Dietary and socio-economic factors in relation to *Helicobacter pylori* re-infection

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**Abstract**

**AIM:** To examine if dietary and socio-economic factors contribute to *Helicobacter pylori* (*H pylori*) re-infection.

**METHODS:** The population of patients consisted of subjects in whom *H pylori* infection had been successfully treated in the past. Patients were divided into two groups: I -examined group (111 persons with *H pylori* re-infection) and II -control group (175 persons who had not been re-infected). The respondents were interviewed retrospectively on their dietary habits and socio-economic factors.

**RESULTS:** A statistically significant lower frequency of fermented dairy products (*P* < 0.0001), vegetables (*P* = 0.02), and fruit (*P* = 0.008) consumption was noted among patients with *H pylori* re-infection as compared to those who had not been re-infected.

**CONCLUSION:** High dietary intake of probiotic bacteria, mainly *Lactobacillus*, and antioxidants, mainly vitamin C (contained in fruit and vegetables), might decrease the risk of *H pylori* re-infection.

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socio-economic factors may contribute to the \textit{H pylori} re-infection.

The aim of this study was to evaluate whether there are differences in dietary habits and lifestyle between subjects after effective eradication who were re-infected and patients who were not re-infected.

**MATERIALS AND METHODS**

The study was carried out in 2002-2007 in a group of patients from the Provincial Gastroenterological Clinic of the Brodnowski Hospital in Warsaw who had ulcer disease or functional dyspepsia, and had been referred for endoscopic examination of the upper digestive tract. All the patients had been successfully treated for \textit{H pylori} infection in the past and successful eradication after at least 6 wk after completion of the treatment was confirmed. The effectiveness of treatment was diagnosed by histology and a urease test (both negative) or urea breath test. Patients with neoplastic diseases were not included, along with persons with no confirmed eradication by the above mentioned methods and those who did not agree to take part in the research.

Patients were divided into two groups by \textit{H pylori} status. One hundred and eleven patients were classified in group I (examined); persons with \textit{H pylori} re-infection, and 175 patients were included in group II (control): persons not re-infected. The period following \textit{H pylori} eradication ranged from 3 to 8 years. The mean time after the eradication treatment was similar for both groups: 5.2 years for group I and 5.6 years for group II.

Characteristics of both groups are presented in Table 1. Group I consisted of 47 women and 64 men aged 24-88. The control group included more women (\(n = 103\)) than men (\(n = 72\)). The range of age of the patients in this group was from 17 to 87 years old. No statistically significant differences between mean age and mean BMI between the groups were observed.

The status of \textit{H pylori} was evaluated using the histological method and urease test (both positive) or urea breath test.

For all patients, a BMI value was calculated. An interview on dietary habits and socio-economic factors was performed by a dietician. The patients were interviewed retrospectively. A specially designed questionnaire was used. The first part of the questionnaire contained questions regarding the usual dietary habits during last year, while the second part referred to selected features relating to the patients’ lifestyle. The questionnaire contained questions providing information, inter alia, on the applied diet, amounts, regularity and type of meals, frequency of consumption of products from various food groups, with particular attention paid to dairy products and fat, as well as salty products and dishes, along with additional salting. Consumption of products and dishes at least once a week was regarded as frequent. For some products and dishes, the analysis covered moderate consumption with moderate frequency, i.e. twice to four times a week, and rare consumption, i.e. once a week or more seldom. For other products and dishes consumption frequency of up to four times a week was regarded rare. The second part of the questionnaire contained questions referring to the patients’ job and additional employment, stress exposure and smoking. Among the examined factors only those that had an impact on the occurrence of \textit{H pylori} infection were selected and discussed. In the statistical analysis of the differences between studied groups, a \(\chi^2\) test was applied, assuming differences of statistical significance for \(P < 0.05\).

**RESULTS**

Dietary factors that are likely to have an impact on \textit{H pylori} infection are presented in Table 2.

Most of the dietary factors analysed in both groups showed no significant differences. Both the patients who had been re-infected and patients from the control group said they ate meals regularly.

Statistically significant differences were noted in case of the frequency of eating dairy products (\(P < 0.0001\)). The percentage of persons who often ate dairy products among patients with \textit{H pylori} re-infection was much lower (41\%) than in the control group (89\%), and a higher proportion of the re-infected patients (32\%) admitted to eating dairy products rarely, while in the control group this percentage was much lower (6\%). A significant difference was also observed in the case of fermented milk drinks (\(P < 0.0001\)). Less than half (43\%) of the re-infected patients consumed these products frequently, while among non-infected persons almost all (95\%) did.

Most patients from both groups ate vegetables frequently (74\% in the group re-infected and 87\% in the control group); but, the differences in the frequency of the consumption of these products were statistically significant (\(P = 0.02\)). The frequency of fruit consumption also showed differences; frequent consumption of these products was declared by fewer persons re-infected (58\%) in comparison to the patients who were not re-infected (76\%) (\(P = 0.008\)).

Selected aspects relating to the lifestyle of examined patients are presented in Table 3.

Patients with \textit{H pylori} re-infection did not vary significantly from the control group in terms of the analysed lifestyle factors. Most of the patients did not work professionally, but declared frequent tiredness and high stress exposure. In both groups, the majority did not smoke.

![Table 1 Characteristics of the examined groups](www.wjgnet.com)

| Group | \(\text{HP (+)}\) | \(\text{HP (-)}\) |
|-------|------------------|------------------|
| \(n\)  | Mean ± Range     | Mean ± Range     |
| Age (yr) |          |          |
| Women | 47   | 63 ± 24-88 | 72   | 54 ± 18-80 |
| Men   | 64   | 57 ± 27-79 | 72   | 54 ± 18-80 |
| Total | 111  | 60 ± 24-88 | 175  | 58 ± 17-87 |
| BMI   | Women | 47   | 24.8 ± 16.3-32.5 | 72   | 24.9 ± 16.2-39.7 |
|       | Men   | 64   | 26.1 ± 15.5-36.1 | 72   | 24.9 ± 16.2-39.7 |
| Total | 111  | 25.5 ± 15.5-36.1 | 175  | 24.9 ± 15.5-36.1 |
Table 2 Comparison of selected dietary factors in the examined groups n (%) | Table 3 Comparison of selected lifestyle factors in examined groups n (%)

| Factors | Responses | Group I HP (+) n = 111 | Group II HP (-) n = 175 | Statistical significance (P) | Factors | Responses | Group I HP (+) n = 111 | Group II HP (-) n = 175 |
|---------|-----------|-------------------------|-------------------------|-----------------------------|---------|-----------|-------------------------|-------------------------|
| Regularity of eating meals (3-5) | Yes | 55 (52) | 97 (56) | NS | Working | Yes | 28 (25) | 39 (23) |
| | No | 51 (48) | 76 (44) | | | No | 83 (75) | 134 (77) |
| Meals prepared on their own | Yes | 53 (48) | 105 (60) | 0.02 | Working overtime | Yes | 18 (78) | 22 (60) |
| | Sometimes | 18 (16) | 33 (19) | | or on weekends | Sometimes | 1 (4) | 3 (8) |
| | No | 40 (36) | 37 (21) | | | No | 4 (18) | 12 (32) |
| Adding fat to stewed, fried and baked dishes | Yes | 75 (68) | 133 (77) | NS | Additional work | Yes | 6 (8) | 8 (7) |
| | Sometimes | 3 (2) | 1 (1) | | outside the main job | No | 65 (92) | 110 (93) |
| | No | 33 (30) | 38 (22) | | Feeling tired | Very often | 58 (53) | 96 (55) |
| Adding fat to dressing | Yes | 67 (61) | 121 (69) | NS | Rather often | 16 (14) | 27 (16) |
| | Sometimes | 3 (3) | 2 (2) | | Rather rarely | 26 (24) | 40 (23) |
| | No | 39 (36) | 51 (29) | | Hardly ever | 10 (9) | 11 (6) |
| Using fats to spread on bread | Yes | 94 (85) | 157 (90) | NS | Self-assessed stress exposure | Rather often | 15 (13) | 27 (16) |
| | Sometimes | 2 (2) | 5 (3) | | Rather rarely | 37 (34) | 42 (24) |
| | No | 15 (13) | 13 (7) | | Hardy ever | 11 (10) | 15 (9) |
| Eating dairy products | Frequently | 45 (41) | 154 (89) | < 0.0001 | Smoking | Yes | 36 (32) | 54 (31) |
| | With moderate frequency | 30 (27) | 9 (5) | | No | 75 (68) | 120 (69) |
| Eating fermented milk drinks (yoghurts, kefirs) | Rarely | 36 (32) | 11 (6) | | | | | |
| Eating meat products and dishes | Frequently | 82 (75) | 120 (69) | NS | | | | |
| | With moderate frequency | 19 (17) | 40 (23) | | | | | |
| Types of meat products and dishes eaten | Rarely | 8 (7) | 14 (8) | | | | | |
| | Fatty | 3 (3) | 2 (1) | NS | | | | |
| | Medium-fatty | 8 (8) | 5 (5) | | | | | |
| | Lean | 63 (60) | 110 (66) | | | | | |
| | Varying | 30 (29) | 50 (30) | | | | | |
| Eating fish | Frequently | 31 (28) | 53 (30) | NS | | | | |
| | With moderate frequency | 33 (30) | 58 (33) | | | | | |
| | Rarely | 47 (42) | 64 (37) | | | | | |
| Eating vegetables | Frequently | 82 (74) | 152 (87) | 0.02 | | | | |
| | With moderate frequency | 21 (19) | 17 (10) | | | | | |
| Eating fruit | Rarely | 8 (7) | 6 (3) | | | | | |
| | Frequently | 65 (38) | 133 (76) | 0.008 | | | | |
| | With moderate frequency | 24 (22) | 23 (13) | | | | | |
| Eating sweets | Rarely | 22 (20) | 19 (11) | | | | | |
| | Frequently | 26 (24) | 47 (27) | NS | | | | |
| | With moderate frequency | 28 (25) | 46 (26) | | | | | |
| Sweetening of drinks (coffee, tea) | Rarely | 57 (51) | 82 (47) | | | | | |
| | Sometimes | 79 (71) | 113 (66) | NS | | | | |
| Alcoholic drinks consumption | Rarely | 30 (27) | 55 (31) | | | | | |
| | Frequently | 14 (13) | 9 (5) | NS | | | | |
| | With moderate frequency | 18 (16) | 29 (17) | | | | | |
| Eating salty dishes | Rarely | 79 (71) | 136 (78) | | | | | |
| | Yes | 35 (32) | 52 (30) | NS | | | | |
| | Sometimes | 15 (13) | 20 (11) | | | | | |
| Additional salting of products and dishes eaten | Yes | 21 (20) | 39 (24) | NS | | | | |
| | Sometimes | 7 (6) | 9 (6) | | | | | |
| | No | 79 (74) | 113 (70) | | | | | |

1Number of persons changed between 23-111 persons in group I and 37-175 persons in group II, which results from the fact that some patients did not provide an answer to some questions; NS-value statistically insignificant.

DISCUSSION

The question of how to lower the risk of H pylori re-infection is very important. This bacterium is the main cause of peptic ulcer disease (70%-90% of cases) and in 1% of infected persons, this leads to the development of gastric cancer.[25] Moreover, the treatment of H pylori is difficult, requires a two-week application of at least three medicines (proton pump inhibitors and two antibiotics) simultaneously, proves successful in only 80%-90% of cases and is connected with the risk of adverse effects of therapy with antibiotics (15%-30% of the treated).[26,27] In some patients, H pylori re-infection occurs after eradication; but, factors responsible for this phenomenon have not yet been identified. It is presumed that these may be at least partly related to poor sanitary conditions and improper lifestyle, especially diet.[12,26,29]

In the present research, the dietary and some socioeconomic factors after successful eradication of H pylori infection were evaluated. The goal of this retrospective study was to point out potential differences in the dietary patterns of patients with H pylori re-infection (group I) and in the control not-re-infected group (group II).

We showed a significant difference in the frequency of consumption of fermented dairy products containing probiotic bacteria, mainly Lactobacillus, between the group with H pylori re-infection and the group without re-infection. This indicates that regular consumption of products containing probiotic bacteria might reduce the risk of H pylori re-infection.

There is some evidence from in vitro and clinical research that can support this hypothesis. Numerous probiotic strains inhibit the growth or adhesion of H pylori to epithelium cells in in vitro conditions. In
Studies on animals infected with H. pylori, it was also observed that probiotic bacteria lowered the intensity of inflammatory conditions in the stomach mucosa. Michetti et al.\(^\text{[15]}\) showed that the supernatant of Lactobacillus johnsonii L1 strain inhibited the growth of H. pylori bacteria whether or not they were connected with epithelial cells. The supernatant was administered for 14 d to 20 volunteers infected with H. pylori in a double-blind randomised study. The results of urea breath tests at the beginning and in the 6th week after the completion of the treatment were significantly lower than the initial results, which is most probably related to lowering the density of H. pylori colonies. In a biopsy taken from the mucosa of the stomach, H. pylori infection was still present\(^\text{[13]}\).

Aiba et al.\(^\text{[31]}\) showed that L. salivarius inhibited the growth of H. pylori in vitro, and, in an animal model, reduced the inflammatory process in the mucosa of infected mice. No such phenomena were observed in the case of L. casei and L. acidophilus.

Cocqennier et al.\(^\text{[16]}\) observed that supernatant from the L. acidophilus LB culture contains anti-bacterial substances produced by this strain, which reduced the viability of H. pylori bacteria and inhibited its adhesion to human cells in vitro and in vivo. Sgouras et al.\(^\text{[31]}\) used L. casei Shirota cells in vitro and in vivo and noted that the cells (not the supernatant) lowered the activity of H. pylori urease. In research carried out on mice, after the application of the above strain, the density of H. pylori colonies decreased, along with the intensity of the inflammation of the mucosa of the stomach\(^\text{[31]}\).

Similar results were obtained in animal; for example, the density of colonisation of stomach mucosa by H. pylori became lower, and inflammatory changes became smaller, after the administration of L. rhamnosus, L. acidophilus and L. gasseri\(^\text{[22,23]}\). Kabir et al.\(^\text{[19]}\) stated that administration of L. salivarius to mice infected with H. pylori decreased the adhesion of pathogens to stomach mucosa cells.

So far, clinical tests have not been able to prove that use of probiotics leads to H. pylori eradication\(^\text{[35,36]}\). Wendakoon et al.\(^\text{[37]}\) made an attempt to prove it in their study of patients with asymptomatic H. pylori infection. The patients were given L. acidophilus and L. casei strains for 30 d, which inhibited H. pylori growth in vitro; but, no eradication in any of the patients was observed.

Several clinical surveys showed that some strains of probiotic bacteria might increase the effectiveness of H. pylori eradication. Canducci et al.\(^\text{[8]}\) noted higher H. pylori eradication rate in patients who, in addition to triple therapy based on rabeprazole, clarithromycin and amoxicillin, were given a lyophilised and inactivated culture of Lactobacillus acidophilus. In a study by Sýkora et al.\(^\text{[49]}\) H. pylori-positive children received the control treatment of omeprazole, amoxicillin and clarithromycin or the treatment consisted of the same antibiotics supplemented with fermented milk (trade name-Actimel) containing L. casei DN-114 001. Eradication success was significantly higher in the test group compared with the control group.

Application of probiotics during H. pylori treatment might not only increase the eradication rate, but it might also decrease the adverse effects of antibiotic therapy. Park et al.\(^{[45]}\) showed that supplements containing probiotic bacteria strains, composed of Bacillus subtilis and Streptococcus faecium, enhanced the intention-to-treat eradication rate of H. pylori, improved drug compliance and reduced side effects. Diarrhoea and overall side effects were more common in the group treated with antibiotics only in comparison to the group treated with antibiotics plus probiotics. De Bortoli et al.\(^{[46]}\) examined whether adding bovine lactoferrin and probiotics to the standard triple therapy for H. pylori infection could improve the eradication rate and reduce side effects. The eradication rate was higher in more patients who underwent standard triple eradication therapy plus bovine lactoferrin and probiotics than in those who underwent standard therapy only. Moreover, fewer patients taking probiotics reported side effects. Improvement of the results of eradication therapy followed by the application of probiotics was also noted in Polish studies covering children with dyspeptic symptoms and confirmed H. pylori infection\(^\text{[42]}\). In the group of children who were given probiotics (L. acidophilus and L. rhamnosus) in addition to standard therapy, not only was significantly higher eradication effectiveness demonstrated, but also a lower intensity of inflammation of the mucosa of the stomach and a lower rate of adverse effects of the therapy were noted.

The results of some studies do not confirm the positive impact of the use of probiotics on the eradication treatment ratio. No difference in eradication rate was observed in H. pylori-positive patients receiving L. reuteri and a placebo\(^\text{[15]}\). Also Goldman et al.\(^\text{[40]}\), in their study of children in Buenos Aires, found no significant differences in H. pylori eradication rates between the group treated with triple therapy plus probiotic food (yogurt containing Bifidobacterium animalis and Lactobacillus casei) and the control group.

Although not all papers confirm the improvement of treatment results for H. pylori infection upon simultaneous treatment with antibiotics and probiotics, the meta-analysis performed by Tong et al.\(^\text{[39]}\), covering 14 randomized trials, suggests that supplementation with probiotics could be effective in increasing eradication rates of anti-H. pylori therapy, and could be considered helpful for patients with previous eradication failure. Pooled H. pylori eradication rates were 83.6% and 74.8% for patients with or without probiotics by intention-to-treat analysis. Furthermore, probiotics showed a positive impact on H. pylori therapy-related side effects. The occurrence of total side effects was 24.7% and 38.5% for groups with or without probiotics.

Results found in most of the studies showed that the use of probiotics during eradication treatment was of benefit to patients. However, more large and well-designed studies of the use of probiotics in H. pylori eradication treatment are necessary, including comparative and dose-ranging trials\(^\text{[46]}\).

We also demonstrated a significantly higher
consumption of fruit and vegetables among persons who were not re-infected. This is probably related to the consumption of a higher number of anti-oxidants, especially vitamin C. Vitamin C, which is highly concentrated in stomach mucosa and gastric juice and probably lowers the risk of gastric cancer and influences the course of H pylori infection through a number of mechanisms. It has a positive impact on the stimulation and activity of granulocytes, macrophages and lymphocytes and the production of immunoglobulins. The direct inhibitory impact of this vitamin on the growth of H pylori is now being examined.

Jarosz et al. showed that four weeks treatment of H pylori infected patients with chronic gastritis with a high dose of vitamin C caused H pylori eradication in 50% of cases. In those patients, a highly significant rise in gastric juice total vitamin C concentration was demonstrated, which persisted for at least four weeks after treatment. However, the mechanism whereby vitamin C treatment results in H pylori eradication is unclear.

Ruiz et al. found a causal association between H pylori infection and low ascorbic acid levels in the gastric juice. Their findings supported two hypotheses that explain this phenomenon: increased oxidation and a decreased secretion of ascorbic acid.

The results obtained from the Third National Health and Nutrition Examination Survey showed that ascorbic acid might affect the risk of H pylori infection. In that survey, higher serum levels of ascorbic acid were associated with a decreased seroprevalence of H pylori and of the presence of pathogenic cagA-positive strain of H pylori.

The data of Park et al. demonstrated that vitamin C levels in whole blood, plasma, and gastric juice and the gastric juice pH in Korean children were closely related to the severity of H pylori infection and the histologic changes in the stomach. These data suggest that vitamin C may play a role in determining H pylori infection and its progression. Thus, vitamin C supplementation might be an important tool for the management of H pylori infection.

There were no differences between analysed lifestyle factors between patients with H pylori re-infection and the control group. However, the results of some surveys indicate the influence of socioeconomic status on H pylori infection. Authors of a Polish study in Lodz observed a much higher prevalence of H pylori infection in children from poor living conditions. In adults from Lublin, the H pylori infection was strongly affected by the lack of basic personal hygiene. In the Czech Republic, the highest risk of H pylori infection was found in children of mothers with basic or lower education, living in crowded accommodations, without access to running warm water, and residing in smaller towns. Low education and heavy smoking were most strongly associated with prevalence of H pylori infection in adults and adolescents. Smoking might also influence H pylori eradication rates. For example, a Colombian study in patients who smoked found that H pylori treatment was less effective. Whereas data from Turkey supported the finding that personal and environmental conditions in adults did not affect H pylori infectivity. Such factors as family income, living conditions, smoking, alcohol consumption and hygiene did not differ statistically between the H pylori positive and negative subjects. Smoking, alcohol consumption, number of children and pets in the household were also not associated with H pylori positivity among adolescents from Novosibirsk.

We studied only a few lifestyle factors without taking into account living conditions, personal hygiene and educational level that could influence H pylori re-infection. The lack of any relation between working, tiredness, stress exposure and H pylori re-infection could be caused by the fact that the majority of studied patients were retired. In our study, smoking did not influence of H pylori status, but not all surveys agree with our finding.

To summarise the results of some of the reviewed studies, the regular consumption of fermented milk products and fruit and vegetables might significantly reduce the risk of H pylori re-infection and this effect could be used in the prevention of the infection among persons in whom H pylori infection had been previously eradicated.

**COMMENTS**

**Background**

*Helicobacter pylori* (H pylori) infection is the main cause of peptic ulcer disease (70%-90% of cases) and in 1% of infected persons, leads to the development of gastric cancer. The treatment of H pylori infection is difficult and requires a two-week application of at least three medicines simultaneously. In some patients, H pylori re-infection occurs after eradication; but, factors responsible for this phenomenon have not yet been identified. It is presumed that these might be at least partly related to poor sanitary conditions and improper lifestyle, especially diet.

**Research frontiers**

H pylori re-infection affects ca. 1%-13% of patients annually; therefore, it is very important to find out how to lower the risk of H pylori re-infection. In this study, the dietary and some socio-economic factors after successful eradication of H pylori infection were evaluated. The goal of this retrospective study was to point out potential differences in the dietary patterns of patients with H pylori re-infection and in the control not-re-infected group.

**Innovations and breakthroughs**

The majority of the studies concerned the influence of dietary patterns on H pylori infection. The present research used a specially designed questionnaire to find out which factors lower the risk of H pylori re-infection.

**Applications**

The results suggest that the regular consumption of fermented milk products and fruit and vegetables might significantly reduce the risk of H pylori re-infection and this effect could be used in the prevention of re-infection among persons in whom the infection had been previously eradicated. The results could also be helpful in preparation of dietary guidelines for patients after H pylori eradication.

**Terminology**

Antioxidant: An antioxidant is a molecule (especially vitamins and microelements) capable of neutralizing free radicals which damage cells; Eradication: Eradication is the elimination or destruction of a thing or group (in this article it is bacteria-H pylori); Probiotics: Probiotics are live microorganisms which, when administered in adequate amounts, confer a health benefit on the host; Supersistant: Supersistant is a liquid remaining above the solid after chemical reaction.

**Peer review**

The main aspects of the paper are adequate. The discussion is complete and deals with different thoughts that are currently controversial. In summary, this is a good retrospective analysis of factors probably related with H pylori re-infection.
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