

Mercury accumulation and progression of carotid atherosclerosis: the prospective 11-year follow-up study in men in eastern Finland

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BACKGROUND AND PURPOSE OF THE STUDY

THE OXIDATION OF LIPIDS IN HUMAN BODY HAS BEEN SHOWN TO ACCELERATE ATHEROSCLEROSIS AND SUBSEQUENTLY INCREASE THE RISK OF CARDIOVASCULAR DISEASE (CVD). MERCURY CAN PROMOTE THE OXIDATION OF LIPIDS AND IT CAN ALSO COUNTERACT THE ANTIOXIDATIVE EFFECTS OF SELENIUM. THUS, IT CAN HAVE NEGATIVE EFFECTS ON CARDIOVASCULAR HEALTH.

HOWEVER, THE KNOWLEDGE ABOUT THE EFFECTS OF MERCURY ON CVD IS LIMITED. WE HAVE PREVIOUSLY SHOWN IN A PROSPECTIVE KUOPIO ISCHAEMIC HEART DISEASE RISK FACTOR (KIHD) STUDY THAT HIGH HAIR METHYLMERCURY CONTENT IS ASSOCIATED WITH INCREASED RISK OF CVD MORBIDITY AND MORTALITY AND PROGRESSION OF ATHEROSCLEROSIS IN MEN.^{1,2} THE PURPOSE OF THIS STUDY WAS TO REASSESS OUR EARLIER FINDINGS FROM THE 4-YEAR FOLLOW-UP OF THE COHORT ABOUT THE PROGRESSION OF ATHEROSCLEROSIS.²

STUDY DESIGN AND METHODS

THE KIHD STUDY IS AN ONGOING POPULATION-BASED STUDY DESIGNED TO INVESTIGATE RISK FACTORS FOR CORONARY HEART DISEASE (CHD), ATHEROSCLEROSIS AND RELATED OUTCOMES IN MIDDLE-AGED MEN FROM EASTERN FINLAND, A POPULATION WITH ONE OF THE HIGHEST RECORDED RATES OF CHD.

THE PRESENT STUDY POPULATION CONSISTED OF 847 MEN, AGED 42-60 YEARS AT STUDY BASELINE IN 1984-89 AND 842 WOMEN AGED 54-73 YEARS AT 11-YEAR RE-EXAMINATIONS.

PROGRESSION OF ATHEROSCLEROSIS WAS DETERMINED BY ULTRASONOGRAPHIC ASSESSMENT OF INTIMA-MEDIA THICKNESS OF COMMON CAROTID ARTERY (CCA-IMT).

SCALP (IN BASELINE) OR PUBIC HAIR MERCURY CONTENT WAS USED AS AN INDICATOR OF THE MERCURY ACCUMULATION IN THE BODY.

MERCURY IN HAIR WAS DETERMINED BY FLOW INJECTION ANALYSIS-COLD VAPOUR ATOMIC ABSORPTION SPECTROMETRY AND AMALGAMATION.

SERUM LIPIDS WERE MEASURED BY AN AUTOANALYZER AND BLOOD PRESSURE BY RANDOM-ZERO SPHYGMOMANOMETER. DIETARY INTAKES OF NUTRIENTS BY 4-DAY FOOD RECORDS.

AGE, SERUM TOTAL, LDL AND HDL CHOLESTEROL, SERUM TRIGLYCERIDES, PLASMA FIBRINOGEN, SERUM SELENIUM, BLOOD GLUCOSE, BMI, CIGARETTE YEARS, DIABETES, FAMILY HISTORY OF HEART DISEASE, ANTIDYSLIPIDEMIC MEDICATION, BASELINE MEAN OR MAXIMAL CCA-IMT, ZOOM LEFT SIDE, SONOGRAPHER, FOLLOW-UP DAYS, MAXIMAL OXYGEN UPTAKE, SYSTOLIC BLOOD PRESSURE, WAIST-TO-HIP RATIO, INCOME, ERYTHROCYTE FOLATE, ALCOHOL INTAKE AND DIETARY INTAKES OF VITAMIN C, IRON AND SATURATED FATTY ACIDS WERE CONSIDERED AS CONFOUNDERS. THESE FACTORS WERE ELIMINATED FROM THE FULL MODEL IF THE JOINT REMOVAL DID NOT RESULT IN A CHANGE OF 10% OR MORE IN THE REGRESSION COEFFICIENT FOR HAIR MERCURY CONTENT.

RESULTS

THE MEAN HAIR MERCURY CONTENT WAS 1.8 µg/g (SD 1.9) IN MEN IN THE BASELINE AND 1.7 µg/g (SD 1.8) IN MEN AND 1.2 µg/g (SD 1.3) IN WOMEN IN THE 11-YEAR RE-EXAMINATIONS.

THE MEAN 11-YEAR CHANGE IN THE MEAN CCA-IMT IN MEN WAS 0.21 mm (MIN-MAX -0.55 - 1.28 mm) AND IN THE MAXIMAL CCA-IMT 0.34 mm (MIN-MAX -0.82 - 2.48 mm).

FOR EACH µg/g INCREASE IN HAIR MERCURY CONTENT, THERE WAS AN AVERAGE 11-YEAR INCREMENT OF 7 µm (95% CI 0-13) IN THE MEAN CCA-IMT AND 12 µm (95% CI 2-21) IN THE MAXIMAL CCA-IMT, ASSESSED BY LINEAR REGRESSION MODEL ADJUSTING FOR AGE, SYSTOLIC BLOOD PRESSURE, SMOKING, SERUM PROPORTION OF DODOSAHEXAENOIC + DODOSPENTAENOIC ACID OF ALL FATTY ACIDS, BASELINE MEAN OR MAXIMAL CCA-IMT, FOLLOW-UP DAYS, AND SONOGRAPHER. FURTHER ADJUSTMENTS FOR ATHEROSCLEROSIS RISK FACTORS DID NOT CHANGE THE RESULTS.

IN THE BASELINE, EACH µg/g INCREASE IN HAIR MERCURY CONTENT WAS ASSOCIATED WITH AN AVERAGE 6 µm (95% CI 0-12) GREATER MEAN CCA-IMT AND IN THE 11-YEAR RE-EXAMINATIONS WITH AN AVERAGE 11 µm (95% CI 2-20) GREATER MEAN CCA-IMT. IN WOMEN HAIR MERCURY WAS NOT ASSOCIATED WITH INCREASE IN MEAN CCA-IMT (MEAN INCREASE 3 µm, 95% CI -7-13).

THE CORRELATION COEFFICIENT BETWEEN FISH INTAKE AND HAIR MERCURY WAS 0.33 (p<0.001) AND 0.31 (p<0.001) IN MEN IN THE BASELINE AND 11-YEAR RE-EXAMINATIONS, RESPECTIVELY, AND 0.17 (p<0.001) IN WOMEN.

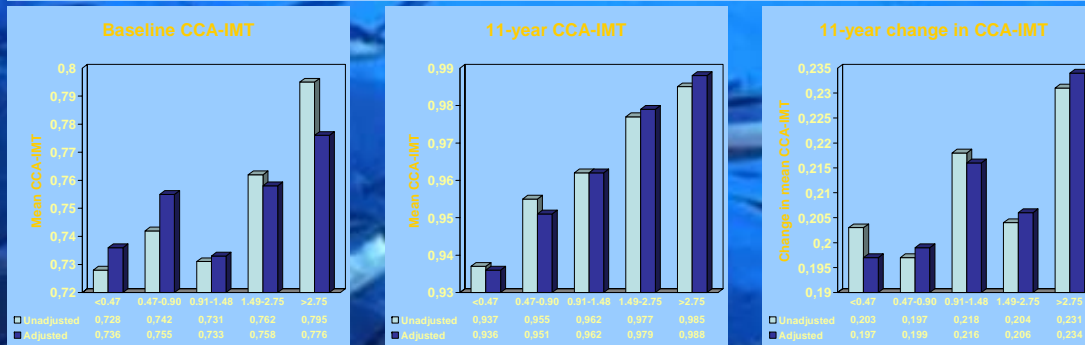


Figure 1. Unadjusted and adjusted increases in the mean CCA-IMT in fifths of hair mercury content in men.

CHARACTERISTICS OF THE STUDY POPULATION

Variable [mean (SD)]	Men, baseline	Men, 11-year	Women, 11-year
Age (years)	51.4 (6.7)	62.5 (6.4)	63.0 (6.5)
Hair mercury (µg/g)	1.8 (1.9)	1.7 (1.8)	1.2 (1.3)
Serum LDL cholesterol (mmol/L)	3.8 (0.9)	3.5 (0.9)	3.7 (0.9)
Serum HDL cholesterol (mmol/L)	1.3 (0.3)	1.1 (0.3)	1.3 (0.3)
Serum triglycerides (mmol/L)	1.4 (0.8)	1.3 (0.7)	1.2 (0.7)
Systolic blood pressure (mm Hg)	131 (15)	134 (17)	137 (17)
Body mass index (kg/m ²)	26.6 (3.2)	27.3 (3.6)	28.3 (5.0)
Serum selenium (µg/L)	118.4 (13.7)	94.3 (15.0)	94.3 (17.7)
Family history of heart disease (%)	51.4	58.2	65.7
Smoker (%)	27.7	18.1	8.1
Fish intake (g/day)	45 (54)	79 (123)	55 (88)
Serum proportion of DHA+DPA (%)	3.1 (0.8)	3.5 (1.1)	3.7 (1.1)
Saturated fatty acid intake (E%)	13.6 (4.0)	14.3 (3.5)	13.9 (3.1)
Vitamin C intakes (mg/day)*	74.5 (53.1)	75.7 (57.1)	94.6 (57.4)
Iron intakes (mg/day)*	13.7 (3.7)	11.1 (3.2)	11.2 (2.3)

*Total number of subjects is 847 men and 844 women.

*Energy adjusted

CONCLUSIONS

HIGH HAIR CONTENT OF MERCURY IS ASSOCIATED WITH EARLY STAGES OF ATHEROSCLEROSIS IN MEN BUT NOT IN WOMEN.

THE CURRENT DATA CONFIRM OUR PREVIOUS FINDINGS THAT HIGH HAIR CONTENT OF MERCURY, INDICATING HIGH FISH INTAKE, IS ASSOCIATED WITH INCREASED PROGRESSION OF ATHEROSCLEROSIS AND SUBSEQUENTLY RISK OF CVD MORBIDITY AND MORTALITY IN MIDDLE-AGED HEALTHY MEN FROM EASTERN FINLAND.

REGULAR HIGH CONSUMPTION OF LARGE PREDATORY FISH FROM LAKES WITH HIGH MERCURY CONTENT SHOULD BE AVOIDED.

¹Virtanen et al. *ATVB* 2005;25:228-233.

²Salonen et al. *Atherosclerosis* 2000;140:265-273.