

Helicobacter pylori infection in children: relation with current household living conditions

W A McCallion, L J Murray, A G Bailie, A M Dalzell, D P J O'Reilly, K B Bamford

Abstract

Background—Studies demonstrating that deprived household living conditions during childhood are risk factors for acquisition of *Helicobacter pylori* infection have been performed mainly in adults, who probably acquired the infection several decades ago. This study investigates whether deprived household living conditions remain important risk factors for infection in subjects (children) with recently acquired infection.

Aims—To examine the relation between current household living conditions and acquisition of *H pylori* infection in childhood.

Subjects/setting—Opportunistically recruited group of 367 children, aged 3 to 15 years, undergoing routine non-gastrointestinal day surgery.

Methods—Anti-*H pylori* IgG antibodies measured by a commercial enzyme linked immunosorbent assay validated for use in children. Postal questionnaire collecting sociodemographic data and data on household living conditions.

Results—Infection was associated with social class and overcrowding in the household. After adjustment for age, social class, and household density, a positive association remained between infection with *H pylori* and bed-sharing between children and parents on one or two nights per week, odds ratio for infection (95% CI), 2.29 (1.21, 4.32) or more frequently, odds ratio for infection (95% CI), 2.95 (1.35, 6.45).

Conclusions—The continuing importance of household living conditions in the acquisition of *H pylori* infection is confirmed and household crowding and sharing a bed with a parent are identified as risk factors for infection.

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Keywords: *Helicobacter pylori*, childhood, risk factors, breast feeding.

Helicobacter pylori is a spiral Gram negative bacterium that colonises the human stomach. It causes type B gastritis,¹ is strongly associated with gastric and duodenal ulceration,² and has been implicated in the causation of gastric carcinoma.^{3,4} No significant non-human or environmental reservoir of *H pylori* infection has been identified indicating that person to person spread is almost certainly the mode of transmission of infection. Intra-familial clustering of infection is well recognised⁵ and

the same strain of organism has been identified in parents and their offspring⁶ strongly suggesting the spread of infection occurs within the home. There is also a strong body of evidence showing that *H pylori* infection is primarily acquired early in life.⁷⁻⁹ Further evidence for both acquisition of infection in childhood and spread within the home is provided by studies that have shown that deprived household living conditions in childhood such as overcrowding^{10,11} and bed-sharing¹² are risk factors for acquisition of *H pylori* infection. A limitation of these studies, however, is that they have investigated adults who probably acquired the infection several decades ago: risk factors for infection acquired decades ago may be less important in recently acquired infection. It has been shown that, in developed countries, an age cohort effect exists¹³ and that the risk of acquisition of infection is decreasing with successive cohorts possibly as a result of improved living conditions in childhood. Recently investigators have suggested that, consequent upon improvements in household living conditions, factors in the community may now be more important in the transmission of *H pylori* infection than conditions within the home.¹⁴ This study investigates whether deprived household living conditions remain important risk factors for infection in subjects (children) with recently acquired infection.

Methods

Subjects

Four hundred and eighty five children aged 3-15 years attending the Royal Belfast Hospital for Sick Children for routine non-gastrointestinal day surgery were recruited over a six month period. Venepuncture was performed on the children under general anaesthesia. Serum (1 ml) was stored at -20°C and assayed in batches for anti-*H pylori* IgG antibodies using a commercial enzyme linked immunosorbent assay (ELISA); Helico G, Porton Cambridge. The assay had previously been validated in 100 children undergoing routine upper gastrointestinal endoscopy, in whom three antral biopsy specimens had been taken for histology, culture, and rapid urease test (CLO-test, Delta West Ltd, Australia) respectively. A positive diagnosis of *H pylori* infection was made if the organism was grown or there was both a positive CLO-test and histological evidence of gastritis. Using these criteria the sensitivity of the ELISA was 100% with a specificity of 92%.

Departments of
Paediatric Surgery
A G Bailie
W A McCallion

and Paediatric
Medicine
A M Dalzell

The Royal Belfast
Hospital for Sick
Children, Belfast

Department of
Epidemiology and
Public Health
L J Murray

and Microbiology and
Immunobiology
K B Bamford

The Queen's
University of Belfast

Department of Public
Health Medicine,
Eastern Health and
Social Services Board,
Belfast
D P J O'Reilly

Correspondence to:
Dr L Murray, Department of
Social Medicine, Bristol
University, Canyng Hall,
Whiteladies Road, Bristol
BS8 2PR.

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TABLE I Unadjusted relations between variables and prevalence of seropositivity to H pylori

Household variable	Category	Number seronegative	Number seropositive	χ^2 value	p Value
Number of children	1	34	13		
	2	93	26		
	3	73	33		
	4	37	23		
	5 or more	13	22	16.2*	<0.0001
Household density (persons per room)	<0.7	85	17		
	0.7-1.0	95	42		
	>1.0	70	58	21.6*	<0.0001
Sharing a bedroom	No sharing	130	38		
	Shared	119	79	12.5†	<0.001
Sharing a bed with a parent (nights per week)	None	197	76		
	1-2	36	24		
	More than 2	17	7	8.99*	<0.01
Sharing a bed with a child (nights per week)	None	189	81		
	1-2	30	11		
	More than 2	31	25	3.41*	0.07
Breast feeding	Never or <2 weeks	192	101		
	2 weeks or more	58	16	4.49†	0.03

*= χ^2 for trend; †= χ^2 .

TABLE II Logistic regression analysis. Prevalence odds ratio for H pylori infection after adjustment for age and social class

Household variables	Odds ratio (95% CI)
5 Children or more in the household*	3.58 (1.35, 9.49)
Household density (persons per room)†	
0.7-1	1.98 (1.03, 3.83)
>1	3.38 (1.75, 6.50)
Sharing a bedroom*	2.11 (1.31, 3.39)
Sharing a bed with a child (nights per week)	
1 or 2	1.10 (0.47, 2.18)
>2*	1.96 (1.06, 3.63)
Sharing a bed with a parent (nights per week)	
1 or 2	2.30 (1.24, 4.29)
>2	2.92 (1.36, 6.26)

*Becomes non-significant after adjustment for housing density; †reference category: <0.7 persons per room.

A questionnaire was posted to the parent(s) or guardian(s) of all children from whom blood had been obtained. The questionnaire gathered sociodemographic information and information on household density (number of adults, children and rooms; not including bathrooms, toilets, and small kitchens), and sleeping arrangements (bed-sharing with a child, parent or adult) pertaining to when the child was aged four or, if aged less than 4, current sleeping arrangements. A child was viewed as sharing a bed with a parent or adult if he/she spent all or part of the night in the adult's bed. Further information obtained included the occurrence and duration of breast feeding as an infant.

Parental occupation was classified according to the Office of Population Censuses and Surveys' Classification of Occupations¹⁵ and social class categorised as manual (IIIM, IV and V) and non-manual (I, II and IIINM). Age of child was used both as a categorical and continuous variable. All other variables relating to the subject or household were categorical. Breast feeding was categorised into a dichotomous variable; never breast fed or breast fed for less than two weeks and breast fed for two weeks or longer. Household density was defined as the number of persons per room. The distribution was positively skewed and was divided into three categories; less than 0.7 persons per room, 0.7-1 persons per room, and more than 1 person per room. The χ^2 test (and where appropriate the χ^2 test for trend)

was used to examine the unadjusted relation between *H pylori* infection and all variables. Multiple logistic regression (SPSS for Windows) was used to adjust for potential confounders.

This study was approved by the Research Ethics Committee of the Queen's University of Belfast. Informed parental consent was obtained in each case.

Results

Questionnaires were returned from 367 subjects, aged 3-15 years (response rate 76%). One hundred and seventeen respondents were *H pylori* seropositive (32%); 42 non-respondents (36%) were seropositive. Seroprevalence of *H pylori* increased significantly with age; 21.4% of children aged less than 6 were seropositive, 29.6% of those aged 6-8 years old, 36.4% aged 9 to 11 years, and 52.8% aged 12 or over (χ^2 for trend 16.5, $p < 0.0001$). Seropositivity was significantly more common in children whose parents were engaged in manual occupations (38.3% infected) than in children whose parents were from non-manual occupations (23.5% infected); $\chi^2 = 9.85$, $p = 0.002$.

Further bivariable analysis showed positive associations between *H pylori* infection and the following household variables; number of children in the household, household density, sharing a bedroom, and sharing a bed with a parent/adult (Table I). There was a significant negative association between infection and breast feeding. Sharing a bed with a child was not significantly associated with infection but was significantly associated with household density (χ^2 for trend 7.0, $p < 0.01$). Sharing a bed with a parent was not associated with household density (χ^2 for trend 0.65, $p = 0.41$).

After adjusting for age and social class the following variables were significantly and positively associated with infection: number of children in the home (if five or more), household density, sharing a bedroom, sharing a bed with a child (on more than two nights a week), and sharing a bed with a parent (see Table II). On further adjustment for household density the only variable that remained significantly associated with infection was sharing a bed with a parent on one or two nights per week, odds ratio for infection (95% CI), 2.29 (1.21, 4.32) or more frequently, odds ratio for infection 2.95 (1.35, 6.45). The odds ratio for infection in subjects sharing a bed with another child on more than two nights per week remained increased (1.65 (0.88, 3.09)) but the relation no longer achieved statistical significance. The odds ratio for infection in subjects who had been breast fed for two weeks or longer remained substantially decreased (0.54 (0.28, 1.06)) after adjustment for age, social class, and housing density but the relation did not achieve statistical significance ($0.05 < p < 0.1$). Social class was strongly associated with infection on adjustment for age, odds ratio for infection in manual classes (95% CI) 2.02 (1.27, 3.32), but after adjustment for household density and sharing a bed

TABLE III *The final logistic regression model, dependent variable H pylori infection*

Variable	Odds ratio
Age (y)	1.20 (1.10, 1.30)
Social class (M: NM)	1.60 (0.97, 2.64)
Household density (persons per room)*	
0.7-1	2.02 (1.04, 3.92)
>1	3.37 (1.73, 6.65)
Sharing a bed with a parent/adult	
1 or 2 nights per week	2.29 (1.21, 4.32)
More than 2 nights per week	2.95 (1.35, 6.45)

*Reference category, <0.7 persons per room.

with a parent the relation between social class and infection was no longer statistically significant although the odds ratio remained raised (Table III).

Discussion

Previous investigations in adults have shown that deprived household living conditions in childhood, particularly overcrowding¹⁰ and sharing a bed^{11,12} are associated with *H pylori* infection. In this study we confirm the association between overcrowding in the household and infection with *H pylori* in a group of children. High household density may present many opportunities for spread of infection through close personal contact. In many instances overcrowding will necessitate children sharing a bed and it is not clear whether sharing a bed is a risk factor for infection independently of overcrowding. Strong colinearity between overcrowding and sharing a bed resulted in Webb *et al* being unable to separate their effects. In this study although bed-sharing with another child and household density were closely related and each was associated with seropositivity for *H pylori* infection when both variables were entered into the regression model household density remained strongly associated with infection while sharing a bed became non-significant (although the odds ratio for infection did remain increased). This suggests that sharing a bed with another child may be merely a measure of overcrowding in the household and not in itself a risk factor for infection.

In developed countries, *H pylori* infection is more common in adults than in children and acquisition of infection primarily occurs in childhood suggesting that infection is transmitted from adult to child. Familial clustering of infection and isolation of the same strain of organism in adults and their children provide evidence that infection may be transmitted from infected parent to the child presumably within the household (although transmission of infection from infected child to uninfected adult is also a possibility). Close personal contact such as the sharing of a bed between a parent/adult and a child may provide the opportunity for transmission of infection from parent to child. Studies to date have not differentiated between sharing a bed during childhood with another child and sharing a bed with a parent/adult. In this study parents or guardians were asked if the child spent part of the night in their bed on one or more nights during the week. One in four children shared a

bed with a parent/adult and this was not related to household overcrowding or social class. Within this group, unlike sharing a bed with another child, sharing a bed with a parent was a strong and independent risk factor for infection. Thus the mechanism of spread of infection from parent to child may be through close personal contact, for example, while sharing a bed.

It is interesting, but perhaps not surprising, that the relation between social class and infection becomes non-significant after adjustment for household density and bed-sharing between a child and an adult, suggesting that, with regard to acquisition of *H pylori* infection, social class is acting as a proxy measure for conditions and practices within the household that increase the likelihood of transmission of the organism from infected to uninfected subject. It is also probable that there are other unidentified factors that contribute to the social class gradient in infection as the magnitude of the odds ratio remained increased after adjustment for household crowding and bed-sharing.

Anti-*H pylori* IgA in human breast milk has been shown to protect against early acquisition of *H pylori* infection in infants in a developing country¹⁶ and in this study breast fed children had a lower prevalence of infection than those bottle fed. This relation did not remain statistically significant after adjustment for confounders; age, social class, and household density. However, as fewer than 25% of the children were breast fed for two weeks or longer and as the magnitude of the effect and the direction of the relation were substantially unaltered with adjustment, one cannot rule out a true protective effect of breast feeding.

The opportunistic group of children studied was not population representative and findings within the group cannot be considered to be directly applicable to children who do not attend hospital for elective day surgery. However, as children from all social classes and from all parts of Northern Ireland were studied, the risk factors for acquisition of infection seen within this group may accurately reflect risk factors in the general population.

In conclusion this study confirms the continuing importance of household living conditions in the acquisition of *H pylori* infection and identifies household crowding and sharing a bed with a parent during childhood as risk factors for infection. There is also some evidence that breast feeding may reduce the risk of infection.

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