



Alimentary Tract

Helicobacter pylori infection in Burkina Faso:
an enigma within an enigma

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Abstract

Background. In Burkina Faso, in contrast with high rates of *Helicobacter pylori* infection from an early age, the prevalence of *H. pylori*-associated diseases (ulcer and gastric cancer) is low.

Aims. To look for the prevalence of *H. pylori* in healthy natives of Burkina Faso, both children and adults.

Methods. We studied the prevalence of *H. pylori* infection in 258 healthy natives of Burkina Faso (70 children aged 6 months–15 years and 188 adults aged 16–65 years), using a serological screening (IgA and IgG *H. pylori* antibodies). All the studied subjects underwent a questionnaire regarding their life-style, socio-economic status, dietary habits and hygienic sanitary conditions. Data concerning the questionnaire were compared between *H. pylori* positive and negative subjects.

Results. The rates of *H. pylori* positivity in children were significantly higher than in adults, and in adults the positivity for *H. pylori* infection decreased with increasing age. The comparison of the questionnaire's data between *H. pylori* seropositive and seronegative subjects showed that poor socio-economic status and hygienic sanitary conditions were similar in the two groups. Instead, a higher prevalence of *H. pylori* positivity was observed in subjects belonging to families living in close contact with sheep, because of their labour and agro-pastoral tradition (shepherds and sedentary farmers).

Conclusion. *H. pylori* infection in Burkina Faso is acquired early in life and is related not only to some yet well-known risk factors (poor socio-economic and hygienic status), but also to a close contact with sheep. The gradually decreasing *H. pylori* seropositivity in adult population of Burkina Faso represents an unexplained enigma, which needs further studies.

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1. Introduction

H. pylori infects more than half of the World population and is a major cause of upper gastrointestinal disease such as gastritis, peptic ulcer and gastric cancer [1]. It is tough that the most common modes of transmission are oro-oral and faecal-oral, and the highest rates of *H. pylori* infection are associated with low socio-economic status, overcrowding and low levels of sanitation. Transmission from person

to person seems to be the most likely route [2], though in specific settings, transmission from zoonotic reservoirs has been recently proposed [3,4].

H. pylori infection is precociously acquired in both developed and developing countries with the difference that in developing countries children acquire the infection very early in life, while in developed countries it is acquired in older age (second and third decades), at a rate of less than 1% a year [2,5,6].

It is clearly established that *H. pylori* infection, unless specifically treated, is a persistent condition that proceeds slowly from chronic gastritis to peptic ulcer and, in a minority of subjects, from atrophic gastritis and intestinal meta-

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plasia to gastric cancer. However, an early life exposure to *H. pylori* appears critical for the development of gastric malignancy [1,2].

Despite the fact that several serological studies in different regions of Africa have shown a wide acquisition of *H. pylori* infection at an early age, the incidence of gastric cancer in this area is extremely low [7]. This finding is known as the 'African enigma', and it is not clear if in this area of the World gastric cancer is rare because of some environmental or genetic population's protective factors, or because *H. pylori* African strains are less malignant than the ones in other areas of the World [7,8].

Burkina Faso (formerly Upper Volta) is a country of West Africa, inside the Sudan–Guinea area, once a colony of French Africa, which gained independence in 1960. The people living in Burkina Faso belong to several ethnic groups (Mossi, Peuhul, Gurunsi, Bobo, etc.). Most of them are Mossi and reside in the hinterland of Ouagadougou, the capital of Burkina Faso. They constitute a very homogeneous population with respect to origin, childhood, socio-cultural and hygienic conditions, life-styles and food consumption. Mossi have a marked agro-pastoral tradition and they are mainly shepherds or sedentary farmers, living in small clay huts of rural villages or of city's suburbs. Their socio-economic status is low and their hygienic sanitary conditions are poor, with bad water supply and reduced living rooms. Consequently, they are at high risk for diseases transmitted by oro-oral and faecal–oral route.

In Burkina Faso, in contrast with precocious exposition to *H. pylori* infection and according to the 'African enigma', the incidences of *H. pylori* related peptic ulcer and gastric cancer appear rare [9]. In addition, today there are no data concerning the prevalence of *H. pylori* infection in Burkina Faso in different classes of age. These reasons have prompted us to look for the prevalence of *H. pylori* infection in healthy natives of Burkina Faso, both children and adults.

2. Material and methods

We performed a cross-sectional study on 258 black natives of Burkina Faso (70 children, 36 males and 34 females, aged 6 months–15 years, mean age 5.3 years and 188 adults, 101 males and 87 females, aged 16–65 years, mean age 37.5 years). They were screened at random from a population of 2600 healthy individuals visiting the St. Camille of Ouagadougou Medical Centre in Burkina Faso, for a medical check-up. None suffered dyspeptic symptoms (vomiting, regurgitation, epigastric pain, hematemesis, etc.) or had signs suggestive of upper gastrointestinal disease.

All the studied subjects provided a blood sample, and sera were collected, frozen at -80°C and carried by one of us (S.M.) to a single centre (Department of Paediatrics, Palermo) where the analysis for *H. pylori* antibodies (IgA and IgG) was carried out. Two commercially available ELISA kits (*H. pylori* IgA and *H. pylori* IgG, EQUIPAR,

Saronno, Italy) were used, according to the manufacturer's instructions. The kits had been validated in children and adult Burkina Faso healthy population, showing a sensitivity of >98% and a specificity of >97%. Sensitivity and specificity were calculated on a panel of negative and positive samples according to the Federal Drug Administration (FDA). Results were expressed in ELISA units/ml. A serum sample was considered positive for *H. pylori* infection if had values >20 U/ml, both for IgA and IgG antibodies.

A detailed questionnaire regarding socio-economic status, hygienic sanitary conditions, life-styles and dietary habits was specifically prepared. All the studied subjects, and in the case of children, their parents, underwent this questionnaire under the supervision of a physician. The following conditions were requested: anagraphic data (age, gender), socio-economic status (parents' occupation, daily and direct contact of the family members with sheep), hygienic sanitary conditions (place, kind and wideness of the residence, number of persons in the household, water supply), life-styles and dietary habits (custom of the mothers to pre-chew the foods of their sons, bed-sharing of mothers with their children and habit of the children to share plates with other family members during the meals). Data concerning the questionnaire were compared between *H. pylori* seropositive and seronegative subjects.

The χ^2 -test with Yates correction or the Fisher's exact test were used for statistical analyses. *P* values were calculated using the two-tailed test and the significance was measured at the $P < 0.05$ level.

Informed consent was obtained from all subjects or their parents, and the study was approved by the Ethics Committee of the St. Camille Medical Centre.

3. Results

Fig. 1 shows the prevalence of seropositivity (only IgA positivity, only IgG positivity, IgA plus IgG positivity and overall positivity) for *H. pylori* infection, both in children and in adults. Children had rates of *H. pylori* positivity (only IgG, IgA plus IgG and overall positivity) significantly higher than adults.

Fig. 2 shows the overall *H. pylori* positivity, stratified among children into four groups of 4 years since 0.5–15 years, and among adults into five groups of 10 years since 16–65 years. It increased precociously in young children and was high during childhood, but gradually declined in adults with increasing age.

Regarding the comparison of the questionnaire's data between *H. pylori* seropositive and seronegative subjects (overall seropositivity, both in children and in adults), the rates of poor hygienic status, of life-styles (residences, water supply, sharing mother's bed) and of dietary habits (mother's pre-chew food, sharing plates during meals) were similar in both groups (Table 1). Instead, the rates of subjects belonging to families in daily and direct contact with sheep,

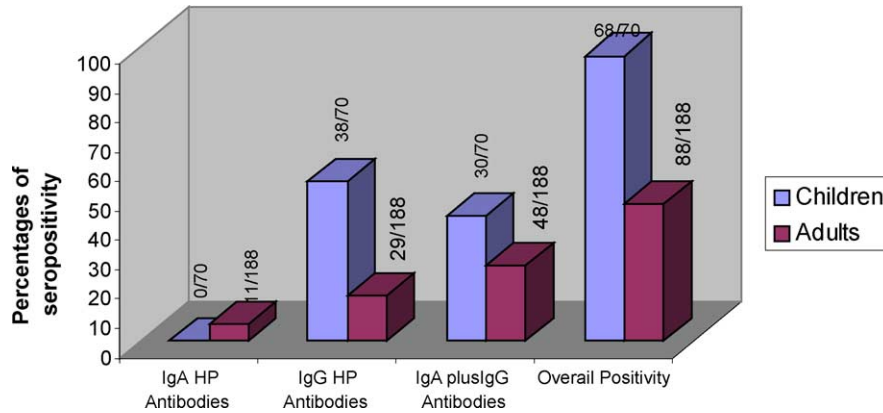


Fig. 1. Prevalence of seropositivity for *H. pylori* infection in children and adults. Children vs. adults: only IgG positivity, $2P < 0.0001$; IgA plus IgG positivity, $2P < 0.001$; overall positivity, $2P < 0.0001$.

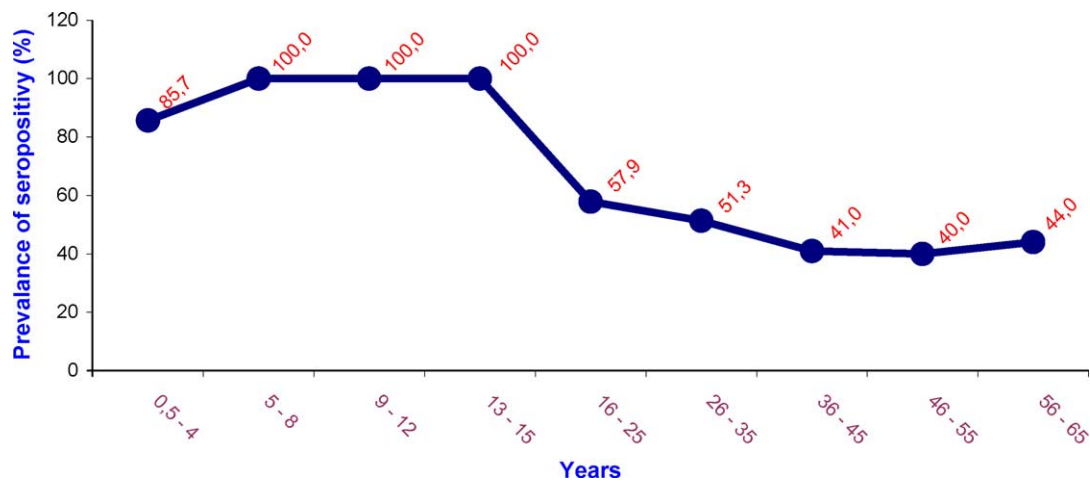


Fig. 2. Overall prevalence of *H. pylori* seropositivity according to the age (χ^2 for trend: 45; $P < 0.0001$).

because of their occupation and their agro-pastoral tradition (shepherds and sedentary farmers), were significantly ($2P < 0.0001$) higher in *H. pylori* positive individuals (150/156, 96.1%) than in *H. pylori* negative subjects (30/29, 4%).

Table 1
Questionnaire’s data concerning residence, water supply, life styles and dietary habits in *H. pylori* seropositive and seronegative subjects (both children and adults)

	Overall <i>H. pylori</i> seropositive subjects	<i>H. pylori</i> seronegative subjects
Residence in huts of rural village	71/156 (45.5%)	49/102 (48%)
Residence in huts of city’s suburbs	79/156 (50.6%)	48/102 (47%)
Restricted and crowded residences	150/156 (96.1%)	97/102 (95%)
Poor water supply	156/156 (100%)	102/102 (100%)
Mother’s pre-chew foods	143/156 (91.6%)	94/102 (92.1%)
Sharing mother’s bed	152/156 (97.4%)	100/102 (98%)
Sharing plates during meals	153/156 (98.1%)	100/102 (98%)

No significant differences were observed between seropositive and seronegative subjects.

4. Discussion

Our study shows that in Burkina Faso *H. pylori* infection is frequent and widespread since early childhood. This is in accordance with previous serological studies in other countries of Africa, showing that in this continent *H. pylori* infection is early and ubiquitous [6–9].

In *H. pylori* infection, the route of transmission seems to be direct from person to person, while its prevalence is related to poor social and hygienic status [1,2]. This might well be the case of our studied subjects because most of them, both children and adults, lived in rural villages or in city suburbs with reduced and crowded rooms and poor water supply.

In Burkina Faso the rates of *H. pylori* infection in adults were lower than in children, and this finding cannot explain a direct transmission of *H. pylori* infection from adults to children. In this regard, previous serological studies have shown a higher prevalence of antibodies against *H. pylori* in some professions (abattoir workers, shepherds, veterinaries) of direct contact with *H. pylori* infected animals [4,10–13]. In addition, raised rates of *H. pylori* infection have been observed among Columbian [14] and Sardinian [15] children

living, as our analysed subjects, in close contact with sheep and sheep-dogs. Finally, *H. pylori* has been isolated from intestinal tract of dogs, cats and sheep [16–18] or from their faeces [3], and it has also been cultured in fresh sheep-milk, where it can survive for several days [19,20]. These data indicate a zoonotic reservoir of *H. pylori* and a possible transmission from animals to humans of *H. pylori*. So we suppose that in Burkina Faso the sheep might be a zoonotic reservoir of *H. pylori*, and that they might be an important source of infection for humans because almost all our *H. pylori* positive subjects were members of shepherds' and farmers' families, with an agro-pastoral tradition and living in close contact with sheep.

It is possible that in our study the *H. pylori* seropositivity might be due to a cross-reactivity with other enteric *Campylobacter* species (e.g. *Campylobacter jejuni*, *Campylobacter coli*, *Campylobacter fetus*), as they are common in developing countries. We have not excluded this cross-reactivity absorbing our studied sera with *H. pylori* or testing them for a specific antigen (*Cag A*), as performed in previous studies [4,11,13]. However, we suppose that the high sensitivity (>98%) and specificity (>97%) of the used tests likely exclude in our study a false cross-reaction.

The high and precocious rates of *H. pylori* infection in Burkina Faso should correspond to high levels of *H. pylori*-associated diseases (i.e. peptic ulcer and gastric cancer), but their prevalence in Burkina Faso, as in other African countries, is low [9,21]. This finding is similar to the one of some Asian countries (South China, India, Bangladesh, Thailand, Philippines), where the early exposition and the high prevalence of *H. pylori* infection since childhood does not lead to raised rates of gastric cancer [22].

So, *H. pylori* infection does not always directly correlate with peptic ulcer and gastric cancer. Instead, some risk factors seem to be implicated with the progression of *H. pylori* infection: genetic diversity of some more virulent *H. pylori* strains containing the cytotoxin-associated gene (*Cag A*) [21], racial differences concerning HLA genes, acid gastric secretion and polymorphism of pro-inflammatory cytokines, which may enhance or suppress inflammation of the gastrointestinal mucosa [23–25], and some dietary habits [26] (salted and smoked foods rich in nitrates are strongly associated with gastric cancer, whereas high consumption of fresh fruits, raw vegetables and alcoholic beverages reduce this risk).

In Burkina Faso, a partial explanation for the 'African enigma' can be offered by the traditional dietary habits during the adult age: high intake of vitamin C, carotenoids and anti-oxidant agents with large amounts of fresh fruit, vegetables and *dolo* (a slightly alcoholic typical beverage of Burkina Faso originated by millet and rich in tannin), which have a protective effect on the progression of the *H. pylori* infection [26,27]. However, further investigations are needed to clarify this issue.

In Burkina Faso, we did not observe an increase of the prevalence of *H. pylori* antibodies after childhood, but con-

versely, a progressive decrease of the seropositivity from young adulthood. This finding amounts to an 'enigma within an enigma', as the rates of *H. pylori* infection usually rise with the age of the population. This enigma within an enigma would not be an enigma if we accept the hypothesis that signs of *H. pylori* infection in these subjects disappear over-time due to the development of atrophic gastritis. In this regard, in South Africa, previous studies [7,8] demonstrated that *H. pylori* is common even at a young age and this leads to the development of atrophic gastritis in a considerable progression of infected subjects during adult life. Then, the real enigma is why there is no progression to peptic ulcer and gastric cancer.

Several mechanisms could determine a decrease of the anti-*H. pylori* antibodies with age: (1) A genetic unknown constitution of some populations might lead over the years to a reduction in the immune response to *H. pylori* infection. (2) Genetic diversity of *H. pylori* strains in Burkina Faso that transform their helical bacillary morphology to coccoid forms, which are accompanied by consistent reduction in antigenicity and virulence [28,29]. (3) The presence of some environmental conditions; the usual diet of native adults of Burkina Faso includes great amounts of millet and sorghum, which favour the conversion of *H. pylori* strains in coccoid forms, with a reduction of their antigenic power [29]. (4) The development of atrophic gastritis as a consequence of precocious exposition to *H. pylori* infection, with increased levels of gastrin and pepsinogen. However, our findings require further confirmations and explanations, while the above hypothesis only reflect the multifactorial pathogenesis of the *H. pylori* infection.

In conclusion, *H. pylori* infection in Burkina Faso occurs frequently in childhood and the routes of infection appear to be linked not only to some well-known risk factors (poor socio-economic and hygienic status), but also to peculiar living and working habits (close contact with sheep), which suggest a zoonotic transmission. According to the 'African enigma' the incidence of *H. pylori* associated diseases is low in natives of Burkina Faso. A partial explanation of this finding might be the protective effect of the traditional dietary habits in Burkina Faso, which have an inhibitory effect on the progression of *H. pylori* infection. The progressive decrease of *H. pylori* seropositivity in adults of Burkina Faso represents a second unexplained enigma, namely 'an enigma within an enigma', which needs further studies.

Conflict of interest statement

None declared.

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References

- [1] Sipponen P. Natural course of *Helicobacter pylori* gastric infection. Ital J Gastroenterol 1998;30(Suppl 3):S264–9.
- [2] Imrie C, Rowland M, Bourke B, Drumm B. Is *Helicobacter pylori* infection in childhood a risk factor for gastric cancer? Pediatrics 2001;107:373–80.
- [3] Dore MP, Vaira D. Sheep rearing and *Helicobacter pylori* infection—an epidemiological model of anthroozoonosis. Dig Liver Dis 2003;35:7–9.
- [4] Papiiez D, Konturek PC, Bielanski W, Plonka M, Dobrzanska M, Kaminska A, et al. Prevalence of *Helicobacter pylori* infection in Polish shepherds and their families. Dig Liver Dis 2003;35: 10–5.
- [5] Poddar U, Thapa BR. *Helicobacter pylori* infection in children. Indian Pediatr 2000;37:275–83.
- [6] Segal J, Ally R, Mitchell H. *Helicobacter pylori*—a African perspective. Q J Med 2001;94:561–5.
- [7] Kuipers EJ, Meijer GA. *Helicobacter pylori* gastritis in Africa. Eur J Gastroenterol Hepatol 2000;12:601–3.
- [8] Kidd M, Louw JA, Marks IN. *Helicobacter pylori* in Africa: observation on an enigma within an enigma. J Gastroenterol Hepatol 1999;14:851–8.
- [9] Ilboudo D, Bougouma A, Zombie R, Diomande I. *Helicobacter pylori* infection in children in the tropical zone endoscopic and histological aspects. Gastroenterol Clin Biol 1998;22:855–7.
- [10] Vaira D, D'Anastasio C, Holton J, Dowsett JF, Londei M, Bretoni F, et al. *Campylobacter pylori* in abattoir workers: is it a zoonosis? Lancet 1988;2:725–6.
- [11] Husson MO, Vincent P, Grabiand MH, Furon D, Leclerc H. Anti-*Helicobacter pylori* IgG levels in abattoir workers. Gastroenterol Clin Biol 1991;15:723–6.
- [12] Morris A, Nicholson G, Liloyd G, Haines D, Rogers A, Taylor D. Seroepidemiology of *Campylobacter pyloridis*. N Z Med J 1986;99:657–9.
- [13] Dore MP, Bilotta M, Vaira D, Manca A, Massarelli G, Leandro G, et al. High prevalence of *Helicobacter pylori* infection in shepherds. Dig Dis Sci 1999;44:1161–4.
- [14] Goodman KJ, Correa P, Tangana Aux HJ, Ramirez H, De Lany JP, Guerrero Pepinosa O. *Helicobacter pylori* infection in the Colombian Andes: a population-based study of transmission pathways. Am J Epidemiol 1996;144:290–9.
- [15] Dore MP, Malaty HM, Fanciulli G, Bilotta M, Mura I, Realdi G. Acquisition of *Helicobacter pylori* infection in school children in Italy. Gastroenterology 1997;112:A105.
- [16] Dore MP, Sepulveda AR, El-Zimaity H, Yamaoka Y, Osato MS, Mototsugu K, et al. Isolation of *Helicobacter pylori* from sheep. Implications for transmission to humans. Am J Gastroenterol 2001;96:1341–96.
- [17] Fox JG. Non human reservoirs of *Helicobacter pylori*. Pharmacol Ther 1995;9(Suppl):93–103.
- [18] Thomson MA, Storey P, Greer R, Cleghorn GJ. Canine–human transmission of *Gastrospirillum hominis*. Lancet 1994;344:1037–8.
- [19] Dore MP, Sepulveda AR, Osato MS, Realdi G, Graham DY. *Helicobacter pylori* in sheep milk. Lancet 1999;354:132.
- [20] Karim QN, Maxwell RH. Survival of *Campylobacter pylori* in artificially contaminated milk. J Clin Pathol 1989;42:778.
- [21] Bravo LE, Van Doorn LJ, Reaple JL, Correa P. Virulence associated genotypes of *Helicobacter pylori*: do they explain the African enigma? Am J Gastroenterol 2002;97:2839–42.
- [22] Miwa H, Go Mae F, Sato N. *Helicobacter pylori* and gastric cancer: an Asian enigma. Am J Gastroenterol 2002;97:1106–12.
- [23] Bamford KB, Fan XJ, Crowe SE, Courley WK, Luthra GK, Brooks EG, et al. Lymphocytes in the human gastric mucosa during *Helicobacter pylori* have a cell 1 phenotype. Gastroenterology 1998;114:482–92.
- [24] Matsukura N, Yamada S, Kato S, Tomtitchong P, Tajiri T, Miki M, et al. Genetic differences in interleukin-1betapolymorphisms among four Asian populations: an analysis of the Asian paradox between *H. pylori* infection and gastric cancer incidence. J Exp Clin Cancer Res 2003;22:47–55.
- [25] Ohtani M, Azuma T, Yamazaki S, Yamakawa A, Ito Y, Maramutsu A, et al. Association of the HLA-DRB1 gene locus with gastric adenocarcinoma in Japan. Dig Liver Dis 2003;35:468–72.
- [26] Palli D. Epidemiology of gastric cancer: an evaluation of available evidence. J Gastroenterol 2000;35(Suppl):84–9.
- [27] Stermer E. Alcohol consumption and the gastrointestinal tract. Ist Med Assoc J 2002;4:200–2.
- [28] Kusters JG, Gerrits MM, Van Strijp JAG, Vandenbroucke-Grauls MJE. Coccoid forms of *Helicobacter pylori* are the morphological manifestation of cell death. Infect Immun 1997;65:3672–9.
- [29] Nakamura A, Park A, Nagata K, Sato EF, Kashiba M, Tamura T, et al. Oxidative cellular damage associated with transformation of *Helicobacter pylori* from a bacillary to a coccoid form. Free Radic Biol Med 2000;28:1611–8.