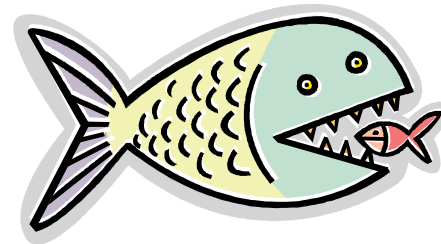


# Fish consumption in relation to cardiovascular risk factors



**Anu Turunen<sup>1</sup>, Liisa Suominen-Taipale<sup>1</sup>, Satu Männistö<sup>2</sup>,  
Hannu Kiviranta<sup>1</sup>, Antti Jula<sup>3</sup>, Jukka Marniemi<sup>3</sup> & Pia K. Verkasalo<sup>1</sup>**

**National Public Health Institute**

Department of Environmental Health<sup>1</sup>

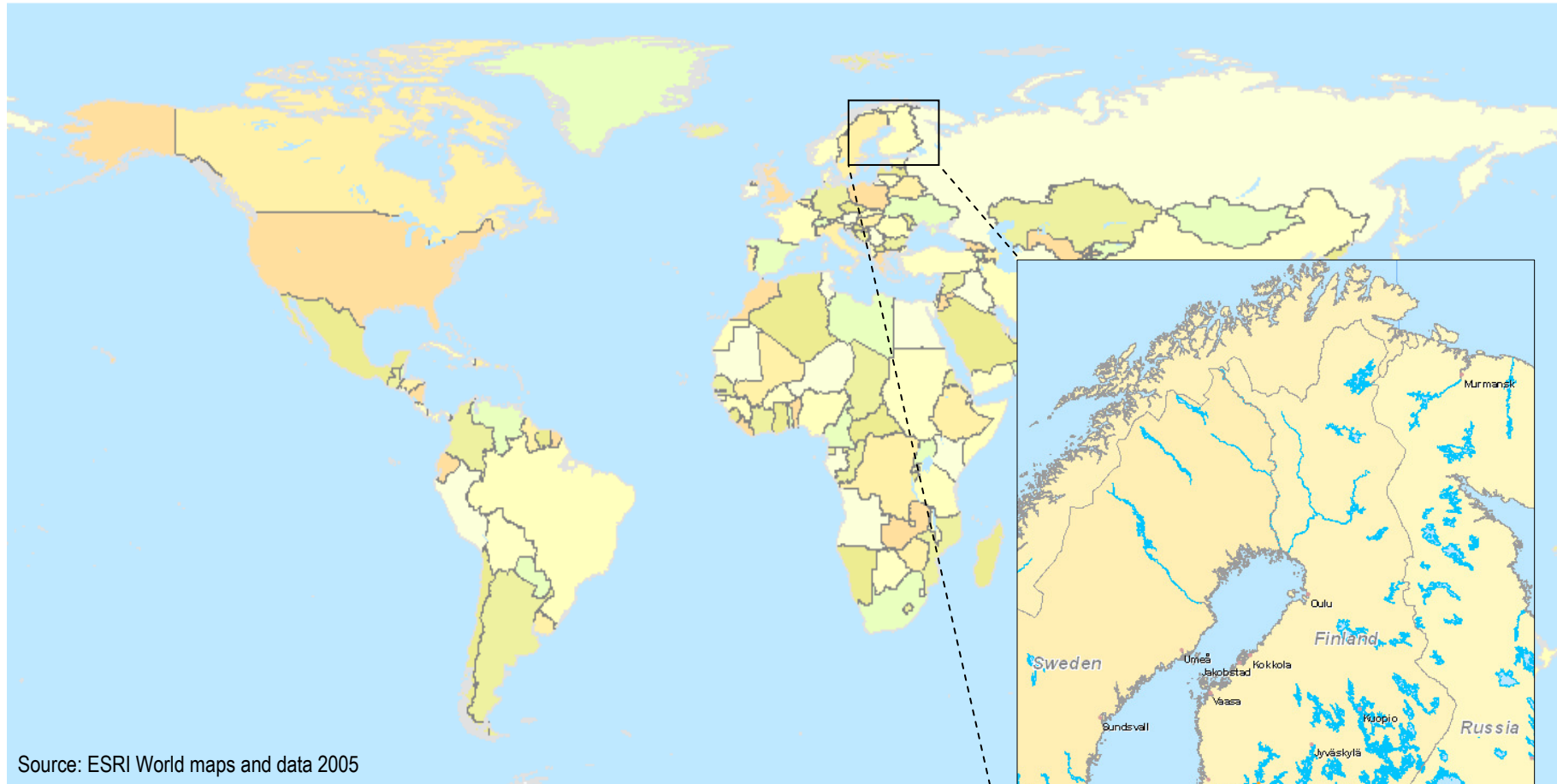
Department of Health Promotion and Chronic Disease Prevention<sup>2</sup>

Department of Health and Functional Capacity<sup>3</sup>

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# 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 analyses<sup>1</sup> between food frequency questionnaire (FFQ) fish consumption and biomarkers of fish consumption among the Fishermen Study men (n=125).

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

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

<sup>2</sup> adjusted R-square

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

<sup>4</sup> World Health Organization's toxic equivalent quantity for dioxins

<sup>5</sup> World Health Organization's toxic equivalent quantity for polychlorinated biphenyls

<sup>6</sup> methyl mercury

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

<sup>8</sup> 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**

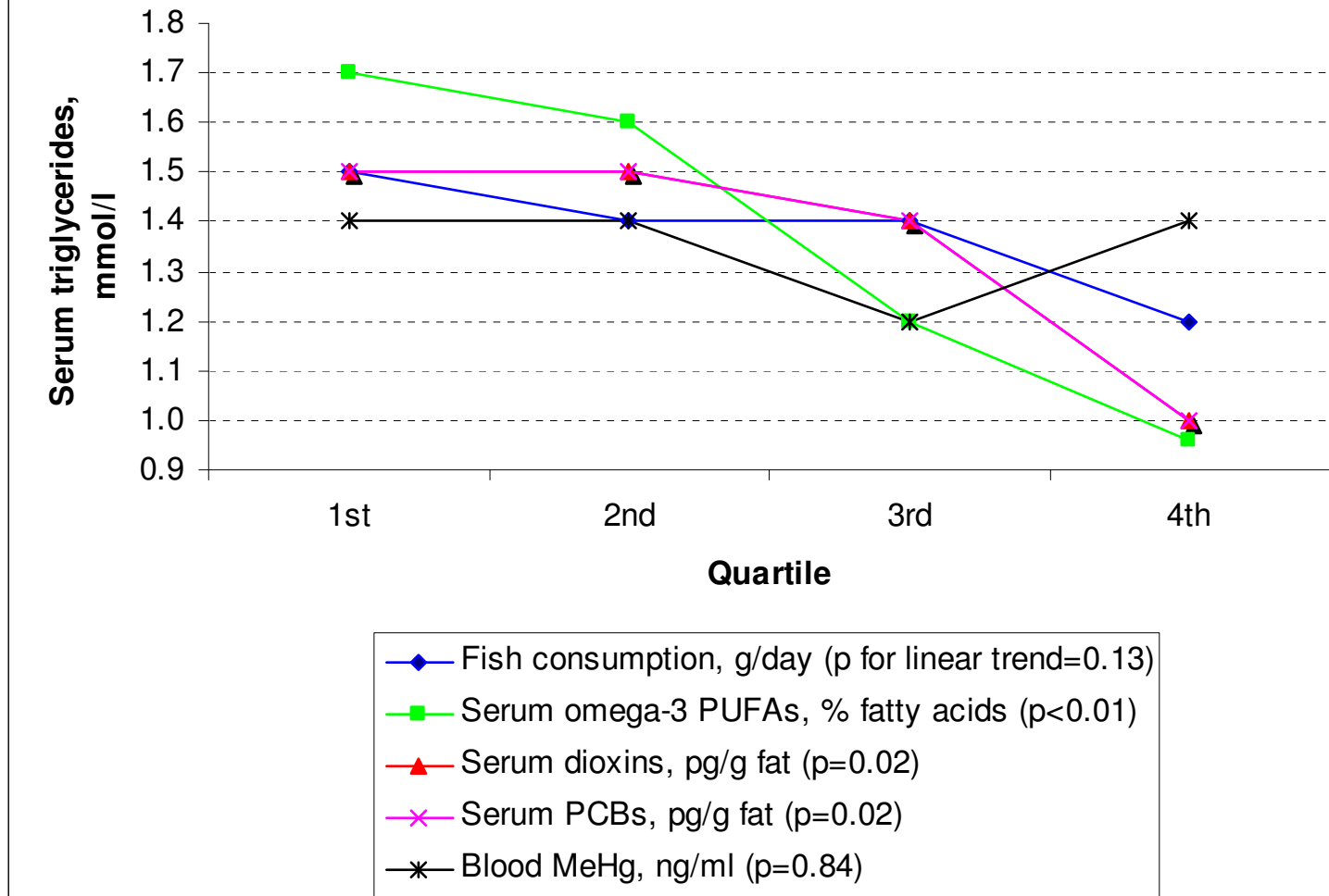
# Blood dioxins, PCBs, and MeHg

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

# Selected CVD risk factors/indicators

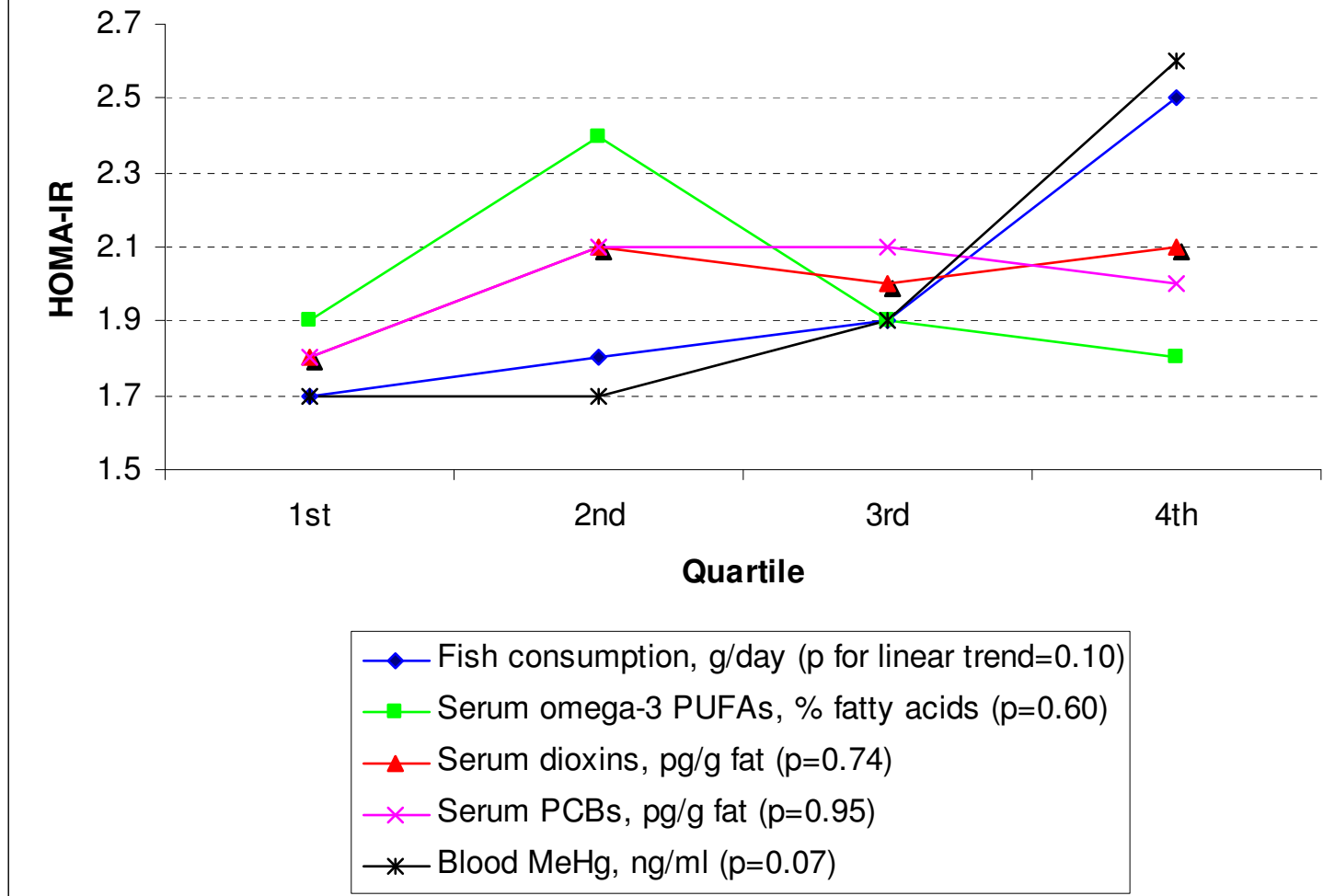
- Serum total, HDL, and LDL cholesterol
- Serum triglycerides
- Serum glucose and insulin, and homeostatic model assessment indexes
  - insulin resistance index (HOMA-IR)
  - beta cell function index (HOMA-B)
- Blood pressure
- BMI, waist girth, waist-hip ratio, and body fat

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



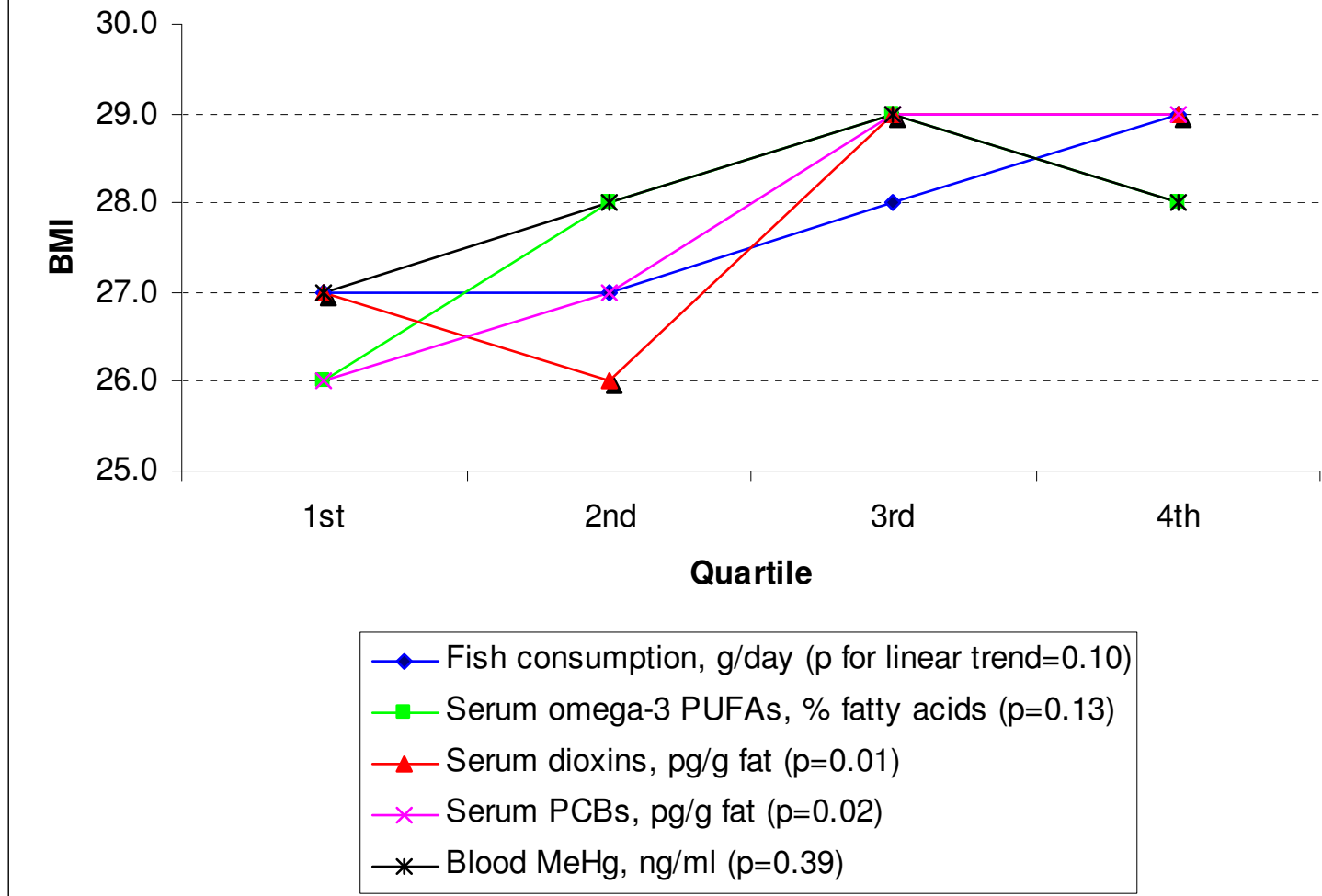
\* adjusted for age, total energy intake, alcohol intake, smoking, waist-hip ratio, and physical activity

### 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!*



[anu.turunen@ktl.fi](mailto:anu.turunen@ktl.fi)

# 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.