

The Finnmark Intervention Study: Does community intervention work? Trends in CVD risk factors in Arctic Norway

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ABSTRACT

Aims: To investigate how a community-based intervention on cardiovascular risk score in Båtsfjord and Nordkapp, limited in time from 1988 to 1993, is influenced by the changes from 1974-1996.

Method: The study describes changes in CVD risk factors in three periods: 1974-1987 (before the intervention), 1987-1993 (short time after the intervention), and 1987-1996 (long time after the intervention). In every time period changes in the intervention municipalities Båtsfjord and Nordkapp were compared separately to changes in three control municipalities in independent cross-sectional analyses of all 40-42 year olds living in the two intervention and three control municipalities at the different points in time.

Results: There were no significant differences in risk factor change between intervention and control municipalities from 1974-1987 or from 1987-1996. In the period 1987-1993, average female systolic blood pressure in Båtsfjord decreased 6.9 mmHg, while it increased 4.1 mmHg in the control municipalities ($p=0.012$). Diastolic blood pressure also decreased 6.1 mmHg while it increased 4.6 mmHg in the control municipalities ($p=0.001$). Average male diastolic blood pressure fell 6 mmHg, while it increased 1.1 mmHg ($p=0.015$) in the control municipalities. Nordkapp did not differ from the control municipalities in the period 1987-1993, maybe due to low statistical power. All five communities together had a reduction in myocardial infarction risk score in the period 1974-1987 ($p<0.001$) in both sexes, but the reductions in risk score from 1987 to 1993 and from 1993 to 1996 were non-significant.

Conclusions: The Finnmark Intervention Study started when secular trends in cardiovascular risk factors had changed considerably already in a positive direction. After a decline in blood pressure in one municipality during the intervention period, risk factor levels merged to similar levels. Single interventions may have meagre effect, but the sum of separate intervention projects in Finnmark together with secular trends has probably played a role in the decline in cardiovascular risk factors from 1974.

INTRODUCTION

Since the registration of county-specific mortality started in Norway in 1871, the county of Finnmark in Arctic Norway has had a total mortality well above the national average.¹ This knowledge gave in 1974 rise to the first countywide cardiovascular disease (CVD) risk factor survey for both men and women in the country.² The CVD surveys have been repeated in Finnmark in 1977, 1987, 1990, 1993, and 1996 (The Finnmark Study).

In 1987, the fishing communities Båtsfjord and Nordkapp were invited to participate in a broad community-based intervention, the Finnmark Intervention Study. Previous studies of this cohort aged 20-62 in 1987, and participating in 1987 and 1993, gave the following main results: Båtsfjord had a more favourable development in systolic and diastolic blood pressure when compared to changes in three selected control municipalities³, and Nordkapp had more favourable changes in body-mass index and cholesterol.⁴

From before we know that large studies as the

North-Karelia Project, Stanford Five-City Project, the Minnesota Heart Health Program, and the Pawtucket Heart Health Program had effect on CVD risk factors.⁵⁻⁸ However, none of these studies have compared risk factor levels a long time before the intervention. Because of the repetitive surveys in the Finnmark Study, we have unique information about risk factor levels 13 years before the start of the Finnmark Intervention Study in 1988.

The aim of this study is to investigate the intervention in Båtsfjord (1988-1991) and Nordkapp (1988-1996) in a time perspective of 22 years by describing cardiovascular disease risk factor changes before, during and after the Finnmark Intervention Study.

MATERIAL AND METHOD

Material and design

The Finnmark Intervention Study (baseline 1987) had a quasi-experimental design. The intervention municipalities Båtsfjord (2500 inhabitants), and Nordkapp

(4000 inhabitants) were chosen based on local initiative, not random sampling. The control municipalities Loppa, Gamvik, and Måsøy (altogether 5000 inhabitants), were selected on the basis of similar age distribution, ethnic background, and reliance on fisheries. All municipalities were located on the coast of Finnmark – separated by deep fjords. The Finnmark Intervention Study used the data from the Finnmark Study (the third and fifth survey) for evaluation. The analyses in this paper use data from the following surveys: 1974 (first Finnmark survey), 1987 (baseline of the Finnmark Intervention Study), 1993 (end of parts of the Finnmark Intervention Study), and 1996 (the sixth Finnmark survey).

Population

The invited samples to the separate surveys in the Finnmark Study have been described previously.^{3,4,9} Although each survey included slightly differing age groups, all persons aged 40-42 were invited every time. This age group was therefore chosen for the present study, enabling us to do a cross-sectional study of the same age group in independent samples over the 22-year period. A person who had his/her systolic blood pressure measured was considered to have attended the examination. Attendance rates were higher in the early surveys than in the later ones. In 1974 84% of the males and 90% of the females attended, whereas only 51% of the males and 67% of the females attended in 1996 (table 1).

Registration of CVD risk factors

Each survey consisted of a physical examination and 1-3 questionnaires. In this paper we only use data from the physical examination and the first questionnaire (information about smoking). The first questionnaire was printed on the invitation letter and handed in at the examination. Trained personnel checked it for mistakes and misunderstanding. In 1974 and 1987 the question about smoking was as follows: Do you at the present smoke daily? If yes, do you smoke cigaret-

tes/cigars/pipe daily? In 1993 and 1996 the question was changed to: Do you smoke cigarettes daily/ do you smoke cigars daily/ do you smoke pipe daily? To analyse proportion of smokers from these latter surveys, these different types of smokers were combined.

Trained personnel measured blood pressure, weight, and height at all occasions according to a set protocol, and blood samples were taken for analyses of non-fasting blood lipids.² In the 1974 survey, blood pressure was measured twice with an Erca mercury sphygmomanometer. The last of the two was used in the analyses. From 1987, the blood pressure was measured three times using Dinamap, which records blood pressure automatically on the basis of oscillometry. The mean value of the two last measures was used for analysis. The conversion formula from Erca to Dinamap for systolic blood pressure and diastolic blood pressure is:¹⁰

- Systolic blood pressure Dinamap = (systolic blood pressure Erca – 4.963) / 0.968
- Diastolic blood pressure Dinamap = (diastolic blood pressure Erca – 23.291) / 0.754.

Throughout the 22-year period, blood samples were sent to the same laboratory. In 1987 the laboratory changed to an enzymatic method in the cholesterol analysis. The conversion formula from the old method to the enzymatic method is:¹¹

- Serum cholesterol (mmol/l) Enzymatic method = 0.92 * (old method) + 0.03.

The laboratory has used international standardisation laboratories as reference. Height and weight were measured to the nearest cm and half-kilogram.²

After the Norwegian Regional Ethical Committee was established, it has approved all the surveys in Finnmark.

Intervention

The interventions in Båtsfjord and Nordkapp during the Finnmark Intervention Study have been described extensively previously.^{3,4} In short they were as follows:

Table 1. The Finnmark Study 1974-96. Invited and attendees at the different surveys.

		1974		1987		1993		1996	
		Invited n	Attended n (%)						
Males	Båtsfjord	43	35 (81)	75	52 (69)	61	46 (75)	50	26 (52)
	Nordkapp	67	56 (84)	91	61 (67)	86	49 (57)	78	42 (54)
	Control	108	92 (85)	136	100 (74)	104	72 (69)	107	52 (49)
	Total	218	183 (84)	302	213 (71)	251	167 (67)	235	120 (51)
Females	Båtsfjord	48	42 (88)	59	49 (83)	44	34 (77)	42	30 (71)
	Nordkapp	81	73 (90)	68	57 (84)	74	62 (84)	65	45 (69)
	Control	66	60 (91)	94	80 (85)	86	61 (71)	69	43 (62)
	Total	195	175 (90)	221	186 (84)	204	157 (77)	176	118 (67)

Båtsfjord

The main aims were:

- To mobilise the inhabitants to participate in health promoting activities
- To change environmental factors influencing health
- To reduce CVD risk factors

Non-Government Organisations were invited to define health problems, suggest solutions, set priorities and agree upon responsibility for the different activities, and a wide variety of activities were arranged together with these organisations.^{13,14}

Individual counselling about diet, smoking, and physical activity was given to high-risk individuals detected at the surveys in 1987, 1990 and 1993, and in ordinary consultations with general practitioners.

Nordkapp

The main aims were:

- To reduce accidents and improve working conditions on fishing boats and in the fishing industry
- To reduce CVD risk factors

Focus was first centred on improvement of working conditions, while individual counselling was emphasised after 1990.

Outcome measurements

Mean cholesterol, systolic blood pressure, diastolic blood pressure, mean proportion of daily smokers, and a myocardial infarction risk-score are used as outcome measurements in this paper. The risk-score is a multiplicative model with a factor for serum cholesterol (range 1-25), systolic blood pressure (range 1-4.5), cigarettes smoked pr. day (range 1-4), and sex (males=5 and females=1). The National Health Screening Service has used this risk-score in its cardiovascular surveys from 1974 onwards.^{2,12} Some slight changes were made in the factor values for blood pressure and cigarettes, and a family factor was included in 1985. However, these adjustments have not been used for the scores in this paper.

Statistical power

The sample size was given by the Finnmark Study. We have calculated the differences possible to detect in all over time differences with this given sample size for some of the outcome measurements. With a power of 0.8 and a significance level of 0.05 it was 8 mmHg for systolic blood pressure, 6 mmHg for diastolic blood pressure, 0.7 mmol/l for cholesterol and a change of 25% points in the proportion of daily smokers.

Statistical analyses

All analyses were done on independent cross-sectional samples aged 40-42 years at the different surveys. Sex-specific multiple linear regression analyses were

carried out for the continuous variables with time and intervention/control municipality as predictors. Logistic regression analyses were carried out for smoking, the only dichotomous variable. In the regression analyses, a significant interaction between municipality and time-span means a different development in the respective intervention municipalities compared to the control municipalities. The risk-score is not normally distributed and was logarithmically transformed. The geometric mean was used in the analyses. The year 1987 (baseline for the intervention) and the control municipalities are reference points for the analyses. The two intervention municipalities are compared separately to the control municipalities during the different time-spans. The risk-score was used in a multiple linear regression analysis to examine the change in overall trend of the five municipalities over the 22-year period.

RESULTS

There were no differences in change in CVD risk factors between intervention and control municipalities from 1974 to 1987 or from 1987 to 1996 (table 2). In the period 1987-1993 (during the intervention), females in Båtsfjord reduced systolic blood pressure by 6.9 mmHg, while systolic blood pressure increased in the control municipalities by 4.1 mmHg ($p=0.012$). They also reduced diastolic blood pressure by 6.1 mmHg while diastolic blood pressure increased in the control municipalities by 4.6 mmHg ($p=0.001$). In the intervention period (1987-1993), males in Båtsfjord reduced diastolic blood pressure by 6 mmHg, while diastolic blood pressure increased in the control municipalities by 1.1 mmHg ($p=0.015$). This was the only difference found between Båtsfjord and control municipalities in any variable or time-span. Nordkapp did not differ from the control municipalities in any variable or time-span (table 2).

Multiple linear regression analyses of change in ln transformed risk-score showed an overall reduction between 1974 and 1987 of 17.6 ($p<0.000$) in males, and 1.7 in females ($p<0.000$). The overall reduction in risk-scores from 1987 to 1993 and from 1993 to 1996, were non-significant (figure 1).

DISCUSSION

The present study shows that the CVD risk factors in Finnmark County were undergoing substantial reductions before The Finnmark Intervention Study started in 1988. In spite of this the development in blood pressure in the intervention period was more favourable in Båtsfjord compared to the control municipalities, whereas no effects of the intervention were observed in Nordkapp. No differences between intervention and control municipalities were still discernible in 1996.

Bias

Selection bias

Possible selection bias in the choice of intervention and control municipalities has been discussed previously.^{3,4} In this long-term cross-sectional monitoring of risk factor developments it is important to evaluate whether the persons attending the surveys are representative of the underlying population. The attendance rate fell substantially from 1974 to 1996 (table 1). From previous studies of cohorts in the same population, we know that those only attending once smoked more.³ This might be a marker for an unhealthy life style among non-attendees. In that case the study would slightly exaggerate the improvements in CVD risk factors over the 22-year period. In the Oslo Health Study the overall prevalence of risk and disease estimates and the distribution of socio-demographic variables, changed very little after reminder rounds.¹⁶ Increasing the attendance rates from 60% to 70% did not have large impact on prevalence figures in the Norwegian Women and Cancer study.¹⁷ Most likely the reduction in attendance rate does not grossly change overall prevalence of risk factors.

Information bias

In all communities and through all the surveys, the blood testing was performed in the same manner and

the samples were analysed at the same laboratory. The analytic method of measuring cholesterol and the measuring method for blood pressure were changed from 1974 to 1987. The question on daily smoking was changed from 1987 to 1993. These changes were accounted for in the data analysis.

Self-reported smoking has been validated and judged as having high sensitivity and specificity among adults.¹⁸ The risk-score, called the Westlund myocardial infarction risk-score, has been validated and is found to show strong prediction of mortality in a 21 year follow up of the Oslo Study.¹⁹

Most data collected from the examination are prone to seasonal change. It has been an intention to perform the examinations in the various municipalities at the same time of the year throughout the whole period. This has been the case for the two first examinations and as far as possible for the four later examinations.

Comparison with other studies

No other intervention studies have data on their intervention and control population 13 years before the controlled intervention started. Neither of the previously mentioned community intervention studies had any possibility to set their intervention study into a longer pre-intervention time perspective.^{6-8,20} The North Karelia Project and the Stanford Five-City

Table 2. The Finnmark Study 1974-1996. Multiple Regression analyses of change in systolic blood pressure, cholesterol, and score ln. Logistic Regression analyses of change in proportion daily smokers. The year 1987, baseline for the intervention, is reference.

		Males				Females			
		Δ1974-1987	1987	Δ1987-1993	Δ1987-1996	Δ1974-1987	1987	Δ1987-1993	Δ1987-1996
Cholesterol mmol/l	Båtsfjord	-0.4	6.3	-0.3	-0.1	-0.9	5.7	0.0	0.1
	Nordkapp	-0.7	6.4	-0.5	-0.5	-0.7	6.1	-0.5	-0.6
	Control	-0.7	6.5	-0.2	-0.1	-0.4	6.2	-0.3	-0.3
	p for equality	0.701		0.465	0.364	0.237		0.481	0.140
SBP mmHg	Båtsfjord	2.8	138.5	-5.6	-1.1	-5.5	126.9	-6.9*	-0.1
	Nordkapp	-5.4	130.4	3.3	-0.3	-8.8	122.1	2.6	2.8
	Control	-1.4	135.2	-0.2	0.3	3.8	125.7	4.1	0.9
	p for equality	0.163		0.108	0.980	0.416		0.020	0.741
DBP mmHg	Båtsfjord	2.1	85.6	-6.0*	-1.8	2.6	80.7	-6.1*	-3.4
	Nordkapp	-1.7	78.8	2.6	-2.6	3.9	77.4	-0.8	-0.8
	Control	-0.2	82.7	1.1	-1.9	0.8	77.2	4.6	1.3
	p for equality	0.493		0.015	0.930	0.536		0.003	0.380
MI risk-score	Båtsfjord	-14.0	29.0	-6.0	-3.0	-2.4	3.1	-0.2	-0.1
	Nordkapp	-22.0	25.0	-1.0	-4.0	-2.4	3.7	-0.2	-0.7
	Control	-17.0	31.0	-3.0	-4.0	-0.6	4.2	-0.3	-0.7
	p for equality	0.598		0.823	0.867	0.112		0.992	0.797
Daily smoking percentage	Båtsfjord	-16.8	50.9	12.1	6.8	-21.4	46.0	24.6	7.3
	Nordkapp	-8.6	58.1	7.2	2.4	-6.8	62.1	10.5	2.3
	Control	-15.2	58.5	-0.2	-12.3	3.0	59.5	7.2	5.6
	p for equality	0.423		0.596	0.337	0.181		0.455	0.948

* The difference between Båtsfjord and Control municipalities is significant $p < 0.05$

Project have however, been able to demonstrate a persistent difference in risk factor levels up to 10 years after the intervention started. These were the earlier studies and the secular trends were not so strong. In the Minnesota Heart Health Program, no long-term risk factor differences were found. The researchers were surprised that secular trends were stronger than the hypothesised effect of the intervention. They conclude that the program was unable to generate enough additional exposure in a large enough proportion of the population to exceed the remarkably favourable secular trends.⁷

Discussion of results

The failure to show substantial long-term differences in risk factor levels between intervention and control municipalities might be due to:

- Strong general declining trends
- Crossover of intervention effects
- Failure of the intervention method (program, theory, measurement)

Strong general declining trends

This study has shown that the intervention study occurred within a strong decreasing trend in both intervention and control municipalities for cholesterol, blood pressure, daily smoking among males, and Westlund risk-score. The largest changes in coastal Finnmark had actually occurred before the intervention study started (figure 1). Health education and health promotion at various levels in the period 1974-1987 could partly be responsible for the downward trend. Repetitive health surveys as in the Finnmark Study could in itself prompt health-promoting behavioural

changes, which was one of the intentions in the Finnmark Study. In conjunction with the surveys the county medical officer was responsible for general health education. High-risk intervention was the responsibility of the local GP's. But low local interest in some communities, heavy workload for the GP's and a high turnover of health personnel, limited the intensity of these efforts.²¹ But despite this, the level of several risk factors greatly declined in Finnmark.²²

Crossover of intervention effects

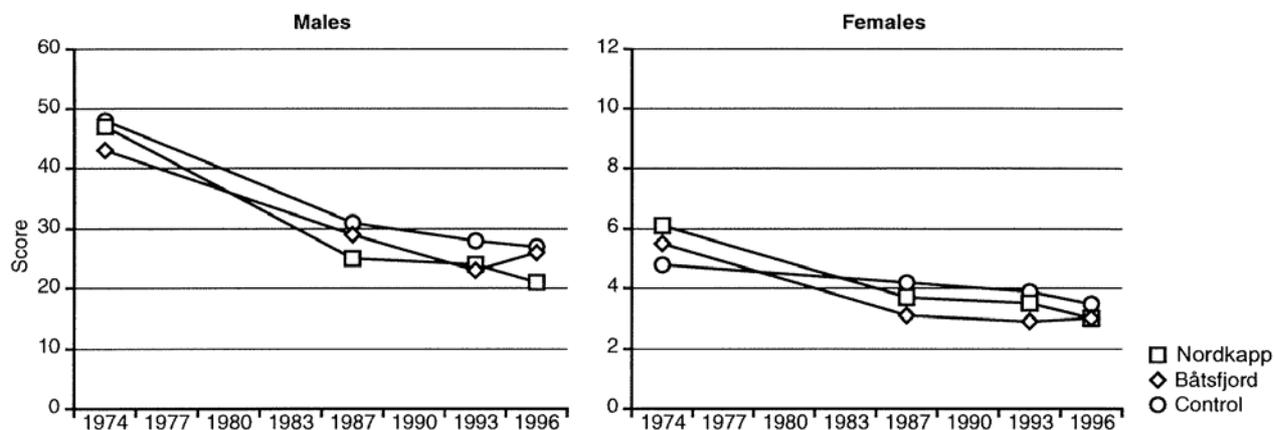
We have previously described the possible crossover effect present in this intervention study.^{3,4} Although some crossover is inevitable, we think the geography and communication of the county, minimized this effect in the intervention period. But after the intervention period, people in the control municipalities might have adopted some of the messages, thus camouflaging possible long-lasting effects of the intervention. Such a "delayed change" in the control municipalities was observed regarding coffee drinking. The inhabitants in the intervention municipalities made a marked change from boiled to filter coffee between 1987 and 1990 after information about the association between cholesterol and boiled coffee. The corresponding change happened in the control municipalities between 1990 and 1993.²³

Possible faults of the intervention method

According to Green and Lewis an evaluation may fail to detect an acceptable level of change due to program failure, theory failure, and/or measurement failure.²⁴

Program failure and theory failure have been extensively discussed in the process evaluation of the intervention.²⁵ In short we would like to elucidate

Figure 1. The Finnmark Intervention study 1974-1996. Change in geometric mean of Westlund myocardial infarction score in cross-sectional samples of 40-42 year olds. Multiple linear regression analyses of ln transformed score.



No difference between municipalities in any time span, both sexes. All over time difference between 1974 and 1987, both sexes, $p < 0.000$. All over time difference in the periods 1987-1993 and 1993-1996, n.s.

some points. The theory of empowerment and bottom up strategies, which were used in the interventions, was difficult to implement in the hierarchical structure of the health service, the local public administration and the fisheries dominated by private enterprise. In addition, the project leaders did not fully understand the theoretical base for this approach. On the other hand this approach released unknown strengths among individuals and organisations, very useful for the fulfilment of the interventions. The theoretical basis was probably sound enough, but there was a lack of clear strategy as to how one should proceed through the different phases of the intervention. The road was made as we moved on, so to speak.

The intervention in Båtsfjord was terminated in the summer 1991. A possible programme failure could be that the intervention lasted too short. It takes time to change life-style and even longer time to observe population-based changes in risk factors.²⁴ Another type of programme failure could be the crossover of intervention effects which has been discussed above.

The National Health Screening Service decided to a large extent the basis sample size. Due to the bottom up structure of the project, intervention also happened in age groups not selected for analysis. If the intervention effect more or less had been confined to the age groups not included in the relevant survey, a type II error would have been presented. We have, however, little reason to believe that the analysed age groups have not been affected by the intervention.

Another possible measurement failure could be low statistical power. The sample size of the analysed 40-42 years old was small and the differences possible to detect within this given sample size is probably larger than we could expect to achieve through an intervention of this type. The age group 40-49 years also met at all surveys, but this group was a mixture of dependent and independent observations. The methods available for such analyses are complicated and for this reason we restrained from using them. Low power of the analyses might be the reason for no significant changes found in Nordkapp and the few changes found in Båtsfjord during the interventions period. Other possible measurement failures have been discussed under information bias.

The reason why not further effects were found was probably due to a combination of strong secular trend, crossover and weakness in program and theory. On the other hand, small interventions like the present one might be important catalysts for general secular trends and for agenda setting, as seen in the question of change from boiling coffee.

In the more comprehensive North Karelia project a reduction in smoking and blood pressure compared to the reference population was seen during the first 10 years of intervention.²⁶ Later the differences between

intervention and control municipalities disappeared. The North Karelia Project functioned, however, as a national demonstration program and gave rise to national activities in the prevention of CVD.²⁰ This could be a contributing cause to the much steeper reduction in cardiovascular mortality in Finland than in the rest of Scandinavia. On a much smaller scale the Norwegian situation is similar. In 1974, the males in Finnmark had the highest risk-score in the country, double the level in the county of Sogn & Fjordane on the west coast. In 1996 the risk-score in Finnmark was only 1.5 times higher.²⁷

In a paper about health promotion research Aarø discusses the fact that many health education efforts have been evaluated, often with meagre results.²⁸ He claims that although behavioural change seen after a single, separate intervention often is negligible, the sum of such actions leads to gradual changes in the climate of opinions and social norms. Together with the secular trend caused by a lot of factors at national, regional and community level, the sum of separate, limited intervention projects in Finnmark have probably played an important role in the considerable decline in CVD risk factors which have taken place since the early seventies.

We do not know whether the Finnmark Intervention Study in itself has contributed to the general secular trend in the area. But the total of the different ways of focusing the problem of high cardiovascular mortality throughout the 22 years might have resulted in the steeper reduction in the Westlund MI risk-score in Finnmark than in Sogn & Fjordane.

CONCLUSION

The Finnmark intervention started when secular trends in coronary risk factors already had changed considerably in a positive direction. After a decline in blood pressure in one municipality during the intervention period, risk factor levels again merged to similar levels. The secular trend is, however, the result of more comprehensive health promotion activities and smaller interventions, like the one in Arctic Norway. The future of community interventions should therefore be looked upon in a broader perspective than the results of this single intervention.

ACKNOWLEDGEMENT

The Programme "Health and Inequality in Finnmark", The Department of Social Affairs and Health, The Programme for "Research and Development in Primary Health Care in North Norway", The National Health Association, and the University of Tromsø, founded and supported this work. The National Health Screening Service collected the data and prepared the files throughout the 22 years. We thank them all for their contributions.

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