

Blood Pressure, Sodium Intake, and Hypertension Control

Lessons From the North Karelia Project



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ABSTRACT

From the very beginning of the North Karelia Project, prevention, detection, and control of hypertension were included as key aims in the project. An intensive hypertension prevention and control program was established in North Karelia in 1972 that included community-based activities to reduce blood pressure levels in the entire population, detect people with hypertension, improve their treatment, establish standard diagnostic and therapeutic methods, and to monitor blood pressure levels, control of hypertension, and the performance of the health care. After the first 5 years of the project, most of these activities were also implemented on the national level. In late 1970s, work to reduce the salt intake was started, and substantial reductions have taken place in salt intake in the Finnish population. Remarkable improvements have been seen both in blood pressure levels and in treatment and control of hypertension in North Karelia and in the whole of Finland. Between 1972 and 2012 in North Karelia, the mean systolic blood pressure among 30- to 59-year-old men has decreased from 149 mm Hg to 135 mm Hg and among women from 153 mm Hg to 129 mm Hg. The decreases in mean diastolic blood pressure have been from 92 mm Hg to 84 mm Hg among men and from 92 mm Hg to 79 mm Hg among women.

Elevated blood pressure is regarded as the most important risk factor contributing both to mortality and disability adjusted life-years at the global level including the developing world [1,2]. In 2010, based on the Global Burden of Disease Study, the 3 leading risk factors for global disease burden were high blood pressure (7.0% of global disability-adjusted life-years), tobacco smoking (6.3%), and alcohol abuse (5.5%). In 2013, dietary risks and high systolic blood pressure were the 2 risk factors both accounting for >7.5% of disability-adjusted life-years.

The relation of blood pressure to the development of stroke has been well-known and that to coronary heart disease was first reported by Kagan et al in the 1950s from the Framingham Heart Study [3]. The efficacy of antihypertensive drug treatment on cardiovascular morbidity and mortality was revealed much later in the 1960s first in the Veterans Administration Cooperative Study [4]. Even in the early 1970s, treatment of hypertension in Finland had been mainly treatment of very high blood pressure levels and acute events of hypertensive crisis with nitroprusside infusion. As understanding of the effects of hypertension control in the prevention of cardiovascular diseases increased the development and the use of antihypertensive medication increased rapidly. The national Social Insurance Institution established a new policy to reimburse drug costs for several diseases, including hypertension in 1964. This enabled wide scale treatment

of hypertension in Finland in principle. However, the majority of people with hypertension were undetected, and no systematic case detection and long-term management plan existed.

At the same time, in late the 1960s and early 1970s, high blood pressure levels and poor control of hypertension were reported in many populations [5-8]. In many countries, roughly one-half of the individuals with hypertension were aware of their elevated blood pressure levels and one-half were obtaining treatment, but only one-half of those treated were controlled adequately [7,8]. This was called “the rule of halves.” There was globally a clear need for both the reduction of blood pressure levels in the populations as well as improvements in organizing hypertension care.

BLOOD PRESSURE AND HYPERTENSION IN NORTH KARELIA IN THE 1970s

In the beginning of the community-based cardiovascular disease prevention program in North Karelia the population survey was carried out to assess the baseline levels of main risk factors. The study was carried out in spring 1972. From the population aged 25 to 59 years, a 6.6% random sample was drawn from the National Population Register. The participation rate was 94%.

According to the baseline survey, the situation in North Karelia was comparable with many international

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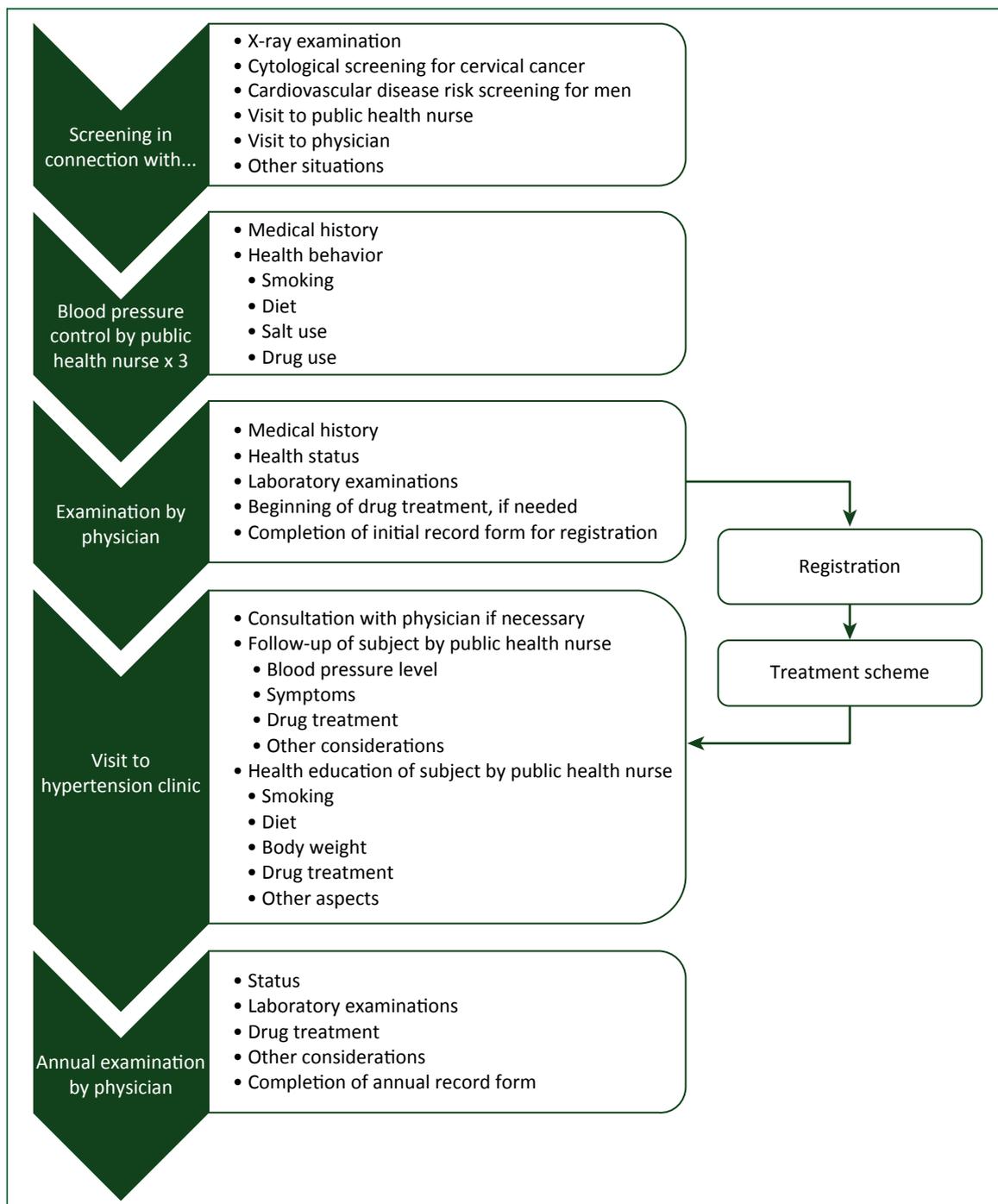


FIGURE 1. The scheme for the follow-up of hypertensives developed in the hypertension program of the North Karelia Project in early 1970s. Figure prepared using data from Nissinen et al. [14].

studies. The mean systolic blood pressure among 25- to 59-year-old men in North Karelia was 147 mm Hg and among women 149 mm Hg. The mean diastolic blood pressure was 91 mm Hg both among men and women [9].

In North Karelia, systolic blood pressure of ≥ 160 mm Hg was found in 23% of men and 31% of women and diastolic blood pressure of ≥ 95 mm Hg in 34% of men and 36% of women [10].

PRINCIPLES OF THE PREVENTION AND CONTROL OF HYPERTENSION CONTROL IN THE NORTH KARELIA PROJECT

At the same time with the establishment of the North Karelia Project in 1971 the World Health Organization expert group proposed a collaborative global study of community-based pilot programs for hypertension control [11]. Altogether, 16 centers joined the study, including North Karelia where such a program was started as part of the North Karelia Project.

The main aim of the hypertension program in North Karelia was to reduce the high blood pressure among the whole population. The more specific objectives were to 1) detect as many of the hypertensives as possible, 2) control blood pressure among as many of them as possible, 3) establish uniform and appropriate diagnostic and therapeutic methods among physicians, and 4) gather information about the epidemiology of hypertension and on hypertension-related functions in health services. The program activities were targeted both at the entire population and hypertensive patients [12-14].

Health education on hypertension targeted to the whole population was organized as part of the project's general health education program [13-15]. The education emphasized hypertension as a risk factor for cardiovascular diseases and the importance of active and effective treatment of hypertension; services were developed for screening, treatment, and monitoring of hypertension. The main channels used were regional and local newspapers and radio. Of about 1500 articles about prevention of cardiovascular diseases published in newspapers during the first 5 years of the project, 53 tackled hypertension as the main topic [14]. Health education material was also delivered at health centers and distributed through pharmaceutical companies and the Finnish Heart Association. Some 100,000 copies related to hypertension were delivered and in 1977 about 25% of participants in the follow-up survey reported having read this leaflet [14].

Most patients with hypertension were treated at local community health centers. Service development included establishment of special hypertension clinics in each local health center in North Karelia [12-15]. Clinics were run by public health nurses trained by the project. This was justified by the large number of patients making it impossible to organize the services solely by physicians. The nurses took care of screenings, follow-up assessments, compliance monitoring, and dietary counseling. Usually patients visited nurses 2 to 3 times a year (Fig. 1). The physicians' responsibility was to decide on drug treatments and clinical evaluation of patients. The nurses working in these hypertension clinics were also involved in training of the other health personnel emphasizing the streamlining of diagnostics, monitoring, and treatment of hypertension and other activities in the health centers. Among other things, the standardization of methodology included checking of the quality of the

sphygmomanometers used in the health centers by project staff [14].

The training of nurses for hypertension control was a novel idea in Finland [16] and elsewhere [17]. At the beginning of the project, an intensive 1-week course in hypertension control was held with participation of at least one nurse from each community [14]. After the course, the project staff discussed with nurses from each health center how to establish their hypertension clinic. During the program, nurses responsible for the hypertension clinics met twice a year to discuss and share experiences and solve common problems. During these meetings, continuing education on hypertension and cardiovascular prevention was organized. Physicians were trained through separate seminars twice a year. Frequent personal contact by the project staff to local health centers were arranged throughout the project period. The knowledge of visiting international experts was utilized in training of health professionals. "Guidelines for Diagnosis, Treatment, and Follow-up of People with Hypertension" was prepared by the coordinating center of the project and distributed to both physicians and nurses working in health centers. Other material, including 12 pamphlets related to different aspects of hypertension control, were prepared and distributed during the first 5 years of the project.

EFFECTS OF THE HYPERTENSION CONTROL IN NORTH KARELIA BETWEEN 1972 AND 1977

Effects of the North Karelia Project were evaluated by population risk factor and health behavior surveys, myocardial infarction and stroke registers, and following death rates from the national Causes of Death register. Population risk factor surveys that included the measurement of blood pressure were organized during the primary project period in the beginning of the project in 1972, and then in 1977 in the province of North Karelia and in the neighboring Kuopio province, which was selected as the reference area. In 1972, the sample was 6.6% of population aged 25 to 59 years in both areas and in 1977 6.6% of the population aged 30 to 64 years. Participation rates in these surveys were extremely good being about 90% in both study areas in both surveys [12].

Changes in blood pressure levels were assessed for the common age group of both surveys, the 30 to 59 years old (Table 1). In North Karelia, the decrease in both systolic and diastolic blood pressure levels during the 5-year period was greater than in the reference area both in men and women [12]. In men, systolic blood pressure decreased in North Karelia from 149 to 143 mm Hg; in the reference area, no change was observed mean systolic blood pressure being 146 mm Hg in both surveys. In women, the decrease in systolic blood pressure in North Karelia was from 153 to 141 mm Hg compared with 147 and 143 mm Hg in the reference area. The diastolic blood pressure decreased in men in North Karelia from 92 to 89 mm Hg and again in the reference area no change was observed diastolic blood

TABLE 1. Systolic and diastolic blood pressure among 30- to 59-year-old men and women

	North Karelia		Reference Area	
	1972	1977	1972	1977
Men				
Systolic blood pressure, mm Hg	149 ± 0.5	143 ± 0.4	146 ± 0.4	146 ± 0.4
Diastolic blood pressure, mm Hg	92 ± 0.3	89 ± 0.3	93 ± 0.2	93 ± 0.2
Women				
Systolic blood pressure, mm Hg	153 ± 0.6	141 ± 0.5	147 ± 0.5	143 ± 0.4
Diastolic blood pressure, mm Hg	92 ± 0.3	86 ± 0.3	91 ± 0.2	89 ± 0.3

Data are presented as mean values ± standard error of the mean.
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pressure being 93 mm Hg in both surveys. In women, the decrease in North Karelia was from 92 to 86 mm Hg and in the reference area it remained unchanged at 91 mm Hg. The decrease was very similar in all age groups.

Awareness, treatment, and control levels improved (Fig. 2). The percentage of those hypertensives not aware of their hypertension decreased in men in North Karelia from 63% to 28%, whereas in the reference area the corresponding decrease was from 65% to 41% [12]. Among women, the corresponding percentages were in North Karelia 34% and 14% and in the reference area, 36% and 21%. The proportion of those treated and normotensive out of all hypertensives increased from 4% to 23% among men and from 5% to 40% among women in North Karelia and in the reference area from 3% to 10% in men and from 7% to 21% in women, respectively.

The effect of the program was evaluated also among cohort of hypertensive people at the baseline survey [18]. All those whose systolic blood pressure was ≥ 175 mm Hg

or diastolic blood pressure ≥ 100 mm Hg or who were taking antihypertensive medication at baseline in 1972 were invited for reexamination in 1977. From North Karelia, 71% of men and 81% of women and in Kuopio province 73% of men and 78% of women participated in this reexamination. The decrease in systolic blood pressure among this cohort was almost double in North Karelia compared with the reference area declining from 167 to 155 mm Hg among men in North Karelia compared with 165 to 160 mm Hg in the reference area. Among women, the respective results were from 177 to 160 mm Hg in North Karelia and 175 to 167 mm Hg in the reference area. Almost similar results were observed in diastolic blood pressure. The percentage of treated subjects increased in North Karelia from 13% to 41% among men and from 28% to 55% among women. The corresponding percentages in the reference area were 13% and 34% in men and 31% and 56% among women.

THE HYPERTENSION REGISTER

The Hypertension Register was established at the start of the hypertension program of the North Karelia Project. The purpose was to register all hypertensive persons in North Karelia to improve their monitoring, maintain the selected standards for treatment and follow-up, give rapid local feedback on the success of treatment and follow-up, and serve the evaluation needs of the project [13,14,19,20]. Case finding was based on measuring the blood pressure of all persons visiting a physician or a public health nurse [14,20]. Screening was also carried out for example in conjunction with radiographic screening for pulmonary tuberculosis.

From May 1972 to April 1977, a total of 17,022 hypertensive subjects were registered representing 9.7% of the total population in North Karelia and between 80% and 90% of the expected number of hypertensive patients [19,20]. Registered patients were followed annually. The proportion of dropouts at these annual follow-up examinations was about 10% to 20%. The percentage of people under antihypertensive drug treatment in the initial examination was 58% in men and 76% in women. At the third follow-up, the treatment rate was 87% in men and 84% in women.

The mean blood pressure of the registered patients decreased continuously throughout the subsequent years of follow-up [19]. The mean blood pressure levels was 176/102 mm Hg in the initial examination. A decrease of 19 mm Hg systolic and 10 mm Hg diastolic blood pressure was observed during the 3-year follow-up.

The use of drugs and achieved treatment levels were assessed among 8459 registered hypertension patients under drug treatment in 1978 and 1979 [21]. One antihypertensive drug was in use in 52% of men and 56% of women, whereas 39% of men and 38% of women were receiving 2 drugs: 54% of men and 57% of women were on diuretic therapy and 54% of men and 43% of women were

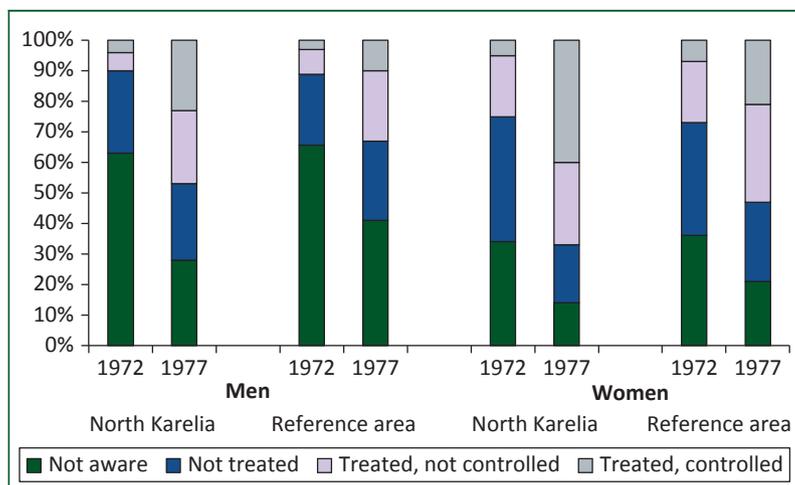


FIGURE 2. Hypertension among those 25 to 64 years old. Awareness, treatment, and control of hypertension among 25- to 64-year-old hypertensives (SBP ≥ 175 mm Hg and/or DBP ≥ 100 mm Hg or under antihypertensive medication) in North Karelia and in the reference area in 1972 and 1977. Reproduced with permission from Tuomilehto et al. [12].

receiving β -blockers. Other medications in use included methyl dopa, clonidine, vasodilators, and reserpine. Of these medicines, about 20% of both men and women used methyl dopa, but the use of other antihypertensive agents was quite rare. Among men, the lowest systolic blood pressure was observed among those using β -blockers alone and among women among those receiving combination therapy of β -blockers and methyl dopa. The lowest diastolic blood pressure levels both in men and women were observed among those taking a combination of diuretics, vasodilators, and reserpine.

LATER ACHIEVEMENTS IN HYPERTENSION CONTROL IN THE NORTH KARELIA PROJECT AND NATIONALLY

After the first 5 years of the North Karelia Project, activities were continued in North Karelia, and implementation of activities to improve hypertension care also started at the national level. The National Hypertension Committee was nominated by the Ministry of Health in 1976 [22]. The committee made recommendations for the detection, diagnosis, and treatment of patients and for training of personnel; in addition, recommendation for the prevention of hypertension in the entire population were made. The responsibilities of different authorities were defined with recommendation to have a local plan of hypertension control for each of the 12 provinces in Finland. In those recommendations, different normal blood pressure values and indications for treatment were given based on age. For the younger population, 120/80 mm Hg was considered normal and for older the level of 140/90 mm Hg. The definite indication for drug treatment was diastolic blood pressure of ≥ 110 mm Hg. Otherwise, consideration based on patient's age, cardiovascular risk factors and blood pressure levels was recommended. In addition to drugs, nonpharmacologic treatment was addressed. These first national recommendations took hypertension as a public health problem into the national agenda.

The population risk factor surveys were continued after the first 5 years of the North Karelia Project among population 25 to 64 years of age. The number of survey areas also increased to include southwestern Finland in 1982, capital area (cities of Helsinki and Vantaa) in 1992, and Oulu province in 1997. Blood pressure and hypertension control has been assessed in all these surveys.

Between 1982 and 1997, the mean systolic blood pressure decreased among men and women aged 25 to 64 years of age in all 3 areas included in the study [23]. In men, regarding systolic blood pressure the decrease in North Karelia was from 144 to 138 mm Hg, in Kuopio province from 145 to 138 mm Hg, and in southwestern Finland from 142 to 135 mm Hg (Table 2). In women, the respective values were 139 and 132 mm Hg in North Karelia, 142 and 132 mm Hg in Kuopio province, and 135 and 128 mm Hg in southwestern Finland. Diastolic blood pressure decreased during this period, except in

TABLE 2. Systolic and diastolic blood pressure among 25- to 64-year-old men and women

	North Karelia		Kuopio Province		Southwestern Finland	
	Men	Women	Men	Women	Men	Women
Systolic blood pressure, mm Hg						
1982	144 \pm 19	139 \pm 20	145 \pm 18	142 \pm 22	142 \pm 18	135 \pm 21
1997	138 \pm 19	132 \pm 20	138 \pm 17	132 \pm 17	135 \pm 16	128 \pm 18
Diastolic blood pressure, mm Hg						
1982	86 \pm 12	83 \pm 12	87 \pm 13	84 \pm 12	85 \pm 12	80 \pm 11
1997	83 \pm 12	80 \pm 11	85 \pm 11	80 \pm 11	85 \pm 10	80 \pm 10

Data are presented as mean values \pm standard deviation.
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TABLE 3. Trends in awareness, treatment, and control of hypertension among hypertensive subjects aged 25 to 64 years

	North Karelia		Kuopio Province		Southwestern Finland	
	1982	1997	1982	1997	1982	1997
Men						
Not aware	40.0	18.9	50.1	24.8	44.0	27.2
Aware not treated	28.8	34.2	29.1	31.3	27.8	32.2
Treated, not controlled	20.4	21.9	15.4	19.2	18.1	21.7
Treated, controlled	10.8	25.0	5.3	24.8	10.1	18.9
Women						
Not aware	22.9	12.6	26.2	15.5	31.7	18.5
Aware not treated	33.8	35.0	33.5	22.6	29.7	37.0
Treated, not controlled	29.2	23.1	23.7	17.9	21.1	14.3
Treated, controlled	14.1	29.4	16.6	44.0	17.4	30.3

Values are %. Hypertension was defined as systolic blood pressure (SBP) ≥ 160 mm Hg and/or diastolic blood pressure (DBP) ≥ 95 mm Hg and/or antihypertensive drug treatment. Not controlled, SBP ≥ 160 mm Hg and/or DBP ≥ 95 mm Hg; controlled, SBP < 160 mm Hg and DBP < 95 mm Hg.
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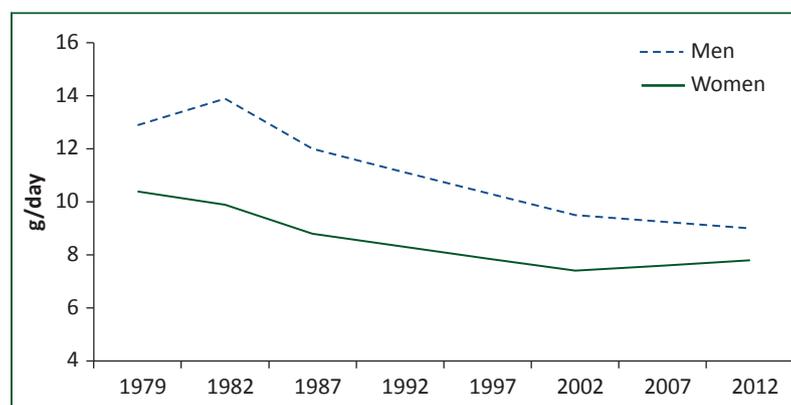


FIGURE 3. Salt intake in North Karelia. Salt intake was assessed by sodium excretion in the 24-h urine collection. Figure prepared using data from Laatikainen et al. [28].

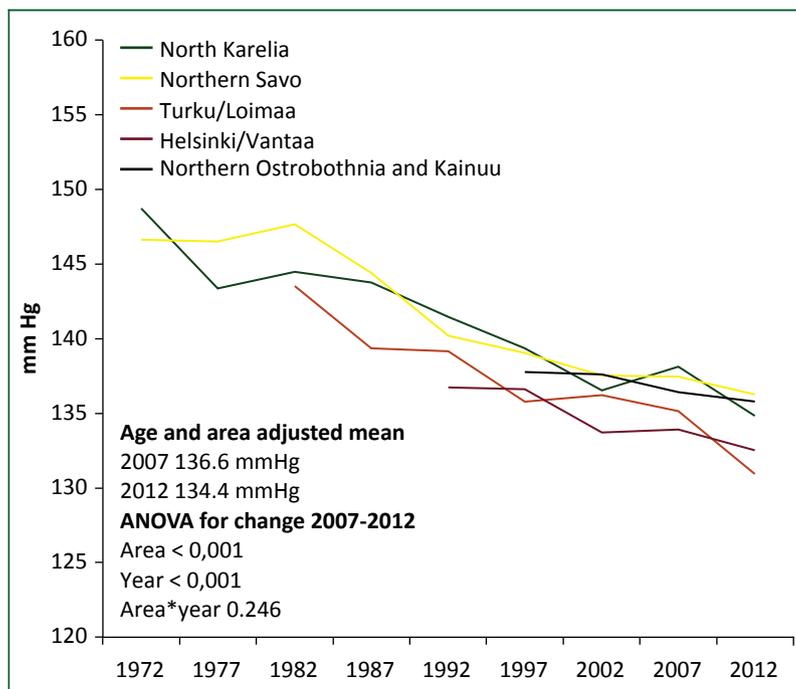


FIGURE 4. Systolic blood pressure among 30- to 59-year-old men by survey area.

southwestern Finland where it remained stable at the level of 85 mm Hg among men and 80 mm Hg among women.

Awareness, treatment, and control levels of hypertension improved over time (Table 3). Percentage of those not

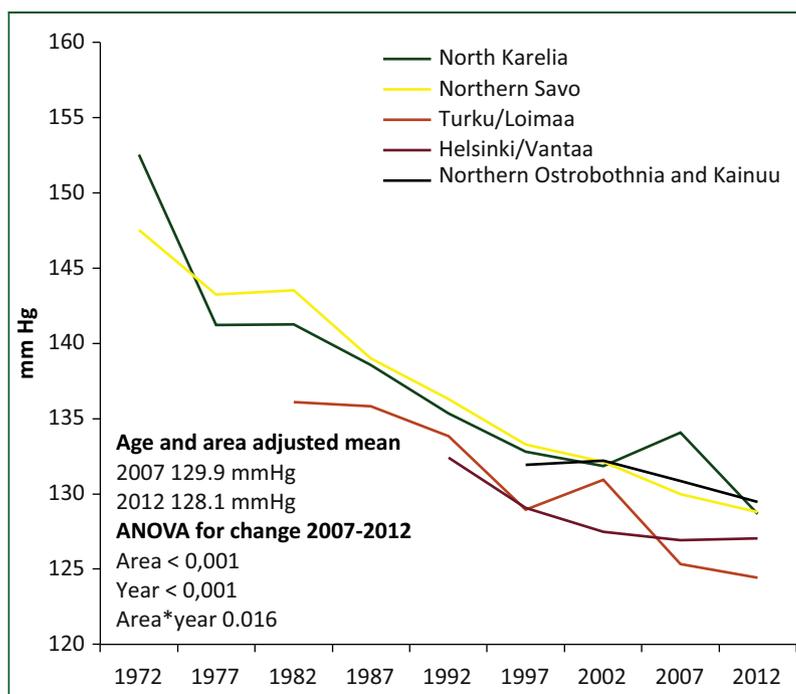


FIGURE 5. Systolic blood pressure among 30- to 59-year-old women by survey area.

aware of their hypertension decreased especially among men. In North Karelia, the decrease was from 40% to 19%, in Kuopio province from 50% to 25%, and in southwestern Finland from 44% to 27% [23]. The proportion of treated and controlled subjects out of all hypertensives increased among men in North Karelia from 11% to 25%, in Kuopio province from 5% to 25%, and in southwestern Finland from 10% to 19%. Among women, an even greater improvement was seen.

SODIUM INTAKE AND RELATED NUTRITION POLICY

The use of salt and intake of sodium were addressed in health education from the beginning of the North Karelia Project. Since the late 1970s, the project began active work to reduce the salt intake of the population. The North Karelia Salt Project was initiated in 1979 to reduce salt consumption [24,25]. The aim of this 3-year project was to evaluate the feasibility and effects of salt reduction in the population. The intervention included 4 main strategies: 1) health education targeted to whole population, 2) education of patients including nutrition counselling, 3) training of personnel, and 4) environmental changes [24].

A national meeting organized by the National Hypertension Committee in 1980 about salt as a risk of hypertension increased the awareness on the excess salt intake as a reason for cardiovascular diseases [26]. It also started the dialogue between health scientists, food industry, and health care and relevant administrators to find possibilities for action to control the excess intake of sodium.

The National Nutrition Council recommended the lowering of the salt intake already in 1978, but the actual recommended level of salt intake was not given until 1981 [26]. The recommendation was related to the findings from the baseline survey of the North Karelia Salt Project in 1979 showing extremely high intake of sodium in population aged 14 to 65 years [24]. The mean 24-hour urinary sodium excretion among men was 215 mmol, corresponding with an intake of nearly 13 g of salt per day, and 171 mmol among women corresponding with an intake of 10 g salt per day. The recommended level was set at <9 g salt per day.

The health education in the North Karelia Salt Project addressed the role of salt intake in hypertension, main sources of salt in Finnish diet and practical advice to reduce salt intake [24]. Education was organized through mass media and printed material. Practical advice, for example instructions for food preparation, was given particularly by housewives' organization. Patient education was organized mainly through the activities of the hypertension register. Training of personnel aimed at increasing their knowledge on the association between salt intake and blood pressure. Food preparation in larger institutions was included in training program. One of the environmental changes was the promotion of "mineral salt" that was introduced in Finland in 1978. In this product, part of the sodium is replaced with potassium and magnesium. Other environmental changes

included cooperation with schools and other institutions to reduce the salt content of meals and with food industry to develop low-sodium products and reduce the salt content of regular products whenever possible.

The Salt Project was evaluated studying cross-sectional random samples of the 14- to 65-year-old population both in North Karelia and in the reference area in 1979 and 1982. These surveys included collections of 24-hour urine for analyses of Na and K excretion to assess salt intake. The 3-year changes in salt intake were very small. The mean Na excretion level decreased slightly only among women and actually among men in North Karelia some increase was observed [25]. The North Karelia Salt Project showed that reducing salt intake at the community level is difficult over a 3-year period and authors concluded that this was owing to insufficient environmental changes [25,27].

Since then, several actions have taken place in Finland [26]. Education has been organized both for the public and health care personnel. Cooperation with the food industry to reduce the content of salt, especially in bread cheese and meat products, has been active. National legislation mandates the labelling of the salt content of foods and the labelling decrees are formulated by the Ministry of Trade and Commerce in close cooperation with nutrition experts and food industry. The recommended salt intake level has gradually decreased: in women, 7-9 g in 1987, 7 g in 1994, 6 g, and in men, 7 g in men in 2005 and currently 5 g.

Since the early 1980s, the intake of salt measured by 24-hour urinary sodium excretion has decreased in North Karelia from >13 g among men and >10 g among women to 9.5 g among men and 7.4 g among women by 2002 [28] (Fig. 3). Thus, a further reduction is still needed.

NONPHARMACOLOGIC TREATMENT TRIAL IN PRIMARY HEALTH CARE IN EASTERN FINLAND

The potential of lifestyle modification in the control of hypertension among hypertensive subjects was assessed in a trial organized in eastern Finland between 1996 and 1999. A 2-year randomized, controlled trial of a lifestyle intervention to reduce hypertension was carried out in primary health care in eastern Finland [29]. Altogether, 715 subjects aged 25 to 74 years of age with systolic blood pressure of 140 to 179 mm Hg and/or a diastolic blood pressure of 90 to 109 mm Hg or having antihypertensive drug treatment were enrolled in the study. Approximately one-half of the subjects were using antihypertensive drug at baseline. Participants were randomized to receive moderately intensified lifestyle counselling aiming at reduction of blood pressure or usual care. The intervention targeted at weight reduction, decrease in sodium intake, reduction in harmful alcohol consumption, increase in physical activity, and quitting smoking if the participant was a smoker.

The 2-year intervention consisted of 7 visits to a public health nurse and 2 group meetings. During the visits to public health nurses, participants were instructed systematically to change their lifestyle on the basis of their

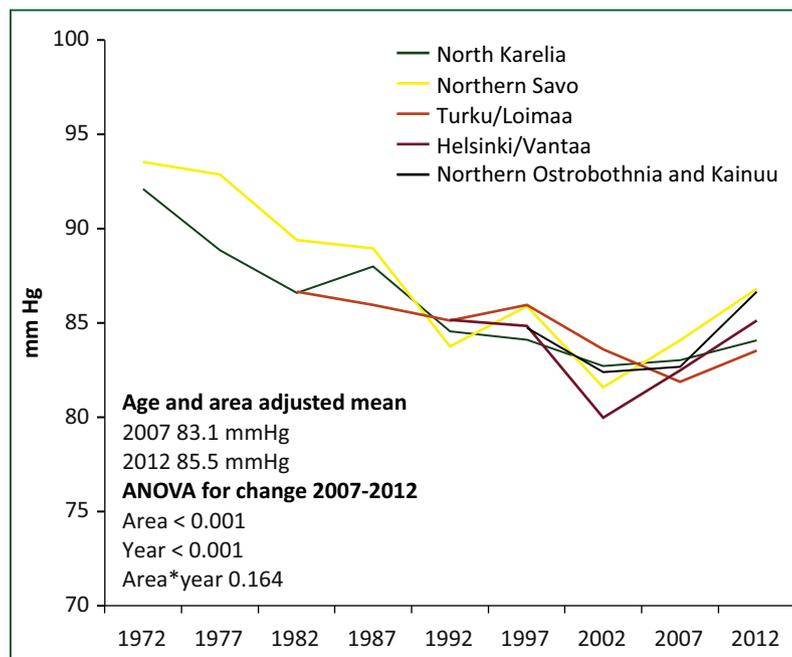


FIGURE 6. Diastolic blood pressure among 30- to 59-year-old men by survey area.

individual situation. Feedback was given based on measurements performed during each visit. The 2 group meetings organized by a dietitian and a physician concentrated on advice to reduce sodium intake and to control weight.

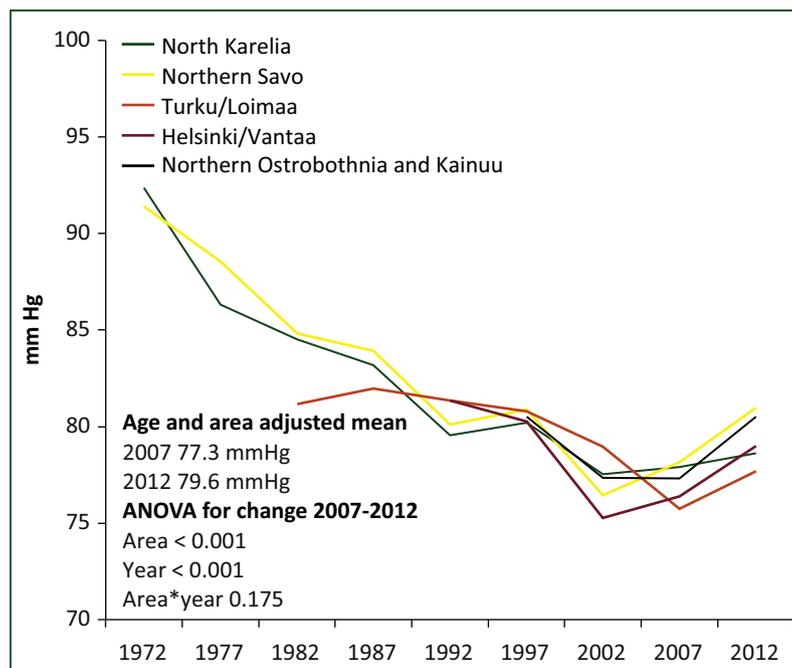


FIGURE 7. Diastolic blood pressure among 30- to 59-year-old women by survey area.

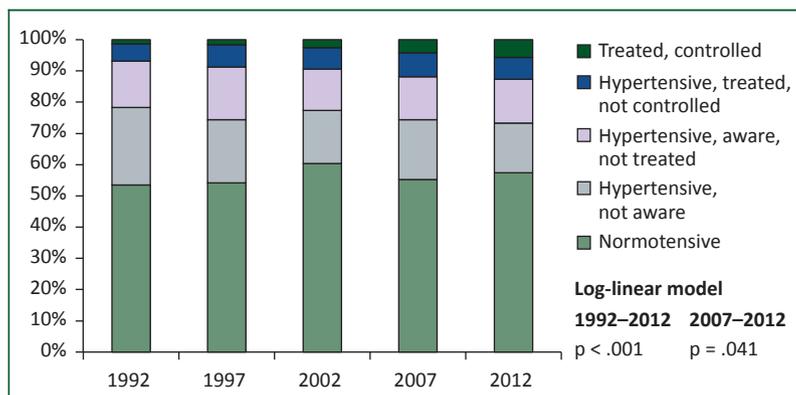


FIGURE 8. Blood pressure categories. Among men 25 to 64 years old, combined data from North Karelia, Northern Savo, Turku, and Loimaa region and capital area are presented. Proportions are age and area adjusted. The cut-off for normotensive is systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg. Same values are used as definitions for treatment control.

Among participants not using antihypertensive medication a significant net reduction of 2.6 mm Hg compared with control group in systolic blood pressure and 2.7 mm Hg net reduction in diastolic blood pressure was observed after 1 year. This reduction in blood pressure was maintained during the second year and was accompanied by a significant reduction in mean body weight of the intervention group. In the group with antihypertensive treatment, the reduction in blood pressure did not differ from the control group.

THE MOST RECENT TRENDS IN BLOOD PRESSURE, SALT INTAKE, AND HYPERTENSION CONTROL IN FINLAND

Since the first years of the North Karelia Project, evaluation activities including the monitoring of risk factors have

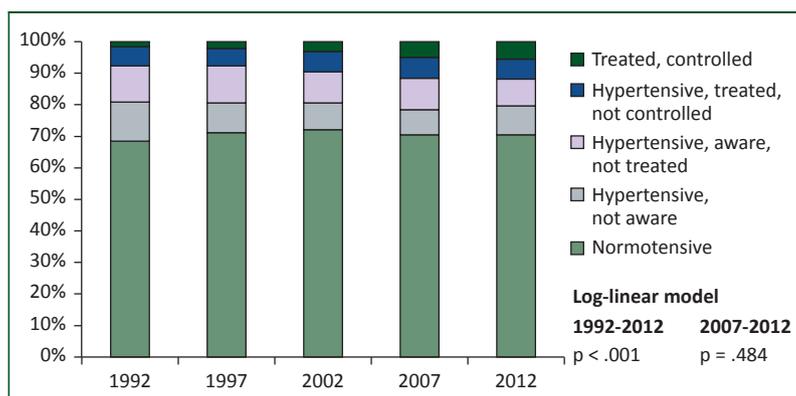


FIGURE 9. Blood pressure categories. Women 25 to 64 years old in combined data from North Karelia, Northern Savo, Turku, and Loimaa region and capital area. Proportions are age and area adjusted. The cut-off for normotensive is systolic blood pressure <140 mm Hg and diastolic blood pressure <90 mm Hg. Same values are used as definitions for treatment control.

widened to cover also other areas in Finland. The trends of mean systolic blood pressure and diastolic blood pressure from 1972 to 2012 among population aged 30 to 59 years are presented in Figures 4–7.

Since the 1970s, the population means of both systolic and diastolic blood pressure have decreased remarkably. The decrease in systolic blood pressure has continued until the last survey in 2012, but some levelling off and even some increase is seen in diastolic blood pressure levels since early 2000.

The proportion of people with hypertension has somewhat decreased from 1992 to 2012 in men, but remained the same among women (Figs. 8 and 9). Men, however, continue to have a clearly higher prevalence of hypertension compared with women. The treatment and especially control levels have continuously improved both among men and women. In women, no change was observed between the 2 last surveys from 2007 to 2012.

The intake of salt was very high in Finland in the late 1970s, but there has been a significant decrease both in men and women until 2007. Between 2007 and 2012, the daily intake of salt started to increase again. The trends of sodium excretion in North Karelia assessed by 24-hour urine collection are shown in Figure 3. According to dietary surveys the increase in the intake of salt between 2007 and 2012 was in men from 9.3 to 10.0 g and in women from 6.8 to 7.0 g [30].

SUMMARY

Favorable trends in blood pressure, salt intake, and treatment and control of hypertension have been observed in North Karelia and later in other parts of the Finland since the 1970s. The activities for prevention and control of hypertension started in the North Karelia Project have been later implemented also nationwide bringing improvements to both population blood pressure levels and management of hypertension. The activities to reduce salt intake have much followed the lines to reduce the cholesterol levels through comprehensive nutrition interventions and policies.

During the last 10 years, positive developments have been attenuated. Decreases in blood pressure levels have levelled off and diastolic blood pressure has even started to increase. Similar changes are observed in salt intake. The decrease in the prevalence of hypertension and even in achievement in optimal care are levelling off. National monitoring has detected these unfavorable phenomena and drawn attention of both policy makers and the public for need to support the favorable trends with continuous activities. To reach the target set recently by the World Health Organization, namely, a 25% reduction in the prevalence of high blood pressure, blood pressure levels must be reduced at the population level, and the effectiveness of hypertension care must be improved.

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