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<th>Prevalence and lifestyle determinants of the metabolic syndrome</th>
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<td><strong>Author(s)</strong></td>
<td>Villegas, Raquel; Creagh, D.; Hinchion, Rita; O'Halloran, D.; Perry, Ivan J.</td>
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Participants with the metabolic syndrome were at risk of developing type 2 diabetes and coronary heart disease. The adverse effects of diabetes and heart disease are well documented, and early identification and intervention is critical.

Methods
Design, subjects and methods of data collection.

The Cork and Kerry Diabetes and Heart Disease Study, is a cross-sectional study of the prevalence of glucose intolerance and associated cardiovascular disease risk factors in an Irish general population sample. Details of the procedures are described elsewhere.

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, she was classified according to her husband's occupation. Participants were stratified into three physical activity categories: inactive, occasionally active (Low, N=407), and moderate to vigorous activity (High, N=144). Data on physical activity were not available for 80 participants.

Smoking status
Participants were classified according to their current smoking status into one of three categories: never smoker (n=463), ex-smoker (n=341) and current smoker (n=190). Data on smoking was not available for 24 participants. Never smokers were defined as those who had smoked cigarettes in the past but did not smoke at present, and those who had never smoked. Ex-smokers were defined as those who had stopped smoking 1 year or more before assessment. Current smokers were defined as those who smoked cigarettes at present.

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Alcohol Intake
Alcohol intake was estimated primarily from the food frequency questionnaire data, cross-checked with the data from the lifestyle questionnaire. We used a food frequency questionnaire (FFQ) adapted from the UK–EPIC study instrument, and susceptible modified by the Irish Food and Nutrition Information Unit to reflect Irish diet. 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.

Anthropometric Measurements,

Blood Pressure Measurements
Blood Pressure was measured with the subject seated, with left arm at heart level, and cuff adjusted for arm circumference. The first and fifth Korotkoff sounds were used to determine systolic and diastolic pressure. All readings were taken by the attending nurse, using a standard blood pressure monitor. (Omron HEM-705CP). 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.

Urine Samples and Fasting Blood Samples
Blood pressure was measured on the right arm in the supine position using a standard mercury sphygmomanometer. Body mass index (BMI) calculated as weight/height 2 (kg/m2) was used as an index of relative weight. Waist and hip circumference and fasting blood samples have been described.

Statified random sampling by age and sex was employed to recruit equal numbers of men and women in four age strata between the ages of 50 and 69 years. Subjects with cardiovascular disease, known diabetes mellitus or other disease, or those receiving medication were not excluded. From a total of 1473 men and women who were invited to participate, 1018 attended for the assessment (491 men and 527 women), a response rate of 69.1%. Allowing for those who could not attend by random sampling, methods of sampling and methods of data collection, including the self-completed questionnaire data, physical measurements (height, weight, waist and hip circumference and fasting blood samples have been described. 

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Definition of the metabolic syndrome

According to the current WHO criteria, the metabolic syndrome is defined on the basis of the following criteria: participants with glucose intolerance (impaired fasting glucose and type 2 diabetes) and/or insulin resistance (defined as the upper quartile of Glucose Homeostasis Model Scores (HOMA scores) with at least 2 of the following additional abnormalities: hypertension defined as SBP > 140 mmHg and/or DBP > 90 mmHg; dyslipidemia: defined as triglyceride > 1.7 mmol/L and/or low HDL < 0.9 mmol/L men, < 1.0 mmol/L women; obesity: defined as BMI > 30 Kg/m2 and/or WHR > 0.9 men, > 0.85 women; microalbuminuria: defined as albumin excretion rate of 20 micrograms/min or as microcreatinine ratio > 30 mg/g.

Glucose intolerance was defined as those participants with type 2 diabetes or impaired fasting glucose, according to the current ADA and WHO criteria,17, 18. Insulin resistance was estimated on the basis of fasting glucose and insulin, using the glucose homeostasis model, (HOMA scores),19. 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 (CABG), or a 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 electrocardiograms (ECG) by a single experienced cardiologist i.e. pathological Q wave > 1mm wide and > 3mm deep.20

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 (24.6%) than in women (17.8%) and it increased with age, (Fig 1).

Table 2 shows a logistic regression analysis with the metabolic syndrome as the dependent variable and physical activity as the independent variable before and after exclusion of participants with previously diagnosed diabetes. Physical activity was inversely and significantly associated with prevalence of 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 associations between the prevalence of 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
consistent associations with alcohol consumption or smoking were observed. 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, metabolic syndrome, including hypertension, obesity, glucose intolerance, and insulin resistance. The association was independent of potential confounders, including previously diagnosed diabetes, other risk factors, and dose response gradient and the findings are consistent with previous studies. Given the degree of random measurement error in the measurement of physical activity it is likely that the magnitude of the association has been underestimated.

We found that ex-drinkers had a higher prevalence of the metabolic syndrome as compared with our reference category of occasional drinkers. However, there was no significant relationship between this measure and prevalence of specific disorders, although the difference was statistically significant for isolated hypertriglyceridemia, and BMI and waist-hip ratio did not vary significantly by alcohol consumption category. The association with ex-drinker status was observed even after adjustment for obesity, changes in body mass index, and the interaction between smoking and diabetes. 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 CHD incidence, CVD mortality and all cause mortality compared with non-drinkers, whilst drinkers are at increased risk for isolated hypertriglyceridemia. Thus, although we have adjusted for previous CVD and diabetes, ex-drinkers may have stopped drinking because of other less well defined reasons. To test 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 risk of 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 emphasise the scale of the challenge we face both in clinical practice and population 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.

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OtherReferences: No References

References


