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Determinants of Socio-Demographic and Environmental Factors in Helicobacter Pylori Infection

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ABSTRACT

Background: Helicobacter pylori (H. pylori) infection ranks as one of most frequent human infections in the world. This study aimed to investigate the determinants of H. pylori infection in patients at Universitas Sebelas Maret Hospital.
Sebjects and Method: This was an analytic observational with a cross-sectional design. The study was conducted at Universitas Sebelas Maret Hospital, Sukoharjo, Central Java, from November to Desember 2023. A sample of 199 patients was selected for this study by fixed disease sampling. The dependent variable was H. pylori infection. The independent variables were number of household members, source of water, toilet type, education level, family income, eating habits, smoking status, region type, and waste disposal. The data were taken via surveys with questionairre. Multiple logistic regression was employed for data analysis.
Results: The risk of H. pylori infection increased with number of households member ≥5 (AOR= 4.52; 95% CI= 1.78 to 11.45; p = 0.001), water source from well (AOR= 3.74; 95% CI= 1.54 to 9.08; p = 0.003), habits of eating by bare hand (AOR= 4.71; 95% CI= 1.98 to 11.20; p= 0 < 0.001), smoking (AOR= 2.68; 95% CI= 1.11 to 6.49; p = 0.028), and living in urban area (AOR= 2.94; 95% CI= 1.10 to 7.80; p = 0.030). Meanwhile, it also decreased with having education level ≥ high school (AOR= 0.24; 95% CI= 0.10 to 0.57; p < 0.001), having family income ≥ 2,200,000 (AOR= 0.15; 95% CI= 0.06 to 0.37; p < 0.001), and implementing waste disposal system with collected by staff (AOR= 0.26; 95% CI= 0.10 to 0.65; p = 0.004).
Conclusion: The risk of H. pylori infection is determined by number of household members, source of water, education level, family income, eating habits, smoking status, region type, and waste disposal.

Keywords: determinants, environmental, helicobacter pylori, socio-demographic

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BACKGROUND

Helicobacter pylori (*H. pylori*) is a gram-negative pathogenic bacterium and its disease causes aggravation of the stomach tissues driving to gastric ulcer. In the event that not treated appropriately, it can result

in a deep rooted infection or predispose individuals to gastric cancer (Muzaheed, 2020). *H.pylori* is the major cause of chronic gastritis, peptic ulcers, and also closely associated with multiple extra-gastrointestinal diseases (Wong et al., 2004; Sugano et al., 2015; Malfertheiner et al., 2017; El-Serag et al., 2018)

H.pylori infects around 50% of the world's population (Zhou *et al.*, 2023). *H.pylori* infection is a public health problem with an estimated number of infections of around 4.4 billion cases worldwide in the last 10 years (Hooi *et al.*, 2017). *H. pylori* disease has been an developing issue in Indonesia with a prevalence of 22.1% (Syam *et al.*, 2015).

The evidence suggests that *H. pylori* has the potential to spread from one person to another. *H. pylori* is mostly spread through contact with infected oral or fecal matter, and through contaminated water. (Georgopoulos *et al.*, 1996; Parsonnet, Shmuely and Haggerty, 1999; Ding *et al.*, 2022) And also intrafamilial spread are common (Parsonnet, Shmuely and Haggerty, 1999; Rothenbacher *et al.*, 2002; Perry *et al.*, 2006). The presence of *H. pylori* in saliva, dental plaque (Al-Hawajri *et al.*, 2004), and feces (Parsonnet, Shmuely and Haggerty, 1999) indicated that person-to-person spreading is probably a major transmission mechanism of *H. pylori* infection.

Several factors are associated with the aggressiveness of *H. pylori* and consequently contribute to epithelial damage. This includes environmental and nutritional factors (Jenkins, 1997). Kotilea, Bontems and Touati, (2019) also explained that family socioeconomic status is the main risk factor for H.pylori infection in children. In addition, food and water sources have a high impact on the prevalence of *H. pylori* infection worldwide. Population socio-demography and personal hygiene have an impact on the prevalence of *H. pylori.* Some risk factors for H.pylori infection include overcrowding, unhealthy environment, and type of toilet facilities (Mnichil *et al.*, 2023). Although there were already numerous study that investigate the risk factors of *H. pylori* infection, in the context of environmental and dietary factors, the risk factors for *H. pylori* infection at the South Asia especially Indonesia are still not comprehensively investigated. Therefore, we conducted a cross-sectional study in Sukoharjo district, Indonesia with the objectives to examine the determinants of socio-demographic and environmental factors in *H. pylori* infection.

SUBJECTS AND METHOD

1. Study Design

This cross-sectional study was conducted at Universitas Sebelas Maret Hospital in Sukoharjo District on November-Desember 2023.

2. Population and Sample

The study population was all in or out patiens who had undergone an endoscopic examination with complaints of the upper digestive tract at Universitas Sebelas Maret Hospital in November-December 2023. Samples were taken based on inclusion and exclusion criteria. The sampling technique used was fixed disease sampling. A total of 199 patients were eligible and became the samples of this study.

The study subjects were included for the following reasons: (1) Patients aged between 12 to 60 years in November or December 2023, (2) Patiens who had undergone an endoscopic examination with complaints of the upper digestive tract at Universitas Sebelas Maret Hospital in November-December 2023, and (3) Patients with a conditions which enables for data collecting.

3. Study Variables

The dependent variable was H. pylory infection. The independent variables number of household members, source of water, toilet type, education level, family income, eating habits, smoking status, region type, and waste disposal.

4. Operational Definition of Variables

Number of household members was defined the entire number of household family members who live and eat from one kitchen.

Source of water was defined a water source is a place or container of natural and/or artificial water found on, above, or below the ground surface.

Toilet type was defined toilet or latrine can refer to household equipment whose main use is as a place to dispose of waste, namely urine and feces.

Education level was defined research subject's highest educational level at the time of interview.

Family income was defined income is money received by the family in the form of wages, salaries, rent, interest, commissions, fees and profits.

Eating habits was defined a way to take food from a plate or bowl and put it into the mouth.

Smoking status was defined an act of burning and smoking tobacco using paper or a pipe.

Region type was defined area where you live .

Waste disposal was defined method of disposing of unused solid or liquid substances/objects originating from the house or the remains of other activity processes.

5. Study Instruments

Data collection was carried out using primary data by conducting surveys via questionairre. Previously written informed consent was carried out after consent was Found.

6. Data analysis

The analysis was carried out with STATA software 17. We used descriptive analysis to determine the frequency distribution of research subjects based on sample characteristics. Bivariate analysis was performed using logistic regression. Multiple logistic regression was used in the multivariate analysis.

7. Research Ethics

Research ethical issues including informed consent, anonymity, and confidentiality, were addressed carefully during the study process. The research ethical clearance approval letter was obtained from the Research Ethics Committee at Dr. Moewardi Hospital, Surakarta, Indonesia, No. 2053/XI/HREC/2023, on November 20, 2023.

RESULTS

1. Sample Characteristics

In this study, Table 1 showed that the number of samples collected was 199 patients. Based on the characteristics, the majority of study subjects were having households members ≥5 people, 104 (52.26%). Based on the source of water distribution, it was found that the samples using pipe was the bigest with 115 people (57.79%). Most of the subjects were using flush toilet, with 150 respondents (75.38%). The majority of samples in this study have education level ≥ high school, with 106 respondents (53.27%). The majority of study subjects were having family income ≥ 2,200,000, 2 (51.26%).

Based on the eating habits distribution, it was found that the samples using spoon when eating was the bigest with 117 people (58.79%). The majority of samples in this study have education level ≥ high school, with 106 respondents

(53.27%). Majority of respondents are active smokers with 101 people (58.79%). Region type of urban was found to be the most common in this study with 104 respondents (52.26%). Most of the subjects were implementing waste disposal by burn or burying in pit, with 100 respondents (50.26%). Also, this study observed 110 infected with *H. pylory* (55.28%) of the total 199 included patients.

Table 1. Sample Characteristic

Characteristics	Category	Frequency	Percentage
Number of household members	< 5	95	47.74
	≥ 5	104	52.26
Source of water	Pipe	115	57.79
	Well	84	42.21
Toilet type	Pit toilet	49	24.62
	Flush toilet	150	75.38
Education level	< High school	93	46.73
	≥ High school	106	53.27
Family income	< 2,200,000	97	48.74
	≥ 2,200,000	102	51.26
Eating habits	With spoon	117	58.79
	With bare hands	82	41.21
Smoking status	No	101	58.79
	Yes	98	41.21
Region type	Urban	104	52.26
	Rural	95	47.74
Waste disposal	Burn or bury in pit	100	50.26
	Taken by staff	99	49.75
***H. pylori* infection**	No	110	55.28
	Yes	89	44.72

2. Bivariate Analysis

The bivariate analysis was conducted using logistic regression test with effect size of Odds Ratio (OR). Table 2 showed that respondents with number of households member ≥ 5 people had risk 3.71 times to having H. pylori infection than respondents with number of households member <5 people (OR= 1.31; 95% CI= 2.05 to 6.73; p < 0.001), and it was statistically significant. The respondents who have source of water from well had risk 3.71 times to having H. pylori infection than respondents who have source of water from pipe (OR= 4.96; 95% CI= 2.70 to 9.12; p < 0.001), and it was statistically significant. The respondents using flush type toilet had 1.23 times to having H. pylori infection than respondents using pit toilet (OR= 1.23; 95% CI= 0.64 to 2.37; p= 0.527), but it was not statistically significant.

Respondents with education level ≥ high school had risk 0.17 less to having H. pylori infection than respondents with education level < high school (OR= 0.17; 95% CI= 0.09 to 0.31; p < 0.001), and it was statistically significant. The respondents with family income ≥Rp.2,200,000 had risk 0.18 less to having H. pylori infection than respondents with family income <Rp 2,200,000 (OR= 0.18; 95% CI= 0.10 to 0.33; p<0.001), and it was statistically significant. The respondents with eating habits using bare hands had 4.11 times to having H. pylori infection than respondents with eating habits using spoon (OR= 4.11; 95% CI= 2.25 to 7.48; p <0.001), and it was statistically significant.

Smoking had risk 2.31 times to having H. pylori infection than not smoking (OR= 2.31; 95% CI= 1.30 to 4.09; p < 0.004), and it was statistically significant. Respondents who lived in urban region had risk 3.37 times to having *H. pylori* infection than respondents who lived in rural region (OR= 3.37; 95% CI= 1.88 to 6.05; p < 0.001), and it was statistically significant. The respondents who implemented waste disposal via collection by staff had 0.20 less chance of getting *H. pylori* infection than respondents who implemented waste disposal by burning or burying in the pit. (OR= 0.20; 95% CI= 0.11 to 0.38; p < 0.001), but it was statistically significant.

Table 2. Determinants of *H.* pylori Infection (an analysis by Logistic Regression)

Variable	Infeksi *H.*pylori				OR	CI 95%		p
	No %		Yes%			Lower limit	Upper limit	
Number of household members								
< 5	68	71.58	27	28.42	3.71	2.05	6.73	< 0.001
≥ 5	42	40.38	62	59.62				
Source of water								
Pipe	82	71.30	33	28.70	4.96	2.70	9.12	< 0.001
Well	28	33.33	56	66.67				
Toilet type								
Pit toilet	29	59.18	20	40.82	1.23	0.64	2.37	< 0.527
Flush toilet	81	54.00	69	46.00				
Education level								
< High school	31	33.33	62	66.67	0.17	0.09	0.31	< 0.001
≥ High school	79	74.53	27	25.47				
Family income								
< Rp.2,200,000	34	35.05	63	64.95	0.18	0.10	0.33	< 0.001
≥ Rp.2,200,000	76	74.51	26	25.49				
Eating habits								
With spoon	81	69.23	36	30.77	4.11	2.25	7.48	< 0.001
With bare hands	29	35.37	53	64.63				
Smoking status								
No	66	65.35	35	34.65	2.31	1.30	4.09	< 0.004
Yes	44	44.90	54	55.10				
Region type								
Urban	72	69.23	32	30.77	3.37	1.88	6.05	< 0.001
Rural	38	40.00	57	60.00				
Waste disposal								
Burn or bury in pit	37	37.00	63	63.00	0.20	0.11	0.8	< 0.001
Taken by staff	73	73.74	26	26.26				

3. Multivariate analysis

The multivariate analysis was conducted using multiple logistic regression test with effect size of Adjusted Odds Ratio (AOR). Table 3 showed that respondents with number of households member ≥ 5 people had risk 4.52 times to having H. pylori infection than respondents with number of households member <5 people (AOR= 4.52; 95% CI= 1.78 to 11.45; p = 0.001), and it was statistically significant. The respondents who have source of water from well had risk 3.74 times to having *H. pylori* infection than respondents who have source

of water from pipe (AOR= 3.74; 95% CI= 1.54 to 9.08; p= 0.003), and it was statistically significant. The respondents using flush type toilet had 0.79 less to having *H. pylori* infection than respondents using pit toilet (AOR= 0.79; 95% CI= 0.28 to 2.26; p= 0.670), but it was not statistically significant.

Respondents with education level ≥ high school had risk 0.24 less to having *H. pylori* infection than respondents with education level < high school (AOR= 0.24; 95% CI= 0.10 to 0.57; p < 0.001), and it was statistically significant. The respondents with family income ≥Rp 2,200,000 had risk 0.15 less to having *H. pylori* infection than respondents with family income < Rp 2,200,000 (AOR= 0.15; 95% CI= 0.06 to 0.37; p < 0.001), and it was statistically significant. The respondents with eating habits using bare hands had 4.71 times to having *H. pylori* infection than respondents with eating habits using spoon (AOR= 4.71; 95% CI= 1.98 to 11.2; p< 0.001), and it was statistically significant.

Smoking had risk 2.68 times to having *H. pylori* infection than not smoking (AOR= 2.68; 95% CI= 1.11 to 6.49; p= 0.028), and it was statistically significant. Respondents who lived in urban region had risk 2.94 times to having *H. pylori* infection than respondents who lived in rural region (AOR= 2.94; 95% CI= 1.10 to 7.80; p = 0.030), and it was statistically significant. The respondents who implemented waste disposal via collection by staff had 0.27 less chance of getting H. pylori infection than respondents who implemented waste disposal by burning or burying in the pit. (AOR= 0.26; 95% CI= 0.10 to 0.65; p = 0.004), but it was statistically significant.

Based on multivariate analysis, it can be concluded that the relationship between number of household members, source of water, education level, family income, eating habits, smoking status, region type, and waste disposal with H. pylori infection, and it was statistically significant. The results of analysis also found that the score of R^2 Nagelkerke was 46.98%, which mean that the eight independent variables namely number of household members, source of water, education level, family income, eating habits, smoking status, region type, and waste disposal could explain the variance of H. pylori infection by 46.98% and the rest 54.02% was explained by other factors.

Table 3. The result of multiple logistic regression analysis

Independent Variables	AOR	CI 95%		p
		Lower limit	Upper limit	
Number of household members ≥ 5	4.52	1.78	11.45	0.001
Source of water (well)	3.74	1.54	9.07	0.003
Flush toilet	0.79	0.28	2.26	0.670
Education level ≥ high school	0.24	0.10	0.57	0.001
Family income ≥ Rp.2,200,000	0.15	0.06	0.37	<0.001
Eating habits by bare hands	4.71	1.98	11.2	<0.001
Smoking status (yes)	2.68	1.11	6.49	0.028
Region type (urban)	2.94	1.10	7.80	0.030
Waste disposal (taken by staff)	0.26	0.10	0.65	0.004
N observation = 199				
-2 log likelihood = -72.55				
Negelkerke R^2 = 46.98%				

DISCUSSION

These study findings showed that respondents with number of households member ≥ 5 people had risk 4.52 times to having H. pylori infection than respondents with number of households member <5 people (AOR= 4.52; 95% CI= 1.78 to 11.45; p= 0.001), and it was statistically significant. These results are the same as the results obtained by Chen *et al.*, (2023) which stated that factors negatively associated with the prevalence of *H. pylori* infection included family size ≤ 3 (OR= 0.695, 95% CI:0.594 to 0.813, p < 0.001). Zhou *et al.*, (2022) also explained that one of the independent factors associated with *H. pylori* infection is a large family in one household (for example, a family of three: (OR 1.97, CI 95% = 1.76 to 2.21) This may be due to exposure to *H. pylori*-infected people suffering from gastroenteritis, especially vomiting, which can increase the risk of new infections.

The respondents who have source of water from well had risk 3.74 times to having *H. pylori* infection than respondents who have source of water from pipe (AOR= 3.74; 95% CI= 1.54 to 9.08; p = 0.003), and it was statistically significant. It was supported by Aziz, Khalifa and Sharaf (2015), which stated that there is a positive relationship between *H.pylori* infection and well water consumption. Syam *et al.*, (2015) also confirmed that the prevalence rate of *H.pylori* infection was much lower in people who used tap water as a source of drinking water compared to wells or rivers (OR=9.67, p = 0.030).

The respondents using flush type toilet had 0.79 less to having *H. pylori* infection than respondents using pit toilet (AOR= 0.79; 95% CI= 0.28 to 2.26; p= 0.670), but it was not statistically significant. This results probably due to the reason that the majority of the samples in this study used flush toilets, so further research is needed with population samples that do not use flush toilets to be able to compare between using flush toilets and not using them on the risk of *H.pylori* infection.

Respondents with education level ≥ high school had risk 0.24 less to having H. pylori infection than respondents with education level < high school (AOR= 0.24; 95% CI= 0.10 to 0.57; p < 0.001), and it was statistically significant. These results are similar as the results obtained by Shiferaw and Abera (2019) which states that low education level shows a statistically significant relationship with the prevalence of H. pylori infection. This relationship may be due to inadequate education or low levels of education having a significant impact on personal hygiene and environmental cleanliness and playing a major role in increasing the prevalence of *H.pylori* infection (Abebaw et al., 2014).

The respondents with family income ≥ Rp.2,200,000 had risk 0.15 less to having H. pylori infection than respondents with family income <Rp.2,200,000 (AOR= 0.15; 95% CI= 0.06 to 0.37; p < 0.001), and it was statistically significant. It was supported by Shiferaw and Abera (2019) which explained that H.pylori infection was significantly higher in low-income households. A large number of studies have proven that low socioeconomic status is a predictive factor for *H.pylori* infection, as it can lead to poor living environment and sanitation conditions (Kotilea, Bontems and Touati, 2019).

The respondents with eating habits using bare hands had 4.71 times to having *H. pylori* infection than respondents with eating habits using spoon (AOR= 4.71; 95% CI= 1.98 to 11.2; p<0.001), and it was statistically significant. Yisak, Belete and Mahtsentu, (2022) explained that Less

frequency of hand washing practices (aOR= 3.09; 95% CI= 1.14 to 8.34), was significantly associated with *H.pylori* infection. In this study, data on how to eat is emphasized on the perception that it is done more often or is preferred.

Smoking had risk 2.68 times to having *H. pylori* infection than not smoking (AOR= 2.68; 95% CI= 1.11 to 6.49; p= 0.028), and it was statistically significant. It was supported by Basílio *et al.*, (2018) which stated that smoking is a risk factor for H.pylori infection (OR: 4.0; 95% CI= 1.13 to 14.5; p=0.031). This may be because smoking causes an increase in gastric acidity and this may explain the negative association between smoking and H. pylori infection (Fletcher, Shulkes and Hardy, 1985).

Respondents who lived in urban region had risk 2.94 times to having H. pylori infection than respondents who lived in rural region (AOR= 2.94; 95% CI= 1.10 to 7.80; p = 0.030), and it was statistically significant. These results are the same as the results obtained by Miernyk *et al.*, (2018) which stated that there is a relationship between *H.pylori* infection and rural residence. It is possible that the availability of clean water for hygiene purposes contributes to transmission in rural communities.

The respondents who implemented waste disposal via collection by staff had 0.27 less chance of getting *H. pylori* infection than respondents who implemented waste disposal by burning or burying in the pit. (AOR= 0.26; 95% CI= 0.10 to 0.65; p = 0.004), but it was statistically significant. It was supported by Nisha *et al.*, (2016) which explained that the lack of good waste disposal facilities is known to increase the risk of H.pylori infection. *H.pylori* infection in drinking water is caused by poor sanitation conditions, improper waste disposal, and lack of public health education (Samra *et al.*, 2011).

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CONFLICT OF INTEREST

The authors declare that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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