Research Article

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2023.51.008137

Female and Male CHD Mortality in Rural and Urban Regions, Pig Map and their Associations with Behavioral and Environmental Factors, Food Processing – Association of Magnesium with CHD, Milk Fats and Whole Grain in Finland

Töysä T*

Licentiate of Medicine, Specialty General Practice, Retired, Student of Eastern Finland, Kuopio, Finland

***Corresponding author:** Töysa T, Licentiate of Medicine, Specialty General Practice, Kuopio, Finland

ARTICLE INFO

Received: June 05, 2023

Published: July 20, 2023

Citation: Töysä T. Female and Male CHD Mortality in Rural and Urban Regions, Pig Map and their Associations with Behavioral and Environmental Factors, Food Processing – Association of Magnesium with CHD, Milk Fats and Whole Grain in Finland. Biomed J Sci & Tech Res 51(4)-2023. BJSTR. MS.ID.008137.

ABSTRACT

Mineral elements, besides of dietary fats, are suggested to have a role in vascular health. This paper discourses upon [MORT] (factors): male (M) and female (F) [CHD] of rural (rur) and urban (urb) regions and acute heart deaths of pigs [pig.MAP], behavioral factors [BEH]: human consumption of alcohol [Alc] , [Sugar], milk fats (from milk and butter) [M_F] and tobacco [Tobac], as well as environmental (factors) [ENV]: (Mg/Ca) and (Mg/K) ratios in total fertilization [ft] as well as in soil [sm] and [Mg.sm]). This study is based on old data and treats computed periods: {1}.(1952-86) (less fats, less soils); {2}.(1952-77).(less soils); {3}.(1961-86) (less fats). Effects of milling are assessed. Pig autopsy data are benefited. The aim of this study is to evaluate associations between [MORT], [BEH] and [ENV]. A special aim of this study is to assess (Mg/Ca) ratio of statistical [M_F] per se and milling effects on dietary Mg balance. The parameter values are represented as moving 3-year averages. Results are given by Figures and correlations.

Results: In {3} (1961-86) the [ft]'s associated significantly negatively with [CHD]'s, [Pig.MAP] and [Sugar]; positively with each other, [Mg.sm], [(Mg/Ca).sm]. [BEH]'s associated significantly with [ENV] and [Pig. MAP]. Especially "heart effects" of [Alc] and [M_F] are discussed. Since the 1950's lower energy supply increased "dilution effect" of sugar and fats on Mg containing foods (g/day) contra (g/total energy). [M_F] effect can partially be explained by its implicitly fixed "liquid-milk" component, with low (Mg/Ca) ratio (0.09). Milling of wheat grain [ad 0.5 % ash (d.w.)] reduced Mg-content ad 1/6 of its whole grain value.

Conclusion: Variation in dietary Mg-content, via (Mg/Ca) and (Mg/K) ratios in fertilization and soil or implicitly via [M_F] (factor), can explain Finnish [CHD] and [pig.MAP]. Benefits of [Alc] can partially be explained by [ENV] factors. Iron can explain [F.CHD]-[M.CHD] difference.

Keywords: Mg, (Mg/Ca) ratio, CHD, milling, fertilization, recycling, soil, sudden death, pig, consumption of alcohol, tobacco, fats, PUFA, implicit Mg/Ca component of liquid milk fats.

Abbreviations: BEH: Behavioral (Factors); CHD: (Here: Age Adjusted) Mortality from Coronary Heart Disease Among Middle-Age Humans; ENV: Environmental (Factors); EQ: Mole Divided by Valence (G); F: Female(S); FM: Mineral Fertilizers; FT: Total (Including Recycled and Mineral) Fertilizers; M: Male(S); MAP: Acute Heart Failure and Sudden Death, of Pigs (Here for Clarity [Pig.MAP]; M_F: Milk Fats; MORT: Mortality (Factor(S)); PUFA: Polyunsatyrated Fatty Acids; OSF: Official Statistics of Finland, RCL: Recycled Nutrients (e.g. Manure); RUR: (< Rural) from Countryside Communities (Non-Town); StatF: Statistics Finland; SM: Soil Mean Value (of 5 years); URB: from Urban Communities; μ: Mean

DOI: 10.26717/BJSTR.2023.51.008137

Introduction

Besides of the dietary fats [1,2], sometimes mineral elements have got attention as candidates of cardiac [MORT] factors: Magnesium (Mg) deficiency is known to have several mechanisms to cause heart disease [3]. In autopsies of pigs, with microangiopathy (MAP), characterized by sudden death, myocardial and endothelial cell damage and capillary microthrombosis, [Pig.MAP] [4] - has been found higher myocardial and hepatic Ca ($p < 0.001$) and lower Mg concentrations ($p < 0.001$) than in healthy slaughter pigs ("possibly associated with oxidative damage") [4]. A countryside veterinary surgeon (Nuoranne) prescribed successfully Mg treatments to farms with increased number of sudden deaths of pigs. He reported even on decreased Mg content in barley (-22 %), oats (-16 %), and in soils (mean below 100 mg/l) in those "problem farms" [5]. Nuoranne even wrote to several journals and newspapers, so promoting Mg supplementation in pig foods [5]. In autopsies [Pig.MAP] associated positively ($p < 0.001$) with iron (Fe) content of the myocardium and liver [6], but low hepatic selenium (Se) had been found only by 22 % of cases [7]. There are several reports concerning association of silicon (Si) with vascular health, e.g. [8]. It has been even shown that (each 28 g/d) intake of whole grain was associated with 14% (pooled RR: 0.86 (0.83-0.89) lower risk for CVD (cardiovascular) mortality and 9% (pooled RR: 0.91 (0.90-0.93)) lower risk of total mortality [9]. The beneficial effects of polyunsaturated fatty acids [PUFAs] have been explained by their trace components [10], not by the PUFA's itself. In veterinary medicine PUFAs have been often (mainly?) reported, since the 1920's, as "toxic" substances on muscles (muscular dystrophy, MD) [11] and liver (toxic liver dystrophy, Hepatosis diaetetica, HD) [12]. [Pig.MAP] (Mulberry heart disease) has been found to be associated with rancid PUFAs of grain as HD and MD, although statistically and histologically it formed a different entity [4, 13]. Even soya oil can promote lipid peroxidation after repeated heating [14]. The primary process in atherosclerosis has been thought to be an injury of LDL apoprotein (apoB) via free radicals (during poor anti-oxidant protection), which makes them more attractive to foam cells [15]. Additional explanation can be found via sustainability (or resilience) of vascular walls (including Tunica media and Tunica adventitia, too) [16,17], with or without silicon.

In this study are assessed detailed [MORT] data: [CHD] of males (M) and females (F) of countryside, (rural, communities) [CHD.rur] and urban communities [CHD.urb] and cases of [Pig.MAP] (1/100,000) and their associations with behavioral factors [BEH]: human consumption of alcohol [Alc], tobacco [Tobac], milk fats (from milk and butter) [M_F] and sugar [Sugar], as well as with environmental [ENV] factors: ratios of [Mg/K] and [Mg/Ca] in total fertilization [ft] and soil [sm] as well as [Mg.sm]. Additionally, are assessed effects of milling on Mg, Ca and K contents of wheat (as an example of cereals). This study is based on old data.

The aim of this study is to evaluate the compliances between [MORT], [BEH] and [ENV] with each other: in order to find a probable explanation for the whole grain health effect and to clarify the [M_F] effect.

Materials and Methods

Three year moving averages (3ym) of age-standardized mortality (per 100,000) from cardiovascular diseases (CHD), among females (F) and males (M), aged 35-64 years, are attained of two subgroups: dwellers in countryside communities, non-towns [CHD.rur] and people of communities with town label [CHD.urb] [18]. Available mortality data are on logarithmic scale: by Females between 50 and 150, by males between 300 and 600. The scale limits and annual values are first measured by ruler as centimeters from the Figure 5 in [18]. Measured units: scale limits $Scal._{min}$ and $Scal._{max}$ (by females and males), then annual measures (M.i).

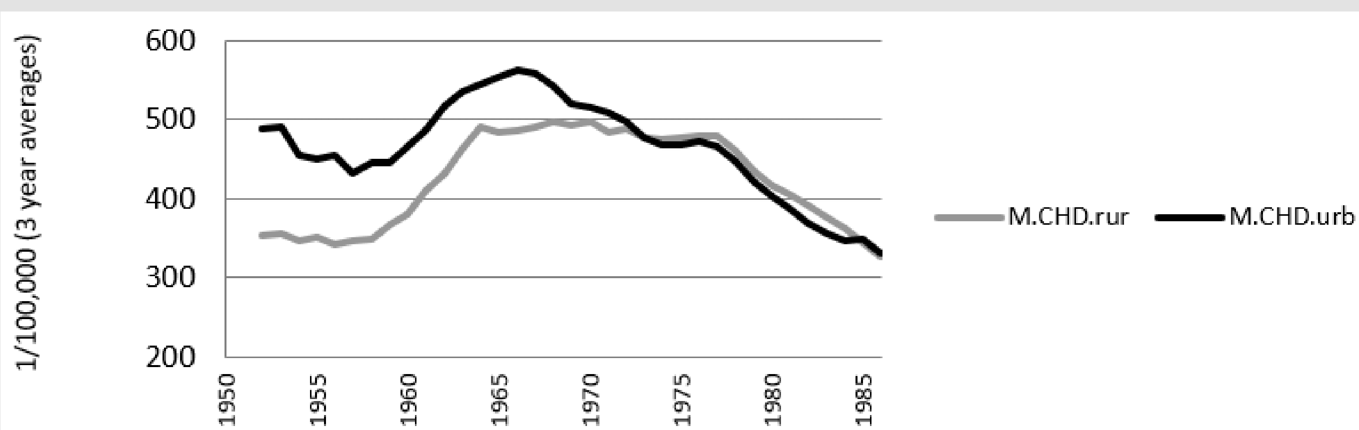

Figure 1: CHD mortality of middle-aged males in rural and urban areas in Finland 1951-87.

 DOI: 10.26717/BJSTR.2023.51.008137

By Exel equations:

$$M.CHD.i = POWER(10;(LOG10(300) + M.i / Scal._{\max} * (LOG10(600) - LOG10(300)))).$$

and

$$F.CHD._{i} = POWER(10;(LOG10(50) + M._{i} / Scal._{\max} * (LOG10(150) - LOG10(50))))$$

(Figures 1 & 2) DData on pig cardiac mortality is from [20,21]. They are explained in [22], but [Pig.MAP] (1/100,000) needed new calculations (it seemed to be less affected by autopsy density). The first [Pig.MAP] ("Enzootischer herztot") was diagnosed in 1954 and it kept this name until 1962. No official data are missing.

Data on alcohol consumption, as 100-% calculated, (l/capita/a) are attained from Statistics Finland (StatF) [23] as [Sugar] consumption data (kg/capita/yr) are from [24]. Sugar data are changed to daily consumption (g/capita/d) by multiplying the numbers by (1000/365.24). Approximate values of milk fats, including butter [M_F] consumption (g/capita/d) are attained by measuring the values from Fig.8 (on linear scale) in [19]. Annual consumption (g) of tobacco products per persons aged 15 years or over (g/15-y/a), [Tobac], are from Statistics Finland ("Tupakkatilasto") [25].

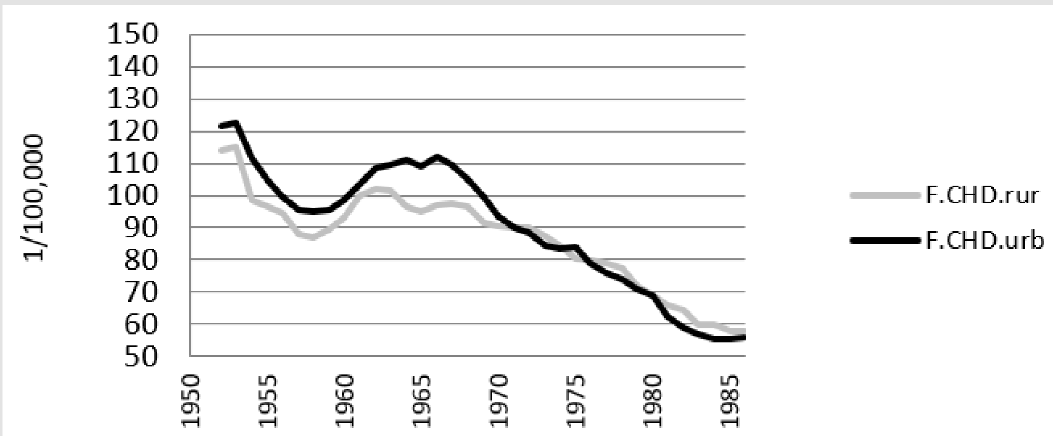

Figure 2: CHD mortality of middle-aged males in rural and urban areas in Finland 1951-87.

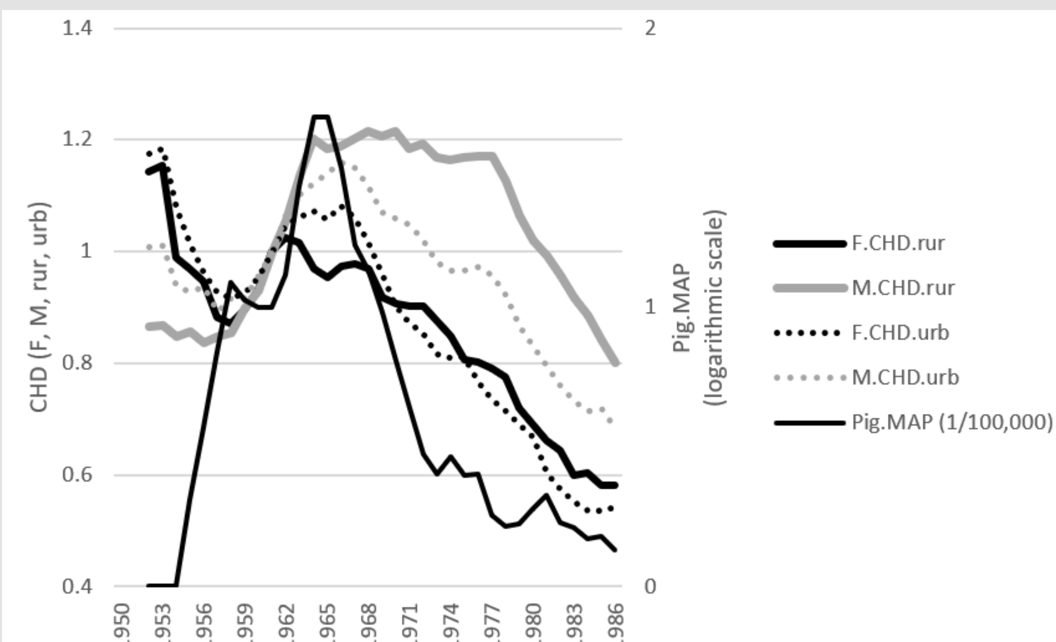

Figure 3: Development of age-adjusted CHD mortality among middle-aged females (F) and males (M) in rural (rur) and urban (urb) areas and MAP of pigs (3-year moving means). Values relative to 1961.

Estimates of fertilizer supply are based on the principles as presented in [26]. Data on K mineral fertilizers [K.min] per ha, in 1951-1960 (-75), are from Sillanpää (1978) [27], their supply in 1961-1987 are from FAOSTAT [28]. Total amounts of [K.min] from FAO (since 1961) are attained by multiplying them by ratio (K/K2O) (0.83) and divided by "arable land" area [29]. The fertilizer values of Sillanpää [fm] & [rcl] for 1951-60, are attained by ruler and adjusted by common [K.min] values (of FAO and Sillanpää) from 1961-65. Because there was no data available on changes of manure yield to fertilization after 1975, the [rcl] values of 1975 were benefited for period 1976-87, too.

The amounts of liming agents (carbonates) in 1951-1999 are from Nordkalk [30]. The same is published in graphics in [31]. (They are difficult to get by numbers). The Mg content of liming agents is based on four sources [30, 33, 34]: Mg-% of liming agents increased at the begin of the 1970's. The basic estimates are from [30]: "by the accuracy of 20 %", was that the average Mg content before 1970 was 2 %, then increased to 6 % in the 1990's and decreased afterwards. The adjustment by Lauronen [30] to the Mg amounts of liming agents to [33] in 1972 (ca +1 kg/ha) did not concern the years before 1972 (by a new interpretation of the messages of [30] by [33] and the author). Other sources of Mg and Ca in mineral fertilization are estimated as in [26]. Because there are deficient data (and different opinions on amounts of Mg recycling per ha [33,35]), [Mg.rcl] and so [Mg.ft] values are only approximates. [Ca.rcl] are estimated here by multiplying [K.rcl] values by 0.46 [36] and [Mg.rcl] by multiplying [Ca.rcl] by 0.52 [36]. Fertilization data (kg/ha) was changed to equivalents per ha (Eq/ha) by multiplying the values by 1,000 and dividing by respective equivalent weights (g).

Soil data are provided by Eurofins Viljavuuspalvelu Oy [37] for years from 1961 to 1990, as mg/l, by 5-year periods: 1961-65 with midpoint 1963 ($MP._{1963}$), 1966-70 with ($MP._{1968}$) and so on. Estimates for annual soil values (V) are calculated by the midpoints of neighbouring periods: The midpoints (MP.i) kept their values. The values for the following years are approximated as follows: $V.(MP._{i+1})$: $V.(MP._{i})$ +1/5*[$V.(Mp._{i+5})$ – $V.MP._{i}$)] , the next: $V.(MP._{i})$ +2/5*[$V.(MP._{i+5})$ – V.(MP.i)] and so on. Values for 1962 and 1961 are computed as follows: for 1962: {($V.(MP._{1963})$ + (-1)*1/5*[$V.(MP._{1968})$ – $V.(MP._{1963})$]}, for 1961: {$MP._{1963}$ +(-1)*2/5*[($Mp._{1968}$) - $MP._{1963}$)]}. Soil values, in (Table 1), are represented as mEq's per liter. Number of Mg samples per period was lower than by Ca and K samples until 1985. Because soil values from 1961-65 are "raw" (non-detailed by soil-types) data, no adjustments were made.

Table 1: CHD mortality among males and females aged 35-64 years in rural and urban regions, behavioral and environmental factors in Finland 1951-87 (3-year averages).

Year	M.CHD. rur	M.CHD. urb	F.CHD. rur	F.CHD. urb	Pig.MAP (1/100.000)	Alc	Tobac	M_F	Sugar	(Mg/Ca). ft (%)	(Mg/K). ft (%)	Mg.sm	(Mg/Ca). sm (%)	(Mg/K). sm (%)
1952	354	489	114	121	0.0	1.79	1616	68	88	28	90			
1953	355	490	115	122	0.0	1.87	1617	69	89	27	95			
1954	346	455	99	111	0.0	1.92	1661	70	102	25	95			
1955	350	450	97	105	2.0	1.93	1681	73	104	24	96			
1956	341	455	94	99	3.6	1.91	1654	64	106	24	94			
1957	346	433	88	96	5.3	1.81	1614	59	108	23	100			
1958	349	446	87	95	6.9	1.79	1632	65	111	23	104			
1959	367	446	89	96	6.5	1.77	1608	65	110	23	112			
1960	380	465	93	99	6.4	1.84	1596	68	111	23	115			
1961	409	486	100	103	6.4	1.95	1534	70	109	24	110	192	23.1	5.37
1962	431	518	102	108	7.1	2.09	1583	77	112	23	104	190	22.7	5.13
1963	464	535	101	110	9.1	2.21	1546	75	109	22	106	188	22.3	4.92
1964	491	545	97	111	10.7	2.30	1549	73	110	21	112	186	21.9	4.72
1965	484	553	95	109	10.7	2.41	1506	73	109	22	110	184	21.5	4.54
1966	486	563	97	112	9.5	2.58	1570	72	112	23	99	181	21.2	4.37
1967	491	559	97	110	7.8	2.74	1594	74	112	24	92	179	20.8	4.21
1968	496	543	97	105	7.2	3.29	1639	69	114	23	89	177	20.4	4.07

 DOI: 10.26717/BJSTR.2023.51.008137

1969	493	520	92	99	6.3	3.80	1653	68	116	23	90	179	20.5	4.12
1970	496	515	90	93	5.2	4.40	1678	60	117	22	93	182	20.7	4.16
1971	484	509	90	90	4.1	4.70	1714	67	119	23	99	184	20.9	4.21
1972	488	496	90	88	3.0	5.13	1734	63	119	24	109	187	21.0	4.26
1973	477	477	87	84	2.6	5.73	1759	61	120	27	111	189	21.2	4.31
1974	475	469	85	84	3.0	6.10	1746	58	115	30	123	189	21.3	4.27
1975	477	469	80	84	2.5	6.33	1685	57	108	32	137	189	21.4	4.23
1976	479	472	80	79	2.6	6.30	1615	57	104	34	147	189	21.5	4.19
1977	479	465	79	76	1.6	6.30	1542	56	99	36	154	189	21.6	4.15
1978	460	447	77	74	1.4	6.27	1554		98	39	155	189	21.7	4.11
1979	435	421	72	71	1.4	6.23	1530		98	39	177	194	22.2	4.19
1980	416	403	69	69	1.8	6.30	1490		98	41	172	198	22.7	4.26
1981	406	386	66	62	2.1	6.37	1445		98	41	181	203	23.2	4.35
1982	392	368	64	59	1.4	6.40	1433		99	41	207	207	23.7	4.43
1983	375	355	60	57	1.3	6.43	1469		98	40	222	212	24.2	4.52
1984	362	346	60	55	1.1	6.47	1450		97	40	241	216	24.5	4.62
1985	344	349	58	55	1.1	6.63	1439		95	40	209	221	24.8	4.73
1986	327	332	58	56	0.8	6.83	1433		95	40	208	225	25.1	4.84

All but soil data are as 3-year moving averages (changed if not readily given) before calculations (Table 1). This causes shortening of the available period of fats. Because soil [sm] values are available for calculations first since 1961 and fat values only for 1952-86, the computational assessments are made separately by three periods: {1} (1952-86).(less soils, less fats); {2} (1952-76).(less fats); and {3} (1961-86).(less fats). Correlations are calculated mainly by Microsoft Exel, a few regressions are computed by IBM SPSS Statistics [27]. Results have been slightly different with each other, possibly because numbers are small and they can contain hidden decimals. Effects of refining on Mg, Ca and K contents and Mg/K ratio of (wheat) grain in cereals and in wheat flour (milled ad ash-% 0.05) [38] are represented in (Table 2). Reduction in Mg (ad 1/(5.6), i.e. ad 18 %) was higher than in Ca or K.

Table 2: CHD mortality among males and females aged 35-64 years in rural and urban regions, behavioral and environmental factors in Finland 1951-87 (3-year averages).

	M.CHD. rur	M.CHD. urb	F.CHD. rur	F.CHD. urb	Pig.MAP (1/100,000)	Alc	Tobac	M_F	Sugar	(Mg/Ca). ft (%)	(Mg/K). ft (%)	Mg.sm	(Mg/Ca). sm (%)	(Mg/K). sm (%)
1952	354	489	114	121	0.0	1.79	1616	68	88	28	90			
1953	355	490	115	122	0.0	1.79	1617	69	89	27	95			
1954	346	455	99	111	0.0	1.92	1661	70	102	25	95			
1955	350	450	97	105	2.0	1.93	1681	73	104	24	96			
1956	341	455	94	99	3.6	1.91	1654	64	106	24	94			
1957	346	433	88	96	5.3	1.81	1614	59	108	23	100			
1958	349	446	87	95	6.9	1.79	1632	65	111	23	104			
1959	367	446	89	96	6.5	1.77	1608	65	110	23	112			
1960	380	465	93	99	6.4	1.84	1596	68	111	23	115			
1961	409	486	100	103	6.4	1.95	1534	70	109	24	110	192	23.1	5.37
1962	431	518	102	108	7.1	2.09	1583	77	112	23	104	190	22.7	5.13
1963	464	535	101	110	9.1	2.21	1546	75	109	22	106	188	22.3	4.92
1964	491	545	97	111	10.7	2.30	1549	73	110	21	112	186	21.9	4.72
1965	484	553	95	109	10.7	2.41	1506	73	109	22	110	184	21.5	4.54

 DOI: 10.26717/BJSTR.2023.51.008137

1966	486	563	97	112	9.5	2.58	1570	72	112	23	99	181	21.2	4.37
1967	491	559	97	110	7.8	2.74	1594	74	112	24	92	179	20.8	4.21
1968	496	543	97	105	7.2	3.29	1639	69	114	23	89	177	20.4	4.07
1969	493	520	92	99	6.3	3.80	1653	68	116	23	90	179	20.5	4.12
1970	496	515	90	93	5.2	4.40	1678	60	117	22	93	182	20.7	4.16
1971	484	509	90	90	4.1	4.70	1714	67	119	23	99	184	20.9	4.21
1972	488	496	90	88	3.0	5.13	1734	63	119	24	109	187	21.0	4.26
1973	477	477	87	84	2.6	5.73	1759	61	120	27	111	189	21.2	4.31
1974	475	469	85	84	3.0	6.10	1746	58	115	30	123	189	21.3	4.27
1975	477	469	80	84	2.5	6.33	1685	57	108	32	137	189	21.4	4.23
1976	479	472	80	79	2.6	6.30	1615	57	104	34	147	189	21.5	4.19
1977	479	465	79	76	1.6	6.30	1542	56	99	36	154	189	21.6	4.15
1978	460	447	77	74	1.4	6.27	1554		98	39	155	189	21.7	4.11
1979	435	421	72	71	1.4	6.23	1530		98	39	177	194	22.2	4.19
1980	416	403	69	69	1.8	6.30	1490		98	41	172	198	22.7	4.26
1981	406	386	66	62	2.1	6.37	1445		98	41	181	203	23.2	4.35
1982	392	368	64	59	1.4	6.40	1433		99	41	207	207	23.7	4.43
1983	375	355	60	57	1.3	6.43	1469		98	40	222	212	24.2	4.52
1984	362	346	60	55	1.1	6.47	1450		97	40	241	216	24.5	4.62
1985	344	349	58	55	1.1	6.63	1439		95	40	209	221	24.8	4.73
1986	327	332	58	56	0.8	6.83	1433		95	40	208	225	25.1	4.84

Results

Period {1},

The whole period, had two limitations: missing data on fat and soil values, but on the other side long duration (34 years). In general [MORT] associated highly significantly negatively with Alcohol ($p < 0.001$), although [M.CHD.rur] associated non-significantly (ns) positively. [Tobac] associated significantly positively with [F.CHD]'s and with [M.CHD.urb], significance level about ($p < 0.001$), but ($p > 0.05$) with [M.CHD.urb] and [Pig.MAP]. Sugar consumption was associated positively with all [MORT]'s, with male [CHD] and [Pig.MAP] ($p < 0.001$), (generally $p < 0.0001$), but non-significantly ($p > 0.05$) with female [CHD]'. [(Mg/Ca).ft] and [(Mg/K).ft] associated very highly significantly ($p < 0.0001$) negatively with [M.CHD.urb], [F.CHD]'s and [Pig.MAP], non-significantly negatively with [M.CHD.rur]. [MORT] associations with [(Mg/K).ft] were similar with [CHD]'s, but association with [Pig.MAP] was weaker (anyhow $p < 0.01$).

Mean of [MORT] correlations with each [BEH]'s is about the opposite number of the mean of the correlations with [ft]'s. Multiple regression by Alc, Tobac and Sugar explained [(Mg/Ca).ft] by 96 % and [(Mg/K).ft] by 68 %. Standardized beta coefficient of [Alc] was the highest and ($p < 0.0001$) in both cases (Table 3). Period {2} is shorter than period {1}, which affects significance levels. [Alc] associated significantly ($p < 0.001$) negatively with [F.CHD]'s and [MF], positively with [ft]'s, positively [M.CHD.rur], non-significantly with [M.CHD.urb] and [Pig.MAP]. [Tobac] associated non-significantly with [ft]'s and [M.CHD.rur]. Other associations with [MORT] were negative, only associations of [F.CHD.urb] ($r = -0.55$, $p < 0.05$), [Pig.MAP] ($r = -0.55$, $p < 0.01$) and [M_F] ($r = -0.45$, $p < 0.05$) exceeded the significance level.

Table 3: Mg, Ca, K and Mg/Ca in wheat grain, 'Cereals' and refined flour in the 1970's (Koivistoinen et al., 1980).

	Spring wheat	'Cereals'	Wheat flour	Grain per
	(1972-76)	orig. (mg/202 g, d.w.)	(ash-% 0.5)	flour
	mean (g/kg)	(g/kg d.w.) computed	(g/kg)	ratios
Mg	1.2	0.64	0.21	5.6
Ca	0.31	0.20	0.13	2.4
K	3.9	2.72	1.50	2.6
Mg/Ca	3.9	3.2	1.6	2.4

[M_F] associated significantly positively with [F.CHD]'s, ($r = +0.73$ & $+0.82$, $p < 0.001$), [M.CHD.urb] ($r = +0.58$, $p < 0.01$), and [Pig.Map], ($r = +0.49$, $p < 0.05$) and negatively with [ft]'s ($r = -0.68$ & -0.58), near sig. level 0.001).

[Sugar] associated negatively ($r = -0.50/-0.44$ with [F.CHD.rur]/[F.CHD.urb], $p < 0.05$) and with [M_F] and [ft]'s ($p > 0.05$). Sugar associations were positive with [M.CHD.rur] ($r = +0.55$, $p < 0.01$), [Pig.MAP] ($r = +0.47$, $p < 0.05$) and [M.CHD.rur] ($r = +0.25$, ns). [ft] associations: [M.CHD]'s associated insignificantly, with both [ft]'s, [M.rur] positively, but [M.urb] negatively. [(Mg/K).ft] associated negatively with [F.CHD]'s ($r = -0.67/-0.70$, $p < 0.001$), but association of

 DOI: 10.26717/BJSTR.2023.51.008137

[(Mg/Ca).ft] was less strong with [F.CHD]'s (r = -0.56/-0.64, sig.level 0.01/0.001). Association of [(Mg/Ca).ft] with [pig.MAP] (r = -0.64, p < 0.001). [ft]'s associated negatively with [M_F] (r = -0.68/-0.58, sig. level 0.001/0.01). Average [MORT] correlations with [Alc] and [M_F] were about opposite numbers to mean [ft] correlations, but not with [Tobac] nor [sugar] (Table 4).

Table 4: Period 1952-86. Represented all factors of available for this period. Selected associations of [CHD]'s, Pig.MAP], [BEH] and [ENV] factors with each other and means of [MORT] and [ft] correlations with [BEH] factors.

	M.CHD.rur	M.CHD.urb	F.CHD.rur	F.CHD.urb	Pig.MAP.1_100.000	Mg_Ca.ft.perc	Mg_K.ft.perc	µ.MORT	µ.ft
Alc	0.18	-0.58	-0.84	-0.89	-0.55	0.84	0.78	-0.53	0.81
Tobac	0.33	0.54	0.58	0.51	0.08	-0.62	-0.74	0.41	-0.68
Sugar	0.60	0.59	0.31	0.31	0.63	-0.67	-0.55	0.49	-0.61
Mg_Ca.ft	-0.24	-0.81	-0.85	-0.88	-0.70	1.00	0.91		
Mg_K.ft	-0.29	-0.84	-0.92	-0.91	-0.50	0.91	1.00		

By excluding [M.CHD.rur] all [MORT] factors associated highly significantly negatively with [Alc] (p < 0.001) and highly significantly positively with [ft]'s (p < 0.001). Association was highest with [Pig.MAP].

[Sugar] associated significantly positively with all [MORT] factors and negatively with [ft]'s, (p < 0.0001) with all, but not with [Pig.MAP]. Associations of [Tobac] were in generally weaker than by [Sugar]. They were highest by men, insignificant with [Pig.MAP]. [Tobac] associations with [ft]'s were significantly negative (r = -0.60/-0.72; resp. sig levels 0.01/0.0001). [(Mg/Ca).ft], [(Mg/K).ft], [Mg.sm] and [(Mg/Ca).sm] associated highly significantly negatively with [CHD]'s, (p < 0.0001), slightly weaker with [Pig.MAP]. Fertilization factors [(Mg/Ca).ft] and [(Mg/K).ft] associated highly significantly, (p < 0.001) with each other, soil [Mg.sm] and [(Mg/Ca).sm], but not with [(Mg/K).sm]. Mean [MORT] correlations with [BEH] factors were about opposite numbers to mean [ft] correlations. Regression of [(Mg/Ca).ft] by (Alc, Tobac and Sugar) explained it by 97 %. [Alc] had the biggest beta coefficient (+0.595). [(Mg/Ca).ft] and [(Mg/K).ft] associated significantly positively with soil Mg and (Mg/Ca) ratio (r >= 0.68, N = 25, p < 0.001). (calculated period 1961-86).

Discussion

The selected [ft]'s (ratios) do not indicate the increase in annual total fertilization, nor the slow exhaustion of soil Mg-reserves between 1952-63. These can explain the "weak" correlations in period 1952-77 (Table 5). (Determinations of soil Mg values are available first since 1961). Heinonen [35] calculated in 1956, that annual 7 kg (Mg/ha) loss of agricultural fields, could be replaced by 5 kg via manure and by 2 kg via new N-fertilizers. These evaluations became soon forgotten until the begin of the 1970's, when Nuoranne wrote his first article (1971). This evaluation is a true sign of Mg deficiency of soil in the 1950's and 1960's, maybe in other countries, too.

High association of [BEH] factors, especially [Alc] and [Sugar] (Tabl.3 and Tabl.7), [M_F] (Tabl.5) with [Pig.MAP], when their physiological effects were excluded, and inverse relation between correlation coefficients of [MORT] and [fert] (Tabl. 3,5,7), supports the role of [BEH]'s as (Mg/Ca) indicators and weaken their (known physiological) explanative power. It is clear that human alcohol consumption cannot decrease [Pig.MAP].

Table 5: For normally distributed variables these are the significance levels of the product moment correlation coefficient r for N pairs of observations.

N =	34		
abs(r) >	0.34	:p < 0.05	*
abs(r) >	0.43	:p < 0.01	**
abs(r) >	0.53	:p < 0.001	***
abs(r) >	0.60	:p < 0.0001	****

Selenium (Se) can only partially explain [Pig.MAP] [6]. Significant Mg deficiency has been shown in patients with acute myocardial infarction (AMI) in magnesium retention test (MRT) [39] and in muscle biopsies (from "musculus lateralis"), from native tissue (opposite to myocardium, which was damaged by infarction) [39]. The bleeding time was increased after MRT (i.e. anti-thrombotic effect after Mg dose) as expected [40]. Remarkable is that CHD is a subtype of CVD by humans and MAP by swines. [Pig.MAP] begun to decrease since 1965, [F.CHD] slightly earlier, [M.CHD.urb] since 1966 (Table 1, Fig.3). Myocardial degeneration of pigs begun to decrease more earlier [22]. Grant observed beneficial effects of selenium on [Pig.MAP] [13], Korpela reported on rather weak association of Se with [Pig.MAP]. Weaker association [7] is possibly explained by later observations during increased Se supply. It has been represented that Mg deficiency can increase lactate production [41], ASAT [42], as well as myoglobin and CK [43] release, indicate muscle dysfunction/damage. (About 50 years ago ASAT was one of the first chemical indictors of acute myocardial infarction).

Table 6: Period 1952-77. Associations of [CHD]'s, [Pig.MAP], [M_F] and [ft]'s with [BEH] and [ENV] factors. Calculated are mean [MORT] and [ft] correlations of each [BEH].

	M.CHD. rur	M.CHD. urb	F.CHD.rur	F.CHD.urb	Pig.MAP (1/100,000)	M_F	(Mg/Ca).ft (%)	(Mg/K).ft (%)	µ.MORT	µ.ft
Alc	0.66	-0.04	-0.70	-0.81	-0.33	-0.70	0.70	0.64	-0.47	0.67
Tobac	0.04	-0.35	-0.30	-0.44	-0.55	-0.45	0.17	-0.12	-0.41	0.03
M_F	-0.07	0.58	0.73	0.82	0.49	1.00	-0.68	-0.58	0.66	-0.63
Sugar	0.55	0.25	-0.50	-0.44	0.47	-0.06	-0.38	-0.06	-0.05	-0.22
Mg_Ca.ft	0.11	-0.39	-0.44	-0.56	-0.64	-0.68	1.00	0.76		
Mg_K.ft	0.28	-0.28	-0.67	-0.70	-0.15	-0.58	0.76	1.00		

Plant Mg is not only dependent on soil Mg, Mg fertilization or weather, it is dependent especially on the harmony of Ca, Mg and K [35]. Plants can take K three-fold to their physiological needs without visible problems in plants (Bear and Toth, 1948 in [35]), but causing Ca and Mg decrease in plants, animals and humans (Table 7). There can be another problem: it is possible, that when the war against hunger needed maximal yields, K fertilization was increased, because the low (Mg/K) ratio gave possibly better yields [44]. Jerlstrom published such a result in 1975 [44]. but wrote that by one experiment it is difficult to build up any theories. It seems that this experiment has been forgotten.

The milling effect is manyfold to fertilization: If fertilization could decrease Mg content of basic food by 20 %, milling can decrease it (still) by 80 %, (Table 2) [38]. (Reliable data on development of milling are scanty). Refining of cereals could explain [M.CHD.rur]. General morbidity and mortality decreased in Denmark during the Spanish Flu [42], including heart diseases. Hindhede's dietary rules (which gave protection against hunger) were: Mainly (wheat and) rye should be milled without extraction of the outer parts. If some parts of the wheat were extracted, the extracted parts had to be mixed with other human foods. Hindhede's diet can be labeled as "whole grain experiment".

Table 7: For normally distributed variables these are the significance levels of the product moment correlation coefficient r for N pairs of observations.

N =	25		
abs(r) >	0.41	:p < 0.05	*
abs(r) >	0.52	:p < 0.01	**
abs(r) >	0.63	:p < 0.001	***

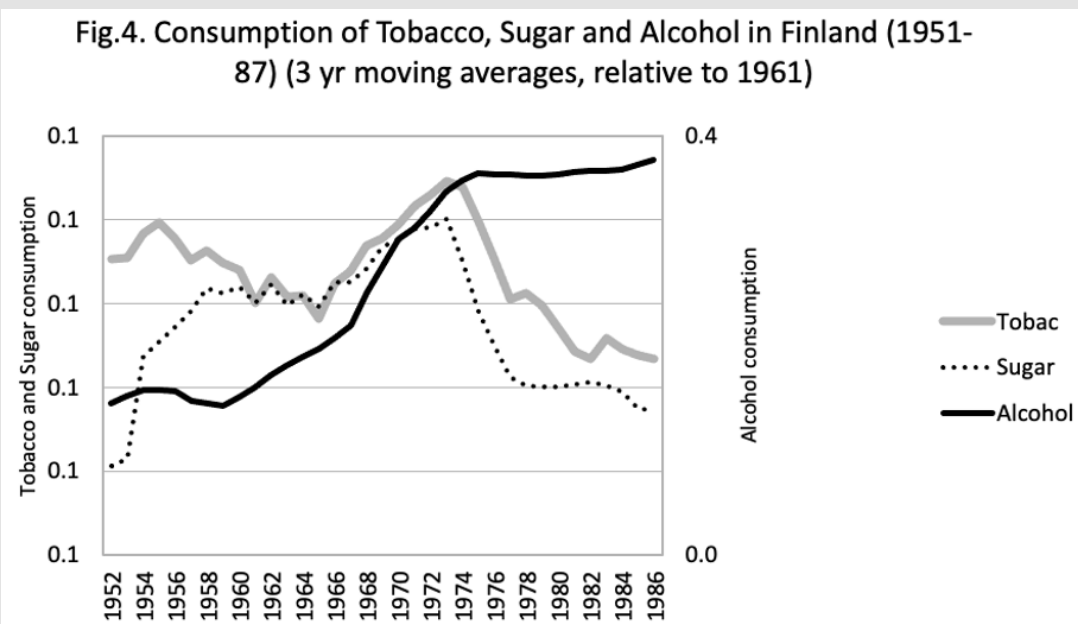

Figure 4.

 DOI: 10.26717/BJSTR.2023.51.008137

The situation in Finland was similar after the II WW. White flour was a luxury product. Countrymen did not like to buy "shop flours", have I heard. In the 1960's in TV was increasingly programs of "better" white flours [45]. Our neighbour told that he had trimmed his mill and "now" they have got from their own wheat nearly as white flour as from the shop. After diluting grain Mg by milling, flour Mg could be diluted by sugar. In Discussion about "fat theories" Professor P Halonen suggested that CHD and atheromatosis could better be explained by sugar [46] than by fats. That's why the [BEH] statistics (Figure 4) is partially expanded ad 1938 in (Figure 5) (by Official Statistics of Finland). This shows the increase of sugar consumption again until the level before war at the begin of the 1950's. An obvious effect of the Nord Karelian Project can be seen in the slope of sugar and tobacco consumption since 1973 (Figure 5). During those times it was often spoken about "dead calories" (calories without protective substances). Another "method" for diluting proportion of fats, sugar and Ca in the Finnish diets during the 1950's was hard work, higher caloric intake (ad 4200 kcal by rural males) [47]. CHD was in those times labeled as well-being disease (Figures 2 & 3). Toxic effects of polyunsaturated fatty acids PUFAs can be based on their tendency to become rapidly rancid [11,12]. Poukka even reported on an old study, in which cod liver oil added to skim milk produced severe muscular disease and additionally that calves need 10-fold amounts of vitamin E to compensate the harms of 10 ml cod liver oil [12]. . Refrigerators and rapid food and feed delivery have possibly changed the situation.

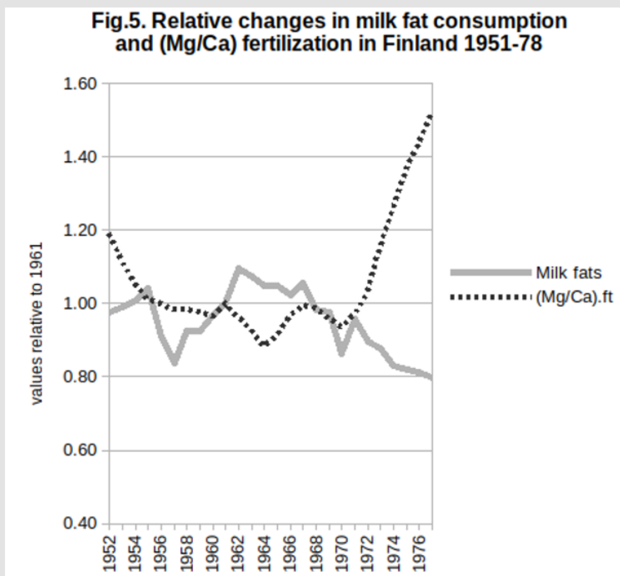

Figure 5.

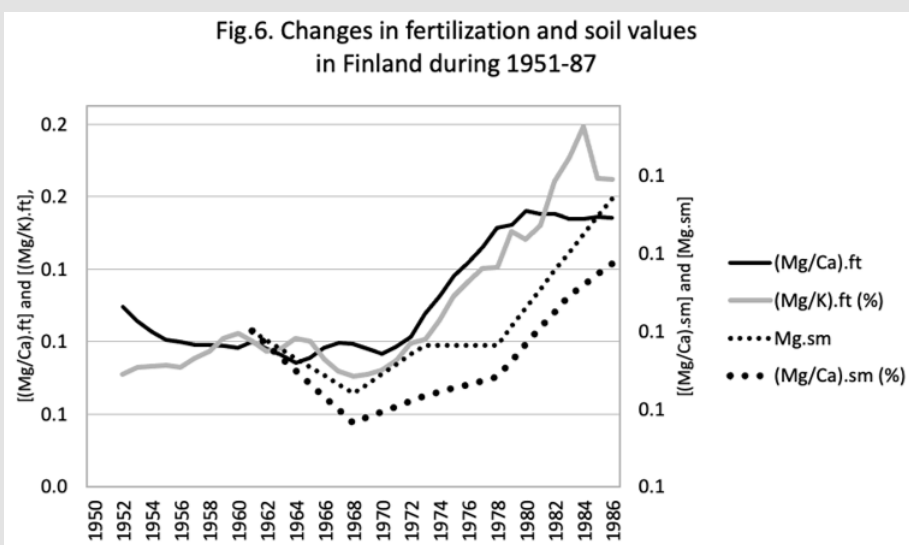

Figure 6.

Food processing at home can be a risk to PUFA quality [14], which could not be evaluated by the study [1]. Study [1] cannot explain why in USA low intake of milk fats associated with very high CHD mortality [2]. Even the low CHD mortality of rural males in Finland at the first half of the 1950's is difficult to be explained by PUFA's. Milk fat content of milk was 4-5 % before processing in dairy [48]. In countryside people drank raw milk especially in the first half of the 1950's, because of the missing cool transport systems.

As such the intervention study [1] was excellently carried out, but the explanation was not perfect during the time of publication of the results in the 1970's [1,2]. The observed association ("statistical effect") of milk fats on public health is associated with its "implicit liquid-milk component" with high Ca content and disadvantageously low Mg/Ca ratio (0.09) [38,4].

It was not problem when people worked hard and consumed much whole grain bread or porridge with high Mg/Ca ratio (4!) [38,45], (Table 2). Koivistoinen [38] wrote that Ca consumption in Finland was exceptionally high (in the 1970's). Artauld-Wild et al. discovered this French/Finnish paradox [49] and suggested that one explanation could be high Ca intake in Finland, which can implicitly be the same in other milk producing countries without lactose intolerance. Figures 1 and 2 suggest on the role of sex hormones in CHD. Reader's Digest wrote, in the 1960's, about an experiment, in which men were treated with estrogens against CHD. But hormones have not become a treatment of choice for CHD. Menstruation (iron loss) could explain [F.CHD]-[M.CHD] difference remarkably [6] e.g. by oxidant-antioxidant balance [6,15].

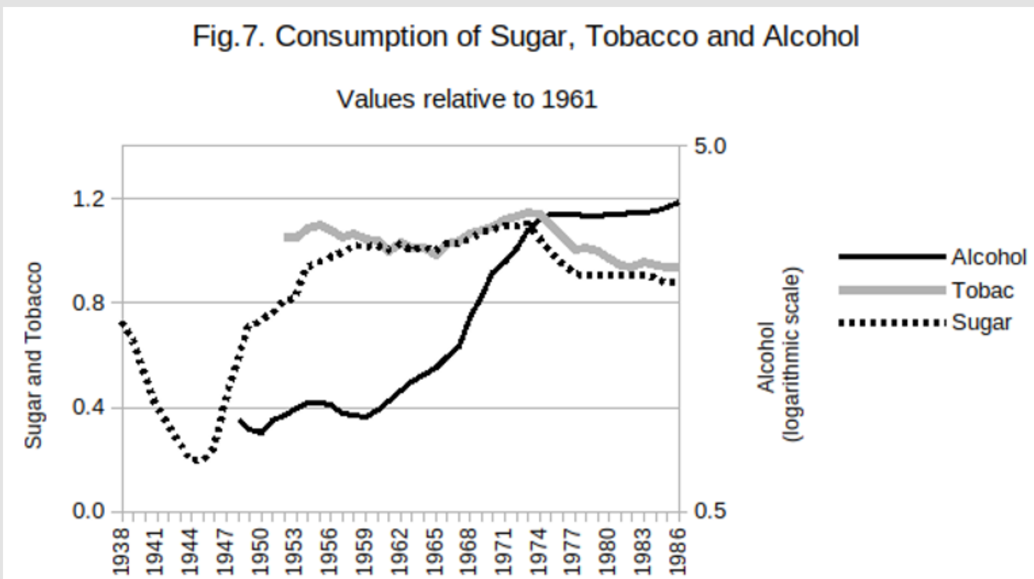

Figure 7.

Table 8: Period 1961-86, N = 2, Associations of [MORT] with [BEH] and [ENV] factors and means of [MORT] and [ft] correlations with [BEH] factors.

	M.CHD.rur	M.CHD.urb	F.CHD.rur	F.CHD.urb	Pig.MAP (1/100.000)	(Mg/Ca).ft (%)	(Mg/K).ft (%)	μ.MORT	μ.ft
Alc	-0.47	-0.81	-0.88	-0.92	-0.95	0.87	0.75	-0.81	0.81
Tobac	0.76	0.60	0.58	0.47	0.17	-0.60	-0.72	0.52	-0.66
Sugar	0.75	0.78	0.80	0.74	0.54	-0.87	-0.88	0.72	-0.88
Mg_Ca.ft	-0.72	-0.92	-0.95	-0.94	-0.85	1.00	0.92		
Mg_K.ft	-0.85	-0.95	-0.95	-0.92	-0.73	0.92	1.00		
Mg.sm	-0.96	-0.93	-0.86	-0.83	-0.63	0.77	0.91		
Mg_Ca.sm	-0.97	-0.84	-0.73	-0.69	-0.46	0.68	0.85		
Mg_K.sm	-0.50	-0.11	0.10	0.12	0.26	-0.12	0.12		

DOI: 10.26717/BJSTR.2023.51.008137

The effects of tender milling and low sugar consumption was possibly promoted by silicon [16,17] during the first years of the 1950's, when even K in yields was 10 % higher than the given in fertilizers together [27]. In those years only 1/3 of total fertilizers was composed of "adjuvant fertilizers", i.e, commercial fertilizers, to promote the effects of the authentic, recycled "multi-fertilizers" (manure). If we approximate leaching, it is possible that plants could take 20% or more of their mineral elements from agricultural soil silicates (by weathering) and groundwater [27] (p19). This could be one explanation why Mg- and Si-content of food and manure could have been higher in the 1950's [35] than roughly approximated here via [36]. The studies of Valkonen et al. [18,19] are very important, because they show not only the decreasing slope CHD epidemics, but its development in the 1950's, which needs further attention.

Conclusions

Variation in dietary Mg-content, via (Mg/Ca) and (Mg/K) ratios in fertilization and soil or implicitly via [M_F] (factor), can explain Finnish [CHD] and [pig.MAP]. Benefits of [Alc] can partially be explained by [ENV] factors. Iron can explain [F.CHD]-[M.CHD] difference.

Table 9: For normally distributed variables these are the significance levels of the product moment correlation coefficient r for N pairs of observations.

N = 25			
abs(r) >	0.41	:p < 0.05	*
abs(r) >	0.52	:p < 0.01	**
abs(r) >	0.63	:p < 0.001	***
abs(r) >	0.681	:p < 0.0001	****

Acknowledgements

I am grateful to Osmo Hanninen and Seppo Haaranen for co-working and co-thinking during many years.

References

1. Turpeinen O, Karvonen MJ, Pekkarinen M, Miettinen M, Elosuo R, et al. (1979) Dietary prevention of coronary heart disease: the Finnish Mental Hospital Study. Int J Epidemiol 8(2): 99-118.
2. Turpeinen O (1979) Effect of cholesterol-lowering diet on mortality from coronary heart disease and other causes. Circulation (New York, N.Y.) 59(1): 1-7.
3. Seelig MS (1980) Magnesium Deficiency in the Patogenesis of Disease. Springer, pp. 114-229.
4. Korpela H (1991) Hypothesis: increased calcium and decreased magnesium in heart muscle and liver of pigs dying suddenly of microangiopathy (mulberry heart disease): an animal model for the study of oxidative damage. J Am Coll Nutr 10(2): 127-131.
5. Nuoranne P (1974) [in Finnish] Magnesium deficiency in pigs ["Sikojen magnesiumin puutteesta] "with a short English summary]. Suomen Eläinlääkärilehti. [Finnish Veterinary Journal] 80: 258-268.
6. Korpela H (1990) Increased myocardial and hepatic iron concentration in pigs with microangiopathy (mulberry heart disease) as a risk factor of oxidative damage. Ann Nutr Metab 34(4): 193-197.
7. Korpela H (1990) Hepatic selenium concentration in pigs with microangiopathy (mulberry heart disease) an animal model for the study of oxidative damage. Int J Vitam Nutr Res 60(2): 156-158.
8. Schwarz K, Ricci BA, Punsar S, Karvonen MJ (1977) INVERSE RELATION OF SILICON IN DRINKING WATER AND ATHEROSCLEROSIS IN FINLAND. The Lancet 1(8010): 538-539.
9. Zhang B, Zhao Q, Guo W, Bao W, Wang X (2018) Association of whole grain intake with all-cause, cardiovascular, and cancer mortality: a systematic review and dose-response meta-analysis from prospective cohort studies. Eur J Clin Nutr 72(1): 57-65.
10. Ostlund Jr RE, Racette SB, Stenson WF (2002) Effects of trace components of dietary fat on cholesterol metabolism: phytosterols, oxysterols, and squalene. Nutr Rev 60(11): 349-359.
11. Poukka R (1965) Changes in the lipids of heart muscle, skeletal muscle and liver of calves suffering from muscular dystrophy. Dissertation Helsinki, p. 11-15.
12. Obel AL (1953) Studies on the morphology and etiology of so-called toxic liver dystrophy (Hepatosis diaetetica) in swine. Acta Path Microbiol Scandinavica 94: 1-119.
13. Grant CA (1961) Morphological and aetiological Studies of Dietetic Microangiopathy in Pigs ("Mulberry Heart"). Acta Veterinaria Scandinavica 2(3): 107.
14. Adam SK, Das S, Soelaiman IN, Umar NA, Jaarin K (2008) Consumption of repeatedly heated soy oil increases the serum parameters related to atherosclerosis in ovariectomized rats. Tohoku J Exp Med 215(3): 219-226.
15. Esterbauer H, Wäg G, Puhl H (1993) Lipid peroxidation and its role in atherosclerosis. Br Med Bull 49(3): 566-576.
16. Thubrikar MJ, Baker JW, Nolan SP (1998) Inhibition of atherosclerosis associated with reduction of arterial intramural stress in rabbits. Arteriosclerosis 8(4): 410-420.
17. Töysä T (2018) Regional associations of CHD and musculoskeletal morbidity with environmental and geographic factors – e.g. Ca, Mg, Si, Sn. Biomed J Sci & Tech Res.
18. Valkonen T, Martikainen P (1990) Development of mortality from ischaemic heart disease in subgroups of the population in Finland. Sosiaalilääketieteellinen Aikakauslehti. Journal of Social Medicine 27: 273-288.
19. Valkonen T, Niemi ML (1982) The Development of Cardiovascular Mortality in Finland from 1951 to 1978. Väestöntutkimuksen vuosikirja 1982, XX.32-44. Finnish Yearbook of population research 20: 32-44.
20. Autopsy statistics. Annual reports of National Veterinary Institute (Valtion eläinlääketieteellisen laitoksen vuosikertomukset) 1957-91. Department of Pathology, National Veterinary Institute, Helsinki.Years 1950-91. (received via Eija Tammisalpa, Finnish Food Safety Authority Evira. Information services).
21. Statistics Finland: Statistical Yearbooks of Finland (1960, Tabl. 82; 1969, Table 78; 1978, Table 71; 1998, Tabl. 93). (number of pigs).
22. Timo T, Osmo H, Seppo H (2018) Human CHD and Pig Cardiac Mortality in Finland during 1954-86. Biomed J Sci & Tech Res 2(4).
23. Statistical Yearbook (Official Statistics) of Finland from 1955, 1960, 1969, 1980 and 1999. (alcohol).
24. Statistical Yearbook (Official Statistics) of Finland 1960 (Tabl.273, p.271); 1970 (Tabl.285, p. 295); 1980 (Tabl.269, p 282); 1999 (Tabl.402, pp. 410). (Sugar).
25. Statistics Finland ("Tupakkatilasto"), SVT (OSF) 1956, 1964, 1974, 1984 and 1994.

26. Toysa T, Hanninen O (2016) Compliance of Finnish Male CHD and Total Mortality with Soil Fertilization in 1957-1990. J J Agriculture 2(1): 013.
27. Sillanpää M (1978) Lannoitus ja maan ravinnevarojen kehitys. Käytännön Maamies, p. 17-20.
28. FAOSTAT, Fertilizers Archive, 1961-2002.
29. FAOSTAT, arable land 1961-2012.
30. Lauronen M. Nordkalk Corporation. personal communications, emails, Sept-Dec 2007, answer to the question of the author: "Yes, the values are in the limits of +/- 20 %."
31. Yli Savola Sari (2002) Kalkitusyhdistyksen Kalkitusopas. 4. uud. p. [Helsinki]: Kalkitusyhdistys.
32. Official Statistics of Finland (Suomen Tilastollinen Vuosikirja) 1961.Use of arable land 1951-60, Tabl.73.
33. Jokinen R (1981) Requirements for Magnesium fertilization in Finland. Journal of the Scientific Agricultural Society in Finland. 53(4): 239-268.
34. Jokinen R. personal communications.
35. Heinonen R (1956) Magnesiumin tarpeesta Suomen pelloilla. Agrogeologisia Julkaisuja No 65. Helsinki.
36. Viljavuustutkimus 2005-09.
37. Viljavuuspalvelu Oy.

a. Ca (mg/l): "http://www.viljavuuspalvelu.fi/index.php?id=107-> Taulukko 5. (1955-2000).

b. K (mg/l): "http://www.viljavuuspalvelu.fi/index.php?id=107-> Taulukko 6. (1955-2000).

c. Mg (mg/l: "http://www.viljavuuspalvelu.fi/index.php?id=107-> Taulukko 8. (1961-2000).

38. Koivistoinen P (1980) Mineral Element Composition of Finnish Foods: N, K, Ca, Mg, P, S, Fe, Cu, Mn, Zn, Mo, Co, Ni, Cr, F, Se, Si, Rb, Al, B, Br, Hg, As, Cd, Pb and Ash. Acta Agriculturae Scandinavica 22.
39. Jeppesen BB (1986) Magnesium status in patients with acute myocardial infarction: a pilot study. Magnesium 5(2): 95-100.
40. Shechter M, Merz CN, Rude RK, Paul Labrador MJ, S R Meisel, et al. (2000) Low intracellular magnesium levels promote platelet-dependent thrombosis in patients with coronary artery disease. Am Heart J 140(2): 212-218.
41. Nuoranne PJ, Raunio P, Saukko P, Karppanen H (1980) Metabolic effects of a low-magnesium diet in pigs. Br J Nutr 44(1): 53-60.
42. Gullestad L, Dolva LO, Soyland E, Manger AT, Falch D, et al. (1992) Oral magnesium sup-plementation improves metabolic variables and muscle strength in alcoholics. Alcohol Clin Exp Res 16(5): 986-990.
43. Cordova A, Mielgo Ayuso J, Roche E, Caballero Garcia A, Fernandez Lazaro D (2019) Impact of magnesium supplementation in muscle damage of professional cyclists competing in stage race. Nutrients 11(8): 1927.
44. Jerlström H G (1975) Studier över möjligheterna att med växt- och jordanalyser beskriva magnesiumsituationen i svensk växtodling. Akademisk avhandling. Institutionen för Markvetenskap, Lantbrukshögskolan Sweden, p. 78.
45. Hindhede H, Shechter M, Bairey Merz CN, Paul Labrador MJ, Shah PK, et al. (1920) The effect of food restriction during war on mortality in Copenhagen. JAMA 74(6): 381-382.
46. Anon (1970) What is the question in the fat dispute? ("Mistä on kysymys rasvariidassa") [in Finnish]. Karjatalous, pp. 378-381.
47. Koivistoinen P, Ahlström A, Nissinen H, Pekkarinen M, Roine P (1970) Mineral Element Composition of Finnish Diets, Part I: Fe, Cu, Mn, Zn, Mg, Na, K, Ca and P. Suomen Kemistilehti B 43: 426-430.
48. Poutiainen E (1965) [in Finnish] Variation in Milk fat content during milking period. Pellervo, pp. 926-927.
49. Artaud Wild SM, Connor SL, Sexton G, Connor WE (1994) Differences in coronary mortality can be explained by differences in cholesterol and saturated fat intakes in 40 countries but not in France and Finland. A paradox. Circulation 90(6): 3118-3119.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2023.51.008137

Töysa T. Biomed J Sci & Tech Res