

The Potential Impact of *Helicobacter Pylori* Infection on the Onset of Metabolic Disease

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Abstract

Background: *Helicobacter pylori* is a gram-negative, spiral-shaped, a pathogenic bacterium. Almost 50% of the world population is infected by this bacterium. Obesity, diabetes, and hypertension are multifactorial diseases that have also become a major public health problem of global significance and are found associated with several risk factors like *H. pylori* infection. It is also considered as a major risk factor in the onset of diseases such as obesity, diabetes, and hypertension.

Methodology: The study is designed to estimate the prevalence of *H. pylori* infections in the Rawalpindi region and to identify “the relationship between obesity, type-2 diabetes, hypertension, and *H. pylori*”. A cross-sectional study was conducted including 192 subjects from Rawalpindi, Pakistan”. Samples were obtained randomly from subjects for the detection of obesity, diabetes, hypertension, and *H. pylori* infection. Statistical analysis was done to establish associations of obesity, diabetes, and hypertension with *H. pylori* infection was assessed by various statistical tests using SPSS.

Results: The incidence of *H. pylori* infection was 44% in the sample population. The prevalence of obesity was observed 28%, type-2 diabetes was observed by 18% and hypertension was 22%. *H. pylori* infections among diabetic persons were observed 35% and 48% in non-diabetic subjects. The infection rate of *H. pylori* is observed high among hypertensive persons.

Conclusions: There is a significant association between obesity, hypertension, and *H. pylori* infection. There is no relationship between” association of diabetes “and *H. pylori*”. Large scale studies are required to assess “the prevalence of *H. pylori* infection”, and metabolic diseases.

Keywords: Obesity; Diabetes; Hypertension; Association; Statistical analysis

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Abbreviations: *H. pylori*: *Helicobacter pylori*; BMI: Body Mass Index; BSR: Blood Sugar Random; IgG: Immunoglobulin G; Kg: Kilogram; mmHg: millimeters of Mercury; mg/dl: milligrams per deciliter; CI: Confidence Interval

Introduction

Helicobacter pylori is a well-known pathogenic bacteria associated with the human stomach. More than 50% of the world population is infected by this bacterium and it is more frequent in developing countries [1]. *H. pylori* infection is a potential risk factor for several other diseases such as chronic gastritis, peptic ulcer, gastric cancer and Mucosa-Associated Lymphoid Tissue (MALT Lymphoma) [2]. It is also considered as class I carcinogen that can induce chronic inflammation [3]. *H. pylori* infection induces the proliferation of CD4+ T lymphocytes. These lymphocytes

recognize the epitope of *H. pylori* which are structurally similar to those of H+/K+-ATPase. In the absence of peripheral tolerance, a Th1-driven autoreactive clone is activated when dendritic cells present these epitopes to naïve T cells [4]. *H. pylori* infection induces the secretion of cytokines, CRP, angiotensinogen, free fatty acid, and leptin hormones and thus reactive oxygen species begin to accumulate that cause chronic inflammation [3]. *H. pylori* infection is suspected to be associated with extra digestive diseases, such as cardiovascular, neurological and metabolic diseases including obesity, diabetes, and hypertension [5].

Obesity is a multifactorial, major public problem that is increasing as well is important globally. Obesity described as the accumulation of extra fats under the skin throughout the body that is sufficient to adversely affect health and reduce life expectancy [6]. Several other health problems which are associated with obesity are

hypertension, diabetes, hypoventilation, back and joint pain issues, cardiovascular diseases and gastroesophageal reflux disorder [7]. The prevalence of obesity in Pakistan is 4.8% where as 20.8% population is overweight according to WHO statistics 2016 [8]. *H. pylori* infection stimulates the excessive release of pro-inflammatory cytokines, such as interleukin (IL-6, IL-8, IL-1 β , and TNF- α). The release of pro-inflammatory cytokines causes chronic inflammation, which further leads to the deterioration of insulin resistance and lipid dysmetabolism. Both insulin resistance and lipid dysmetabolism contribute significantly to obesity. Besides, *H. pylori* infection induces a decrease in the production and secretion of the orexigenic hormone ghrelin. Ghrelin, as a multifunctional polypeptide secreted from gastric mucosa, is involved in ingestion, appetite, and nutrition, especially lipid absorption and lipogenesis [3]. Ghrelin is primarily secreted from the stomach and implicates in the coordination of eating behavior and weight regulation. Circulating ghrelin levels are decreased in human obesity, suggesting a potential association of ghrelin with obesity. Moreover, *H. pylori*-infected subjects have lower serum leptin levels. The decrease in serum leptin levels could stimulate appetite, and overfeeding may result in overweight and obese. Therefore, obesity and *H. pylori* infection may interact with each other and form a large complex [9]. Hormone ghrelin exerts long-term appetite-stimulating behavior through its receptors in the hypothalamic paraventricular and arcuate nuclei. Decreased exposure to *H. pylori* results in increased ghrelin and downregulated gastric leptin in children and in adults, thus increasing appetite-stimulating behavior and leading to obesity. Interestingly, ghrelin has storage in abdominal white adipose tissue. *H. pylori* could be an indicator of changes in the gut microbiome. It reflects the complex interaction between microbes and the immune system. When *H. pylori* are eradicated (other microbes will be influenced as well), the inner balance of microbes, appetite-related hormones, and the immune system will be broken, and the person will become obese [10] (Figure 1).

Type 2 Diabetes mellitus is another one of the most important causes of morbidity, mortality, and burden on health-system worldwide. Type 2 diabetes mellitus is more prevalent and is characterized by hyperglycemia and a combination of impaired insulin secretion and insulin resistance [11]. According to the World Health Organization (WHO) estimated 422 million people suffered from diabetes [12]. The prevalence of diabetes in Pakistan is 26.3% [13]. *H. pylori* infection increases the risk of diabetes is not clear, it is biologically plausible. *H. pylori* infection induces inflammation, and inflammation is suspected to cause diabetes. Besides the inflammatory pathway, it was suggested that *H. pylori* infection can affect the regulation of ghrelin and leptin. *H. pylori* infection induces hepatic insulin resistance by the c-Jun/miR-203/SOCS3 signaling pathway [1]. There is an immediate immune response with a production of pro-inflammatory substances such as cytokines, eicosanoids and acute-phase proteins during infection that may have effects on extra digestive sites. Many vasoactive substances and cellular mediators, such as tumor necrosis factor alpha (TNF- α) and other cytokines are produced in the gastric mucosa in response to *H. pylori* infection. These mediators may be transported in the bloodstream and may promote an inflammatory response in organs distant from stomach (Figure 1).

It is said that *H. pylori* infection plays a role in some endocrine disorders such as autoimmune thyroid disease, diabetes, and primary hyperparathyroidism and may have a high prevalence among patients with diabetes [14]. Insulin resistance can develop in the presence of inflammation or as a result of alterations in counter-regulatory hormones that affect insulin, *H. pylori* infection may thus promote insulin resistance by inducing chronic inflammation and affecting insulin-regulating gastrointestinal hormones [14]. The Ghrelin can also modulate insulin sensitivity and stimulate insulin-induced glucose uptake, and the *H. pylori* infection can impair Ghrelin synthesis [3].

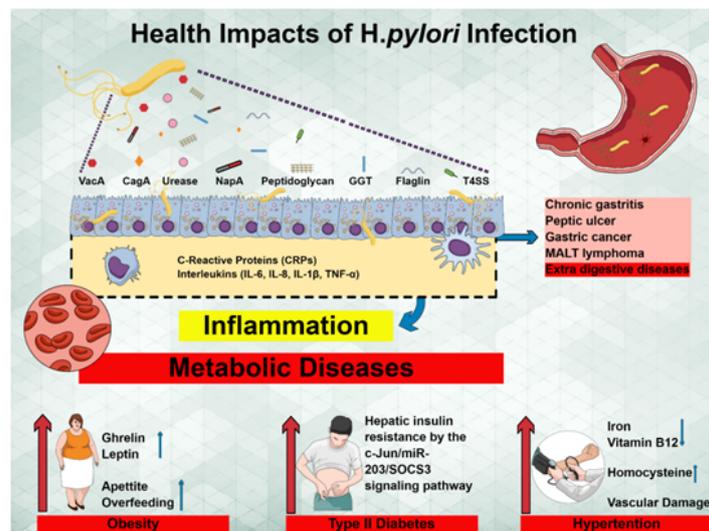


Figure 1 Various epitopes and secretions from *Helicobacter pylori* induces the proliferation of CD4+ T-lymphocytes that induces the secretions of C-reactive proteins and interleukins those are key factors for inflammation. Inflammation along with elevated levels of CRPs and interleukins in circulating blood causes the higher levels of Ghrelin and Leptin that are considered to be risk factors for obesity. *H. pylori* infection may induce hepatic insulin resistance as well as due to decreased absorption of Iron and Vitamin B12 homocysteine level may rise that leads toward vascular damage.

High blood pressure or hypertension is another leading risk factor for global mortality and is estimated to have caused 9.4 million deaths and 7% of disease burden [15]. The detection, treatment, and control of hypertension are low especially in developing countries such as in Pakistan leading to swear conditions such as stroke and heart and renal failure. The prevalence of hypertension in Pakistan is 46.2% [16]. *H. pylori* infection and peptic disease likely affect gastric physiology, including alterations in metabolic hormones (eg, ghrelin and leptin) and micronutrient absorption such as iron and vitamin B12. Vitamin B12 deficiency leads to increased homocysteine concentration and causes vascular damage [17]. The infection with *H. pylori* has a positive association with high LDL, low HDL, and cardiovascular disease and successful *H. pylori* eradication decreased the risk of high LDL and low HDL [3].

Metabolic diseases like obesity, type 2 diabetes, and hypertension, an outcome of *Helicobacter pylori* infection is a major discussion in the recent past. To determine the onset of these diseases in infected individuals could clear the fog in this domain. The major objectives of the study were to find the prevalence of *H. pylori* infections in the Rawalpindi region and to identify the association between metabolic diseases such as obesity, diabetes, and hypertension.

Materials and Methods

Ethics statement

All individuals signed informed consent prior to their enrollment in the study stating that their data could be used in future medical research. Also, the study was planned according to the ethical guidelines provided by the ethical committee of the Capital University of Science and Technology, Islamabad.

Subjects and clinical data

The cross-sectional study was carried out from May 2017 to August 2017 at several regions of Rawalpindi district, Pakistan. Inclusion criteria were complete age range 18 to 70 years, with no visible physical and mental disability, no pregnancy, Exclusion criteria were the age range below 18 and above 70 years, physically and mentally unfit or disabled persons, having pregnancy in case of female subjects. Socio-demographic information of participants having "a similar socioeconomic status, judged by work type and level of instruction was collected on properly designed data acquisition form. Informed consent was obtained from all participants.

Sample size

The sample size was calculated by using formula

$$\text{Sample Size} = Z^2 * P (1-p) / e^2$$
$$Z^2 * P (1-p) / e^2 N$$

Where N is the size of the population, e is the margin error and Z is z-score of the number of standard deviations [18]. An estimated sample size of 192 subjects was calculated using the above formula with a 7.1% margin, 95% level of confidence and 1.96 z-score. In this study, 200 total samples were collected. Finally, 192 subjects 105 females and 87 males were enrolled.

Evaluation of *H. pylori* infection status

One step *H. pylori* test was performed on-site. The one-step *H. pylori* test device (Standard diagnostic, Inc. Korea) was used to detect IgG type antibodies to *H. pylori* in the blood to aid in the diagnosis of *H. pylori* infection in the laboratory. This test is a rapid chromatographic immunoassay for the qualitative detection. This test was used to identify the subjects that were suffering from *H. pylori* infection or they were infected with *H. pylori* infection in the recent past.

Evaluation of obesity infection status

Standing height and body weight were recorded without shoes with light clothing for all subjects. BMI was calculated as weight divided by height squared. Normal weight, overweight, and obesity were defined as BMI <24, 24-30, >30 Kg/m² respectively [8].

Evaluation of diabetes infection status

Blood sugar random BSR levels were detected by Fingerstick procedure using the device "EasyGlucometer Code C25". Blood sugar was measured by Type II Diabetes Mellitus was defined as a random plasma glucose of 200 mg/dl or greater [11].

Evaluation of hypertension infection status

Blood pressure was measured in the right arm using a mercury sphygmomanometer after 20 min of rest with the participants in a sitting position. The first and fifth Korotoff sounds were used as systolic and diastolic blood pressure. Hypertension was defined as participants having systolic blood pressure (SBP)>140 mmHg and/or diastolic blood pressure (DBP) >90 mmHg.

Clinical examination

All subjects were interviewed regarding current health status (diabetes mellitus, hypertension, eating disorder, and medication for obesity, diet plan to control obesity, minor surgeries and medication used for other diseases). Blood samples and anthropometric parameters including body height, body weight, body mass index (BMI) and blood pressure were measured or calculated for all participants.

Statistical analysis

Results "were presented as mean \pm standard deviation and" percentage. The Wilcoxon Rank Sum test was used for comparison of continuous data, while the chi-square test was used for comparison of categorical variables. Odds ratios and 95% CI values were calculated by" descriptive statistics and risk factor was judged. Chi-square analysis was used to determine the factors that were associated with diseases (obesity, type 2 diabetes mellitus, and hypertension). "Significance was defined as $p>0.05$. Correlation between *H. pylori* and obese individuals is judged with respect to calculated BMI. In the next step correlation between infected diabetic and non-diabetic individuals was judged. Association was also checked between hypertension and *H. pylori* infection. The "statistical analysis was carried out" by "using Statistical Package for Social Sciences (SPSS) Version 20". Prevalence in the form of percentage was obtained using MS Excel.

Results

Population characteristics and metabolic measures

Out of the total 192 subjects, 55% (105) were females and 45% (87) were males. Obese and Control groups mean age was 38.18 years, minimum 17 years and maximum 85 years with a standard deviation of 14.546. The mean weight obtained was 71.10 Kg with a standard deviation of 15.484. Mean height was observed 63.70 inches with a standard deviation of 3.959. Systolic blood pressure varies from 100 mmHg to 170 mmHg with a mean value of 126.11 mmHg and a standard deviation of 14.725. Diastolic Blood pressure varies from 60 mmHg to 110 mmHg with a mean value of 82.97 and a standard deviation of 8.396. Minimum Blood Sugar Random (BSR) was observed 61 mg/dl and the maximum was 600 mg/dl with a mean value of 146.04 and a standard deviation of 104.164 (Table 1). Prevalence of *Helicobacter pylori* infection according to sociodemographic factors is shown in (Tables 2 and 3).

Status *helicobacter pylori* infection

In this study, the aim was “to investigate the prevalence of *H. pylori* infection and its relation with BMI in” subjects of Rawalpindi. “Overall prevalence of *H. pylori* infection was” observed approximately 44% including both male and female subjects. Out of 192 subjects, 85 people were found seropositive for *H. pylori* IgG antibody and 102 people were found negative. 85 seropositive people were either currently infected or either had an infection in the past. It was observed that 16% (30) Males out of 192 subjects and 29% (55) female subjects were seropositive for *H. pylori* infection and 57% (30) males, 26% (50) female subjects from a total of 192 subjects were found seronegative.

Table 1 Characteristics of study participants.

	N	Minimum	Maximum	Mean	Std. Deviation
Age	192	18	85	38.18	14.546
Weight (Kg)	192	44	160	71.10	15.484
Height (Inches)	192	49	78	63.70	3.959
Body Mass Index (BMI)	192	16.0	53.2	27.368	6.2519
Systolic BP (mmHg)	192	100	170	126.11	14.725
Diastolic BP(mmHg)	192	60	110	82.97	8.396
Blood Sugar Random (mg/dl)	192	61	600	146.04	104.164

Inclusion criteria: Healthy persons minimum age of 17 years, with no any physical disability

Exclusion criteria: Pregnant women, disabled/ mentally or immunologically compromised individuals, individuals under 17 years of age

N is total number of subjects

Table 2 Prevalence of metabolic diseases.

Diseases/Prevalence	Prevalence	Prevalence in Males	Prevalence in Females
<i>H. pylori</i> Infection	44%	16%	29%
Obesity	28%	5%	23%
Diabetes	18%	8%	10%
Hypertension	22%	8%	14%

*Prevalence of *Helicobacter pylori*, obesity, diabetes, hypertension for the population of Tehsil Kahuta, District Rawalpindi, Pakistan

*Sample size 192 comprising 87 males, 105 females

BMI normal range: 18.5-24.9, Overweight 25-29.9, Obese above 30-39.9, BSR normal 80-140 mg/dl Diabetic BSR ≥ 200 mg/dl, Hypertensive blood pressure ≥ 90/140 mmHg, normal < 85/130mmHg, high normal 85-89/130-139 mmHg.

Status of obesity

According to WHO BMI classification criteria 5% subjects were underweight, 33% individuals were normal lean 34% were overweight, 16% subjects were categorized as Obese Class I as there BMI was above 25, 7% subjects were under Obese Class II and 4% were categorized under Obese class III as there BMI was greater than 40. All individuals having BMI greater than 30 were considered obese and the prevalence of obesity was observed 28% in subjects of the Rawalpindi region. It was observed that 1% underweight, 9% Normal lean Individuals 9% Overweight and 13% obese subjects were seropositive for *H. pylori* IgG. Among obese class-I, 43% subjects were infected and 57% of individuals were not infected similarly among obese class-II and obese class III 64% & 37% of subjects were infected and 36% & 63% were found negative.

Status of diabetes

Diabetes is another increasing health problem worldwide as well as in Pakistan. The prevalence of diabetes was observed 18% as 35 individuals out of 192 were diabetic. *H. pylori* infection in diabetic subjects was 9% positive and 9% negative. Similarly, 35% positive and 48% negative for non-diabetic subjects.

Status of hypertension

22% of subjects were observed patients of Hypertension (high blood pressure). 74% of subjects were normal with no blood pressure complaints only 4% of subjects were observed with low BP complaints. 3%, 27%, and 14% of subjects were found infective for subjects having low, normal and high blood pressure. 1%, 47%, and 8% were not infective among subjects having low, normal and high blood pressure (Table 2). Comparison of metabolic diseases in *H. pylori* positive and *H. pylori* negative groups is shown in (Table 4).

Table 3: Prevalence of *Helicobacter pylori* infection according to sociodemographic factors.

Variables	Total	<i>H. pylori</i> Positive	<i>H. pylori</i> Negative	P-value
Age	192	85	107	0.014
Age Groups	<18 years (11)	2	9	0.236
	18-27 years (46)	17	29	
	28-37 years (34)	15	19	
	38-47 years (53)	25	28	
	48-57 years (27)	16	11	
	58-67 years (14)	8	6	
	68-77 years (5)	2	3	
	>77 years (2)	0	2	
Gender	Male (87)	30	57	0.013
	Females (105)	55	50	
Height	192	85	107	0.64
Weight	192	85	107	0.59
BMI	192	85	107	0.009
Systolic BP	192	85	107	0.109
Diastolic BP	192	85	107	0.054
Blood Pressure	Low (8)	6	2	0.001
	Normal (142)	52	90	
	High (42)	27	15	
BSR	192	85	107	0.258
Heart Disease	Yes (12)	4	8	0.431
	No (180)	81	99	
Eating Disorders	Yes (90)	48	42	0.018
	No (102)	37	65	
Physical Activity	Yes (32)	9	23	0.044
	No (160)	76	84	
Education Level	Nil (58)	32	26	0.085
	Low (37)	18	19	
	Moderate (72)	28	44	
	High (25)	7	18	
Job Status	Nil (105)	47	58	0.938
	Govt. Employee (29)	12	17	
	Self Employed (17)	8	9	
	Private Sector (41)	18	23	
Marital Status	Married (144)	76	68	0.000
	Unmarried (48)	9	39	
History of Surgery	Yes (65)	25	40	0.246
	No (127)	67	60	
Medication to Control Obesity	Yes (0)	0	0	-
	No (192)	85	107	
Medication for any other Disease	Yes (38)	18	20	0.668
	No (154)	67	87	
Diet Plan for Obesity	Yes (3)	0	3	0.120
	No (189)	85	104	

*Age (years), Age Groups (10 years), Systolic BP, Diastolic BP, Blood Sugar Random (BSR) were measured.

*Question were asked if the subjects had low normal or high blood pressure problem, if they had history of any heart disease, eating disorders, physical activity, history of surgery, medication to control obesity, medication for any other disease, diet plan for obesity. Answers were recorded in the form of Yes or No.

*Education level Nil (No any Education from school), Low (education up to grade 5), Moderate (up to grade 12), High (up to graduation or above)

Table 4 Comparison of metabolic diseases in *H. pylori* positive and *H. pylori* negative groups.

Variables	Total	<i>H. pylori</i> Positive	<i>H. pylori</i> Negative	P-value
Obesity	Obese (54)	30	24	0.049
	Non Obese (138)	55	83	
Diabetes	Non Diabetic (157)	67	90	0.346
	Diabetic(35)	18	17	
Hypertension	Hypertensive (42)	27	15	0.003
	Normal (150)	58	92	

Table 5 Association of Helicobacter pylori infection with metabolic diseases.

Statistical Analysis	Total Samples	Normal	Diseases	Chi- square Values	Degree of Freedom	P-Value	Odds Ratio 95% CI	Phi Values	Cramer's V test	Association
Correlation of <i>H. pylori</i> and Obesity	192	138	54	4.513 ^a	1	0.049	1.992	0.153	0.153	Positive and slightly significant
Correlation of <i>H. pylori</i> and Diabetes	192	157	35	0.889 ^a	1	0.346	1.422	0.068	0.068	No Association
Correlation of <i>H. pylori</i> and Hypertension	192	152	42	12.938 ^a	1	0.003	3.360	0.260	0.260	Positive and slightly significant

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.49.

b. Computed only for a 2x2 table

*P-value= <0.05

CI: 95% confidence Interval

Association of *h. pylori* with obesity, diabetes, and hypertension

Pearson's Chi-square is a test for independence or correlation coefficient" and a test for association. For 139 controls and 53 subjects, Chi-square test values for *H. pylori* and obesity was calculated as 4.513 with a degree of freedom that is equal to 1 and a *p*-value of 0.034 that showed association is present, Phi and Cramer's V test values were 0.153 which shows that results are significant. The odds ratio with a 95% confidence interval was obtained as 1.992. For *H. pylori* and diabetes including 157 controls and 35 subjects Chi-square test values was 0.889 with a degree of freedom that equals to 1 and *P*-value of 0.346 according to these values, the association was not present, Phi and Cramer's V test values were obtained as 0.068 which represents less significant results. For 142 controls and 50 subjects Chi-square test values for *H. pylori* infection and hypertension were obtained 12.938 with a degree of freedom equals to 1 and *p*-value of 0.00 represents significant association, odd ratio value was 3.360 and Phi and Cramer's V test values were calculated that were 0.260 (Table 5).

Discussion

Mean values of calculated BMI suggests that peoples of Rawalpindi region are overweight and are not obese, systolic diastolic blood pressure is observed normal, blood random sugar levels were observed above them normally. This might be because of the high consumption of soft drinks, juices, tea, and sweets as well as due to no physical activity (walk, exercise, etc.) observed other than workload.

By comparing the infection rate of *H. pylori* in males and females

separately, it was observed that the prevalence was high among female subjects. All seropositive males and females were found symptomatic for disorders like stomach pain, and vomiting, etc. The reason for the high prevalence among females is might be the consumption of market foods as they are not properly washed with clean water before preparation as well as storage conditions are also not proper.

H. pylori infection trend was found increasing from normal to overweight and obese subject (Figure 2A) which was further confirmed by observing *H. pylori* infection trend among obese class I, obese Class II and obese Class III (Figure 2D). It is clear that the prevalence of *H. pylori* infection among obese subjects is high than normal lean subjects. Diabetic subjects are more susceptible to various infections due to their suppressed immunologic conditions. However, *H. pylori* infections among diabetic persons were observed as equal to non-diabetic subjects (Figure 2B). The prevalence of hypertension was calculated 22% whereas 28% obese shows association of weight gain and hypertension as approximately equally increasing. Figure 2C shows that the infection rate is high among persons having high blood pressure or are hypertensive (Figure 2).

The significant "association between obesity and *H. pylori* infection was observed as *P*-value is obtained 0.034 is less than the alpha value 0.05 which means the results are statistically significant in" other words obesity and *H. pylori* infection are not independent are dependent on each other. There was no significant association between diabetes and *H. pylori* infection, in other words, diabetes and *H. pylori* infection are independent as *P*-value obtained was 0.889 was greater than the alpha value

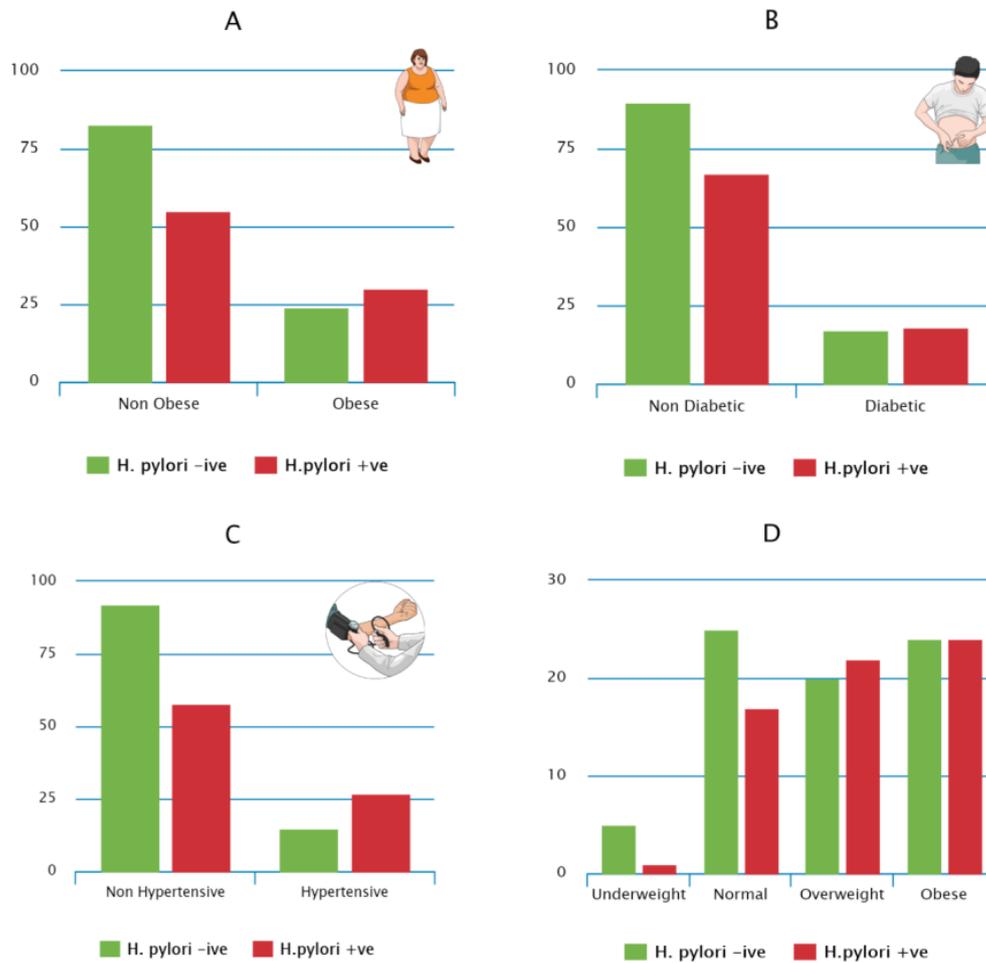


Figure 2 Association of Helicobacter pylori with Obesity, diabetes and Hypertension. A: Association of *H. pylori* infection with obesity, obese subjects have more infection rate *H. pylori* than non-obese. B: Association of *H. pylori* infection with Diabetes, there is almost equal infection rate of *H. pylori* observed in diabetic subjects. C: Association of *H. pylori* Infection with Hypertension, hypertension was observed greater in *H. pylori* seropositive subjects than *H. pylori* seronegative subjects D: *H. pylori* infection trend among obese individuals found to be increasing from obese class I to obese class III.

of 0.05 which means the results are statistically not significant. There is a significant association between *H. pylori* infection and hypertension, in other words, hypertension and *H. pylori* infection are dependent on each other as *P-value* obtained were 0.000 is smaller than the alpha value of 0.05 which means the results are statistically significant.

Odd ratio involved for risk suggests that odds for developing obesity 1.992 times greater for "individuals having *H. pylori*" positive infection compared with *H. pylori*-negative infections. Odd ratio involved for risk from (Table 5) suggests that odds for developing diabetes 1.422 times greater for individuals having *H. pylori*-positive infection compared with *H. pylori*-negative infections. Odd ratio involved for risk from (Table 5) suggests that odds for developing hypertension 3.360 times greater for individuals having *H. pylori*-positive infection compared with *H. pylori*-negative infections.

Cramer's "V is a measure of association so it tells us how important findings are" if the value is 0 then no relationship, 0.1 for a low relationship, 0.2 for moderate relationship and 0.3 for a strong relationship. Here for obesity and *H. pylori*, the value is obtained

(Table 5) 0.153 which means there is a moderate relationship between the association of obesity and *H. pylori*. Phi Values also suggest that there is a relationship present between obesity and *H. pylori* infection. For diabetes and *H. pylori*, Cramer's V value is obtained (Table 5) 0.068 which means there is no relationship between the association of diabetes and *H. pylori*. Phi values 0.068 also suggest that there is no relationship present between diabetes and *H. pylori* infection. For Hypertension and *H. pylori*, Cramer's V value is obtained (Table 5) 0.260 which means there is a moderate to a strong relationship between the association of hypertension and *H. pylori* infections. Phi values 0.296 also suggest that there is a relationship present "between *H. pylori* infection and hypertension.

Conclusion

"Overall prevalence of *H. pylori* infection was" observed 44% including both male and female subjects. By comparing the infection "rate of *H. pylori* in" males and females separately, it was observed that the prevalence was high among female subjects. The prevalence of obesity was observed 28% in subjects

of the Rawalpindi region. *H. pylori* infection trend was found increasing “from normal to overweight and obese” subject which was further confirmed by observing *H. pylori* infection trend among “obese class I, obese Class II” and “obese Class III”. The prevalence of diabetes was observed 18% as 35 individuals out of 192 were diabetic. Diabetic subjects are more susceptible to various infections due to their suppressed immunologic conditions. However, *H. pylori* infection among diabetic person were observed as equal to non-diabetic subjects. 22% of subjects were observed patients of hypertension (high blood pressure). The infection rate of *H. pylori* is observed high among persons having high blood pressure or are hypertensive.

There is a significant “association between obesity and *H. pylori* infection in” other words “obesity and *H. pylori* infection are” not independent and are dependent on each other. There is a moderate relationship between the association of obesity and *H. pylori*. There is no significant association between diabetes and *H. pylori* infection in other words diabetes and “*H. pylori* infection are independent”. “There is no relationship between the” association of diabetes “and *H. pylori*”. There is a significant association between *H. pylori* infection and hypertension, in

other words, hypertension and *H. pylori* infection are dependent on each other. There is a moderate to a strong relationship between the association of hypertension and *H. pylori* infections. In conclusion, data suggest that there is a positive relationship of *H. pylori* infection with obesity, hypertension and inverse relationship “was observed between *H. pylori* infection and diabetes”.

Large scale studies are required in several regions of Pakistan to check “the prevalence of *H. pylori* infection”, obesity, diabetes, and hypertension. The various statistical method and study designs can be used to assess association. Studies are required to trace out the mechanisms by which *H. pylori* induce obesity and hypertension.

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