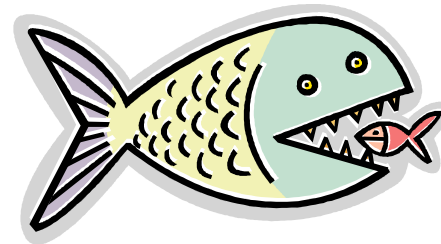


Fish consumption in relation to cardiovascular risk factors



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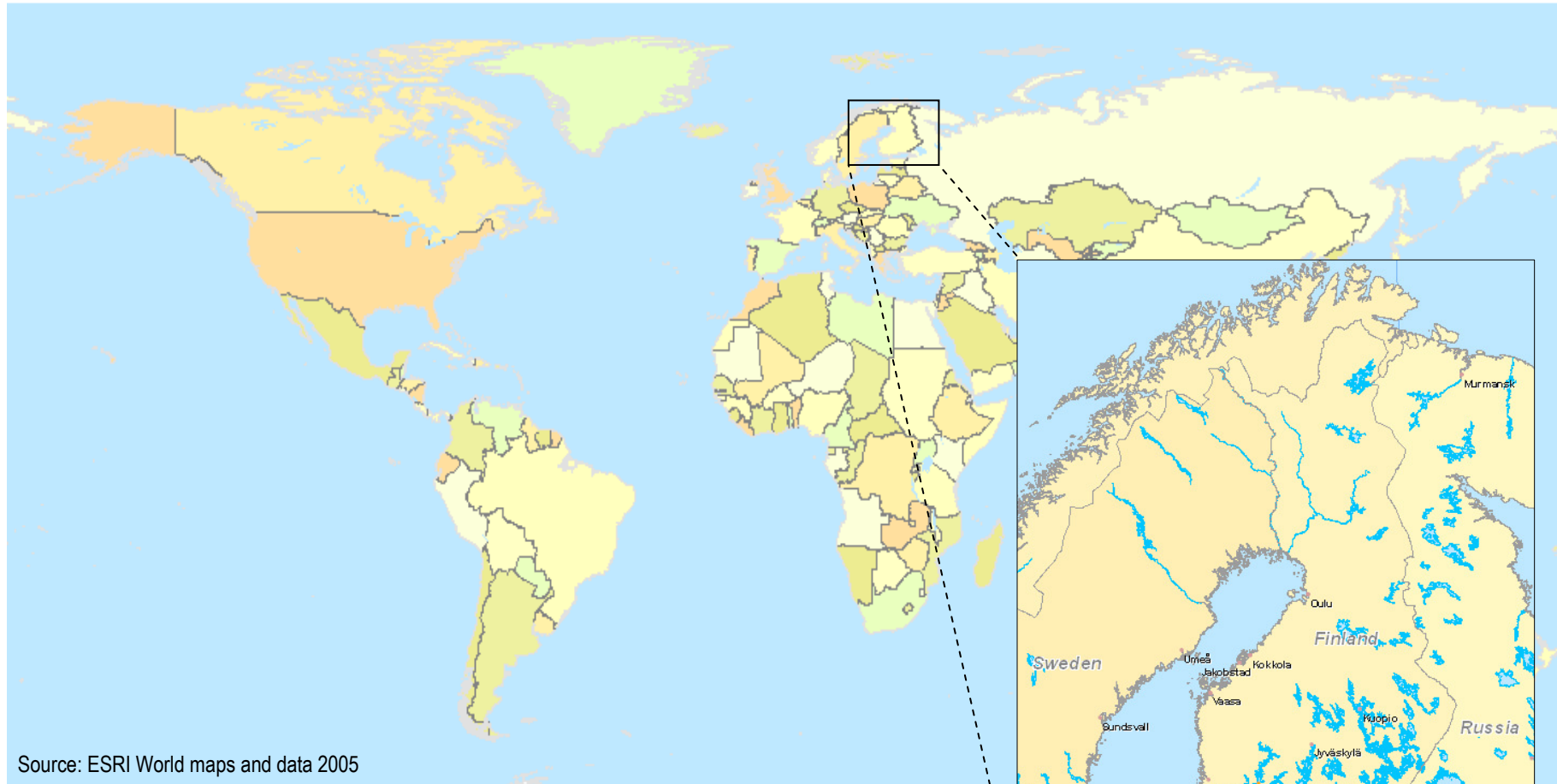
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World Congress of Epidemiology 2008, Porto Alegre, Brazil



Where is Finland (Suomi)?



Source: ESRI World maps and data 2005

Flight distance between Kuopio, Finland and Porto Alegre, Brazil: 12,650 km.

Background 1/3

- Fish and omega-3 PUFAs are known to protect from cardiovascular diseases (CVD).
- However, fish may also contain toxic persistent organic pollutants (dioxins and PCBs) and methyl mercury (MeHg).

Background 2/3

- In our Fishermen study project, we want to assess the overall health effect of fish consumption.
 - Do the benefits outweigh the potential hazards even if the fish is highly contaminated?

Results of multiple linear regression analyses¹ between food frequency questionnaire (FFQ) fish consumption and biomarkers of fish consumption among the Fishermen Study men (n=125).

		FFQ fish consumption, g/day					
		β	SE	p	Model R-square ² %	Partial R-square by LMG metrics ³ %	95% CI
Model 1	Serum WHO _{PCDD/F} -TEQ ⁴ , pg/g fat	0.43	0.075	<0.01	32	23	13–34
Model 2	Serum WHO _{PCB} -TEQ ⁵ , pg/g fat	0.42	0.069	<0.01	34	25	15–36
Model 3	Blood MeHg ⁶ , ng/ml	0.39	0.079	<0.01	28	17	6.8–28
Model 4	Serum omega-3 PUFAs ⁷ , % FAs ⁸	0.68	0.16	<0.01		14	5.9–26
Model 5	Serum WHO _{PCDD/F} -TEQ ⁴ , pg/g fat	0.28	0.096	<0.01	25	13	6.9–21
	Blood MeHg ⁶ , ng/ml	0.20	0.091	0.03		8.6	3.6–16
	Serum omega-3 PUFAs ⁷ , % FAs ⁸	0.17	0.18	0.35		6.2	2.2–13
Model 6	Serum WHO _{PCB} -TEQ ⁵ , pg/g fat	0.29	0.087	<0.01	35	15	7.8–23
	Blood MeHg ⁶ , ng/ml	0.16	0.093	0.08		8.1	3.2–15
	Serum omega-3 PUFAs ⁷ , % FAs ⁸	0.21	0.17	0.23		6.3	2.3–14

¹ fish consumption and biomarker variables are log transformed, adjusted for age and total energy intake

² adjusted R-square

³ regressors' relative contribution to the model's total explanatory value with 95% bootstrap confidence interval, i.e., the relative importance of the biomarker

⁴ World Health Organization's toxic equivalent quantity for dioxins

⁵ World Health Organization's toxic equivalent quantity for polychlorinated biphenyls

⁶ methyl mercury

⁷ omega-3 polyunsaturated fatty acids, the sum of eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA), and docosahexaenoic acid (DHA)

⁸ proportion from all serum fatty acids

Aim

- Our aim was to study the associations between
 - habitual fish consumption/fish consumption biomarkers and
 - selected CVD risk factors/indicators
- Hypotheses:
 - High fish consumption and omega-3 PUFA intake is associated with, e.g.,
 - high serum HDL cholesterol
 - low serum triglycerides, serum insulin and insulin resistance, and blood pressure
 - High exposure to dioxins and PCBs may have harmful effects on, e.g.,
 - glucose metabolism
 - insulin resistance
 - BMI

Study populations

- Fishermen study
 - professional fishermen and their family members
 - 125 men and 138 women
 - data collection from August 2004 to May 2005
- Health 2000 health examination survey
 - general population sub-sample
 - 571 men and 702 women
 - data collection from October 2001 to December 2002

Fish consumption

- validated, self-administered, and semi-quantitative food frequency questionnaire (FFQ)
 - 10 fish dishes/species (128 food items and mixed dishes)
 - **fish, g/day**

Serum omega-3 PUFAs

- fasting serum samples
 - sum of eicosapentaenoic, docosahexaenoic, and docosapentaenoic acid
 - **omega-3 PUFAs, % from all serum fatty acids**

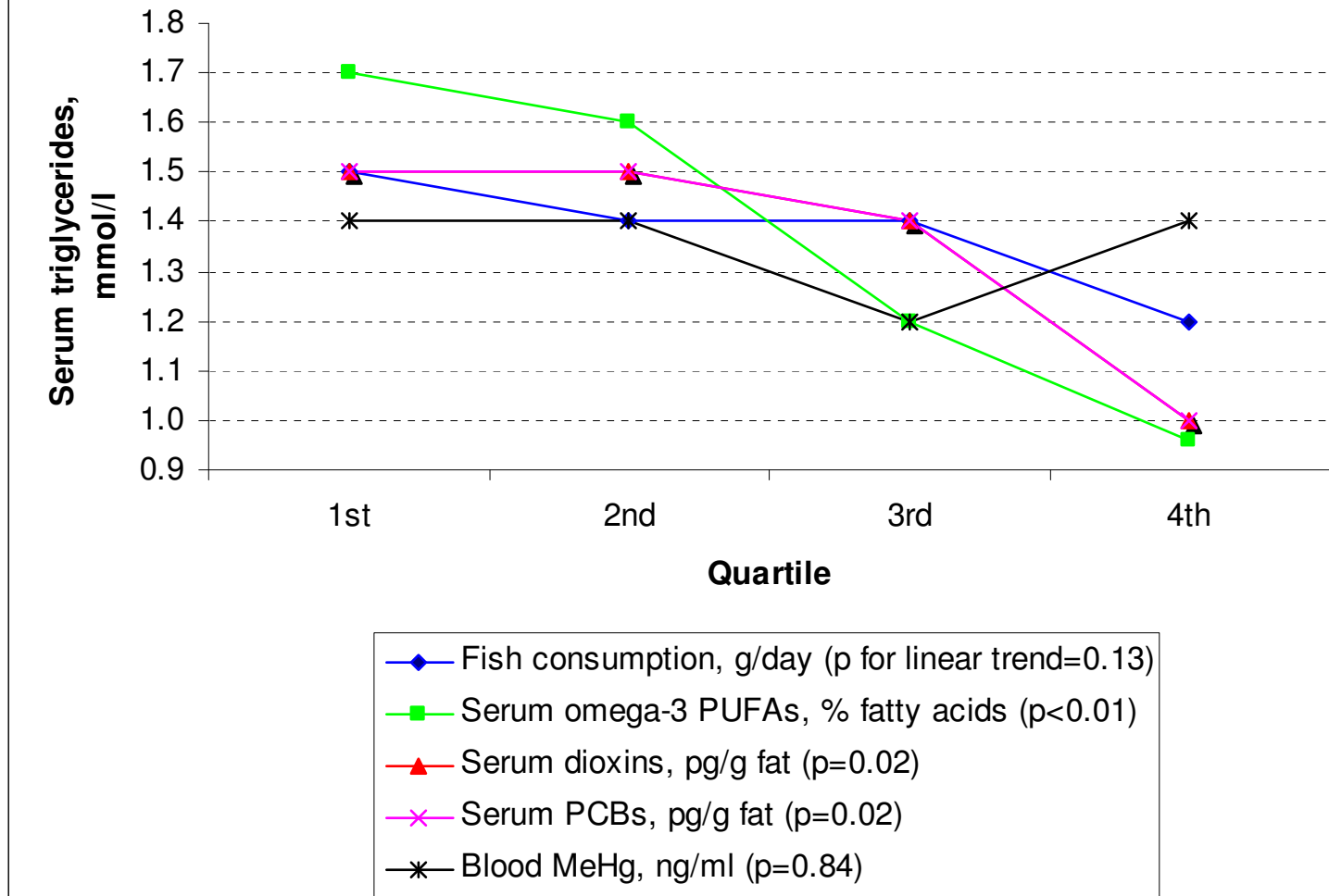
Blood dioxins, PCBs, and MeHg

- fasting serum samples
 - WHO toxic equivalents (TEQs)
 - **WHO_{PCDD/F}-TEQ, pg/g fat**
 - **WHO_{PCB}-TEQ, pg/g fat**
- fasting whole blood samples
 - **MeHg, ng/ml**

Selected CVD risk factors/indicators

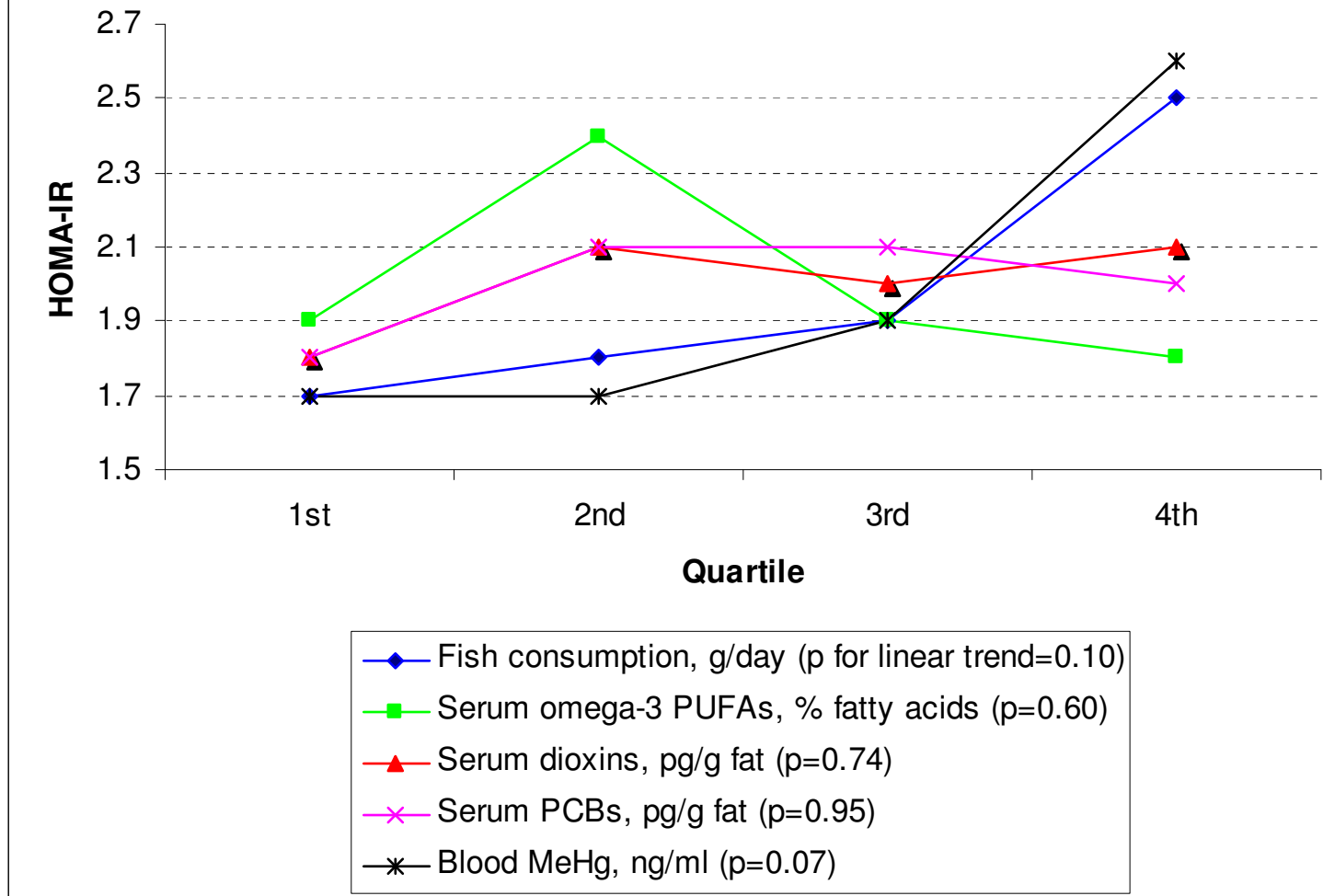
- Serum total, HDL, and LDL cholesterol
- Serum triglycerides
- Serum glucose and insulin, and homeostatic model assessment indexes
 - insulin resistance index (HOMA-IR)
 - beta cell function index (HOMA-B)
- Blood pressure
- BMI, waist girth, waist-hip ratio, and body fat

Adjusted* means for serum triglyceride concentration by fish consumption and fish consumption biomarker quartiles among the Fishermen study men (n=125)



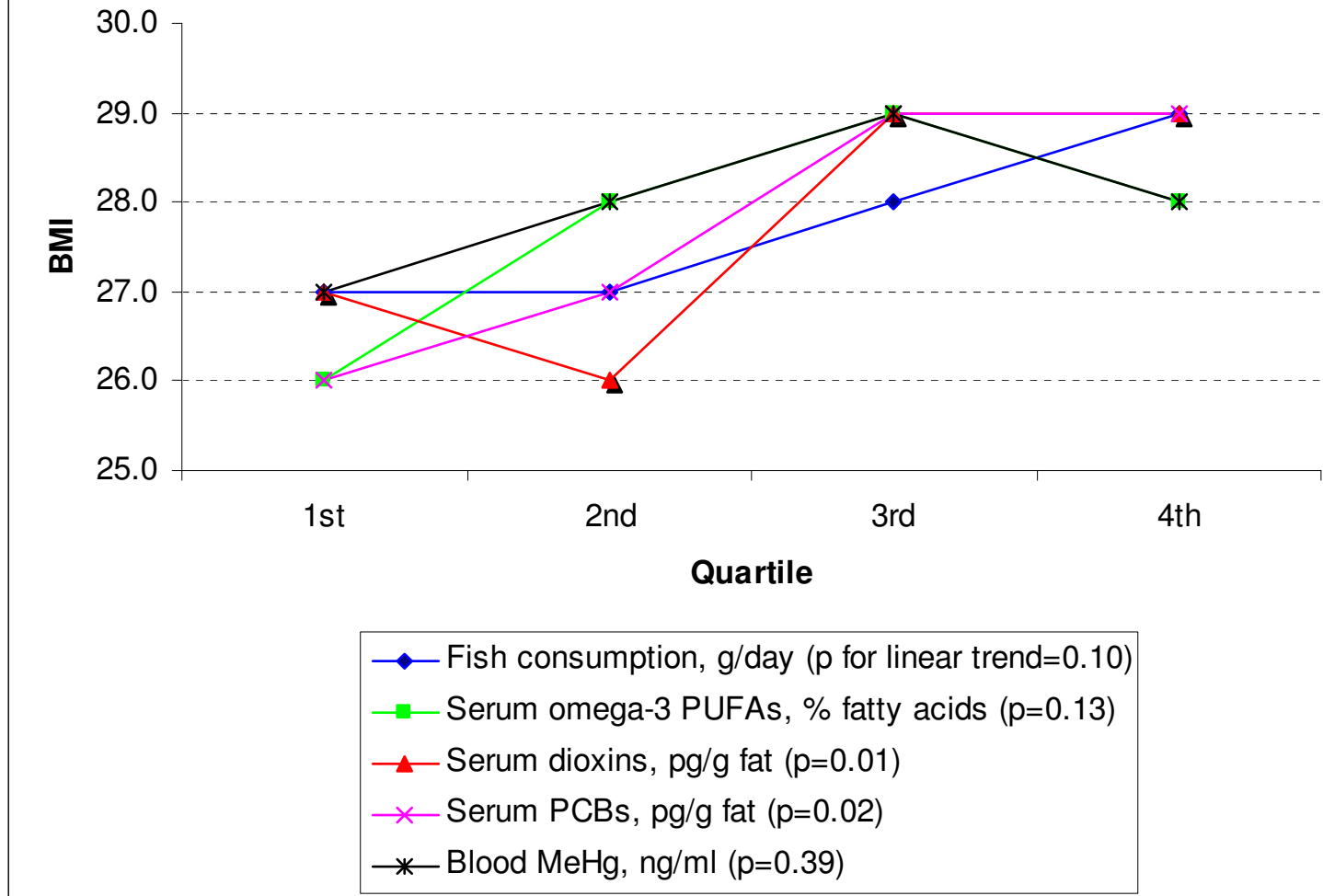
* adjusted for age, total energy intake, alcohol intake, smoking, waist-hip ratio, and physical activity

Adjusted* means for insulin resistance index (HOMA-IR) by fish consumption and fish consumption biomarker quartiles among the Fishermen study men (n=125)



* adjusted for age, total energy intake, alcohol intake, smoking, waist-hip ratio, and physical activity

Adjusted* means for body mass index (BMI) by fish consumption and fish consumption biomarker quartiles among the Fishermen study men (n=125)



* adjusted for age, total energy intake, alcohol intake, smoking, and physical activity

Preliminary conclusions

- It is not possible to separate the effects of omega-3 PUFAs and environmental contaminants in this study.
- Environmental contaminants seem to reflect the effects of fish consumption BUT they may have individual effects on some of the CVD risk factors.

Published studies

- Turunen AW, Verkasalo PK, Kiviranta H, Pukkala E, Jula A, Männistö S, Räsänen R, Marniemi J, Vartiainen T. **Mortality in a cohort with high fish consumption.** Int J Epidemiol. 2008 Jun 25. [Epub ahead of print]
- Rantakokko P, Turunen A, Verkasalo PK, Kiviranta H, Männistö S, Vartiainen T. **Blood levels of organotin compounds and their relation to fish consumption in Finland.** Sci Total Environ. 2008 Jul 25;399(1-3):90-5.

Ongoing studies

- Cancer incidence among Finnish fishermen
- Exposure to persistent organic pollutants among Finnish fishermen
- Fish consumption in relation to, e.g.,
 - carotid artery intima-media thickness
 - left ventricular hypertrophy and susceptibility to arrhythmias
 - mental well-being and functional capacity

Thank you!
Obrigada!
Kiitos!



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LMG metrics

- Lindeman RH, Merenda PF & Gold RZ (1980) Introduction to Bivariate and Multivariate Analysis. Longman Higher Education.
- Kruskal W (1987) Relative importance by averaging over orderings. The American Statistician 41, 6-10.
- Grömping U (2006) Relative importance for linear regression in R: The package relaimpo Journal of Statistical Software 17.