Body mass index is strongly associated with impaired insulin sensitivity in Europeans from 14 countries, independent of age, sex, social class and smoking habits: the RISC Study

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Background and Aims

- Impaired insulin sensitivity (IS) is associated with a large number of cardiovascular risk factors, including obesity and smoking. As subjects from low social class tend to be more obese and smoke more, it is of interest to test whether impaired IS differs with social class.
- This study was aimed to analyse the relationship among IS, obesity, social background parameters and smoking habits in European healthy individuals.

Materials and Methods

- This investigation is a part of the ongoing **R**elationship between **I**nsulin **S**ensitivity and **C**ardiovascular disease (**RISC**) study aimed to investigate, during the follow-up, the role of insulin resistance in the development of cardiovascular disease in 19 European centers in 2002–2004. Participants were recruited in 2002–2004, in the centers shown in Figure 1.
- These subjects were selected to be healthy with a low cardiovascular risk profile. Inclusion criteria were: age 30–60 years, no symptomatic cardiovascular disease, blood pressure <140/90 mmHg, total cholesterol <7.8 mmol/L, triglycerides <4.6 mmol/L, and glucose (fasting/2 hours after oral glucose tolerance test) <7.0/11.1 mmol/L
- In each subject, at baseline, a range of data was collected, which included anthropometric, demographic and life style data. Also, each of them underwent oral glucose tolerance test (OGTT), euglycaemic hyperinsulinaemic (40 mU/m^2/min) clamp (insulin sensitivity expressed as M/I; mg/kg/min/ insulin level during the last 40 min of clamp) and ultrasound (US) examination of extracranial carotid arteries
- Here we report on 1284 subjects who completed the baseline studies, the data on the relationship between (a) IS (measured by the euglycaemic hyperinsulinaemic clamp), (b) body mass index (BMI) and waist circumference (determined during anthropometric measurements) and (c) occupational category and smoking habits (determined from the lifestyle data questionnaire).
- Statistical significance was tested by using t-test and univariate analysis of variance (SPSS 10.0 for Windows).

Figure 1

RISC Study - Participating Centres

Pisa
London
Amsterdam
Newcastle
Lyon
Odense
Dublin
Perugia
Geneva
Frankfurt

Malmö
Rome
Glasgow
Vienna
Madrid
Athens
Milan
Belgrade
Kuopio

Participating centres indicated in black circles

Patient characteristics

	Total	Male	Female
Number	1284	575	709
Age (years)*	44.0+/-8.3	43.4+/-8.4	44.6+/-8.2
M/I (mg/kg/min/nM)*	14.1+/-7.1	12.4+/-6.4	15.4+/-7.4**
BMI (kg/m2)*	25.7+/-4.1	26.6+/-3.5	25.0+/-4.4
Waist (cm)*	87.0+/-12.9	93.9+/-10.4	81.3+/-11.9
Smokers (number)	594	260	334
Occupational category (numbers):			
Non-manual	969	427	542
Self-employed	66	39	27
Manual	249	109	140

*Data presented as mean+/-SD and numbers
** p<0.001 vs male

Results

- No significant difference was seen in insulin sensitivity (M/I) (p=0.094) between occupational groups adjusted for age (p= 0.41), sex (p<0.001), body mass index (BMI) (p<0.001), and study centre (p<0.001), in general or stratified for gender. (Table 1., Figure 2.)
- The same results were obtained with waist circumference replacing BMI.
- BMI differed between manual and non-manual female workers (p= 0.045), but not between corresponding categories of male workers. (Table 2.)
- No interaction with waist and social class was noticed (p= 0.69).
- However, the BMI correlated significantly with M/I (p<0.001), but M/I was not associated with smoking, after adjusting for all other factors including social class. (Table 3.)

Figure 2

Insulin sensitivity (M/I) in study population according to occupational category

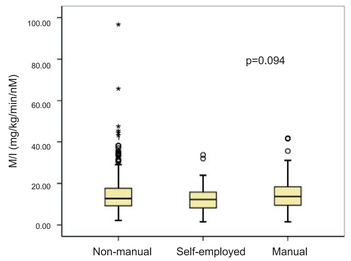

Table 1

Insulin sensitivity (M/I) according to occupational category and gender

	Insulin sensitivity (M/I) (mg/kg/min/nM)*	
	Male	Female
Non-manual	12.2+/-6.1	15.5+/-7.5**
Self-employed	11.6+/-6.3	14.3+/-6.0**
Manual	13.5+/-7.6	15.2+/-6.0**

* Data presented as mean+/-SD
** p<0.01 vs corresponding category in male
p=NS between occupational category in both, male and female

Table 2

BMI according to occupational category and gender

	BMI (kg/m^2)*	
	Male	Female
Non-manual	26.5+/-3.4	24.7+/-4.4
Self-employed	27.4+/-4.4	27.2+/-5.0**
Manual	26.6+/-3.7	25.4+/-4.0

*Data presented as mean+/-SD
** p<0.01 vs non-manual female and p<0.05 vs manual female

Table 3

Multivariate associations between insulin sensitivity (M/I) and age, sex, BMI, smoking habits and social class

	Insulin sensitivity (M/I)		
	Total	Men	Women
Age	p=NS	p=NS	p=NS
Sex	p<0.001	/	/
BMI	p<0.001	p<0.001	p<0.001
Smoking habits	p=NS	p=NS	p=NS
Occupational category	p=NS	p=NS	p=NS

Multivariate analysis (ANCOVA) has been applied and significance levels calculated after adjustment for co-variates.

Conclusions

- In this study, obesity is found to be strongly associated with impaired IS independently of other covariates, especially of social background and smoking habits in healthy subjects across Europe.
- The results imply that prevention of obesity should therefore be the main objective to prevent impairment of IS in all subjects at risk, irrespective of their social background.

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Further information on the RISC Study and participating centres can be found on **www.egir.org.**

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