Relation of smoking and alcohol and coffee consumption to active *Helicobacter pylori* infection: cross sectional study

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Abstract

Objective: To assess the relation of smoking and alcohol and coffee consumption to active *Helicobacter pylori* infection.

Design: Cross sectional study of patients attending a general practitioner. Active *H pylori* infection was measured by the ^{13}C-urea breath test and detailed quantitative information on smoking and on alcohol and coffee consumption was obtained by a standardised self administered questionnaire.

Setting: One general practice in Germany.

Subjects: 447 patients aged 15-79 who had not had peptic ulcer disease or treatment for *H pylori* infection.

Main outcome measures: Prevalence of *H pylori* infection according to smoking and alcohol and coffee consumption.

Results: Overall prevalence of infection was 21% (94/447). There was no significant relation between smoking and active *H pylori* infection. Alcohol consumption showed a negative dose-response relation and coffee consumption a positive dose-response relation with active infection. After adjustment for potential confounders, the odds ratios for patients who drank $\leq$75 g and $>$75 g of ethanol a week compared with non-drinkers were 0.90 (95% confidence interval 0.55 to 1.59) and 0.33 (0.16 to 0.68), respectively (P value for trend 0.005, assuming that 1 litre of beer and 0.5 l of wine contain on average 50 g of ethanol in south Germany). Adjusted odds ratios for patients who drank $<$3 cups and $\geq$3 cups of coffee per day compared with those who did not drink coffee were 1.49 (0.71 to 3.12) and 2.49 (1.23 to 5.03), respectively (P value for trend 0.007).

Conclusion: These results suggest a protective effect of alcohol consumption against active infection with *H pylori* and an opposite effect of coffee consumption.

Introduction

Helicobacter pylori is a major cause of type B gastritis and is strongly associated with duodenal and gastric ulcer disease.[1] Seroprevalence studies have consistently identified socioeconomic conditions in childhood as major risk factors for infection.[2 3] By contrast, results on the role of socioeconomic and lifestyle factors during adulthood have been inconsistent.

Most studies addressing the role of lifestyle factors during adulthood have measured IgG titres, which indicate chronic infection,[4–9] but infection may be acquired and eliminated throughout adulthood.[10 11] Thus serological tests might not be best for assessing the role of factors that might primarily affect current (active) infection. Furthermore, most studies have been of patients with major gastrointestinal disorders, who might have changed their lifestyle since becoming ill.[12–16] Other limitations of previous studies include crude assessment of lifestyle habits, such as a simple dichotomisation of alcohol consumption[4 15 17]; limited power due to a small sample size[5 14 15 17]; and failure to adjust for risk factors that might confound the association of lifestyle factors with *H pylori* infection.[5 12 14 15] We investigated the relation of *H pylori* infection to smoking and alcohol and coffee consumption, taking care to overcome or at least minimise these problems.

Subjects and methods

Study design and population

We carried out a cross sectional study among patients who attended a general practitioner in Blaustein, a community of about 15 000 inhabitants in the south of Germany, at fixed weekdays between June and September 1996. Patients aged 15-79 years were recruited during usual visits to the practice. Participation was voluntary, and informed consent was obtained in each case. A total of 501 patients (94% of eligible patients) agreed to participate. Patients with a history of gastric or duodenal ulcer (32 patients) were excluded because they might have changed their lifestyle because of their gastrointestinal problems. To avoid false negative test results, we additionally excluded 16 patients who had been treated for *H pylori* infection and 6 patients receiving antibiotic treatment, leading to a final sample size of 447 patients.

Data collection

Active infection with *H pylori* was determined by breath testing with carbon-13. An initial breath sample was collected in a plastic bag. The patients then received 200 ml of apple juice (pH 2.2-2.4) containing 75 mg non-radioactive ^{13}C-urea (Mass Trace, Woburn, Massachusetts). Thirty minutes later a second breath sample was collected. The breath samples were analysed with an isotope selective non-dispersive infrared spectro-

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meter (Wagner Analytical Systems, Worpswede, Germany). An increase in the ratio of ^{13}C-carbon dioxide to ^{12}C-carbon dioxide between the baseline sample and the 30 minute sample of more than 5 per 1000 was considered to indicate active infection.

Patients were asked to fill out a standardised questionnaire on medical history, sociodemographic factors, and other factors that were suspected to be potentially related to *H pylori* infection, including smoking, alcohol consumption (average amount of different alcoholic beverages a week), and coffee consumption (average number of cups a day).

Statistical analysis

We obtained summary statistics relating to smoking and to alcohol and coffee consumption and assessed the bivariate associations between the three variables. The average total and beverage specific weekly alcohol consumption were calculated assuming that 1 litre of beer or 0.5 litres of wine contain 50 g ethanol (which are typical ethanol contents of the beer and wine consumed in Southern Germany) and that the alcohol content of one unit of liquor (0.02 litres) is about 8 g ethanol. We then estimated the relation of smoking and alcohol and coffee consumption to active *H pylori* infection by crude and adjusted odds ratios. Adjusted odds ratios and their 95% confidence intervals were estimated by multiple logistic regression. The following covariates which were suspected to be related to infection on the basis of previous knowledge were included in the multivariable modelling: age (in years), sex, nationality (German, other), schooling (≤9 years, 10-11 years, ≥12 years, or ongoing schooling, reflecting standard categories of the German school system), and parental history of gastric or duodenal ulcer (yes, no). Initially, potential two factor interactions between smoking and alcohol and coffee consumption were assessed. None of these interactions was significant ($P > 0.18$ in all cases), however, and therefore no interaction terms were included in the final model. All analyses were carried out with the SAS statistical software package.[18]

Results

Table 1 shows the sociodemographic factors of the study population. About two thirds of the patients were women. The mean age was 42.8 years, and slightly more than half of the patients (57%) were under 45. Most patients (97%) were of German nationality.

About a quarter of the patients were current (26%) or former (25%) smokers. The average number of cigarettes smoked a day by current smokers was 13.5. Other forms of smoking were negligibly rare in this study population.

Table 2 shows alcohol consumption. About half of the patients reported that they drank beer (48%) or wine (49%), but beer, being the main source of alcohol in Germany, was on average consumed in larger amounts. Only 17% reported that they drank spirits. Overall, two thirds of the patients reported drinking some form of alcohol.

Most patients (73%) reported drinking coffee regularly. Mean consumption was 3.3 cups daily (median 3 cups daily).

Smoking and alcohol and coffee consumption were strongly related to each other. For example, current smoking was about twice as common among participants who consumed more than 75 g of alcohol a week (52/141, 37%) than among non-drinkers (30/152, 20%), or among participants who drank 3 or more cups of coffee a day (64/187, 34%) than among participants who did not drink coffee (22/120, 18%). Coffee and alcohol consumption were likewise positively related.

Table 1 Study population by sex, age, nationality, and schooling

	No of subjects (n=447)
Sex:	
Female	283
Male	164
Age (years):	
15-29	107
30-44	149
45-59	98
60-79	93
Nationality:	
German	434
Other	12
Schooling (years):	
≤ 9	191
10-12	141
≥ 13	113

Table 2 Alcohol consumption in the study population by type of beverage

Beverage	No of drinkers*	Alcohol consumption (g ethanol/week)†		
		Mean	Median	Range
Beer	214	96.1	50	0-500
Wine	219	56.0	50	0-500
Spirits	76	13.1	8	0-120
Any alcoholic beverage	295	114.1	75	0-608

*Some subjects drank more than one type of alcoholic beverage.
†Assuming that 1 litre of beer and 0.5 l of wine contain on average 50 g ethanol in south Germany.

Table 3 shows the relation of smoking and alcohol and coffee consumption to active *H pylori* infection. The overall prevalence of infection was 21% (94/447). Infection was slightly more common among former smokers (25%) and current smokers (22%) than among those who had never smoked (18%), and it was considerably higher among participants who drank 3 or more cups of coffee a day (28%) than among other participants. These patterns persisted after control for potential confounding in multivariable analysis, which showed a positive dose-response relation between coffee drinking and infection (P value for trend 0.007), with a moderate but not significant increase in the odds of infection among former and current smokers (odds ratios 1.48 and 1.57, respectively). By contrast, we observed a negative association between alcohol consumption and *H pylori* infection that was considerably strengthened after controlling for smoking, coffee consumption, and the other covariates in multiple logistic regression (P value for trend 0.005). In particular, there was a clear, highly significant reduction in the prevalence of infection among participants who reported drinking more than 75 g ethanol a week compared with non-drinkers (adjusted odds ratio 0.33 (95% confidence interval 0.16 to 0.68)). There was also a significant positive relation between age and foreign nationality and the risk of infection.

To assess whether the association between alcohol consumption and infection was confined to a specific

type of alcoholic beverage, we carried out additional analyses in which alcohol from beer and wine were entered as separate variables in the multivariable modelling. A negative association between the amount of alcohol consumed and *H pylori* infection was seen for both beer and wine (P value for trend 0.027 and 0.023, respectively), although the association was slightly more pronounced for wine (table 4).

Discussion

We found a moderate but not significant increase in the prevalence of *H pylori* infection among smokers, a negative dose-response relation between alcohol consumption and active *H pylori* infection, and a positive dose-response relation between coffee consumption and active infection. The negative dose-response relation between alcohol consumption and active infection applied to both beer and wine.

A limitation of our study is the fact that information on smoking and on alcohol and coffee consumption was ascertained by a self administered questionnaire without verification by biological markers. Self reports of smoking are typically reasonably accurate,[19] but we believe that alcohol consumption, as in other epidemiological studies, has probably been underreported to some extent. Information on alcohol consumption was given before *H pylori* infection was known, and potential underreporting would most likely have been non-differential with respect to infection. Such underreporting could not have produced the observed patterns if alcohol consumption was unrelated to *H pylori* infection.[20]

Smoking

Our results on the relation between smoking and *H pylori* infection are similar to those from other studies. Despite differences in the populations studied and the methods used, most studies reported slightly increased odds of *H pylori* infection among smokers,[4 6 12 13 15] but these odds were significant in only two studies.[12 13] These patterns are consistent with a possible weak increase in active *H pylori* infection by smoking, which might be too subtle to be verified in most single epidemiological studies because of limited power.

The observed net association of smoking with active *H pylori* infection may result from various mechanisms with partly antagonistic effects on the risk of infection. Potentially relevant effects of smoking include an increase in acid and pepsin secretion and changes in gastric motility, prostaglandin synthesis, gastric mucosal blood flow, and mucus secretion.[21]

Alcohol consumption

Several studies have reported the relation between alcohol consumption and *H pylori* infection.[4 6 9 13–17] Most of them did not find a significant association. A recent study from Finland found a positive association between alcohol consumption and *H pylori* infection among younger people (aged 18-35) and a negative association among older age groups (≥46).[9] Yet, interpretation and generalisation of these findings are difficult because the study was conducted among military staff who had endoscopy for gastric complaints and who drank heavily.

In contrast to most previous studies, we ascertained alcohol consumption in a strictly quantitative manner by type of beverage. Our results suggest a major protective effect of alcohol at moderate and high consumption but not at low consumption, which might explain the failure to detect any effect of alcohol in studies in which participants were simply classed as drinkers or non-drinkers. Furthermore, previous studies did not control[14 15] or only partly[17] controlled for factors that may confound the association between alcohol consumption and *H pylori* infection. Our analysis shows that the negative association between alcohol consumption and *H pylori* infection may easily remain undetected unless relevant confounders are adjusted for.

Another reason for the differences between our results and previous results on the role of alcohol consumption may be how infection was measured. Most previous studies used IgG titres to measure infection.[4 6 9] High IgG titres may persist after elimination of active infection,[10] so elimination of infection resulting from alcohol consumption might be missed in studies using IgG titres as markers of infection.

Several mechanisms might mediate the apparent protective effects of alcohol consumption. Alcoholic beverages have many direct and indirect effects on the gastric mucosa, on gastric emptying,[22] and on gastric acid secretion,[23] and these may affect the living conditions of *H pylori* in the stomach. In particular, moderate alcohol consumption might invigorate

Table 3 Relation of smoking and alcohol and coffee consumption to active *H pylori* infection

	No of subjects	No (%) with infection	Odds ratio (95% CI)	
			Crude	Adjusted*
Smoking:				
Never smoked	220	40 (18.2)	1.00	1.00
Former smoker	110	28 (25.5)	1.54 (0.89 to 2.66)	1.48 (0.81 to 2.72)
Current smoker	116	25 (21.6)	1.24 (0.71 to 2.16)	1.57 (0.81 to 3.05)
Alcohol consumption (g ethanol/week)†:				
None	152	35 (23.0)	1.00	1.00
⩽ 75	152	38 (25.0)	1.11 (0.66 to 1.89)	0.90 (0.51 to 1.59)
> 75	141	21 (14.9)	0.59 (0.32 to 1.06)	0.33 (0.16 to 0.68)‡
Coffee consumption (cups/day):				
None	120	14 (11.7)	1.00	1.00
< 3	138	26 (18.8)	1.76 (0.87 to 3.55)	1.49 (0.71 to 3.12)
⩾ 3	188	53 (28.2)	2.97 (1.57 to 5.65)	2.49 (1.23 to 5.03)§

*Adjusted for other variables listed in table and for sex, age, nationality, school education, and parental history of ulcer.
†Assuming that 1 litre of beer and 0.5 l of wine contain on average 50 g ethanol in south Germany.
‡P value for trend in multivariable analysis 0.005.
§P value for trend in multivariable analysis 0.007

Table 4 Relation of alcohol consumption to active *Helicobacter pylori* infection by source of alcohol

	No of subjects	Odds ratio (95% CI)*
Alcohol (g ethanol/week)†		
From beer:		
None	233	1.00
⩽ 50	110	0.85 (0.45 to 1.59)
> 50	103	0.38 (0.17 to 0.85)‡
From wine:		
None	228	1.00
⩽ 50	157	0.83 (0.47 to 1.48)
> 50	61	0.33 (0.14 to 0.81)§

*Adjusted for alcohol consumption from other source and for sex, age, nationality, school education, parental history of ulcer, smoking, and coffee consumption.
†Assuming that 1 litre of beer and 0.5 l of wine contain on average 50 g ethanol in south Germany.
‡P value for trend in multivariable analysis 0.027.
§P value for trend in multivariable analysis 0.023.

Key messages

- Although *H pylori* infection is commonly acquired during childhood, active infection may be acquired and eliminated throughout adulthood
- This study of patients in a general practice found no significant relation between smoking and active *H pylori* infection
- Drinking alcohol seemed to protect against active *H pylori* infection
- This protective effect was dose dependent and similar for beer and wine
- Drinking coffee was associated with an increased prevalence of active *H pylori* infection
- The protective effect of alcohol on active *H pylori* infection may be related to its antimicrobial effects

mucosal defence by its effects on prostaglandins.[24] Both beer and wine are potent stimulants of acid secretion and gastrin release,[23] and wine has strong antibacterial activity.[25]

Coffee consumption

The positive relation between coffee consumption and *H pylori* infection identified in our study is consistent with results from a cohort study among epidemiologists in which the risk of seroconversion (change from negative to positive results for antibodies to *H pylori* in serum was 4.6 times higher among those who drank more than 2 cups of caffeinated drinks a day than among the others.[11] The mechanisms underlying this association require further research.

Conclusion

Our study in patients of a general practitioner suggests a protective effect of alcohol consumption against active *H pylori* infection and an opposite effect of coffee consumption. Further research should address the observed associations in representative population samples and aim to obtain a more complete understanding of their underlying mechanisms.

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1 National Institutes of Health Consensus Conference. *Helicobacter pylori* in peptic ulcer disease. *JAMA* 1994;272:65-9.
2 Mendall MA, Goggin PM, Molineaux N, Levy J, Toosy T, Strachan D, et al. Childhood living conditions and Helicobacter pylori seropositivity in adult life. *Lancet* 1992;339:896-7.
3 Webb PM, Knight T, Greaves S, Wilson A, Newell DG, Elder J, et al. Relation between infection with Helicobacter pylori and living conditions in childhood: evidence for person to person transmission in early life. *BMJ* 1994;308:750-3.
4 EUROGAST Study Group. Epidemiology of, and risk factors for, Helicobacter pylori infection among 3194 asymptomatic subjects in 17 populations. *Gut* 1993;34:1672-6.
5 Maxton DG, Srivastava ED, Whorwell PJ, Jones DM. Do non-steroidal anti-inflammatory drugs or smoking predispose to Helicobacter pylori infection? *Postgrad Med J* 1990;66:717-9.
6 Graham DY, Malaty HM, Evans DG, Evans DJ, Klein PD, Adam E. Epidemiology of Helicobacter pylori in an asymptomatic population in the United States. Effect of age, race, and socioeconomic status. *Gastroenterology* 1991;100:1495-501.
7 Gasbarrini G, Pretolani S, Bonvicini F, Gatto MRA, Tonelli E, Mégraud F, Mayo K, et al. A population based study of Helicobacter pylori infection in a European country: the San Marino study. Relations with gastrointestinal diseases. *Gut* 1995;36:838-44.
8 Gilboa S, Gabay G, Zamir D, Zeev A, Novis B. Helicobacter pylori infection in rural settlements (kibbutzim) in Israel. *Int J Epidemiol* 1995;24:232-7.
9 Paunio M, Höök-Nikanne J, Kosunen TU, Vainio U, Salaspuro M, Mäkinen J, et al. Association of alcohol consumption and Helicobacter pylori infection in young adulthood and early middle age among patients with gastric complaints. *Eur J Epidemiol* 1994;10:205-9.
10 Meyer B, Werth B, Beglinger C, Dill S, Drewe J, Vischer WA, et al. Helicobacter pylori infection in healthy people: a dynamic process? *Gut* 1991;32:347-50.
11 Parsonnet J, Blaser MJ, Perez PG, Hergrett BN, Tauxe RV. Symptoms and risk factors of Helicobacter pylori infection in a cohort of epidemiologists. *Gastroenterology* 1992;102:41-6.
12 Bateson MC. Cigarette smoking and Helicobacter pylori infection. *Postgrad Med J 1993;69:41-4.*
13 Fontham ETH, Ruiz B, Perez A, Hunter F, Correa P. Determinants of Helicobacter pylori infection and chronic gastritis. *Am J Gastroenterol* 1995;90:1094-101.
14 Rokkas T, Pursey C, Uzoechina E, Dorrington L, Simmons NA, Filipe MI, et al. Campylobacter pylori and non-ulcer dyspepsia. *Am J Gastroenterol* 1987;82:1149-52.
15 Chodos JE, Dworkin BM, Smith F, van Horn K, Weiss L, Rosenthal WS. Campylobacter pylori and gastroduodenal disease: a prospective endoscopic study and comparison of diagnostic tests. *Am J Gastroenterol* 1988;83:1226-30.
16 Höök-Nikanne J. Effect of alcohol consumption on the risk of Helicobacter pylori infection. *Digestion* 1991;50:92-8.
17 Dooley CP, Cohen H, Fitzgibbons PL, Bauer M, Appleman MD, Perez-Perez GI, et al. Prevalence of Helicobacter pylori infection and histologic gastritis in asymptomatic persons. *N Engl J Med* 1989;321:1562-6.
18 SAS Institute. *SAS language: reference.* Version 6. 1st ed. Cary, NC: SAS Institute, 1990.
19 Patrick DL, Cheadle A, Thompson DC, Diehr P, Koepsell T, Kinne S. The validity of self-reported smoking: a review and meta-analysis. *Am J Public Health* 1994;84:1086-93.
20 Brenner H, Loomis D. Varied forms of bias due to nondifferential error in measuring exposure. *Epidemiology* 1994;5:510-7.
21 Endoh K, Leung FW. Effects of smoking and nicotine on the gastric mucosa: a review of clinical and experimental evidence. *Gastroenterology* 1994;107:864-78.
22 Jian R, Cortot A, Ducrot F, Jobin G, Chayvialle JA, Modigliani R. Effect of ethanol ingestion on postprandial gastric emptying and secretion, biliopancreatic secretions, and duodenal absorption in man. *Dig Dis Sci* 1986;31:604-14.
23 Singer MV, Leffmann C, Eysselein VE, Calden H, Goebell H. Action of ethanol and some alcoholic beverages on gastric acid secretion and release of gastrin in humans. *Gastroenterology* 1987;93:1247-54.
24 Robert A, Nezamis JE, Lancaster C, Davis JP, Field SO, Hanchar AJ. Mild irritants prevent gastric necrosis through "adaptive cytoprotection" mediated by prostaglandins. *Am J Physiol* 1983;245:G113-21.
25 Weisse ME, Eberly B, Person DA. Wine as a digestive aid: comparative antimicrobial effects of bismuth salicylate and red and white wine. *BMJ* 1995;311:1657-60.

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A memorable patient

"A list of complaints or..."

It is traditional for general practitioners to try and list the number of problems a patient brings to the consulting room before tackling each one, perhaps in order of priority as governed by the patient.

A mother came to me some months ago with her 3 year old child who had three such problems: she had not been "right" for the past 10 days; she had developed a nasty nappy rash; and she had had a sore tongue for three days, which had come on since she had made the appointment. It was tempting just to reassure as the child seemed very well playing with the toys in the consulting room. Was this perhaps a virus, among the myriad of viruses which seem to be ubiquitous in the community? I'm not sure why, but on this occasion I asked Mum to undress the child completely and sure enough she had a faint, almost indiscernible, rash over her torso and her hands and feet were peeling. In addition she had a nasty erythematous rash over her bottom area and the tongue—yes you've guessed it—was a beautiful "strawberry red." The child also had a mild fever, which I measured, and I confirmed that this was something much more specific. Scarlatina was the diagnosis, not a virus, which explained this seemingly random list of unconnected and ill defined complaints. I reflected on how easy it is to miss something like this if the "list approach" to consultations is taken to its logical conclusion.

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