Review Article

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Serum Cholesterol in East and West Finland in Summer 1956 and Winter 1957 and Its Regulation – Discussion on Dietary Fats, Silicon, Selenium, Magnesium, Weathering and Climatic Factors

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Abbreviations: CHD: Mortality from Coronary Heart Disease (of 35-64 y old men, 1/100,000); Mg: Magnesium; Se: Selenium; [Se.H_2O]: Hot Water Extractable Se; [Se.sol]: Soluble Se (explained in text); [Se.tim]: timothy Se; [Se.tot]: Total Se; Si.gw: Groundwater Silicon; [SOC.min]: Soil Organic Carbon of Mineral

ABSTRACT

Introduction: The casual low cholesterol in the East Finland in June 1956 has been discussed earlier. It was not explained by the value of cholesterogenic formula, but better by silicon (Si), magnesium (Mg) and climatic factors. This revised article tries to explain the eastern low cholesterol from 1956 via agricultural soil selenium (differently extracted: [Se.(H_2O)], [Se.sol], [Se.tot]), timothy Se [Se.tim.79] from pre-Se-fertilization period, groundwater Si [Si.gw], soil organic carbon of mineral soils [SOC.min(61-70)] and mortality from CHD.(64-84).The statistical data are as such or adjusted by provinces (N = 11) from old sources. Hot-water-extractable Se are from 3 years, N=1340, generally autumnally collected. Other Se samples are from a prospective study from June 1979 (N=250). Mortality of middle-aged men from coronary heart disease (CHD) works as a risk indicator of ASO.

Results: Associations (r) of [Se.H_2O] were higher to the respective associations of [Se.sol] with the following parameters: [Se.tot] (0.90***/0.80**), [Se.tim] (0.73**/0.64*), [Si.gw] (0.77**/0.66*), [SOC.min] (0.81**/0.63*). [Se.tim] associated slightly stronger with [Se.tot] than with [Se.H_2O]. Significances and associations with [Si.gw] and [SOC.min] decreased in order (/): [Se.H2O] (**/**) > [Se.sol] (*/*) > [Se.tot] (0.53(*)/0.57(*)) > [Se.tim] (0.38ns/0.53(*)). CHD was explained (r) significantly by [Si.gw] (-0.85***) and [SOC.min] [-0.76**), nearly significantly by [Se.H2O] (-0.58(*)) and [Se.sol] (-0.58(*)), non-significantly by [Se.tot] (-0.32ns) and [Se.tim] (-0.08ns).

Conclusions: High (autumnal) correlation of [Se.H_2O] with [Se.tot] was possibly associated with depot function of humus. Slightly higher correlation of [Se.sol] with [Se.tot] is not surprising, because [Se.H_2O] samples were collected from the respective provinces, but from different fields, in different seasons¬¬. Environmental factors can have a role in the regional atherosclerosis, even inside of the known risk factors. Seasonal variation in milk fat composition will be assessed later.

Introduction

The old textbooks of biochemistry wrote that polyunsaturated fats (PUFA) decrease blood cholesterol content. Some experiments support the theory, that PUFA's can even protect against atherosclerosis (free abbr. ASO). Keys et al have developed dietary "cholesterogenic formula" for prognosticating serum cholesterol and development of ASO. The aim of this article is to find explanation to the eastern summer cholesterol 5.2 mmol/l, which is 9 % lower to the respective western value, although same time the cholesterogenic index in east was 8 % higher to its respective western value (Table 1). Serum (total) cholesterol (mmol/l) was in summer 9 % lower (E/W ratio 0.91) and in winter 27 % higher than in west. Winter values in west were 10 % and in east 53 % higher than in summer [1]. Values of cholesterogenic formula (g) [2*saturated fatty acids (SFA) – polyunsaturated fatty acids (PUFA)] were 8-9 % higher in east than in east. Their winter values were 1-2 were lower to their summer values. Summer-winter means of cholesterol and cholesterogenic formula were 8-10 % higher in east. (Cholesterol values mg/100 ml are divided by its molar weight 386,7 g/mol and multiplied by 10). Especially summer cholesterol of the east, 5.2 (mmol/l), is in disagreement with the high value of the cholesterogenic formula (105.8), cf. cholesterol of the west (5.7) with value of the cholesterogenic formula 98.1. Seasonal variation in cholesterol was 10 % in the west, but 42 % in the east [2]. Because cholesterol can be seen as an inflammation marker and inflammation can be seen as a causative factor of coronary heart disease, here mortality from CHD has been benefited as an indicator on possible cholesterol associations (Figure 1). Cholesterol levels are dependent on inflammation, TNF-alfa and IL-6 [3].

Low serum and milk silicon (Si) content has been associated with inflammation [4]. Low daily intake of magnesium (Mg) is reported to be associated with elevated CRP in humans [5]. Mg (Mg deficiency) can increase serum cholesterol level by controlling HMG CoA reductase [6]. Additional Si [7] or selenium (Se) [8] can decrease serum cholesterol level. Weathering of Mg and Si from soil silicate matrix, which occurs e.g., via fungal and bacterial assistance [9,10], is temperature dependent and starts somewhat later than K liberation [11]. This explains why generally Mg availability via grass is the lowest in the spring [12]. Additionally, temperature of May 1955 was 1-3 degrees lower to the average. Precipitation in June was unusually high in the Southwest Finland (Åland and Lapland) and less to average in other provinces [13]. Rainy weather can increase K contents and decrease Mg contents of plants [12]. High precipitation could dilute the weathered Mg and Si. So, in Jun 1955 the weather conditions could promote more Si and Mg access in East than in West. Less rain in East could be associated with higher amount of sunshine, synthesis of vitamin D and possible anti-depressive effects, with possible metabolic effects. Total selenium (Se.tot) (µg/kg), "soluble" Se [Se.sol] (µg/l) and timothy Se content [Se.tim] µg/kg are from [Sippola,[12]]. [Se.tot] was extracted by several acids (HF, HNO_3, $HClO_4$ and HCl), in special order and heating. [Se.sol] was extracted with acid ammonium acetate-0.02 M Na2EDTA solution. [Se.tim] extraction is explained in [Sippola [12]]. [$Se.H_2O$] from 1978-80 are provided by Viljavuuspalvelu Oy. Extraction was as follows: Dry and milled soil sample was extracted with boiled water at ratio 1:3. Leachate was analyzed using CV-AAS equipment (Kalevi Koivunen, Eurofins Viljavuuspalvelu Oy (Tables 2-4) [13-25].

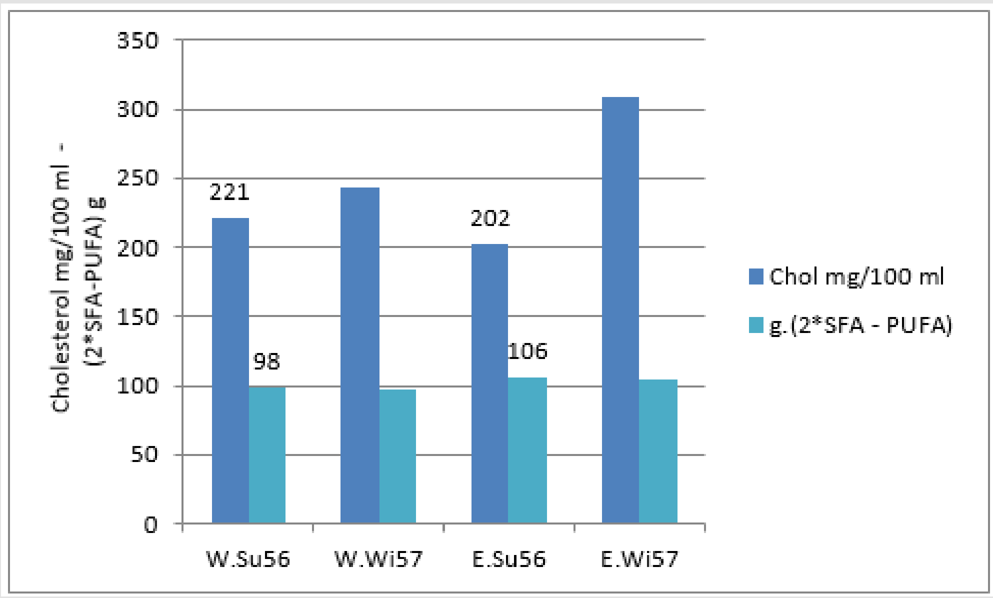

Figure 1: Shows the great variation in eastern cholesterol values and association of its low summer value with the highest value of cholesterogenic formula (2*SFA-PUFA).

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Table 1.

	Summer 1956			Winter 1957			East.tot	West.tot	E/W
	West	East	E/W	West	East	E/W			
Cholesterol mg/100 ml	221	202	0.91	243	309	1.27	232	255	1.1
Cholesterol mmol/l	5.7	5.2	0.91	6.3	8	1.27	6	6.6	1.1
Winter/Summer				1.1	1.53				
g.(2*SFA - PUFA)	98.1	105.8	1.08	96.5	105	1.09	97	105	1.08
Winter/Summer				0.98	0.99				

Table 2.

(xx). Rural Centers & xx_Provinces	Arable land under cultivation 1988	Se (µg/l)
(01).Uudenmaan	131.5	9
(02).Nylands Sv	70	6
01_Uusimaa	201.5	8
(03).Varsinais-Suomen	233.2	8
(04a).Finska Hushållningss.	17.3	8
(05).Satakunnan	171.8	7
(06.1).(04)_(Hämeenkyro, Ikaalinen,Mouhijärvi, Viljakkala)	26.5	6
02_Turku_and_Pori	448.8	7.5
(06.2).(04).Pirkanmaan = (06) - [06.1]	75.1	6
(07).Hämen	150.2	8
(08.1).(04).Itä-Häme = (08) -[(08.2)+ (08.3)]	29.1	8
04_Häme	254.4	7.4
(09).Kymenlaakso	83.9	6
(10).Etelä-Karjala	62.4	6
05_Kymi	146.3	6
(11).»Mikkelin läänin»	90.7	6
(08.2).(06).Itä-Häme.(Hartola, Heinola's,Sysmä)	15.9	8
06_South_Savo (Mikkeli)	106.6	6.3
08_(12).North_Savo (Kuopio)	146	5
07_(13).Northern_Karelia	100.5	6
14.Keski-Suomen.(incl Jämsä, Leivonmäki)	94.5	5
(08.3).(09).(Joutsa, Kuhmoinen, Luhanka)	7.6	8
09_Central_Finland	102.1	5.2
(15).Etelä-Pohjanmaan	256.7	6
(16).Österbottens Sv	103.4	6
(17.1).(10).Keski-Pohjanmaan = (17) - (17.2)	45.7	5
10_Vaasa	405.8	5.9
(17.2).(11).(Kalajoki, Reisjärvi, Sievi)	23.7	5
(18).Oulun	177	5
(19).Kainuu	40.3	4
11_Oulu	241	4.8
12_Lapland	53	4

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Table 3.

Provinces (PR)	Se.H_2O µg/l	Se.sol	Se.tot.79 µg/kg	Se.tim.79	Si.gw mEq/l	SOC.min %	M.CHD.(64-84) 1/100,000
01_Uusimaa	8	13.3	301	7.4	3.65	1.08	447
02_Turku..	7.5	12	245	7.8	3.77	1.06	386
04_Häme	7.4	13	255	8.1	3.59	1.05	414
05_Kymi	6	8.3	191	7.2	3.53	0.99	511
06_South_Savo (Mikkeli)	6.3	12.7	222	8.7	3.42	0.95	531
08_North_Savo (Kuopio)	5	10.1	214	7.2	2.87	0.79	564
07_North. Karelia	6	9.5	211	7.3	2.95	0.8	622
09_Central_Finland	5.2	9.8	167	5.5	3.01	0.89	515
10_Vaasa	5.9	11	161	5.5	3.88	1.18	370
11_Oulu	4.8	8.6	127	5.7	3	0.78	553
12_Lapland	4	8.7	121	4.4	2.33	0.7	529

Table 4.

	Se.H_2O µg/l	Se.sol. Na.EDTA.79	Se.tot.79	Se.tim.79	Si.gw	SOC.min %	M.CHD.(64-84)
Se.H_2O µg/l	1	0.81	0.9	0.73	0.77	0.81	-0.58
Se.sol.Na.EDTA.79	0.81	1	0.8	0.64	0.66	0.63	-0.58
Se.tot.79	0.9	0.8	1	0.81	0.53	0.57	-0.32
Se.tim.79	0.73	0.64	0.81	1	0.38	0.53	-0.08
Si.gw	0.77	0.66	0.53	0.38	1	0.96	-0.85
SOC.min %	0.81	0.63	0.57	0.53	0.96	1	-0.76
For normally distributed variables these are the significance levels of the product moment correlation coefficient (r) for N pairs of observations							
N =	11						
abs(R) >	0.6	:P<0.05	*				
abs(R) >	0.722	:P<0.01	**				
abs(R) >	0.823	:P<0.001	***				

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