Chronic infection with *Helicobacter pylori*, *Chlamydia pneumoniae*, or cytomegalovirus: population based study of coronary heart disease

J Danesh, Y Wong, M Ward, J Muir

**Abstract**

**Objective**—To study possible associations between coronary heart disease and serological evidence of persistent infection with *Helicobacter pylori*, *Chlamydia pneumoniae*, or cytomegalovirus.

**Design**—Population based, case-control study, nested within a randomised trial.  

**Setting**—Five general practices in Bedfordshire, UK.  

**Individuals**—288 patients with incident or prevalent coronary heart disease and 704 age and sex matched controls.  

**Results**—High concentrations of serum IgG antibodies to *H pylori* were present in 54% of cases vs 46% of controls, with corresponding results for *C pneumoniae* seropositivity (33% vs 33%), and cytomegalovirus seropositivity (40% vs 31%). After adjustments for age, sex, smoking, indicators of socioeconomic status, and standard risk factors, the odds ratios (95% confidence intervals) for coronary heart disease of seropositivity to these agents were: 1.28 (0.93 to 1.75) for *H pylori*, 0.95 (0.66 to 1.36) for *C pneumoniae*, and 1.40 (0.96 to 2.05) for cytomegalovirus.  

**Conclusions**—There is no good evidence of strong associations between coronary heart disease and serological markers of persistent infection with *H pylori*, *C pneumoniae*, or cytomegalovirus. To determine the existence of moderate associations between these agents and disease, however, larger scale studies will be needed that can keep residual confounders to a minimum.  

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Keywords: ischaemic heart disease; *Helicobacter pylori*; *Chlamydia pneumoniae*; cytomegalovirus

It has been suggested that coronary heart disease may be associated with persistent bacterial or viral agents.1 Reports of such associations have raised the possibility that anti-infective treatments, such as a short course of antibiotics, might be able to prevent disease.2 3 Most studies have involved measurements for serum antibodies to *Helicobacter pylori*, *Chlamydia pneumoniae*, or cytomegalovirus, but only one report4 has measured antibodies to more than one of these agents in the same population, and none has reported measurement for all three. Also, previously reported meta-analyses5 6 have indicated that published studies have generally been prone to biases and lacked adequate sample sizes. We have therefore conducted a population based, case-control study with measurements of markers for these three agents and for standard risk factors and possible confounding variables.

**Methods**

**PARTICIPANTS AND LABORATORY METHODS**

In the early 1990s, 8100 volunteers aged 35 to 64 years at entry to a trial of nurse health checks in five Bedfordshire general practices completed questionnaires and gave non-fasting venous blood samples that were centrifuged and stored at −80°C within 24 hours after venesection.7 Practice nurses took measurements of participants’ height, weight, and blood pressure. For the present study, cases were defined on the basis of incident coronary heart disease death (n = 76) notified by national mortality statistics following entry to the trial (average follow up four years), or on the basis of self reported coronary heart disease at the baseline interview (103 cases with a history of myocardial infarction, and 109 with angina but no myocardial infarction) that could be verified by systematic searches of the medical notes by research nurses. Cases with more than one manifestation of coronary heart disease were classified by their most severe disease (that is, coronary heart disease death > myocardial infarction > angina). We randomly selected 704 people without a history of coronary heart disease from among the trial participants to match the cases on sex and age (within five years). Operators unaware of the case-control status of the blood samples measured serum lipid concentrations using standard assays, and IgG antibodies to *H pylori* using a commercial kit (Orion; Pyloriset, Espoo, Finland), to *C pneumoniae* (whole organism antigen), and to cytomegalovirus (whole organism antigen) using time resolved fluorimetry (Delfia; Wallac, Turku, Finland). The coefficients of variation within and between assays for the infective agents were about 4% and 18%, respectively. A validation study in 480 individuals from another study indicated good agreement with standard microimmunofluorescence for *C pneumoniae* antibodies.7

**STATISTICS**

The distribution of *C pneumoniae* titres was approximately normal, and cytomegalovirus titre distribution was approximately bimodal. As there are no generally agreed cut offs for seropositivity to *C pneumoniae* or cytomegalovirus antibodies, analysis by thirds of titres was
Table 1  Baseline characteristics of cases and controls

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Cases (n = 288)</th>
<th>Controls (n = 704)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>59.2 (5.9)</td>
<td>59.0 (6.1)</td>
<td>Matched</td>
</tr>
<tr>
<td>Male</td>
<td>200 (69%)</td>
<td>475 (67%)</td>
<td>Matched</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>27.4 (4.4)</td>
<td>26.1 (3.8)</td>
<td>&lt; 0.00001</td>
</tr>
<tr>
<td>Current smokers</td>
<td>155 (54%)</td>
<td>278 (39%)</td>
<td>&lt; 0.00001</td>
</tr>
<tr>
<td>Treated hypertensives</td>
<td>23 (8%)</td>
<td>23 (3%)</td>
<td>0.001</td>
</tr>
<tr>
<td>Treated diabetics</td>
<td>133 (46%)</td>
<td>124 (18%)</td>
<td>&lt; 0.00001</td>
</tr>
<tr>
<td>Blood sample</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cholesterol (mmol/l)</td>
<td>6.58 (1.65)</td>
<td>6.33 (1.48)</td>
<td>0.007</td>
</tr>
<tr>
<td>Low density lipoprotein cholesterol (mmol/l)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High density lipoprotein cholesterol (mmol/l)</td>
<td>1.18 (0.44)</td>
<td>1.30 (0.42)</td>
<td>&lt; 0.00001</td>
</tr>
<tr>
<td>Triglycerides (mmol/l)</td>
<td>2.48 (1.40)</td>
<td>2.15 (1.33)</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

Values are mean (SD) unless otherwise stated.

prespecified for each of these agents (that is, seropositive samples were defined as those in the top third of the control distribution, and seronegative samples as those in the bottom third), whereas the manufacturer’s recommended cut off was used to determine H pylori seropositivity. Associations of infective agents with coronary heart disease, risk factors, and other characteristics were investigated using t tests, χ² tests, and regression modelling (STATA Corporation, Texas, USA). The sample size was sufficient to detect odds ratios of 1.5-fold or larger with 80% power at the 5% level of significance, assuming about 50% seropositivity for each of the infective agents in the general population.

Results

As would be expected, there was a higher prevalence of known risk factors in cases with coronary heart disease than in controls (table 1).

Table 2 shows the prevalence of seropositivity of antibodies to each of the infective agents by case–control status. For H pylori, measurements were available for 246 cases and 642 controls, of which 134 cases (54%) and 294 controls (46%) were seropositive. For C pneumoniae, measurements were available for 288 cases and 704 controls, of which 94 cases (33%) and 234 controls (33%) had serum antibody titres in the top third of the distribution. For cytomegalovirus, measurements were available for 288 cases and 704 controls, of which 114 cases (40%) and 221 controls (33%) had serum antibody titres in the top third of the control distribution, and seronegative samples as those in the bottom third, whereas the manufacturer’s recommended cut off was used to determine H pylori seropositivity.

Discussion

More than 70 seroepidemiological studies have reported on associations between coronary heart disease and chronic infection with H pylori, C pneumoniae, or cytomegalovirus. Most, however, have been based on small sample sizes, involved opportunistic control groups prone to selection biases, made few adjustments for possible confounders, and involved measurement for only one of these agents. It seems likely that chance effects, or the preferential publication of more extreme associations (that is, “publication bias”), or both, may at least partly account for the generally larger odds ratios reported in smaller studies without appropriate adjustment for confounders than in larger studies with population based controls. If there remains uncertain whether infection with any of these agents is really associated with coronary heart disease.

Our present population based, case–control study of 288 cases involved adjustment for standard vascular risk factors and several indicators of socioeconomic status. It confirmed the tendency to less extreme results in more reliable epidemiological studies of persistent infections and coronary heart disease, as we observed no strong association of coronary heart disease with levels of serum IgG antibodies to H pylori, C pneumoniae, or cytomegalovirus. For H pylori, the adjusted odds ratio of 1.3 is compatible with the findings of a meta-analysis of four long term prospective reports involving a total 1441 cases that yielded a combined risk ratio of 1.2 for coronary heart disease death or myocardial infarction (95% confidence interval 1.0 to 1.4). Evidence for a moderate association between H pylori and coronary heart disease is, however, difficult to interpret even in population based studies, particularly as residual confounding by factors
related to socioeconomic status is likely. For *C. pneumoniae*, the three previously reported prospective seroepidemiological studies of coronary heart disease death or myocardial infarction (358 cases in all) collectively suggest a weakly positive association, albeit with very wide confidence limits, whereas the largest retrospective population based study of 302 cases did not report a positive association and time (especially for agents such as serum antibody titres within individuals over time (especially for agents such as *C. pneumoniae* and cytomegalovirus, which are prone to reinfection and reactivation, respectively). Results from such studies should be more informative than existing reports, particularly if they involve cases at younger ages where any real association between infections and coronary heart disease might be stronger than at older ages.

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