Can a sustainable community intervention reduce the health gap? — 10-Year evaluation of a Swedish community intervention program for the prevention of cardiovascular disease

Lars Weinehall¹, Gideon Hellsten², Kurt Boman¹,³, Göran Hallmans⁴, Kjell Asplund⁵ and Stig Wall¹

¹Epidemiology, Department of Public Health and Clinical Medicine, Umeå University, Umeå, Sweden, ²Norsjö Primary Health Care Centre, Norsjö, Sweden, ³Department of Medicine, Skellefteå County Hospital, Skellefteå, Sweden, ⁴Nutritional Research, Department of Public Health and Clinical Medicine, Umeå University, Umeå, Sweden, ⁵Internal Medicine, Department of Public Health and Clinical Medicine, Umeå University, Umeå, Sweden


Objectives: This paper evaluates the 10-year outcomes of a Northern Sweden community intervention program for the prevention of cardiovascular disease (CVD), with special reference to the social patterning of risk development.

Methods: Using a quasi-experimental design, trends in risk factors and predicted mortality in an intervention area (Norsjö municipality) are compared with those in a reference area (Northern Sweden region) by repeated independent cross-sectional surveys.

Results: There were significant differences in changes in total cholesterol level and systolic blood pressure between the intervention and reference populations. The predicted coronary heart disease mortality (based on the North Karelia risk equation), after adjustment for age and education, was reduced by 36% in the intervention area and by 1% in the reference area.

Conclusions: We conclude that a long-term community-based CVD prevention program which combines population and individual strategies can substantially promote a health shift in CVD risk in a high risk rural population. When evaluated for different social strata, we found no signs of an increasing health gap between socially privileged and less privileged groups. Socially less-privileged groups benefited the most from the present prevention program.

Key words: cardiovascular disease, community intervention, health promotion, prevention, primary health care, social factors.

Lars Weinehall, Epidemiology, Department of Public Health and Clinical Medicine, Umeå University, S-901 85 Umeå, Sweden. Tel.: +46 90 785 2731, fax: +46 90 13 89 77, e-mail: Lars.Weinehall@epiph.umu.se

BACKGROUND

In the US as well as in Europe, prevention programs using a population-oriented strategy to focus on cardiovascular risk factors have aimed to increase public awareness of lifestyle behaviors and encourage alterations of these behaviors to shift the risk of the entire population to a lower level (1–4). This has also been a major theme in several national as well as international health strategy documents (5–8). Prospective studies in different populations over the past 30 years have addressed the correlation between cardiovascular disease (CVD) risk factors and CVD morbidity and mortality (9). There has been broad scientific agreement that smoking, hypercholesterolemia, and hypertension should be considered factors of major importance for the prevalence of CVD (10). There is, however, increasing concern regarding a widening social gap in CVD mortality (11–15). In the US (14) as well as in Finland (15) these social inequalities have been reported to increase with a substantial decline in CVD mortality during the last few decades.

Community intervention (CI) programs have usually attempted to create joint ventures between different health-promoting agencies in the local targeted community. In many programs, however, it has been difficult to integrate the healthcare sector into the programs (16), despite an understanding that support from health professionals might add necessary legitimacy to the intervention (17).

The Province of Västerbotten in Northern Sweden has, in relation to the rest of the country, higher CVD incidence and mortality rates (18). A long-term CVD prevention program, the Västerbotten intervention program (VIP), was initiated in 1985. Simultaneous with...
the launch of the VIP, the two northern-most provinces of Sweden, Norrbotten and Västerbotten, joined the WHO MONICA Project, forming the Northern Sweden MONICA Study (19, 20).

As an evaluation strategy, a geographically well-defined local area (Norsjö municipality) was selected as the study population and Northern Sweden (based on the Northern Sweden MONICA surveys) was selected as the reference population (21).

Previously, results from the first 6 years of the Norsjö programme documented a significant reduction in hypercholesterolemia in all social strata in the intervention area (22).

AIM
The aim of this paper is to evaluate the 10-year outcome of the Norsjö programme, with special reference to the social patterning of the risk factor changes.

MATERIAL AND METHODS

Intervention program and setting
In Sweden the provincial County Councils are responsible for providing healthcare, while the municipalities are responsible for environmental protection, child welfare, education, caring for the elderly, nursing homes, facilities for leisure time activities, and other social needs. The single municipality focused on in this article, Norsjö, is one of the smaller municipalities, and constitutes a rural district. Compared to Västerbotten County as a whole, the CVD mortality was significantly higher in Norsjö during the 1970s (23), providing the rationale for launching a CVD intervention program in 1985 under the auspices of the provincial County Council. The planning process and the initial phase of the Norsjö programme have been documented elsewhere (24).

Study design
Risk factor changes in people exposed to the CI program between 1985 and 1994 (the intervention area) will be compared to risk factor levels in a population not receiving any of these specific interventions, i.e. that of the Northern Sweden MONICA surveys (the reference area). The quasi-experimental evaluation design is based on comparisons between data from 10-yearly, independent cross-sectional surveys in the intervention area, and data from three repeated cross-sectional surveys in the reference area. The surveys in the intervention area were carried out during October and November of each year, while the surveys in the reference area were carried out between January and April. To reduce random variability, cross-sectional risk factor data from the intervention area were combined two by two years (Figure 1). To compare changes in estimated risk over time, data from the combined 1985, 1986, and 1987 surveys in the intervention area were compared to the 1986 Northern Sweden MONICA survey, data from the combined 1988, 1989, 1990, and 1991 surveys in the intervention area were compared to the 1990 Northern Sweden MONICA survey, and data from the combined 1992, 1993, and 1994 surveys in the intervention area were compared to the 1994 Northern Sweden MONICA survey.

Population-based health promotion activities
The population-based intervention concentrated on messages about lifestyle factors (i.e. eating habits, alcohol use, physical activity, social networking, and emotional support) and was carried out by local associations, sports clubs, the media, and food retailers (22, 25). Special attention was paid to questions on nutrition. The different components of the Norsjö intervention programme have previously been reported (26).

On the whole, the preventive work in Norsjö was accomplished within the framework of the existing community organizations and with almost no additional financial support. According to the health economic evaluation of the program, the estimated per capita cost per year was 90 SEK (approximately £8) (27).

Individually oriented disease prevention activities
The individual strategy focused on traditional risk factors (principally plasma lipids, blood pressure, and smoking) in defined age groups. All people aged 30, 40, 50, and 60 years were invited annually to a health provider survey focusing on the traditional risk factors for CVD. More than 90% of people invited participated in the 10 consecutive cross-sectional surveys (26). As the health examination was intended to be an integral part of the community-based activities and, thereby, serve as an opportunity for health communication, it was decided that the individual counseling performed by family physicians, district nurses, and dietitians should include all age-eligible participants and not only individuals at higher CVD risk. Therefore all participants were individually given verbal information about their test results and provided with appropriate medical counseling.

Among those screened for risk factors, individuals at higher risk received further medical and lifestyle advice according to the project guidelines. The ordinary medical services at the health center took care of those in need of medical treatment.
Reference population

The two counties of Norrbotten and Västerbotten in Northern Sweden, with a total population of 510,000, served, through the Northern Sweden MONICA Project, as the reference area. An age-stratified random sample of 2,000 inhabitants from the reference area, aged 25–64 years, was selected from the population registers in 1986, 1990, and 1994; they were invited to take part in screening examinations for cardiovascular risk factors. The participation rate ranged from 76.7% to 81.3% (26). Detailed analyses of non-participants have been reported elsewhere (28). The health surveys in Norsjö were modeled to allow comparisons with the MONICA study, and the MONICA Project Manual for health surveys was also used for the guidance of the surveys in the intervention area. To reduce measurement bias, the health survey teams of the Northern Sweden MONICA study and the Norsjö programme participated in joint training and practice courses.

Definition of variables and data collection procedures

Marital status was classified into two groups: single (also including divorced, widow/widower); and married (including persons living in a consensual union). Education covered total years at school. Low education is here referred to as 0–9 years at school, while ≥ 10 years at school indicates a medium-to-high education level. Blood pressure levels were recorded by means of a mercury random-zero sphygmomanometer with the subject in a sitting position. Hypertension was defined as systolic blood pressure ≥ 160 mmHg and/or diastolic blood pressure ≥ 95 mmHg and/or reported use of anti-hypertensive medication during a period of 14 days before the health survey. Blood samples for total cholesterol determination were obtained after a minimum of 4 h of fasting and were stored in a deep-freeze blood bank at −80°C. Samples from each subject from the different cross-sectional and panel surveys were analyzed twice on the same occasion. Smokers were defined as those reporting daily smoking of cigarettes, cigarillos, cigars, or a pipe. Those who reported that they were “occasional smokers” were classified as non-smokers. The above methods were identical to those used in the reference population.

Statistics

High risk factor patterns were assessed in terms of odds ratios adjusted for confounding factors in logistic regression analysis. Time trends within the different cross-sectional surveys were assessed by linear regression in each study, while the significance of the differences in changes between the studies was assessed by ANOVA. A p-value of <0.05 was regarded as statistically significant. The risk calculation predicting coronary heart disease (CHD) mortality was based on data from the 20-year evaluation of the North Karelia Project and includes age, gender, total cholesterol, diastolic blood pressure, and daily smoking (29).

Approvals

The study was approved by the Research Ethics Committee at Umeå University and the data handling procedures by the National Computer Data Inspection Board.

RESULTS

Means

A summary of the changes in risk factor levels between the 10 consecutive cross-sectional surveys in the intervention and reference areas is shown in table I. At the start of the prevention program, total cholesterol levels were very high in the intervention area (mean 6.81 mmol/l), significantly higher than those in the reference population. They showed a statistically significant 10-year declining trend among men as well as women in both the intervention and reference areas (p<0.001). However, there was a significant difference in the amount of change in the total cholesterol level (p<0.001 for both men and women) between the intervention and reference populations, as tested by...
comparing trends between equivalent years. In the intervention area the reduction in the mean total cholesterol level was 12% for males and 11% for females, compared to reductions of 4% and 6%, respectively, in the reference area.

With regard to systolic blood pressure, there was a significant difference in the amount of change between the intervention and reference populations ($p<0.01$ for men and $p<0.05$ for women), while for diastolic blood pressure a significant difference in the amount of change was present only among men ($p<0.01$) (Table I). The proportions of individuals receiving antihypertensive pharmacological treatment did not change significantly during the 10 years of intervention reported in this study (data not shown).

The proportion of daily smokers did not change significantly in the intervention area during the evaluated 10-year period. In the reference area, however, significantly fewer men smoked in 1994 than in 1986 and 1990 (Table I).

**High risk individuals in different social strata**

In terms of odds ratios, the decline in hypercholesterolemia was significant in both areas. Consistent patterns were shown when analyzing changes by social categories. This is illustrated in Figure 2, which shows no indication of an increasing gap in risk between men and women, between married and single persons, or between those with high and low education. The magnitude of change was, however, significantly larger in the intervention area.

**Predicting CHD mortality**

To summarize the combined effects of the risk factor changes, a model based on data from the North Karelia Project was used (30). This risk equation was used as a summing measure based on the included risk factors, rather than to predict future development of the disease. According to this estimation the crude probability of CHD mortality was predicted to be reduced by 34% in the intervention area ($p<0.001$) and by 12% in the reference area ($p=0.069$). A similar pattern could be seen for males and females separately (Table II).

When stratifying for educational level the pattern of age-adjusted estimated risk was very different in the intervention area compared to the reference area: the gap between the privileged (high education) group and less privileged (low education) group was reduced by 18% in the intervention area but increased by 27% in the reference area (Figure 3). After adjustment for age and education, the predicted risk reduction was 36% in the intervention area and 1% in the reference area (Table II).

**DISCUSSION**

In this small Northern Sweden rural community we suggest long-term community intervention to be effective in influencing major CVD risk factors. Compared to the Northern Sweden MONICA reference population, reductions in cholesterol level and blood pressure were significantly more pronounced in the intervention area. These reductions occurred earlier in the intervention area, despite the intervention area representing a rural population perhaps slow to adopt secular trends. The changes were achieved not only among the better-educated individuals, as the decline in predicted risk was even more pronounced among those with less education.

When the 10-year intervention program was designed, the intention was to address eating habits as well as smoking, alcohol consumption, and physical activity. However, activities linked to food, cooking, diet, and lipids seemed to be those most appreciated in the local community. A content analysis of newspaper output during the first 4 years of the Norsjö programme illustrates the exposure, with 84% of the newspaper articles being related to food, cooking, and eating habits (25).

It has previously been reported that the Norsjö population approved of the intervention program (26). The participation rate was high both in the intervention area (90%) and in the reference area (79%), indicating acceptance of the program. It is possible that people’s willingness to attend the health surveys increased when invited by physicians and nurses they knew. It is also reasonable to assume that public awareness over the course of decades about CVD as a major health problem in this community was an important motivator. For instance, it has been demonstrated that participants in breast self-examination educational programs interact with their social network in the diffusion of the health message (31), and it is likely that the same process occurs among local community members in a rural area with many social ties.

In a recent review article, Sellers et al. (32) attempt to understand the variability in the effectiveness of community heart health intervention programs over the past 25 years. However, very few of the programs met the definition of a true CI program (one which aims to shift the risk factor distribution in a general population). Based on a meta-analysis of seven eligible programs, one of which is the Norsjö programme, they concluded that the variability is mainly a function of the nature of the intervention, how it is implemented,
Table I. Mean values for total cholesterol, diastolic and systolic blood pressure, and daily smoking in the intervention and reference areas. Standardized based on age distribution by gender in reference area in 1986

<table>
<thead>
<tr>
<th></th>
<th>Intervention area</th>
<th>Reference area</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. Mean</td>
<td>No. Mean</td>
<td>No. Mean</td>
<td>No. Mean</td>
<td>No. Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cholesterol (mmol/l)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>260  6.86</td>
<td>269  6.49</td>
<td>226  6.07</td>
<td>202  6.19</td>
<td>211  6.03</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>268  6.76</td>
<td>234  6.54</td>
<td>232  6.05</td>
<td>188  6.13</td>
<td>197  6.03</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diastolic BP (mmHg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>260  84.6</td>
<td>266  80.5</td>
<td>225  86.4</td>
<td>202  81.7</td>
<td>208  81.5</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>266  82.2</td>
<td>232  80.0</td>
<td>232  80.7</td>
<td>188  82.0</td>
<td>196  79.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic BP (mmHg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>160  130.0</td>
<td>266  125.3</td>
<td>225  128.2</td>
<td>202  123.7</td>
<td>208  123.3</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>266  128.4</td>
<td>232  125.7</td>
<td>232  123.5</td>
<td>188  123.9</td>
<td>196  121.1</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daily smoking (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>251  20</td>
<td>262  21</td>
<td>226  23</td>
<td>203  21</td>
<td>211  14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>266  21</td>
<td>231  24</td>
<td>232  25</td>
<td>188  21</td>
<td>198  22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05; **p<0.001.
and the population exposed to the intervention, as well as the way in which the intervention is evaluated.

**Use of primary care providers**

In the Norsjö intervention community, primary healthcare providers played an important role in the realization of the program, both as promoters of the overall prevention concept and as providers of screening and individual counseling. Thus it might be relevant to compare the Norsjö outcome with those of other programs that have actively integrated health sector providers into the intervention. In most of these programs, however, the role of the healthcare sector has been quite marginal (16).

Among reported CI programs with a quasi-experimental evaluation design, which have actively integrated the health sector into the intervention,
Table II. Trend for estimated CHD mortality risk (%) in intervention and reference areas. The risk estimation is based on data from North Karelia, Finland. Unadjusted, age-adjusted, education-adjusted, and joint age-and-education-adjusted estimates shown separately. All adjustments according to the distribution in the reference area in 1986.

<table>
<thead>
<tr>
<th>Intervention area</th>
<th>Reference area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimated risk</td>
</tr>
<tr>
<td>Crude</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>5.28</td>
</tr>
<tr>
<td>Women</td>
<td>2.45</td>
</tr>
<tr>
<td>Men</td>
<td>8.16</td>
</tr>
<tr>
<td>30–40 years</td>
<td>0.95</td>
</tr>
<tr>
<td>50–60 years</td>
<td>9.51</td>
</tr>
<tr>
<td>Age-adjusted*</td>
<td>5.38</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>7.98</td>
</tr>
<tr>
<td>Medium/high</td>
<td>2.61</td>
</tr>
<tr>
<td>Education-adjusted</td>
<td>5.30</td>
</tr>
<tr>
<td>Age-and-education-adjusted</td>
<td>5.46</td>
</tr>
<tr>
<td>Women</td>
<td>2.47</td>
</tr>
<tr>
<td>Men</td>
<td>8.60</td>
</tr>
</tbody>
</table>

*Risk equation for men: IHD = 1/(1 + e^{1.273 - 0.108 X age - 0.806 X smoking - 0.021 X diastolic blood pressure - 0.384 X total cholesterol})

Risk equation for women: IHD = 1/(1 + e^{1.490 - 0.104 X age - 1.240 X smoking - 0.0306 X diastolic blood pressure - 0.365 X total cholesterol}).
However, these experiences can be compared to other US secular trends, where social inequalities have been reported to be increasing in parallel with the decrease in CVD mortality (16).

Limitations
This study has some limitations. First, it was carried out in a local rural community with high CVD incidence and its results cannot simply be extrapolated to other communities. Second, when assessing change in a high risk population, the classical regression-to-the-mean effect may arise, i.e. the initial group of subjects with extreme values of, say, total cholesterol includes considerable random variation if based on a single measurement, and the extreme values are bound to be lower at a later date. In this study, however, we have refrained from analyzing subgroups selected on the basis of the outcome measure and, in order to decrease the influence of random variation, based the analyses on time periods rather than single years.

The Norsjö model is demanding in terms of time and effort. Even though the model, which combines population-oriented activities and individual counseling, has been estimated to be quite cost-effective (50), it has to be promoted year after year, as new age groups are included. Notably, the most challenging part is probably not repeating the health surveys, as they have the same design over the years, but constantly revitalizing the population-oriented activities by the use of new ideas, new methods, and new collaborators, and delivering old messages in contemporary new packages.

CONCLUSION
This study suggests that a key issue for sustainable prevention is to actively involve both the healthcare sector and healthcare providers within the larger framework of a CI program. By recognizing primary prevention in a community as a process of social change, and by providing an environment where public health players join forces, we suggest that local CIs can reach those most in need as well as the affluent and well-educated, thereby counteracting the apparently increasing socioeconomic gap in cardiovascular health.

ACKNOWLEDGEMENTS
This research was supported by grants from the Swedish Council for Planning and Co-ordination of Research and the Swedish National Public Health Institute. We thank the citizens in Norsjö who so willingly participated in the health examinations, the Norsjö Municipality Board for productive

*Scand J Public Health* 29 (suppl 56)
cooperation, and the personnel at the Norsjö Primary Care Center for individual preventive counseling, data collection, and fruitful collaboration. We thank Dr. Carol Lewis, Cooperstown, NY, for critical review of the manuscript and the County Council of Västerbotten for its persistence in maintaining the Västerbotten intervention program.

REFERENCES

32. Sellers DE, Crawford SL, Bullock K, McKinley JB. Understanding the variability in the effectiveness of

Scand J Public Health 29 (suppl 56)