Title | Prevalence and lifestyle determinants of the metabolic syndrome  
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Participants were classified by socio-economic categories, based on the standard occupational classification system of the Irish Central Statistics Office combined with educational attainment. When a participant defined herself as a housewife, the occupation of their partner was used for classification. We defined five socio-economic categories as subsequently modified by the Irish National Nutritional Surveillance Unit to reflect the Irish diet, lifestyle questionnaire. We used a food frequency questionnaire (FFQ) adapted from the UK−EPIC study instrument, 15 and waist hip ratio was used as a measure of central obesity. The questionnaire addresses the metabolic syndrome in multivariate analysis relative to occasional drinkers, (OR=2.38; 95%CI, 1.08−5.26). Prevalence of the metabolic syndrome was 21.0% (95% C.I. 18.7% to 24.1%). Analyses were based on the mean of the second and third of three BP measurements. Data on the use of anti−hypertensive drugs was obtained from the self−completed questionnaire.

Blood Pressure Measurements
Blood Pressure was measured with the subject seated, with left arm at heart level, and cuff adjusted for arm circumference. Each subject had at least two blood pressure measurements (height, weight, waist and hip circumference and fasting blood samples have been described, 11). We excluded participants who did not fast for at least 8 hours (N=51), those whose fasting status was unknown (N=50), and one participant with type 1 diabetes). In analysis of the glucose, insulin, HDL−cholesterol and triglyceride data, we excluded participants who did not fast (N=51), those whose fasting status was unknown (N=50), and one participant with type 1 diabetes (N=2); too confused (N=1) and untraceable (N=2), the effective response was 69.9%.

Statistical analyses of continuous variables were performed using analysis of variance or Kruskal−Wallis test, as appropriate, and for categorical variables, chi−squared tests were used. Two definitions of the metabolic syndrome according to both criteria in a sample of men and women aged 50 to 69 years, participants 7 The lack of an accepted definition has impeded epidemiological research on this disorder 3. The aims of this study were to investigate associations between physical activity, alcohol consumption and cigarette smoking and the prevalence of the metabolic syndrome according to the WHO criteria in a general population sample of middle-aged men and women.

Methods
Design, subjects and methods of data collection.

The metabolic syndrome has been proposed to include a set of metabolic and anthropometric characteristic of which glucose intolerance, hyperinsulinaemia, hypertriglyceridaemia, increased levels of plasminogen activator inhibitor, and low concentrations of tissue plasminogen activator have also been associated with the syndrome, 1. As in any syndrome not all the features are present in the same individual. The syndrome has been given different names such as the insulin resistance syndrome, or syndrome X,1 and the deadly quartet, 1. The metabolic syndrome is an important marker of increased risk for both cardiovascular disease and type 2 diabetes, 4,5.
Glucose intolerance was defined as those participants with type 2 diabetes or impaired fasting glucose, according to the current ADA and WHO criteria. Insulin resistance was estimated on the basis of fasting glucose and insulin, using the glcose homeostasis model, (HOMA scores). Pre-existing cardiovascular disease was determined based on the following: a self reported history of myocardial infarction or angina and/or a history of a Coronary Artery Bypass Graft or Coronary Artery Angioplasty or a positive Rose Questionnaire or a history of stroke, peripheral vascular disease or abdominal aortic aneurysm or evidence of a definite previous myocardial infarction (MI) on an analysis of the electrocardiographs (ECC) by a single experienced cardiologist i.e. pathological Q wave >1mm wide and > 3mm deep. Statistical analysis

Associations between the prevalence of the metabolic syndrome and physical activity, smoking status and alcohol intake were examined using logistic regression analysis with adjustment for age, sex, socio-economic status, pre-existing CVD and other potential confounding factors. Results

Table 1 shows the prevalence of the metabolic syndrome and its components in this population. Three quarters of the sample met current criteria for central and/or overall obesity and almost half were hypertensive. The prevalence of the syndrome was 21.0% (95% CI 18.3% -23.7%) in the entire group. It was higher in men (24.61%) than in women (17.8%) and it increased with age, (Fig 1).

Table 2. Logistic regression analysis with metabolic syndrome (WHO) as the dependent variable and physical activity as the independent variable, before and after exclusion of already diagnosed type 2 diabetics. N=823* OR (95% CI) P value

<table>
<thead>
<tr>
<th>Exercise category</th>
<th>OR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Medium</td>
<td>0.69</td>
<td>0.05</td>
</tr>
<tr>
<td>High</td>
<td>0.54</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Table 2 shows a logistic regression analysis with the metabolic syndrome as the dependent variable and physical activity as the independent variable. As before and after exclusion of participants with previously diagnosed diabetes. Physical activity was inversely and significantly associated with prevalence of the metabolic syndrome. This association was independent of age, sex, other environmental factors and pre-existing CVD. A dose-response gradient was also observed. The odds ratios for the metabolic syndrome associated with medium and high compared to low activity levels were 0.60 (95% CI 0.39−0.90, P=0.01) respectively (P for trend = 0.01), in multivariate analysis, excluding those with previously diagnosed diabetes.

Table 3. Logistic regression analysis with metabolic syndrome (WHO) as the dependent variable and alcohol intake as the independent variable, before and after exclusion of already diagnosed type 2 diabetics. N=793* OR (95% CI) P value

<table>
<thead>
<tr>
<th>Alcohol category</th>
<th>OR (95% CI)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occasional</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Never</td>
<td>0.69</td>
<td>0.08</td>
</tr>
<tr>
<td>Light</td>
<td>0.84</td>
<td>0.03</td>
</tr>
<tr>
<td>Moderate</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>High</td>
<td>0.84</td>
<td>0.03</td>
</tr>
</tbody>
</table>

The odds ratios for the ex-drinker category compared to occasional drinkers was 2.29 (95% CI, 1.10−4.73, P=0.02), in multivariate analysis following exclusion of participants with previously diagnosed diabetes. We found no associations between the metabolic syndrome and other alcohol consumption categories.

Discussion

Approximately one fifth of Irish men and women in the 50 to 69 years age group meet current WHO criteria for the metabolic syndrome. These findings reflect the extremely high prevalence of obesity in this population with approximately three quarters of the sample meeting current criteria for central and or general obesity. There was a clear inverse association between the prevalence of the metabolic syndrome and levels of physical activity. No
The inverse association between metabolic syndrome prevalence and physical activity must be interpreted cautiously given the cross-sectional design of this study. However the association is plausible, given the associations between physical activity and insulin sensitivity, obesity, glucose intolerance, and insulin resistance. The association was independent of potential confounders, including previously diagnosed diabetes, obesity, waist-hip ratio, and current physical activity level.

We found that ex-drinkers had a higher prevalence of the metabolic syndrome as compared with our reference category of current drinkers and non-drinkers. Both categories had a similar level of overall central obesity, BMI and waist-hip ratio did not vary significantly by alcohol consumption category. The association with ex-drinker status was observed for multiple metabolic syndrome components, including hypertension, obesity, glucose intolerance, and insulin resistance. This association is particularly difficult to interpret in a cross-sectional study. There is considerable evidence from prospective studies that ex-drinkers are at increased risk of CVD incidence, CVD mortality and all cause mortality, compared with never drinkers and moderate drinkers, for up to 25 years after drinking cessation. However, although we have adjusted for previous CVD and diabetes, ex-drinkers may have stopped drinking because of other less well defined health problems. To ensure these results confirm the need to separate ex-drinkers from never drinkers in studies of alcohol-disease relationships.

We found no significant association between smoking status and prevalence of the metabolic syndrome. This was unexpected given the evidence of a possible link between smoking and insulin resistance and type 2 diabetes. This negative finding may simply reflect the limited power of the study to examine this issue.

In summary, three quarters of this sample of middle aged men and women are obese, almost half are physically inactive and one in five meet current international criteria for the metabolic syndrome. It is now clear that diabetes and cardiovascular disease share common environmental and lifestyle antecedents or causal factors. The metabolic syndrome is a critical component of the common causal pathway linking CVD and type 2 diabetes. The findings in this paper emphasize the scale of the challenge we face both in clinical practice and public health to contain the epidemic of CVD and type 2 diabetes. We now have evidence from intervention studies of the effectiveness of diet and exercise in the prevention of the metabolic syndrome, and type 2 diabetes in high risk subjects. There is a need for greater awareness of the metabolic syndrome in clinical practice to provide a focus for counselling on weight loss and exercise combined with appropriate pharmacological intervention, including anti-hypertensive and lipid lowering therapy. Ultimately we will need to consider broader societal level measures to tackle this problem, in particular measures designed to reduce calorie intake and promote higher levels of physical activity.

References