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CHD Mortality in Finland and the Province of North Karelia - Changes around 1972 - The Start of the North Karelia Project

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ABSTRACT

The North Karelia Project (NKaP) began in April 1972 and was associated with CHD mortality reduction. It was noted as a success, with low critical notes. This article shows statistical and visual assessments of Finnish (FI) age-adjusted CHDFI and total mortality (TOTFI) development of middle-aged Finnish males and females, usually by 3-year means, from 1952 to 2000, or shorter range. Assessed are CHD development in urban (URB) and rural (RUR) and in the Province of North Karelia (NKa). Evaluations have been made even by exponent (power) of e, given by Exel for exponential trendlines. Results have been evaluated by their percentages of their values in 1972 [CHD (i/1972)]).

Results: Periodical mean of female and male CHDFI decline in 1967-71 was 8.6 and in 1973-77 4.5 %, ca 1/3 slower. Male (CHD_{NKa}/ CHD_{FI}) ratio was varying, but CHDNKa was 31 % higher to CHD.FI at the begin and at the end of the period 1972-2000. In 1972-2000 the exponents (power) of e for the exponential trendlines of male CHD were about equal in NKa (-0.046) and in FI (-0.047). CHD reduction was accelerated in the 1980's in FI and NKa. In 1972-82 CHD_{FI} declined slower than TOT_{FI} and cardiovascular diseases (CVD_{FI}) total. CHD_{RUR} was lower than CHDURB before 1972, after that they varied ca similarly.

Conclusion: Not female, nor male CHD reduction seemed to be accelerated after 1972. CHD reduction was slower to total mortality in 1972-78. Male CHD was higher in NKa to FI and their annual total relative changes were similar during 1972-2000. CHD reduction accelerated in 1984–86 and was more rapid in the 1986–2000 than in 1972-85.

Keywords: CHD; Male; Female; 1972; North Karelian Project

Abbreviations: 3YM: Three-Year Mean; CHD: (Mortality from) Coronary Heart Disease; CVD: (Mortality from) Cardiovascular diseases (excl. alcohol-related); F: Female; FI: Finnish (or Finland); M: Male; Mortality (numbers): Age Adjusted Mortality Amongst People a) Aged 35–64 (or 15–64) (1/100,000); e: Euler's Number: ca 2.718; etl: Exponential Trendline; NKaP: The North Karelia Project; NKa: The Provice of North Karelia (Differently Defined than in NKaP); TOT = Total Mortality: Mortality from all Causes; CHD(i/1952): CHD.i/CHD_{1952}: percentages of CHD values (in year i, of CHD 1972).. (N.B. in Figures Post-Suffixes can be Shortened for Visual Reasons); RUR: Rural; URB: Urban; Δ: Difference

Introduction

The North Karelia Project (NKaP) began in April 1972 and was associated with CHD mortality reduction [1]. It included data from the North Karelia and Kuopio (Northern Savo) provinces. Label "North Karelia" seems to be used for the collected data and Figures from these two provinces. Although NKaP was obviously most actively functioning in the North Karelia it was working in the whole Finland via press, TV-programs and practices of Health Centers. The statistical results of NKaP have been discussed sparsely [2], where part of the critique is between the lines. The role of CHD inside cardiovascular diseases (CVD, excl. alcohol-related) is one aim of this paper. The aim of this study is to evaluate development of CHD_{FI}, CHD_{RUR}, CHD_{URB} before and after 1972 and to assess development of CHD_{FI} and CHD_{NKa} in 1972-2000, as well as CHD_{FI}, CVD_{FI} and TOTFI in 1972-90.

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Materials and Methods

Annual age-adjusted CHD and TOT (mortality) (1/100,000) of males and females, aged 35–64, between 1969 and 2001 from the whole Finland and the province of North Karelia (N.B. difference with NKaP) are from Statistics Finland, only male data from North Karelia is presented [3]. Respective annual Finnish CHD and TOT (mortality) of males and females from 1951-68 are attained by measuring and computation from graphics [2] (on p. 274). These data is changed to 3-year means (3YM) of TOT FI and CHD FI for 1952-2000 (Table.1, Fig.1 & Fig.2). CHD URB & CHD RUR attained from [2] (on p. 278) for 1952-86 are represented in Fig.6 (was given) by 3 year means. Annual data of male CHD NKa are from [3] is represented by 3-year means. Free-of-charge statistical databases of the whole population, aged 15-64, [4] (Fig.5), have been used for comparing TOT and CHD development with the respective values and their associations with CVD and CVD less.CHD. Exponents of e of the exponential trendlines (etl) of M.CHD .NKa and M.CHD .FI , produced by Exel have been used for evaluation of the steepnesses in CHD reduction (Table 2, Figures 3-4).

Table 1: Age-adjusted CHD and Total Mortality of Finnish Males and Females, aged 35-64 yrs, 1/100,000 by 3-yr means and by percentages of 1952 values (decimals given by need).

Year	$M.CHD_{3ym}$	$F.CHD_{3ym}$	$M.TOT_{3ym}$	$F.TOT_{3ym}$	$M.CHD_{3ym\ (i/1952)}$	$F.CHD_{3ym(i/1952)}$	$M.TOT_{3ym(i/1952)}$	$F.\ TOT_{3ym(i/1952)}$
1952	387	113	1391	698	100,0	100,0	100	100
1953	374	104	1338	675	96,6	92,1	96	97
1954	373	101	1329	653	96,3	89,2	96	93
1955	374	97	1321	636	96,8	85,8	95	91
1956	370	94	1334	634	95,6	83,0	96	91
1957	362	89	1319	623	93,6	78,5	95	89
1958	367	88,0	1299	609	94,9	77,9	93	87
1959	379	90	1287	589	97,8	79,4	93	84
1960	399	93	1287	581	103,0	82,4	93	83
1961	427	99	1310	580	110,4	87,4	94	83
1962	454	102.6	1323	572	117,3	90,8	95	82
1963	480	102.9	1338	561	124,1	91,1	96	80
1964	491	101	1346	550	127,0	89,3	97	79
1965	502	99	1339	541	129,8	87,4	96	78
1966	507	101	1335	532	131,0	89,3	96	76
1967	510.8	100.0	1329	525	132,0	88,5	96	75
1968	507	98	1347	522	131,1	86,8	97	75
1969	495	92	1336	512	127,8	81,7	96	73
1970	493	90	1340	500	127,3	79,3	96	72
1971	484.4	87.9	1302	477	125,2	77,8	94	68
1972	481	87	1280	456	124,2	76,7	92	65
1973	465.9	83.8	1244	442	120,4	74,2	89	63
1974	460	82	1220	433	118,9	72,8	88	62
1975	461	81	1205	429	119,3	71,4	87	61
1976	464	78	1186	416	119,9	68,8	85	60
1977	460.0	75.3	1165	398	118,9	66,7	84	57
1978	442	73	1125	386	114,3	65,0	81	55
1979	416	70	1072	371	107,5	62,0	77	53
1980	399	67	1037	363	103,2	59,6	75	52
1981	386	63	1005	350	99,8	55,3	72	50
1982	372	60	976	349	96,2	53,3	70	50
1983	357	57	950	340	92,3	50,6	68	49
1984	348	56	946	336	89,9	49,7	68	48

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1985	339	55	943	330	87,6	49,1	68	47
1986	320	56	927	333	82,7	49,7	67	48
1987	298	55	904	336	76,9	48,7	65	48
1988	282	52	890	333	72,9	45,9	64	48
1989	270	47	881	328	69,7	41,3	63	47
1990	255	42	860	319	66,0	36,9	62	46
1991	238	38	831	314	61,5	34,0	60	45
1992	220	35	798	310	57,0	31,0	57	44
1993	205	33	765	301	53,0	29,2	55	43
1994	191	31	740	295	49,4	27,3	53	42
1995	181	29	719	283	46,7	25,5	52	41
1996	170	26	705	283	43,9	23,0	51	40
1997	159	26	690	277	41,2	23,0	50	40
1998	151	25	680	275	39,1	21,9	49	39
1999	148	25	665	273	38,3	22,5	48	39
2000	140	23	640	272	36,2	20,1	46	39

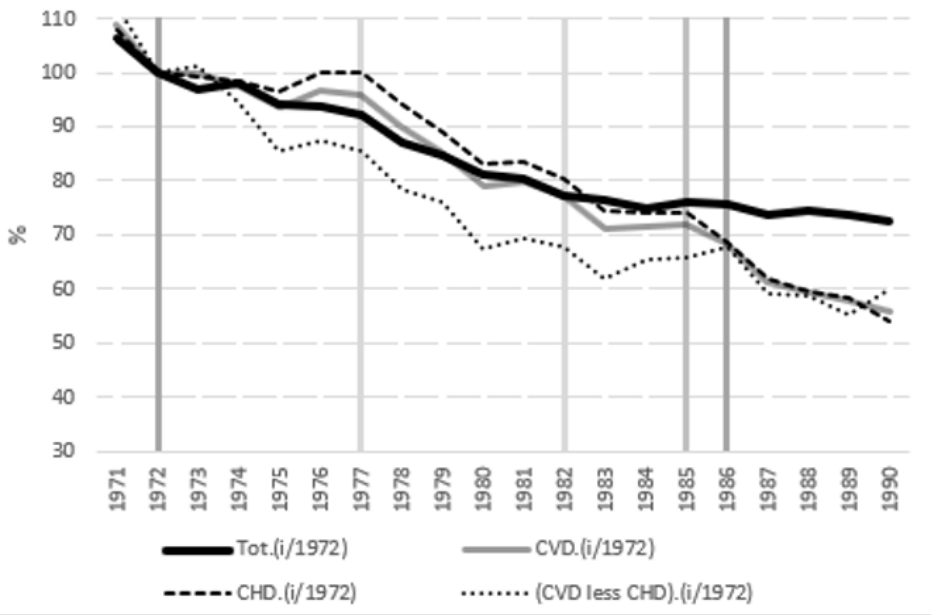

Figure 1: Development of Tot, CVD, CHD and CVD $_{\text{less CHD}}$ in 1971-90, relative to 1972.

General presentation of the Development of Finnish CHD and TOT Mortality Changes

Figures 2 & 3 serve a general survey of Finnish female and male CHD and TOT development in 1952-2000 (by 3ym). The start point of CHD (and Tot) epidemic can be defined:

a) By their values in 1952

b) By the year just before they exceeded this

c) By their lowest values in (1952-60)

d) By the year before CHD exceeded TOT. The end point can be defined by the year, when CHD is equal or lower to the value of the start point.

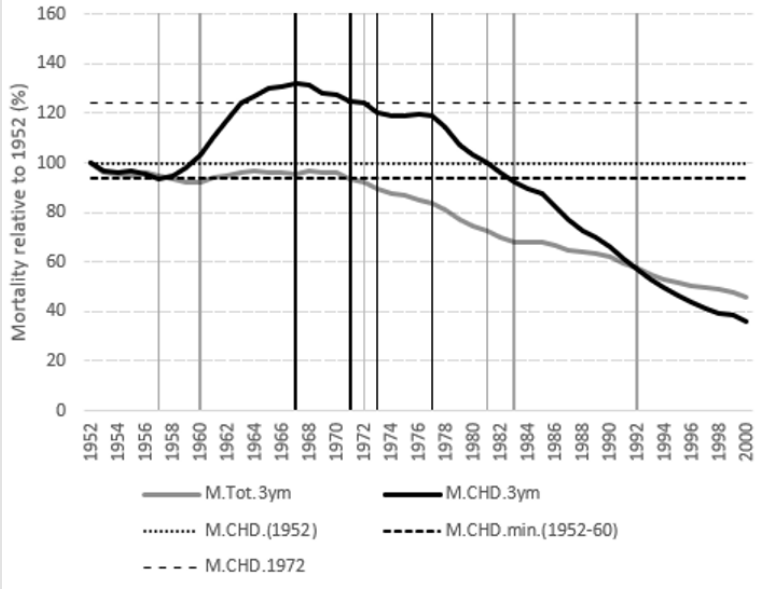

Figure2: Finnish Male CHD and TOT (mortality) percentages of 1952, with CHD levels of 1952 and 1972 and the lowest value in 1952-60, with limits of the study periods 1967-71 and 1973-77.

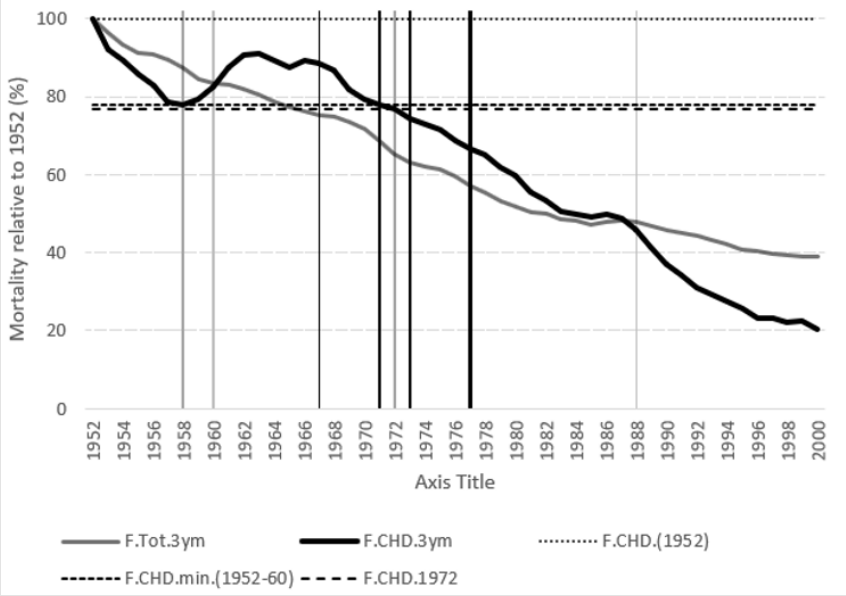

Figure 3: Finnish Female CHD and TOT (mortality) percentages of 1952, with CHD levels of 1952 and 1972, with the lowest value in 1952-60 and limits of the study periods 1967-71 and 1973-77.

(In order not to need fractionate the years of the beginning neither the ends, because passings do not occur exactly at the beginning or at the end of the year). We can say that the epidemic occurred somewhat between the (as above defined) start and the end points (years), inter alia because the by ruler measured ("Kuvio 1," on p, 274 in [2]) and estimated data for 1952-69 are not accurate. Relative values and labels for periods with selected start points have been used: For period with start in 1952: [CHD.i/CHD.1952 = CHD. (i/1952)] (e.g. Figures 2 & 3) and for periods with start in 1972 respectively [CHD. (i/1972)], e.g. for comparing of different parameters. Figure 2 shows male CHD and TOT (mortality) percentages of 1952 with vertical lines showing limits of 1967-71, year 1972 and 1973-77. Other vertical lines show start and end points of differently defined CHD epidemics, as earlier presented. Stagnation in CHD decrease is shown between 1973 and 1977. Figure 3 shows female CHD and TOT (mortality) percentages of 1952 with vertical lines showing limits of study periods 1967-71 and 1973-77, as well as the year 1972. There are even presented in the text earlier defined, start and end points for the CHD epidemics. Female CHD never again exceeded the its start value (CHD1952). F. CHD1972 was lower to its lowest value in 1952-60 before 1972 (the beginning of NKaP). Even the exponents of e of the exponential trendlines (etl) of M.CHD.NKa and M.CHD.FI, produced by Exel have been used for easy evaluation of the steepness in CHD reduction (Table 2 & Figures 4 & 5).

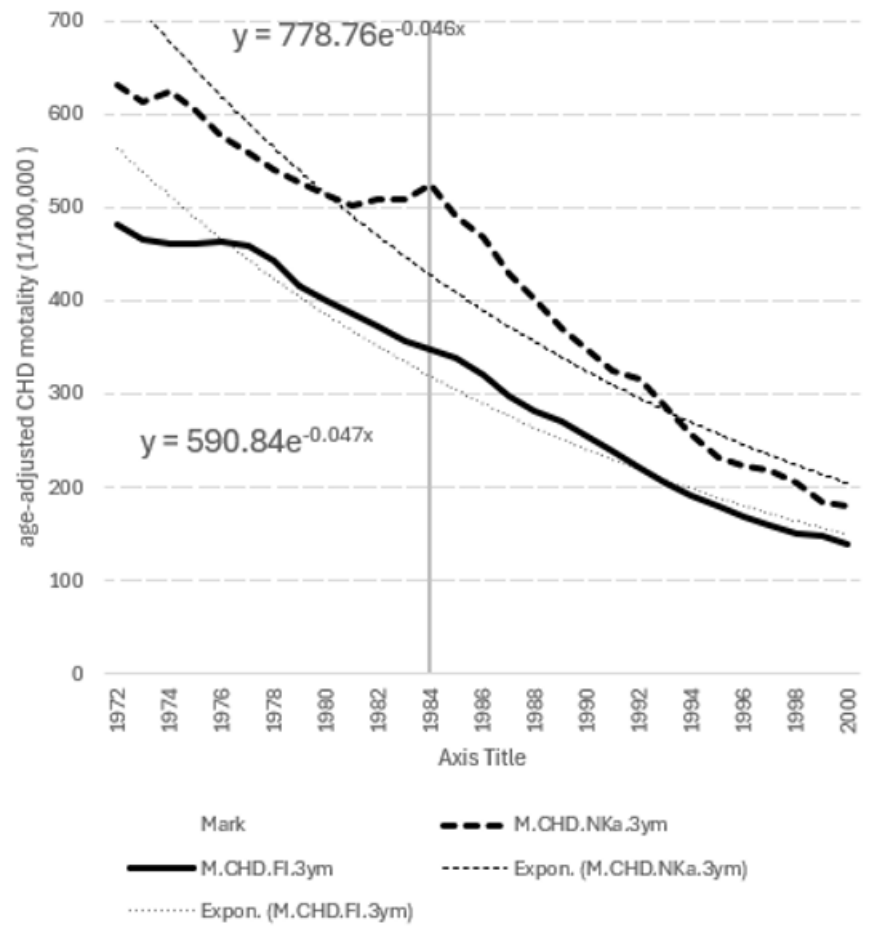

Figure 4: Male CHD in North Karelia (NKa) and the whole country (FI) with exponential trendlines and its parameters.

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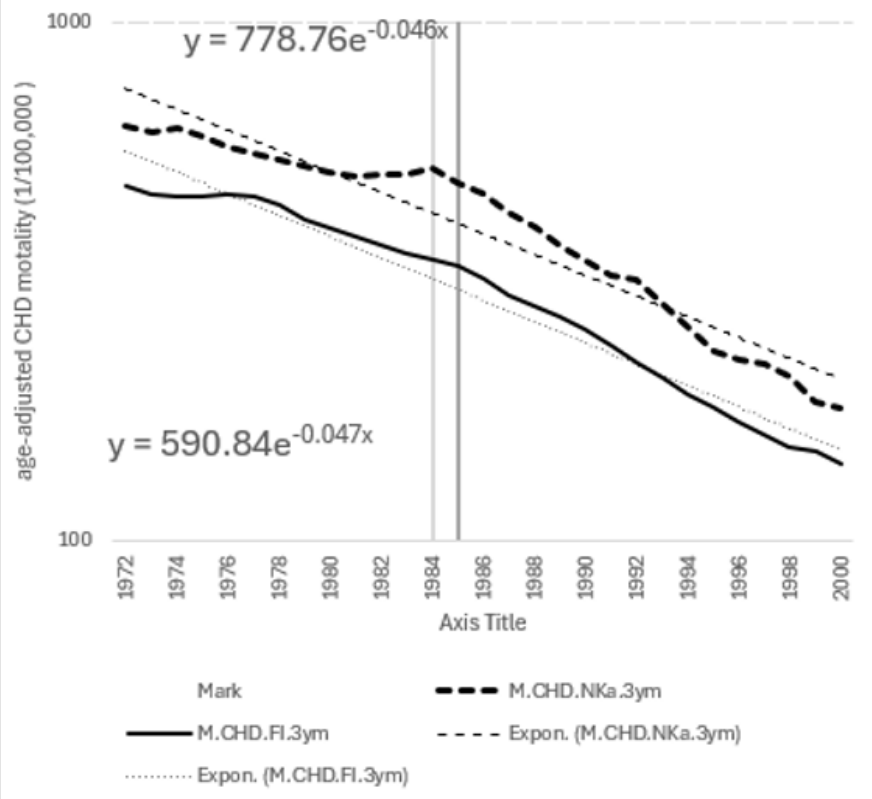

Figure 5: Male CHD in North Karelia (NKa) and the whole country (FI) with exponential trendlines and its parameters, on logarithmic scale.

Table 2: Shows Female and Male CHD mortality in 1967, 1971, 1973 and 1977, as well as differences Δ(CHD1971 - CHD1967) (" Before 1972") and Δ(CHD1977 - CHD1974) (" After 1972"), by absolute (1/100,000) values and in percents, means of female and male (FM) periodical values, their (inter-periodical) differences as such and in percents.

	1967-71				1973-77				
	F.CHD	M.CHD	Mean.Δ.(FM) "Before 1972"		F.CHD.	M.CHD	Mean.Δ.(FM) "After 1972"	Inter-periodical change	Inter-periodical change (%)
1967	100	511		1973	84	466			
1971	88	484		1977	75	460			
Δ.CHD.abs	12.1	26.4			8.5	5.9			
Mean.Δ.CHD.abs			19.3				7.2	12.1	63
Δ.CHD.%	12.1	5.2			10.2	1.3			
Means.Δ.CHD.%			8.6				5.7	2.9	34

Results

CHD Reduction in 1967-71 Compared with Reduction in 1973-77

Because NKaP started in April 1972, the year 1972 is excluded and comparison is made by female and male CHD changes (Δ) in 1967-71 ('Before 1972') to respective changes in 1973-77 ('After 1972'). Data from Tables 1 & 2. shows absolute values of CHD (1/100,000) at the beginning and at the end of the test periods: "Before 1972" values for 1967 and 1971, "After 1972 values for 1973 and 1977, their (F & M) differences and Mean. Δ. (FM) and comparing periodical values as such and in percents. Mean (FM). CHD reduction "Before 1972", 19.3 (1/100,000) was 12.1 cases (63 %) higher to "After 1972" (7.2). Mean (FM). CHD reduction "Before 1972" was 8.6 % and "After 1972" 5.7 %, which is 34 % lower than the change "Before 1972".

Development of Male CHD in Finland and the Province of North Karelia during 1972-2000

Annual data on age-adjusted CHD mortality of males, (1/100,000), aged 35-64, in the Province of Northern Karelia and Finland are from [2]. Table 2 & Figures 4 & 5 show age adjusted CHD mortality of males, aged 35-64, of Finland (FI) and the Province of North Karelia (NKa) by 3-year means (3ym) in 1972-2000 and their ratios (CHD_{NKa}/CHD_{FI}), additionally their percentages of 1972 and exponent of e, of their exponential trendlines, produced by Exel. (Computed means of (CHD_{N-Ka}/CHD_{FI}) for 1972-77, 1996-2000 and 1972-2000 at the ready). Although variation in M.CHD was higher in NKa than in FI, (Figures 4 & 5) their mean ratios during the first (1972-76) and the last 5 years (1996-2000) were the same: 1.31, i.e. male CHD was 31 % higher in NKa to FI, but a little lower to the average (CHD_{NKa}/CHD_{FI}) ratio: 1.35. Between 1972–2000 CHD_{NKa} was reduced ad 28 % from its start value in 1972 and CHD_{FI} respectively ad 29 %, highly similarly. Figure 4 shows male CHD_{NKa} and CHD_{FI} with their exponential trendlines. The measures for steepnesses (the exponents of e) of the exponential trendlines are produced by Exel, without efforts of the author. (N.B. CHD.NKa excludes the data from Northern Savo (Kuopio) province, which are included in NKaP ([1], Figure 2, p. 153). Figure 5 shows male CHD from NKa and FI on logarithmic scale. Although there was abundant variation, the relative difference between NKa and FI was the same at the beginning and at the end, in the middle third the (relative) difference was higher. Similar deviations upwards from the exponential trendlines (which are linear on logarithmic scale) are seen in FI and NKa curves at 1984-85, which suggest on new factor(s) (e.g. surgery [5] or changes in our biosphere, selenium supplementation in fertilizers [6]?).

Discussion

The development of TOT and CHD (Fig.1 & Fig.2) show remarkable co-variation during 1966-79, by males remarkable stagnation in 1974-77, which suggest on the common risk and protective factors. An abrupt change in CHD of North Karelia (Figure 2 in [1], p. 153) during the 1980's and similar deviation from the exponential trendlines on logarithmic scale (Figure 5) suggest on effects of new factor(s) at about 1984-85, including coronary surgery [6] and changes in our biosphere, e.g. selenium [7].

Comparing New Mortality Data with above Presented

Table 3. Age-standardised death rate, aged 15-64 (1/100 000) are from Statistics Finland [4] in order to check the CHD stagnation in 1972-77 (Tables 3 & 4). CHD and CVD show stagnation in 1972–77. During 1973-77 mean CHD was 1.2 % lower than CHD 1972 (c.f mean exponential annual CHD reduction was 4.6 %, Table 2). In 1972-82 CHD declined slower than TOT. CVD was associated moderately with TOT from 1971 until 1982. Rapid decrease in CHD and CVD began in 1985 and the next year in CVD less.CHD . The rapid CHD change at 1985-86 suggest on new "anti-risk-factors(s)", other than [5] (e.g. selenium [6] and/or coronary surgery [7]).

Table 3: Age-standardised death rate, aged 15-64 (1/100 000) Figures given as percentages of 1972 values.

	$TOT_{(i/1972)}$	$CVD_{(i/1972)}$	$CHD_{(i/1972)}$	$CVD_{less\ CHD).(i/1972)}$
1971	106,3	109,1	107,9	112,2
1972	100,0	100,0	100,0	100,0
1973	96,8	99,8	99,3	101,3
1974	98,0	97,3	98,4	94,6
1975	94,2	93,5	96,4	85,6
1976	93,8	96,7	100,1	87,6
1977	92,2	95,9	99,9	85,4
1978	86,9	89,9	94,2	78,3
1979	84,7	85,3	88,9	75,9
1980	81,1	78,9	83,2	67,6
1981	80,4	79,8	83,7	69,4
1982	77,3	76,9	80,4	67,8
1983	76,3	71,1	74,5	62,0
1984	74,8	71,7	74,1	65,4
1985	76,2	71,8	74,1	65,8
1986	75,7	68,4	68,7	67,7
1987	73,9	61,2	61,9	59,3
1988	74,5	59,3	59,6	58,6
1989	73,8	57,6	58,5	55,2
1990	72,4	55,7	54,2	59,8

Table 4: Causes of Death, mean distribution in 1972-86 (%).

	Tot	CVD	CHD	$CVD_{less\ CHD}$
All causes (Tot)	100	73	55	18
Prp of CVD		100	75	25

Table 5: Male CHD (3ym) in the whole country (FI) and North Karelia (NKa.), with percentages of 1972 and the exponent x of e of their exponential trendlines produced by Exel and values of Exponential trendlines relative to start values, EXP (Δ.yr * x) in percents and Mark for labeling years.

							$x_{.NKa}$	$x_{.FI}$	
		CHD					-0,046	-0,047	
Δ.yr		NKa	FI	(NKa/FI)	$NKa_{(1/1972)}$ %	$FI_{(1/1972)}$ %	EXP(Δ.yr*x) %	EXP(Δ.yr*x) %	Mark
0	1972	631	481	131	100	100	100	100	1000
1	1973	613	466	132	97	97	96	95	1000
2	1974	624	460	136	99	96	91	91	1000
3	1975	604	461	131	96	96	87	87	1000
4	1976	576	464	124	91	96	83	83	1000
5	1977	559	460	122	89	96	79	79	1000
6	1978	541	442	122	86	92	76	75	1000
7	1979	527	416	127	84	87	72	72	1000
8	1980	513	399	128	81	83	69	69	1000
9	1981	503	386	130	80	80	66	66	1000
10	1982	509	372	137	81	77	63	63	1000
11	1983	508	357	142	81	74	60	60	1000
12	1984	524	348	151	83	72	58	57	1000
13	1985	491	339	145	78	71	55	54	1000
14	1986	468	320	146	74	67	53	52	1000
15	1987	430	298	144	68	62	50	49	1000
16	1988	403	282	143	64	59	48	47	1000
17	1989	370	270	137	59	56	46	45	1000
18	1990	347	255	136	55	53	44	43	1000
19	1991	324	238	136	51	50	42	41	1000
20	1992	317	220	144	50	46	40	39	1000
21	1993	286	205	139	45	43	38	37	1000
22	1994	258	191	135	41	40	36	36	1000
23	1995	232	181	128	37	38	35	34	1000
24	1996	222	170	131	35	35	33	32	1000
25	1997	219	159	137	35	33	32	31	1000
26	1998	206	151	136	33	31	30	29	1000
27	1999	185	148	125	29	31	29	28	1000
28	2000	179	140	128	28	29	28	27	1000
Mean (1972-76)				131			Annual change		
Mean (1996-2000)				131			(1-EXP(x)]		
Mean (1972-2000)				135			4.5 %	4.6 %	

Rural and Urban Male CHD

Age-standardized CHD mortality (1/100,000) of males aged 35-64, from rural (RUR) and urban (URB) regions in 1952-86, by 3-year means from [2] is represented in Figure 6. The data are attained by measuring from ("Kuvio 5", i.e. Figure 1) in [2], where it was on logarithmic scale, and computed to linear scale. The data are earlier represented on linear scale e.g. in [8]. Fig.6 shows that in 1952-58 the average CHD URB (455/100,000) was 31 %, higher than the respective CHD RUR (348/100,000)]) and in 1966 higher by 17 %. Higher CHD URB associated with 30 % lower butter consumption (14.4 and 18.9 g/d) in 1966 [9]. Higher rapidity in decline of butter consumption in urban regions [g/d, urban/rural] from [8.7/15.1] in 1971 to [7.9/13.7 g/d] in 1976) was associated with faster CHD URB reduction [9], but about to the same level with CHD RUR in 1973–86. These changes

do not suggest cardio-protective effects of butter fat reduction. No regional data on milk fat consumption before 1966 is available. Another Question is possible: Is it fair to compare fat consumption of people, whose daily diets are 2000 kcal, with people who consume 4200 kcal daily, as supposed by Finnish farmers in the 1970's [10]. Open question: which were the protective factors in countryside in 1953-58 (with supposedly higher milk fat consumption [2]) having the same power as by "the avoided main risk factors" (with new medicines and social insurance, supported by coronary surgery) in 13 years (1972-85)? Maybe the secret of the good results og the unsatyrated fatty acids [11] was not based on the primary quality of fats, but on the method to protect the unsaturated fatty acids and possible some other protective substances against excess temperature and oxygenation and becoming rancid? The calculated higher magnitude of stagnation in CHD reduction (Fig.1, Fig.2, Table 2) by males in 1973-77 could be associated nicotine abstinence [8]. The silence in discussion could have been caused by the fact that the CHD data concerning 1951-68 is not calculated in free access.

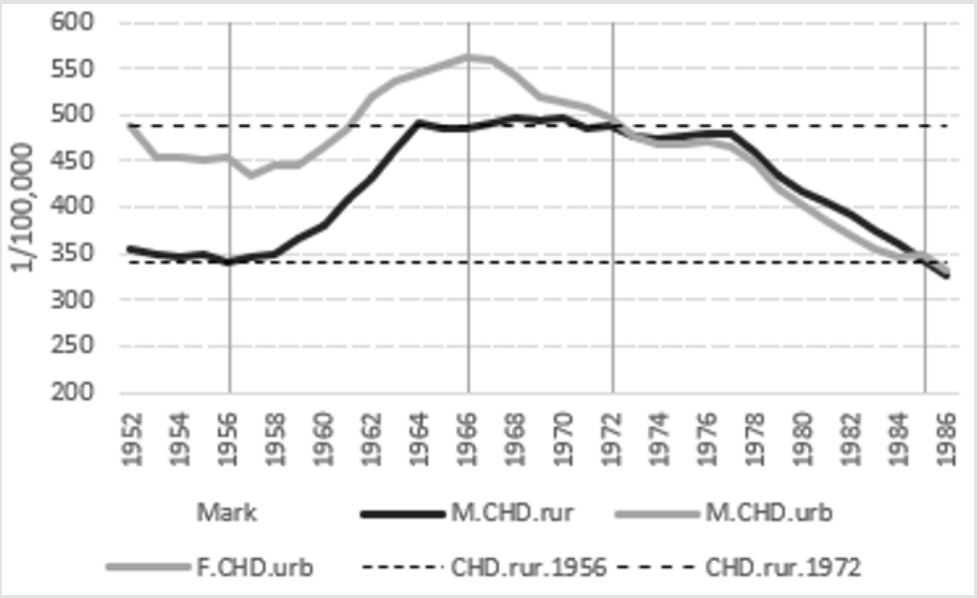

Figure 6: Age-standardized Male CHD mortality in rural (rur) and urban (urb) regions in 1952-86, 3-year means.

Conclusion

Not female, nor male CHD reduction seemed to be accelerated after 1972. CHD reduction was not faster than TOT in 1972-78. Male CHD was higher in NKa to FI and their annual total relative changes were similar during 1972-2000. CHD reduction accelerated in 1984–86 and was more rapid in the 1986–2000 than in 1972-85.

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