Association between the metabolic syndrome and parental history of premature cardiovascular disease

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Aims The goal of this study is to assess the association between the metabolic syndrome (MS) and parental history of cardiovascular disease (CVD).

Methods and results Participants were recruited in a population survey of 3441 men and women, aged 35–64. MS was defined with NCEP-III guidelines. Familial history of myocardial infarction (MI), angina, and stroke was assessed with a standardized questionnaire. Parental premature CVD was defined if CVD occurred before 55/65 years in the father/mother. A total of 390 men and 281 women had MS. Positive parental CVD was associated with MS in women (43.0 vs. 36.8%, P < 0.001) but not in men (36.9 vs. 31.8%, P = 0.06). Similarly, parental premature CVD was associated with MS in women (19.2 vs. 11.8%, P < 0.0007) but not in men (11.1 vs. 11.1%, ns). In women with MS, the age, centre, and educational level adjusted odds ratios [OR (95% CI)] of having a positive parental premature stroke was 1.84 (1.0–3.38), P = 0.049. This OR was 1.76 (1.23–2.76), P = 0.007 for combined parental premature MI and stroke and 1.67 (1.17–2.38), P = 0.004 for combined parental MI, stroke, and angina. After further adjustment on personal coronary heart disease and CVD risk factors, the ORs of having a positive parental history of combined premature MI and stroke [1.75 (1.11–2.76), P = 0.016] or MI, stroke, and angina [1.79 (1.21–2.63), P = 0.003], remained statistically significant, in women with MS.

Conclusion The MS is associated with parental premature CVD independently of classical CV risk factors, suggesting that MS is a contributor to the familial aggregation of premature CVD.

Introduction

The metabolic syndrome (MS) is characterized by the clustering of abdominal obesity, hyperglycaemia, insulin resistance, hypertriglyceridaemia, low HDL-cholesterol, and hypertension.1–5 These factors are influenced by nutritional habits, physical activity, and socio-economic factors.6–10 In addition, the MS aggregates in families, suggesting that behavioural and genetic factors affect its development.11 Large population-based studies have shown that the MS increases the risk of cardiovascular12–16 and all-cause mortality.14–18 The relative risk of cardiovascular disease (CVD) is generally higher (range 1.3–4) than that of non-specific causes of mortality (range 1.2–1.8), suggesting that the CVD disease is a major outcome of the MS.

Similar to the MS, coronary heart disease (CHD) tends to cluster in families.19–21 This is, to a large extent, accounted for by the familial aggregation of hypercholesterolaemia, hypertension, and diabetes. The contribution of the MS, however, has not been investigated extensively. This may be due to the lack, up to a recent date, of a consensual definition of the MS. An earlier study in Asians has shown that the MS was associated with parental cardiovascular risk factors and disease.22 Therefore, the goal of this study is to assess the association between the MS and parental history of CVD disease. To this end, the family history of CVD was assessed in subjects with and without the MS from a large population-based study.

Methods

Subjects

Participants were recruited in the framework of the WHO-MONICA population survey conducted from 1995 to 97 in three distinct geographical areas from France: the urban community of Lille in the north, the district of Bas-Rhin in the east, and the district of Haute-Garonne in the south-west of France. The sample included representative subjects aged 35–64, stratified by town size, randomly selected from the electoral rolls to obtain 200 participants for each gender and 10-year age group (WHO-MONICA Project protocol). A total number of 1778 men and 1730 women completed the protocol.

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After signing an informed consent, participants were administr-
tered a standard questionnaire, and physical measurements were
made by a specially trained nurse. The questionnaire covered
questions on socio-economic factors, physical activity at work and
during leisure activities, alcohol consumption, smoking status,
personal medical history, family history, attitudes, and knowledge
concerning several diseases and current drug therapy.

The level of physical activity during leisure time was self-reported
as: no physical activity, light (light physical activity almost every
week), intense (at least 20 min more than once a week). Physical
activity at work was divided into four groups: sedentary, regular
walking and handling of <10 kg loads (light), handling of 10–24 kg
loads (average), and handling of >25 kg loads (heavy). Current
cigarette smokers were defined as subjects reporting at least one
cigarette per day. Total alcohol intake was expressed as the sum
of mL alcohol per week from wine, beer, cider, and spirits. The
educational level was assessed by counting the number of years of
schooling and classified into three categories: primary, secondary
or technical, and university. For each major cardiovascular risk
factor (hypercholesterolaemia, hypertension, and diabetes), the
subjects were asked (i) whether their medical doctor had ever men-
tioned the risk factor, (ii) whether they were treated, and (iii) what
treatment was used. Hypercholesterolaemia was defined as LDL-
cholesterol ≥1.6 g/L or treatment for hypercholesterolaemia;
hyper tension as systolic or diastolic blood pressure ≥140/
90 mmHg or treatment for hypertension; diabetes fasting glycaemia
≥1.26 g/L or treatment for diabetes.

Parental history of CVD was assessed during the interview
by the registered nurse. Vital status and age of the parents were
first assessed. Then, the parents’ history and age at occurrence of
myocardial infarction (MI), angina, and stroke events were
recorded. Premature CVD event was defined if it occurred ≤55
year in the father and ≤65 year in the mother. A parental history
of CVD disease was considered positive if an event occurred in the
father or the mother. In addition, two composite events were
defined as ‘MI or stroke’ or ‘MI or stroke or angina’ in at least one
of the parents. Whenever the age at occurrence of an event was
not known, parental history of CVD was considered positive but
not premature. When parental history was not available, the
subject was excluded. No attempt was made to exclude related
individuals. However, because in this study each individual was
randomly selected from the population, the likelihood that individ-
uals from the same family enter the sample was small.

Anthropometric measurements included body weight (rounded to
the nearest even decimal), waist (at a level midway between lower
rib margin and iliac crest; to the nearest 0.5 cm), and height (to
the nearest cm) were taken on subjects in light clothing without shoes.
Body mass index (BMI) was calculated according to the Quetelet
equation. Blood pressure was measured on the right arm, with the
subject in a sitting position and after a minimum 5 min rest, using
a standard mercury sphygmomanometer. Two consecutive measures
of systolic and diastolic blood pressure were recorded to the nearest
2 mmHg. The second blood pressure record was taken at least 1 min
after the first one. The mean value of the two blood pressure read-
ings was taken into account.

The MS was defined, according to the NCEP III recommenda-
tions, by the presence of at least three or more of the following
abnormalities: waist girth >102 cm in men and >88 cm in women,
triglycerides ≥150 mg/dL, HDL-cholesterol <40 mg/dL in men and
<50 mg/dL in women, blood pressure ≥130/85 mmHg or treatment
with blood pressure-lowering medications and fasting glucose
≥110 mg/dL or treatment for diabetes (therefore including subjects
with diabetes). Eighty-two subjects with triglycerides ≥150 mg/dL
could not be classified because of fibrate treatment. These subjects
were excluded from the analyses.

A blood sample of 20 mL was drawn on disodium EDTA after the
subjects had fasted for at least 10 h, kept at room temperature,
and centrifuged within 4 h. Lipid and lipoprotein levels were
measured centrally at the Purpan Hospital Biochemical Laboratory
(Toulouse). The quality of biological measurements was assessed
within the framework of the MONICA Project. Glucose was measured
by the glucose oxidase method (DuPont Dimension). Plasma insulin
was measured by radio-immunossay (Bilsuline, Eria Pasteur).
Serum triglyceride and HDL-cholesterol levels were measured
enzymatically (DuPont Dimension).

**Statistical analyses**

Statistical analyses were performed with the SAS System for
Windows (SAS Institute Inc., Cary, NC, USA). Because the clustering
of metabolic factors and their relation with environmental factors is
different in men and women, analyses were performed in men
and women separately. The \( \chi^2 \) test was used to compare the
prevalence of parental history of CVD in controls and subjects with
the MS. Logistic regression analyses were used to assess the associ-
ation between parental history (dependent variable) and the MS
(independent variable). Three models were performed: in the first
model, the age, centre, and level of education were included for
adjustment; in the second model, personal history of CHD was
added to the first model; and in the third model, personal history of
hypercholesterolaemia, hypertension, and diabetes were used
for further adjustment. Quantitative variables were used directly
and categorical variables were transformed to dummy variables.
The level of statistical significance was set at 5%.

**Results**

*Table 1* shows the characteristics of the sample. NCEP III
criteria for the MS were satisfied in 390 men and 281
women. Subjects with the MS were older, had higher BMI,
waist girth, plasma triglycerides, and low HDL-cholesterol
levels. The prevalence of hypercholesterolaemia, hyper-
tension, and diabetes was higher in men and women with
than without the MS.

The prevalence of the parental CVD disease in men and
women is shown separately in *Table 2*. The prevalence of
parental history of CVD disease (MI, angina, and stroke) varied
from 10.4% for angina in men to 19.9% for MI in women.
Reporting of CVD events were significantly higher in women
than those in men. The prevalence of parental premature
CVD disease (MI, angina and stroke) varied from 5.8% for MI
in women to 3.2% for stroke in men. There was little
overlap among premature events. The prevalence of parental
CVD disease and premature CVD disease was significantly
higher in subjects with a personal history of CHD ranging
from 17.6% for angina in men to 42.2% for angina in women
and from 5.3% for premature angina in men to 10.8% for
premature MI in women—than in subjects without CHD.

The prevalence of parental CVD disease in subjects with
the MS and in controls is presented in *Table 3*. In men,
there was no evidence for any statistically significant differ-
ence in the prevalence of parental CVD disease between
subjects with the MS and control. Only, after exclusion of
subjects with CHD, there was a borderline (\( P = 0.05 \))
statistically significant higher prevalence of combined MI,
stroke, and angina in men with the MS than in controls. In
women, the prevalence of parental angina (\( P = 0.006 \)),
stroke (\( P = 0.039 \)), combined MI and stroke (\( P = 0.044 \)),
and combined MI, stroke, and angina (\( P = 0.004 \)) was higher
in those with the MS than in controls. Similarly, the prevalence
of parental premature MI (\( P = 0.055 \)), stroke (\( P = 0.007 \)),
combined MI and stroke (\( P = 0.002 \)), and combined MI,
stroke, and angina (\( P = 0.0007 \)) was higher in women with
the MS than in controls. In contrast, there was no evidence
for any statistically significant difference in the prevalence of premature or non-premature CVD disease between the controls and the MS in subjects with a personal history of CHD (data not shown).

Table 4 shows the odds ratio [OR and (95% CI)] of parental CVD disease in subjects with the MS. After adjustment for age, centre, and levels of education, the association between the parental CVD disease and the MS disappeared in men and women. There was only a positive borderline association between the MS and the combined parental MI, stroke, and angina in women. In contrast, the association between the MS and parental premature stroke ($P = 0.049$), combined stroke and MI ($P = 0.007$) and combined stroke, MI, and angina ($P = 0.004$) remained significant after adjustment for age, centre, and level of education. Further adjustment on personal history of CHD did not affect the association, whereas additional adjustment for hypercholesterolaemia, hypertension, and diabetes slightly lowered the association that remained statistically significant for combined MI and stroke ($P = 0.016$) and combined MI, stroke, and angina ($P = 0.0003$). Finally, the analyses were repeated using the EGIR and IDF consensus definition to identify individuals with the MS. These analyses yield very similar results.

**Discussion**

The clustering of CVD disease in families is, to a large extent, accounted for by the familial aggregation of major CVD risk factors. The goal of this study is to assess the possible contribution of the MS to that aggregation. The

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**Table 1** Characteristics of controls and subjects with the metabolic syndrome by gender

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th></th>
<th>Women</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Controls</td>
<td>Metabolic syndrome</td>
<td>$P$-value</td>
<td>Controls</td>
</tr>
<tr>
<td>$n$</td>
<td>1347</td>
<td>390</td>
<td></td>
<td>1423</td>
</tr>
<tr>
<td>Age (year)</td>
<td>$50.3 \pm 8.6$</td>
<td>$53.2 \pm 8.2$</td>
<td>$&lt;0.0001$</td>
<td>$50.1 \pm 8.5$</td>
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<tr>
<td>BMI (kg/m$^2$)</td>
<td>$25.7 \pm 3.2$</td>
<td>$30.4 \pm 4.1$</td>
<td>$&lt;0.0001$</td>
<td>$24.7 \pm 4.3$</td>
</tr>
<tr>
<td>Waist (cm)</td>
<td>$92.9 \pm 9.4$</td>
<td>$106.2 \pm 9.8$</td>
<td>$&lt;0.0001$</td>
<td>$80.9 \pm 11.2$</td>
</tr>
<tr>
<td>Triglycerides (g/L)</td>
<td>$1.05 \pm 6.3$</td>
<td>$2.22 \pm 1.46$</td>
<td>$&lt;0.0001$</td>
<td>$0.81 \pm 0.33$</td>
</tr>
<tr>
<td>HDL-cholesterol (g/L)</td>
<td>$0.54 \pm 0.14$</td>
<td>$0.41 \pm 0.11$</td>
<td>$&lt;0.0001$</td>
<td>$0.67 \pm 0.16$</td>
</tr>
<tr>
<td>Hypercholesterolaemia (%)</td>
<td>$11.0$</td>
<td>$20.5$</td>
<td>$&lt;0.0001$</td>
<td>$8.8$</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>$39.5$</td>
<td>$76.1$</td>
<td>$&lt;0.0001$</td>
<td>$29.2$</td>
</tr>
<tr>
<td>Diabetes (%)</td>
<td>$3.0$</td>
<td>$26.9$</td>
<td>$&lt;0.0001$</td>
<td>$1.0$</td>
</tr>
</tbody>
</table>

Values are mean ± SD or percentage.

**Table 2** Prevalence of parental CVD and parental premature CVD by gender

<table>
<thead>
<tr>
<th></th>
<th>Parental CVD</th>
<th></th>
<th>Parental premature CVD</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>$P$-value</td>
<td>Men</td>
</tr>
<tr>
<td>Whole sample</td>
<td>$n = 1737$</td>
<td>$1704$</td>
<td>$&lt;0.013$</td>
<td>$1737$</td>
</tr>
<tr>
<td>MI (%)</td>
<td>$16.6$</td>
<td>$19.9$</td>
<td>$&lt;0.0001$</td>
<td>$5.1$</td>
</tr>
<tr>
<td>Angina (%)</td>
<td>$10.4$</td>
<td>$13.7$</td>
<td>$&lt;0.0002$</td>
<td>$4.2$</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>$13.4$</td>
<td>$16.1$</td>
<td>$&lt;0.020$</td>
<td>$3.2$</td>
</tr>
<tr>
<td>MI or stroke (%)</td>
<td>$27.5$</td>
<td>$32.2$</td>
<td>$&lt;0.0003$</td>
<td>$8.2$</td>
</tr>
<tr>
<td>MI or stroke or angina (%)</td>
<td>$32.9$</td>
<td>$38.5$</td>
<td>$&lt;0.0007$</td>
<td>$11.1$</td>
</tr>
<tr>
<td>Subjects without personal history of CHD</td>
<td>$n = 1663$</td>
<td>$1685$</td>
<td>$&lt;0.0001$</td>
<td>$1663$</td>
</tr>
<tr>
<td>MI (%)</td>
<td>$16.3$</td>
<td>$19.8$</td>
<td>$&lt;0.002$</td>
<td>$4.8$</td>
</tr>
<tr>
<td>Angina (%)</td>
<td>$10.0$</td>
<td>$13.4$</td>
<td>$&lt;0.01$</td>
<td>$4.1$</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>$12.9$</td>
<td>$16.0$</td>
<td>$&lt;0.01$</td>
<td>$3.0$</td>
</tr>
<tr>
<td>MI or stroke (%)</td>
<td>$26.9$</td>
<td>$31.9$</td>
<td>$&lt;0.0004$</td>
<td>$7.7$</td>
</tr>
<tr>
<td>MI or stroke or angina (%)</td>
<td>$32.3$</td>
<td>$38.1$</td>
<td>$&lt;0.0004$</td>
<td>$10.6$</td>
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<tr>
<td>Subjects with personal history of CHD</td>
<td>$n = 74$</td>
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<td>$&lt;0.052$</td>
<td>$74$</td>
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<tr>
<td>MI (%)</td>
<td>$24.3$</td>
<td>$31.6$</td>
<td>$&lt;0.03$</td>
<td>$10.8$</td>
</tr>
<tr>
<td>Angina (%)</td>
<td>$17.6$</td>
<td>$42.1$</td>
<td>$&lt;0.85$</td>
<td>$5.4$</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>$24.3$</td>
<td>$26.3$</td>
<td>$&lt;0.40$</td>
<td>$8.1$</td>
</tr>
<tr>
<td>MI or stroke (%)</td>
<td>$41.9$</td>
<td>$52.6$</td>
<td>$&lt;0.0004$</td>
<td>$18.9$</td>
</tr>
<tr>
<td>MI or stroke or angina (%)</td>
<td>$47.3$</td>
<td>$73.1$</td>
<td>$&lt;0.0004$</td>
<td>$21.6$</td>
</tr>
</tbody>
</table>

Results are in percentage. $x^2$ analysis was for comparison.
<table>
<thead>
<tr>
<th></th>
<th>Parental CVD</th>
<th></th>
<th>Parental premature CVD</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Controls</td>
<td>Metabolic syndrome</td>
</tr>
<tr>
<td>Whole sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>1347 390</td>
<td>1423 281</td>
<td>1347 390</td>
<td>1423 281</td>
</tr>
<tr>
<td>MI (%)</td>
<td>16.0 19.0</td>
<td>19.6 21.4</td>
<td>5.1 5.1</td>
<td>5.3 8.2</td>
</tr>
<tr>
<td>Angina (%)</td>
<td>10.2 11.0</td>
<td>12.7 18.9</td>
<td>4.4 3.3</td>
<td>5.1 6.4</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>12.6 16.2</td>
<td>15.3 20.3</td>
<td>3.2 3.3</td>
<td>2.9 6.1</td>
</tr>
<tr>
<td>MI or stroke (%)</td>
<td>26.6 30.5</td>
<td>31.1 37.4</td>
<td>11.1 11.1</td>
<td>11.8 19.2</td>
</tr>
<tr>
<td>MI or stroke or angina (%)</td>
<td>31.8 36.9</td>
<td>36.8 43.0</td>
<td>11.1 11.1</td>
<td>11.8 19.2</td>
</tr>
<tr>
<td>Subjects without personal history of CHD</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>n</td>
<td>1308 355</td>
<td>1413 272</td>
<td>1308 355</td>
<td>1413 272</td>
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<tr>
<td>MI (%)</td>
<td>15.7 18.6</td>
<td>19.5 21.3</td>
<td>4.9 4.5</td>
<td>5.2 8.1</td>
</tr>
<tr>
<td>Angina (%)</td>
<td>9.7 11.3</td>
<td>12.6 17.7</td>
<td>4.2 3.7</td>
<td>5.2 6.2</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>12.3 15.2</td>
<td>15.2 20.2</td>
<td>2.9 3.4</td>
<td>2.8 5.9</td>
</tr>
<tr>
<td>MI or stroke (%)</td>
<td>26.1 29.9</td>
<td>30.9 37.1</td>
<td>7.7 7.9</td>
<td>7.8 13.2</td>
</tr>
<tr>
<td>MI or stroke or angina (%)</td>
<td>31.1 36.6</td>
<td>36.6 46.0</td>
<td>10.6 10.7</td>
<td>11.8 18.8</td>
</tr>
<tr>
<td>Subjects with personal history of CHD</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>39 35</td>
<td>10 9</td>
<td>39 35</td>
<td>10 9</td>
</tr>
<tr>
<td>MI (%)</td>
<td>25.6 22.9</td>
<td>40.0 22.2</td>
<td>10.3 11.4</td>
<td>10.0 11.1</td>
</tr>
<tr>
<td>Angina (%)</td>
<td>25.6 8.6</td>
<td>30.0 55.6</td>
<td>10.3 0</td>
<td>0.051 0.001</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>23.1 25.7</td>
<td>30.0 22.2</td>
<td>12.8 2.9</td>
<td>10.0 11.1</td>
</tr>
<tr>
<td>MI or stroke (%)</td>
<td>46.2 37.1</td>
<td>60.0 44.4</td>
<td>23.1 14.3</td>
<td>20.0 22.2</td>
</tr>
<tr>
<td>MI or stroke or angina (%)</td>
<td>53.9 40.0</td>
<td>70.0 77.8</td>
<td>28.2 14.3</td>
<td>20.0 33.3</td>
</tr>
</tbody>
</table>

Results are in percentage. $\chi^2$ analysis was used for comparison.
results showed that the MS is associated with parental premature CVD disease and that this association is partially independent of major CVD risk factors. These data suggest that the MS could be a contributor to the familial aggregation of CVD disease.

This study reports an association between the MS and the parental premature CVD disease in a large population-based study. In agreement with these data, similar association have been reported between individual components of the MS such as body weight, glucose intolerance, elevated triglycerides or hypertension, and parental CVD disease. The results of this study extend these observations to the MS. Furthermore, the persistence of the association after adjustment for offspring’s CVD risk factors (i.e., diabetes, hypercholesterolaemia, and hypertension) suggests that the MS is an independent contributor to parental history of premature CVD disease.

These results can be explained by the fact that the MS or metabolic disorders may be more prevalent among parents of subjects with the MS. This hypothesis is supported by the earlier observations of a positive parental history of diabetes, insulin resistance, hypertension, and obesity in the subject with the MS. As the MS clusters several metabolic disorders, one possibility could be that parents concentrate similar factors resulting in an increased risk of CVD disease. The reasons for the parental–filial relation may be linked through genetic or behavioural factors that influence adiposity and CVD risk factors.

The association between the MS and parental CVD was observed in women but not in men. Similar differences between the metabolic disorders and CVD were reported in other population-based studies. One possible reason for this gender difference could be that men do not recall as efficiently as women their parents’ CVD events. However, as the reporting of premature parental CVD events was similar in men and women, this is not a likely explanation. Another possibility could be that the personal history of CVD, which tends to dilute the association, is more prevalent in men than in women, therefore obscuring a possible association. However, when the analyses were repeated after excluding men without CHD, there still was no significant association. Finally, the lack of association between the metabolic disorders and CVD were reported in other population-based studies.

### Table 4 OR (95% CI) of parental CVD and parental premature CVD in subjects with the metabolic syndrome

<table>
<thead>
<tr>
<th>OR (95% CI)</th>
<th>P-value</th>
<th>OR (95% CI)</th>
<th>P-value</th>
<th>OR (95% CI)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1: adjustment for age, centre, and level of education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MI</td>
<td>1.26 (0.93–1.69)</td>
<td>0.13</td>
<td>1.14 (0.76–1.44)</td>
<td>0.43</td>
<td>1.77 (0.69–1.97)</td>
</tr>
<tr>
<td>Angina</td>
<td>0.96 (0.66–1.40)</td>
<td>0.84</td>
<td>1.34 (0.93–1.86)</td>
<td>0.10</td>
<td>0.65 (0.35–1.21)</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.12 (0.81–1.55)</td>
<td>0.48</td>
<td>1.11 (0.77–1.51)</td>
<td>0.55</td>
<td>0.95 (0.50–1.81)</td>
</tr>
<tr>
<td>MI or stroke</td>
<td>1.12 (0.87–1.44)</td>
<td>0.38</td>
<td>1.17 (0.84–1.46)</td>
<td>0.26</td>
<td>1.10 (0.71–1.66)</td>
</tr>
<tr>
<td>MI or stroke or angina</td>
<td>1.15 (0.90–1.46)</td>
<td>0.26</td>
<td>1.31 (1.00–1.75)</td>
<td>0.05</td>
<td>0.98 (0.68–1.42)</td>
</tr>
<tr>
<td>Model 2: adjustment for age, centre, and level of education, and personal history of CHD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MI</td>
<td>1.23 (0.91–1.66)</td>
<td>0.18</td>
<td>1.12 (0.81–1.56)</td>
<td>0.49</td>
<td>1.08 (0.63–1.85)</td>
</tr>
<tr>
<td>Angina</td>
<td>0.94 (0.64–1.37)</td>
<td>0.72</td>
<td>1.30 (0.91–1.85)</td>
<td>0.15</td>
<td>0.64 (0.34–1.20)</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.09 (0.79–1.52)</td>
<td>0.58</td>
<td>1.10 (0.78–1.55)</td>
<td>0.58</td>
<td>0.89 (0.47–1.72)</td>
</tr>
<tr>
<td>MI or stroke</td>
<td>1.09 (0.85–1.41)</td>
<td>0.49</td>
<td>1.16 (0.88–1.54)</td>
<td>0.30</td>
<td>1.02 (0.67–1.55)</td>
</tr>
<tr>
<td>MI or stroke or angina</td>
<td>1.13 (0.88–1.44)</td>
<td>0.33</td>
<td>1.28 (0.98–1.69)</td>
<td>0.07</td>
<td>0.93 (0.64–1.35)</td>
</tr>
<tr>
<td>Model 3: adjustment for age, centre, and level of education, and personal history of CHD, hypercholesterolaemia, hypertension, and diabetes</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MI</td>
<td>1.38 (0.99–1.91)</td>
<td>0.06</td>
<td>1.12 (0.77–1.62)</td>
<td>0.55</td>
<td>1.27 (0.71–2.25)</td>
</tr>
<tr>
<td>Angina</td>
<td>0.93 (0.61–1.42)</td>
<td>0.74</td>
<td>1.35 (0.90–2.01)</td>
<td>0.14</td>
<td>0.68 (0.34–1.36)</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.08 (0.75–1.55)</td>
<td>0.69</td>
<td>1.23 (0.84–1.78)</td>
<td>0.27</td>
<td>0.88 (0.44–1.79)</td>
</tr>
<tr>
<td>MI or stroke</td>
<td>1.17 (0.88–1.55)</td>
<td>0.27</td>
<td>1.24 (0.91–1.70)</td>
<td>0.17</td>
<td>1.12 (0.71–1.77)</td>
</tr>
<tr>
<td>MI or stroke or angina</td>
<td>1.12 (0.92–1.56)</td>
<td>0.17</td>
<td>1.33 (0.97–1.81)</td>
<td>0.07</td>
<td>1.02 (0.68–1.53)</td>
</tr>
</tbody>
</table>

Logistic regression was used for comparison.
between offspring's MS and CVD. Finally, another possible bias may be related to the fact that subjects with a high risk CVD profile such as subjects with the MS or with a personal history of CVD may be more aware of their parents' CV disease. This is supported by the slight lowering of OR after adjustment for personal history of CHD and CVD risk factors. However, this bias also applies to the control subjects without the MS but carrying other metabolic disorders, therefore reducing the strength of the association. Finally, cardiovascular risk factors such as blood pressure, glycaemia, and blood lipids were measured once at entry, which limits the precision of the measurement.

In conclusion, the results of this study showed that the MS is associated with parental premature CVD disease independently of major CVD risk factors suggesting that the MS is an independent contributor to familial aggregation of premature CVD. Although the relation between cardiovascular risk factors and subsequent CVD disease is not always straightforward, the finding of an association between the MS and parental premature CVD risk supports the concept that subjects with the MS have an unfavourable CVD prognosis.

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References


