community studies.

The effects on risk factors in the North Karelia project can be compared with those observed in some recent major risk factor intervention studies. Compared with the six-year results of the multicenter MRFIT study in the United States, the results in North Karelia in the entire population are somewhat greater for smoking and for serum cholesterol but slightly smaller for diastolic blood pressure (34). Thus the overall impact of community-based intervention appeared greater in North Karelia even though the American study was concerned with only some 6500 high risk men who were each intervened upon with considerable intensity and cost.

The overall results in North Karelia also seem to be considerably better than the results of the British heart disease prevention project, even when only high

risk subjects in that multicenter factory study are considered (51). The results of the subsequent Belgian project were also somewhat better than in Britain, but still smaller than in North Karelia, especially at the six-years point of follow-up (26). In a smaller scaled clinical trial, the Oslo study, the effect of the intervention on smoking and serum cholesterol was greater than in North Karelia (21). In that study, however, the intervention concerned only about 600 men with very high cholesterol values, and the intervention was carried out in only one center by a few devoted professionals. Special interventions among restricted groups of the population have also resulted, naturally, in much larger risk factor changes in North Karelia. For example, in a special dietary intervention study among 30 families, an intensive dietary counselling resulted in 24% reduction in the average serum cholesterol level of the middle-aged adults of these families (11). But such costly measures obviously cannot be used for changing the population's risk factor levels.

The key question naturally is how CHD-related lifestyles and risk factors can be permanently achieved and maintained in the entire population in a cost-effective way. The answer from the North Karelia Project, supported by the results from the Stanford Study, calls for a broad-ranged and determined intervention in the whole community. Practical activities integrated with the existing community organizations should be based on sound theoretical principles.

It is obviously difficult to know clearly which of many potential determinants from either baseline factors or intervention methods may be responsible for the favorable risk factor changes and whether further replications elsewhere can be readily achieved. A community program of this sort ultimately tests whether a specific program as a whole (which should be designed so that it can be applied on a larger scale) is feasible and effective under given conditions. The impact of various community conditions and of different components of the project on successes and failures can be evaluated only to a limited extent. It is clear that the great magnitude of the problem in North Karelia (but also in the reference area), the Finnish health service system, and cultural factors have all contributed to the achievement in the North Karelia Project. However, great concern was expressed at the planning stage because of the rural, low socioeconomic nature of the area, with high unemployment, and few medical resources, and because of the area's prevalent dairy farming.

The strategy in North Karelia was to introduce a general community action, using the service structure as a backbone. The role of the Project was to catalyze and promote activities that would enable people themselves to make the necessary changes in their habits. The Project team, in close contact with the community, outlined the different activities and provided materials and training. It was realized from the very beginning that mere provision of information would not be enough. Teaching people practical skills was emphasized. Var-

ious methods of persuasion were applied; people were asked to comply, not necessarily to reduce their own disease risk, but as part of a common action and a county pride. Since influencing lifestyles is ultimately a community problem, the North Karelia Project involved all segments of the community to achieve the desired goals.

Results of the process evaluation and the experiences of the Project team indicated that the success in North Karelia was not primarily based on increase in health knowledge or changes in health-related attitudes. Instead, broad-ranged community organization—including provision of primary health care services and involvement of various other community organizations—were of central importance. The project was able to disseminate its message through media and through opinion leaders so that it created a social atmosphere more favorable to change. The new lifestyles gradually diffused among the population. Ten years is sufficiently long to document a permanent change process, and exclude a temporary campaign effect.

DISEASE CHANGES Given the observed changes in CHD risk factors, the second evaluation question is whether significant changes occurred in the disease rates. Earlier evaluation showed that the coronary mortality rates started to decrease in North Karelia during the first five years, but no clear differences between the two areas were observed. During the period from 1974 to 1979 (when the impact of risk factor reduction could start to show) the reduction in age-standardized male CHD mortality was 22% in North Karelia, 12% in the reference area, and 11% in the whole country, excluding North Karelia. Thus the reduction in coronary mortality among North Karelian men has not only been substantial, but actually double that in the reference area and the rest of the country. This supports the view of some experts that there is delay between risk factor changes and respective changes in CHD rates (28, 50).

The results from North Karelia show not only that risk factors can be changed, but that such changes lead to reduced CHD rates. The North Karelia Project results thus support the findings of the Oslo study and the Belgian study (21, 26), and are in accordance with the results of the numerous prospective studies and several single-factorial intervention studies on hypertension and elevated serum cholesterol levels (22, 30, 58, 63) concerning a causal relationship between the risk factors and CHD. The negative results from the British (51) study were probably a consequence of rather small changes in risk factors. The negative results in the MRFIT study (34) demonstrate the problems with randomized clinical trials and may be due to several possibilities, most notably to complications of large-dose diuretic drug therapy.

In addition to the given effects on coronary mortality the results of the project show a general positive impact on people's health. The patterns of all CVD and total mortality follow that of CHD mortality. Favorable effects on other

noncommunicable diseases were also indicated, notably on respiratory diseases. Evaluation concerning subjective health and emotional consequences demonstrate improved subjective health, reduced emotional and psychosocial problems, and general satisfaction with the activities in North Karelia.

National and International Perspectives

FINNISH PERSPECTIVE Before 1977 it was the policy of the Project team not to promote CVD risk factor changes in the reference area or nationally. However, already during this period the Project had a great deal of positive national publicity. After 1977 the project team became involved in national applications. Governmental health education and hypertension committees recommended many project experiences for national use and recommended establishment of a new office for health education in the National Board of Health. The Project's health education materials have been distributed nationwide in great numbers. A major national activity has been a series of national health education programs on Finnish television carried out by the project since 1978 (40, 46). Antismoking legislation was introduced in 1977.

The changes observed in the reference area and other available information show that CVD-related lifestyles have started to change in Finland as a whole. Associated with these national changes is a favorable change in cardiovascular disease rates. The coronary heart disease mortality of Finnish men, which used to be highest in the world, has decreased nationwide and Finland is losing its position as the country with the highest coronary mortality rates.

The program and the follow-up in North Karelia, as well as the national applications, continue. This is necessary to fully gauge the impact of the activity. At the same time, experiences from similar programs in other countries are needed to confirm the results obtained in North Karelia and to show the impact of various cultural factors and some different intervention strategies. Fortunately, several such studies have recently been launched. In addition to Finland, community-based studies have been launched especially in the USA.

US AND INTERNATIONAL PERSPECTIVE In 1970, a group at Stanford University (California, USA) became convinced that behavioral science must become aligned with the traditional biomedical sciences in a multidisciplinary assault to alleviate the human suffering associated with the chronic diseases so prevalent in the US. Within that context, the Stanford group designed a community-wide public health education study that included elements from both the biomedical and social science traditions. The result was the Three Community Study. Field operations began in 1972, in which educational programs were introduced to communities at large to modify knowledge, attitudes, and behaviors associated with cardiovascular disease and to attempt

to demonstrate the feasibility of reducing cardiovascular risk for adults in a community setting.

The strategy was to identify clearly the lifestyle antecedents of cardiovascular disease that were relevant to adults of varying ethnic and occupational groups. Appropriate subpopulations then became the "audiences" to be informed and assist in undertaking long-term modification of their risk-taking behavior. To do this for large groups of individuals, such as total communities, the costs of the educational efforts for risk reduction had to be reduced to a practical level.

The health education strategy selected was to employ a means that could be widely used in any community. Therefore, two intervention communities were used in establishing a mass education program for risk reduction. Community leaders among health providers, and the mass media, were recruited to assist in the effort.

The study waged extensive mass media campaigns over a two-year period in two of these communities, and in one of these, face-to-face counseling was also provided for a small subset of high-risk people. A third community served as a control. A sample of the population from each community were interviewed and examined before the campaigns began and one and two years afterwards to assess knowledge and behavior related to cardiovascular disease (e.g. diet and smoking) and also to measure physiological indicators of risk (e.g. blood pressure, relative weight, and plasma cholesterol). In the control community the risk of cardiovascular disease increased over the two years, but the treatment communities showed a substantial and sustained decrease in risk. In the community in which there was some face-to-face counseling the initial improvement was greater and health education was more successful in reducing cigarette smoking, but at the end of the second year the decrease in risk was similar in both treatment communities. These results strongly suggested that comprehensive educational programs directed at entire communities may be very effective in reducing the risk of cardiovascular disease (15, 31).

The risk reduction achieved in the test communities exceeded that in the reference town by margins fairly similar to the ones described for the North Karelia Project. Among the intensive instruction samples greater changes occurred, especially in the proportion of smokers who quit smoking by the end of the second and third years. The study was terminated as planned after three years, with the third year involving a reduced educational program. Effects were well maintained during this third year (19, 70).

These results encouraged the Stanford Heart Disease Prevention Project (SHDPP) to initiate a more ambitious study, known as the Five City Project (FCP) (12, 13). In this investigation, begun in 1978, two larger cities were selected for educational intervention, and three were assigned for reference. Since the total populations of the five cities was approximately 350,000 people,

with a modest expectation of risk reduction it was anticipated that significant reduction in morbidity and mortality could also be obtained if the study were to last nine years. Because a self-sustaining program in the community was sought, and because of the success of the North Karelia Project in utilizing community organization in its effort, the aim was to enhance and systematize the community organization program in the FCP. Preliminary mid-course results on risk reduction are encouraging and indicate another replication of the success in community education for risk reduction (14).

Since the completion of the Stanford Three Community Study and the first five years of the North Karelia Study, several other multi-risk factor studies have been launched—all with an emphasis on community-wide comprehensive health educational programs designed to reduce risk and, in some cases, morbidity and mortality. These studies are on the north coast of New South Wales in Australia, near Capetown in South Africa, and in Heidelberg in the Federal Republic of Germany, as well as in Minnesota, Rhode Island, and Pennsylvania in the US. The studies in Minnesota and Rhode Island are large, comprehensive, and long-term. The three US studies of Stanford, Minnesota, and Rhode Island are linked through their common federal funding resources and through shared methodology for outcome evaluations.

A number of additional studies are being planned or are already under way in Europe (e.g. Italy, Yugoslavia, GDR, Portugal, USSR, Hungary, Norway) or elsewhere (e.g. Cuba, People's Republic of China, Israel). Many of these studies are comparable to the previously mentioned studies, but some of them lack a formal reference area or concentrate on persons at high risk of disease rather than on the community as a whole. Some communities are too small to measure changes in disease rates, hence these studies are concerned with changes in behavior and risk factors only.

Table 10 lists the some of these projects, best documented internationally, and indicates the country in which the study has been taking place, the years of community education, the number of communities involved, and their populations. Randomization of communities was employed only in the Swiss study (20). Reductions in cardiovascular risk factors have been observed in several studies, but so far significant morbidity and mortality changes have been observed only in the North Karelia Project, which also has the longest follow-up. During the next few years, many findings as well as new challenges will emerge from the ongoing studies.

CONCLUSIONS

There has for long been little question about the role of smoking and elevated blood pressure in the development of CVD. The results of the LRC study have also firmly established the importance of elevated serum cholesterol as a CHD

Table 10 Community-based multifactor CVD risk reduction/CVD risk factor studies[a]

Description	Country	Years of education	Reference
1. North Karelia Project: two counties, one treatment, one reference, n = 433,000.	Finland	1972–1982	Puska et al 1981, 1983
2. Stanford Three Community Study: three towns, two treatments, one reference, n = 45,000.	USA (California)	1972–1975	Farquhar et al 1977
3. North Coast Project: three towns, two treatments, one reference, n = 70,000.	Australia	1977–1980	Eggers 1978
4. Swiss National Research program: four towns, two treatments, two references, n = 40,000.	Switzerland	1978–1980	Gutzwiller et al 1979
5. Community Health Improvement Project: two counties, one treatment, one reference, n = 224,000.	USA (Pennsylvania)	1979–1986	Stolley & Stunkard 1980[b]
6. Eberbach-Wiesloch Project: three towns, two treatments, one reference, n = 30,000.	Federal Republic of Germany	1976–1990	Nussel 1981[b]
7. South African Study: three towns, two treatments, one reference, n = 16,000.	South Africa	1980–1983	Rossouw 1981
8. Stanford Five City Project: five cities, two treatments, three references, n = 350,000.	USA (California)	1980–1986	Farquhar 1978
9. Minnesota Heart Health Study: two towns, two cities, two suburbs, paired treatment and reference, n = 356,000.	USA (Minnesota)	1982–1989	Blackburn 1980
10. Pawtucket Heart Health Study: two cities, one treatment, one reference, n = 173,000.	USA (Rhode Island & Massachusetts)	1982–1986	Carleton 1980

[a]This list is necessarily incomplete and represents projects personally known to the authors of studies based on communities, including at least one reference area, and involving use of comprehensive public health education and community organization methods.

[b]Personal communication.

risk factor. Now the question is whether such changes should concern only people with high risk or the entire population, and if the latter, how can such changes be promoted in the population?

We feel that even if we question some of the given evidence, we have good reason to promote general risk factor reductions in whole populations. Stopping smoking has many health benefits; reduction of obesity and increasing vegetable and fiber consumption are likely to be beneficial; and treatment of hypertension is warranted. People should be helped to make changes that a great proportion of them want and that reduce the risk of several chronic diseases and premature death, and promote health. These factors are common in the community and are closely linked with lifestyles. Any intervention limited to a small group of people at high risk cannot alone have much of a long-term community impact. In community-based interventions people themselves ultimately make the decisions about their health practices and lifestyles. The proposed changes, recommended for example by a recent WHO expert group (69) on the prevention of CHD, are moderate and safe, can be enjoyable, and are likely to reduce the risk of several major noncommunicable diseases and promote health in general. People have a right to this information and to be helped to make such changes.

We conclude from our results and experiences in the North Karelia Project that well-conceived community-based programs can have an important impact on life styles and risk factor levels in the population. With a sustained program it is also possible to maintain these more favorable levels over a long period. These changes result in reduced rates of cardiovascular disease and improved health and well-being among the entire population. A major community-based intervention study can also act as a powerful demonstration project to enhance nationwide reductions in risk factors and control of the cardiovascular disease epidemic.

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