Prevalence of Helicobacter Pylori and Health Related Risk Factors at the University of Central Florida

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Evan Holsonback
University of Central Florida

PREVALENCE OF *HELICOBACTER PYLORI* AND HEALTH RELATED RISK FACTORS AT THE UNIVERSITY OF CENTRAL FLORIDA

by

EVAN HOLSONBACK

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Thesis Chair: Suha Saleh, Ph.D.

ABSTRACT

Helicobacter pylori (H. pylori) is a Gram-negative bacterium that infects and resides in the gastric mucosa of humans. Without treatment, *H. pylori* infection may cause chronic inflammation of the gastric mucosa. This inflammation creates progressive damage to the lining of the stomach and can lead to multiple diseases located in the upper gastrointestinal region. Worldwide prevalence of *H. pylori* infection is estimated to be close to 50%. *H. pylori* has been identified as the primary cause of peptic ulcer disease, gastric cancer, and mucosa-associated lymphoid tissue lymphoma.

The purpose of this study was to identify the prevalence and risk factors associated with *H. pylori* infection among students, faculty, and staff at the University of Central Florida. A cross-sectional design with a convenience sample was implemented to acquire a study population of 60 participants. The sample was analyzed through the use of a twenty question survey and a rapid blood antibody test kit. The infection rate of the sample was 1.75%. Statistically significant results were found for the relationship between age and upper gastrointestinal symptoms. Trends were also noticed between alcohol consumption, stress levels, and upper gastrointestinal symptoms.

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INTRODUCTION

Background & Prevalence

Helicobacter pylori (H. pylori) is a Gram-negative bacterium that infects and resides in the gastric mucosa of humans. Its pathogenic effects were discovered by Barry Marshall and Robin Warren in the antral mucosa of humans in 1984 [1]. *H. pylori* has been identified as the primary cause of peptic ulcer disease [2], gastric cancer [3], and mucosa-associated lymphoid tissue lymphoma (MALT) [3]. In 1997, it was established that *H. pylori* was one of the most common human pathogens, colonizing about 60% of the world population [4]. Worldwide infection of Helicobacter pylori has decreased since 1997; however, infection from the bacteria is still an issue in most countries. In parts of Europe, South America, and Asia prevalence rates average around 50% [5]. Rates of infection vary greatly between developed and developing countries [6]. In 2003, the prevalence of *H. pylori* infection among developed countries ranged from 10%-50%, while rates among developing countries were as high as 80-90% [7]. Although this study analyzed developed countries, it is important to note that the United States was not included. The U.S. has not recently been included in prevalence studies most likely because developing countries exhibit much higher infection rates, and thus receive more attention.

Immigration also plays an interesting role in the prevalence of *H. pylori*. It is thought that *H. pylori* infection is still an issue in developed countries because of immigration. Immigrants originating from lower socioeconomic areas with a lower standard of hygiene are more likely to be infected, and may carry the bacteria into their new homes and neighborhoods [8].

Associated Diseases

H. pylori infection causes chronic inflammation of the gastric mucosa. This inflammation creates progressive damage to the lining of the stomach and can lead to multiple diseases located in the upper GI region. These diseases include peptic ulcer, duodenal ulcer, acute gastritis, chronic gastritis, gastric adenocarcinoma, and gastric mucosa-associated lymphoid tissue lymphoma [1,9,10,11]. It has been recognized that 77% of the world's non-cardia gastric cancer is attributable to *H. pylori* infection [3]. Stomach cancer is the third leading cause of cancer death worldwide, after lung and liver cancer [12]. Additionally, *H. pylori* rates have been found to be at least two times as high in areas with high stomach cancer rates [11].

It has also been thought that *H. pylori* may lead to diseases located outside the stomach. Some of these diseases include rosacea and idiopathic urticaria, autoimmune thyroid disease and thrombocytopenic purpura, iron deficiency anemia, Raynaud's phenomenon, scleroderma, migraine, and Guillain-Barré syndrome [13]. These associations are not well established, as the relationship between *H. pylori* and the diseases are difficult to isolate.

Associated Risk Factors

Many risk factors have been identified which increase the likelihood of *H. pylori* infection. Risk factors that will be analyzed in this study include age, gender, race, educational level, smoking, caffeine, nonsteroidal anti-inflammatory drugs (NSAID), alcohol, hand-washing, intake of raw foods, and stress.

Age, Gender, Race, and Education Level

There has been a significant increase in the likelihood of infection as age increases among most populations [7,11]. This risk increases as age increases until age 60 or 70, at which point the risk of infection decreases [11].

Several studies have found a higher rate of infection among men compared to women. Although the difference is subtle, it has presented in multiple studies [11,14].

H. pylori infection has also been identified at different rates among different races. In metropolitan Houston, black individuals demonstrated a rate of infection of 70%, while whites expressed a rate of infection of 34%. This difference still remained after adjustments were made for age, gender, educational level, income, and use of alcohol or tobacco [15]. Although this study was published in 1991, recent infection rates still seem to differ between races in the American population [16].

The level of education an individual completes has also been identified as playing a significant role in the likelihood of an individual contracting the infection [8,14]. It is possible that higher education may equip an individual to make better health-related decisions.

Drugs, Alcohol, Food, and Health Habits

Smoking tobacco has yielded discordant results when comparing multiple studies. Some studies suggested smoking is a risk factor, while others found there was no association between smoking and *H. pylori* infection [8,14,17].

A study conducted in south Germany found *H. pylori* prevalence to be 21% from a sample of 447 patients. Individuals who drank less than three cups of coffee per day possessed an infection rate of 18.8%, while those who drank three or more cups of coffee per day possessed

an infection rate of 28.2%. Those who never drank coffee possessed an infection rate of 11.7% [17]. Further, a cohort-designed study conducted among epidemiologists tested serum donated to the CDC serum bank for the presence of *H. pylori*-specific immunoglobulin G. The risk ratio found for *H. pylori* infection for those who drank more than two cups of caffeinated drinks per day compared to those who drank two cups or less per day was 4.6 [18]. This means that those who drank more than two cups of caffeinated drinks per day were 4.6 times more likely to be infected by *H. pylori*.

Non-steroidal anti-inflammatory drug (NSAID) use is a causative factor of gastroduodenal ulcer disease, along with *H. pylori*. It is not known exactly how both the drug and bacteria interact with one another, but it has been shown that they create a cumulative risk for acquiring gastroduodenal ulcer disease [13].

Alcohol is another factor with conflicting findings in terms of *H. pylori* infection. Some studies found there was no association between alcohol consumption and *H. pylori* infection, while others suggest alcohol may decrease the likelihood of infection [8]. A study in 1997 found that when alcohol was consumed at amounts greater than 75 grams of ethanol per week, which is about five drinks, it offered a major protective effect against *H. pylori* infection [17]. It was suggested that the decreased likelihood of infection was due in part to alcohol's stimulatory effects on gastrin cells and increase in acid secretion. This may create an environment *H. pylori* cannot effectively colonize. In 2016, another study showed a protective effect of alcohol consumption. The evidence showed that moderate alcohol intake reduced the likelihood of infection by about 22%, and may facilitate elimination of *H. pylori* [19]. (Light alcohol intake was defined as <1 drink/day, while heavy drinking was classified as ≥ 4 drinks/day.) These findings

should be considered with the fact that alcohol use may also damage the lining of the stomach upon excessive consumption [13].

Sanitary practices showed a strong association with *H. pylori* infection [11]. More specifically, as the frequency of hand-washing before eating and after using the restroom increased, the likelihood of contracting the infection decreased [20].

In a study conducted in Chicago in 2008, eleven samples of raw chicken from one supermarket, and eighteen samples of ready-to-eat sushi from two restaurants were tested for *H. pylori*. The results showed 4/11 (36%) raw chickens were positive for *H. pylori*, and 8/18 (44%) of ready-to-eat sushi meals were positive for *H. pylori* [21]. According to this study, *H. pylori* may be colonized on some of the foods we eat, and the foods we cook.

Stress

It has been found that higher stress exposure is associated with poorer mental and physical health [22]. More specifically, exposure to stress has been identified to increase an individual's risk for several different gastrointestinal diseases, including gastroesophageal reflux disease, peptic ulcer, functional dyspepsia, inflammatory bowel disease, and irritable bowel disease [23]. This may be true because stress increases intestinal permeability, visceral sensitivity (increased perception to pain in the gut), and alteration in gastrointestinal motility. Stress also leads to mast cell activation resulting in the release of many pro-inflammatory mediators [23]. Further, as an individual experiences greater amounts of stress, they may be more likely to neglect important health-related decisions. For these reasons, an individual experiencing greater amounts of stress exposure may be more likely to contract *H. pylori* infection.

Special Populations

A study conducted in 2002 identified the decrease of *H. pylori* infection among developed countries, while infection rates among developing countries remained relatively constant [24]. It is imperative to identify why certain countries experience lower rates of infection. Once identified, these factors can be implemented into the daily habits of individuals living in other regions to promote a decrease in the prevalence of infection. Thus, it is important to conduct research not only in the highly affected areas, but also in the areas with low prevalence rates.

In addition, although the United States is considered a developed country with a higher socioeconomic standard than most countries, the U.S. is host to thousands of individuals who permanently reside or previously resided in other countries. These individuals may have come from a country or region with high prevalence rates of *H. pylori*. A large population that temporarily resides in the U.S. are international university students. A study published in 2016, promoted awareness of *H. pylori* infection in international students and immigrants [25]. For example, the number of Chinese international students in the U.S. during 2011-2012 was 194,028. The rate of *H. pylori* prevalence in the general population of China was 71.4% [25]. As of 2011-2012 the total number of international students in the U.S. was 764,524.

The same study listed the top ten countries from which most international students matriculated. Of the ten countries, eight possessed *H. pylori* prevalence rates over 50% in the general population. These values can be seen below in *Table 1*.

So, although the prevalence of *H. pylori* infection in the U.S. is lower than most countries, there are still populations in the U.S. that are very likely to be infected, and will require treatment from American healthcare professionals.

Table 1: Number of international students at U.S. universities compared with rate of H. pylori in the ten leading countries of origin 2011-2012 [25]

Country	No. of students	Rate of *H. pylori*
China	194,028	71.4%
India	100,270	79%
South Korea	72,295	59.2%
Saudi Arabia	34,139	47%
Canada	26,821	30%
Taiwan	23,250	54.5%
Japan	19,996	70.0%
Vietnam	15,572	74.6%
Mexico	13,893	66%
Turkey	11,973	82.5%
All others	252,287	
USA		24.8%

The proposed study will conduct research among college students, faculty, and staff at the University of Central Florida (UCF). This population is unique, and offers much potential to further what is known about *H. pylori* infection. The population is valuable because it offers a unique set of characteristics in which certain risk factors are present. As previously stated, age is an important factor contributing to *H. pylori* infection. Most college students are younger than the general population. This may decrease their likelihood of infection [7]; however, other risk factors may be present in higher concentrations. For example, caffeine consumption has been shown to be common among the college-aged population [26]. Some college students possess

other risk factors such as stress, regular alcohol consumption, and irregular sanitary practices that may contribute to the likelihood of infection.

This study will be conducted in an area of higher socioeconomic status compared to other regions of the world. Thus, many conditions present in developing countries will be absent. This allows certain risk factors to be isolated and investigated to determine their impact.

Rooted in the reviewed literature, several findings are predicted from the proposed study: *H. pylori* infection rates will be affected by age, stress, consumption frequency of certain foods, drinks and drugs, as well as the frequency of certain health-related habits.

METHODS

Study Design

The purpose of this study is to identify the prevalence and risk factors associated with *H. pylori* infection among students, faculty, and staff at the University of Central Florida. A cross-sectional design with a convenience sample was implemented to acquire a study population of 60 participants. Data was gathered from the study population through the use of an eighteen question survey, followed by an antibody blood test for *H. pylori*. After all participants completed the survey and were tested for the *H. pylori* antibody, the results were analyzed to identify any existing associations between their survey responses and the *H. pylori* test results. The survey was also analyzed to identify any relationships between the reported risk factors and gastrointestinal symptoms or disease.

Sampling

Recruitment tables were set up outside of the Health and Public Affairs 1 (HPA 1) building where students, faculty, and staff were asked to volunteer in the study. At the tables, information regarding *H. pylori* and associated health-risks was provided in a brochure. Once the volunteers agreed to participate in the study, they were directed inside the HPA 1 building to complete the survey on a computer. The first page of the survey was an informed consent in which the individual was asked if they agreed to participate in the study. If the individual did not agree, they were not allowed to proceed to the survey. Once consent was provided, then several eligibility questions appeared. The eligibility questions ensured the participants were over 18, not pregnant, and were either a student, faculty, or staff at UCF. Once the participants were eligible

to participate in the study, they were assigned a number in which their survey results and *H. pylori* test results were matched. After a number is assigned, they were permitted to complete the rest of the survey. Then participants were tested for *H. Pylori* using a rapid finger prick test.

Instrumentation

This study used two instruments to evaluate the sample population. The survey included eighteen questions. The first three questions were formed to assess participant eligibility. The following fifteen questions assessed the demographic of the individual, past medical history, and general health-related habits. The survey was created and conducted through Qualtrics, a web-based survey system. Qualtrics is a common survey tool used among researchers at the University of Central Florida.

Once the survey was completed, and the participant was considered eligible to be tested, they proceeded to be tested for *H. pylori*. The test kit used was an FDA-cleared CLIA-waived whole-blood rapid test used to detect the presence of an antibody against *H. pylori*. The *H. pylori* whole blood rapid test was determined to possess a sensitivity of 95.1%, and a specificity of 94.1% by the Clinical Laboratory Improvement Amendments (CLIA). The participants were tested inside the HPA 1 building, near the administration of the survey. The participant's finger was cleaned with an alcohol pad, and then pricked to obtain a drop of blood to place in the test kit. Once the result was produced from the kit, the result was properly matched to the participant's assigned number. The number assigned to the participant during the survey allowed the test results and survey answers to be matched without acquiring any identifying information. Any biohazardous waste was properly disposed.

The blood test used to detect *H. pylori* infection was a screening test, and did not confirm if *H. pylori* infection was present. So, when an individual tested positive, they were advised to see their primary care physician for appropriate testing and possible diagnosis and treatment.

After the entire sample population completed the survey, the survey results and the corresponding *H. pylori* test results were downloaded into SPSS for proper data analysis. Data analysis included comparison of means and measurements of statistical significance using an analysis of variance (ANOVA).

Hypotheses

Experimental Hypothesis (H_1): As the age of participants at the University of Central Florida increases, the likelihood of *H. pylori* infection will increase.

Null Hypothesis (H_0): There will be no association between the age of participants and the likelihood of *H. pylori* infection.

Alternative Hypotheses: (H_2) As more caffeinated drinks, NSAIDs, and raw sushi or raw meat are consumed, there will be an increase in the likelihood of *H. pylori* infection.

(H_3) As the frequency of alcohol consumption increases, a protective effect will present, and the likelihood of *H. pylori* infection will decrease.

(H_4) As stress increases, the likelihood of *H. pylori* infection will increase.

(H_5) As the frequency of handwashing increases, there will be a decrease in the likelihood of *H. pylori* infection.

(H_6) As an individual consumes more caffeinated drinks, NSAIDs, raw sushi or raw meat, experiences more stress, or washes their hands less often before eating and after using the restroom, there will be an increase in reported gastrointestinal symptoms.

Ethical Considerations

This study has been reviewed and approved by the Institutional Review Board (IRB) at the University of Central Florida. All participants will possess full autonomy throughout the study. The ultimate purpose in conducting this study is to do good, prevent harm, and to promote overall health and wellness. By promoting health and wellness among participants at UCF, our hope is to take what is learned from this study, and apply it to individuals outside our study population.

RESULTS

H. Pylori Rapid Blood Test

Throughout a period of six days, 60 participants completed the survey. Of those 60 participants, 57 completed the *H. pylori* rapid blood test. Of the 57 that completed the survey and blood test, one participant produced a positive result for *H. pylori* infection. Thus, the infection rate for this sample was 1.75%. Three participants did not agree to complete the *H. pylori* blood test. The primary reason for refusal to participate was because individuals needed to attend class or did not have time to complete the study. Additionally, some individuals did not want to experience a finger prick required for the kit.

Basic Demographic Description of Sample

The surveyed sample consisted of 60 individuals. *Table 2* describes the age, UCF affiliation, gender, race, and student status of the sample.

Table 2: Description of Sample

	N	Percent of Sample
Age		
18-22	41	68.3
23-27	13	21.6
28-32	1	1.7
33-39	1	1.7
40-49	2	3.3
50-59	1	1.7
>59	1	1.7
UCF Affiliation		
Undergraduate	55	91.7
Graduate	2	3.3
Faculty	2	3.3

Staff	1	1.7
Gender		
Male	29	48.3
Female	31	51.7
Race		
White, Non-Hispanic	23	38.4
Black, Non-Hispanic	9	15
Hispanic, Latino	18	30
Asian, Pacific Islander	8	13.3
Multiracial	2	3.3
Student Status		
Freshman (1-30 credits)	6	10
Sophomore (31-60)	6	10
Junior (61-90)	27	45
Senior (91-120+)	15	25
Graduate	2	3.3
Non-Degree Seeking	2	3.3

Family History, Present Illnesses, and Symptoms of Sample

The survey administered obtained information regarding participant's present illnesses, family history, and relevant symptoms. These diseases included gastric ulcer, gastritis, gastroesophageal reflux disease (GERD), heart disease, diabetes, thyroid disease, hypertension, irritable bowel syndrome, Crohn's disease, iron deficiency/iron deficiency anemia (ID/IDA), and also allowed participants to enter any other diagnosed disease. The tables below account for the multiple responses participants selected for each question. The column listed "N" accounts for all participants that selected that option. Multiple responses were allowed to be selected. The "percent" column describes the percentage of the sample that selected that option.

Table 3: Family History, Present Illnesses, and Upper GI Symptoms

	N	Percent
Family History		
Gastric Ulcer	2	3.3
Gastritis	2	3.3
Gastroesophageal Reflux Disease	5	8.3
Heart Disease	12	20
Diabetes	29	48.3
Thyroid Disease	6	10
Hypertension	10	16.7
Irritable Bowel Syndrome	4	6.7
Iron Deficiency/Iron Deficiency Anemia	6	10
Other	7	11.7
Present Illnesses		
Gastric Ulcer	0	0
Gastritis	0	0
Gastroesophageal Reflux Disease	2	3.3
Heart Disease	1	1.7
Diabetes	2	3.3
Thyroid Disease	2	3.3
Hypertension	3	5
Irritable Bowel Syndrome	0	0
Iron Deficiency/Iron Deficiency Anemia	2	3.3
Other	6	10
Upper GI Symptoms		
Aching/burning in your abdomen or acid reflux	7	11.7
Nausea	1	1.7
Abdominal gas symptoms	2	3.3
Early satiety or feeling full shortly after you start eating	3	5
General abdominal discomfort	5	8.3

General Health Habits of Sample

Along with identifying the prevalence of *H. pylori*, the purpose of this study was to identify the general health habits of students, faculty, and staff at UCF. Factors such as smoking

status, consumption of caffeine, NSAID use, alcohol intake, handwashing habits, raw sushi or raw meat consumption, and stress levels were analyzed and also compared with the frequency of gastrointestinal (GI) symptoms.

Smoking, Caffeine, NSAID

Smoking status, caffeine consumption, and use of NSAIDs were evaluated through multiple questions on the survey. Smoking status was categorized into nonsmoker, previous smoker, and current smoker. The survey results indicated that 93.3% of participants were nonsmokers, 1.7% of participants were previous smokers, and 5% of participants were current smokers.

In addition, 61.7% of the sample consumed caffeine daily, while 38.3% did not. Further, 51.7% of participants consumed 1-2 caffeinated drinks per day, 6.7% consumed 3-4 caffeinated drinks per day, and 3.3% consumed 5 or more caffeinated drinks per day. Caffeine consumption was compared with GI symptoms to consider any possible differences between the frequency of caffeine consumed and the presence of GI symptoms. There was a slight increase in GI symptoms as individuals consumed more caffeinated drinks per day; however, the sample size in each group was small and did not demonstrate a significant relationship.

Table 4: Caffeine Consumption Compared with GI Symptoms

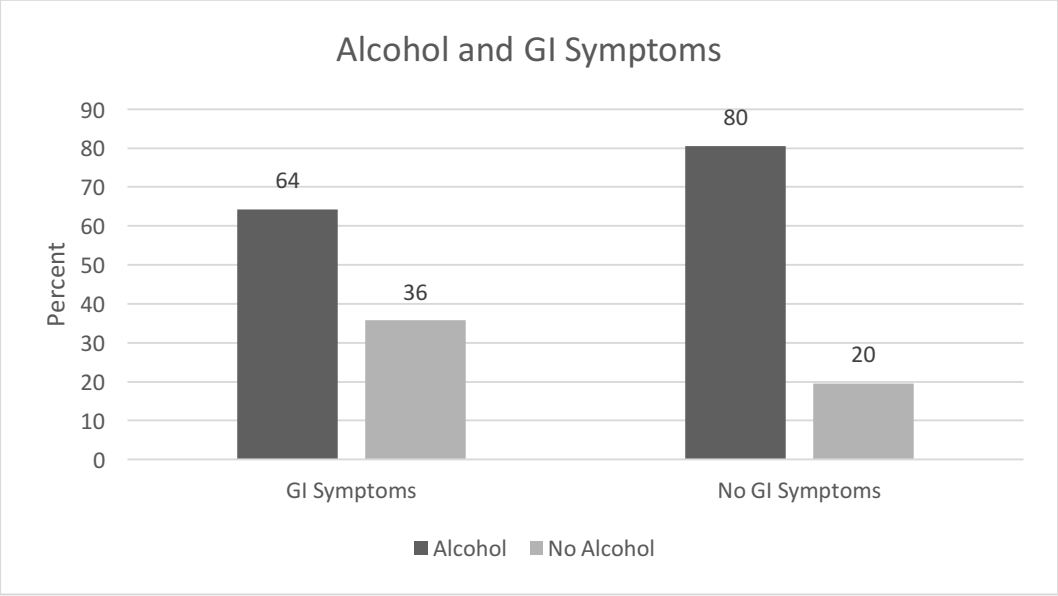
Caffeine and GI Symptoms						
		Caffeinated drinks consumed per day				Total
		0	1-2	3-4	5+	
GI symptoms present:	yes	5	7	1	1	14
	no	18	24	3	1	46
Total		23	31	4	2	60

Regarding NSAID use, 8.3% claimed to use them often, 66.7% claimed rarely, and 25% claimed to never use them.

Alcohol

It was found that 48.3% of females and 25.6% of males consumed alcohol often or occasionally, and 51.6% of females and 65.5% of males consumed alcohol never or rarely. Alcohol consumption was compared with the experience of GI symptoms. The GI symptoms listed on the survey included aching/burning in their abdomen or acid reflux symptoms, nausea, abdominal gas symptoms, early satiety, or general abdominal discomfort. To compare the two groups, the sample was grouped into alcohol drinkers or non-alcohol drinkers, as well as the presence of any GI symptoms or no GI symptoms. The results are expressed in *Figure 1* below.

Figure 1: Alcohol Consumption Compared with GI Symptoms



Handwashing

The frequency of handwashing was investigated by asking participants how often they wash their hands before eating and after using the restroom. Before eating, 30% of participants claimed to always wash their hands, while 70% of participants do not always wash their hands. After using the restroom, 80% of participants claimed to always wash their hands, while 20% of individuals claimed they did not always wash their hands.

Table5: Handwashing Before Eating Compared with GI Symptoms

Handwashing Before Eating and GI Symptoms				
		Do you always wash your hands before eating?		
		no, not always	yes, always	Total
GI Symptoms Present:	yes	8	6	14
	no	34	12	46
Total		42	18	60

Table 6: Handwashing After Using the Restroom Compared with GI Symptoms

Handwashing After the Restroom and GI Symptoms				
		Do you always wash your hands after using the restroom?		
		no, not always	yes, always	Total
GI Symptoms Present:	yes	3	11	14
	no	9	37	46
Total		12	48	60

Raw Food Consumption

Consumption of raw foods such as raw sushi and raw meat were investigated to analyze any associations between *H. pylori* infection or GI symptoms. It was found that 73.3% of the sample consume raw sushi or raw meat rarely, occasionally, or often, while 26.7% of participants never do. No associations were able to be drawn.

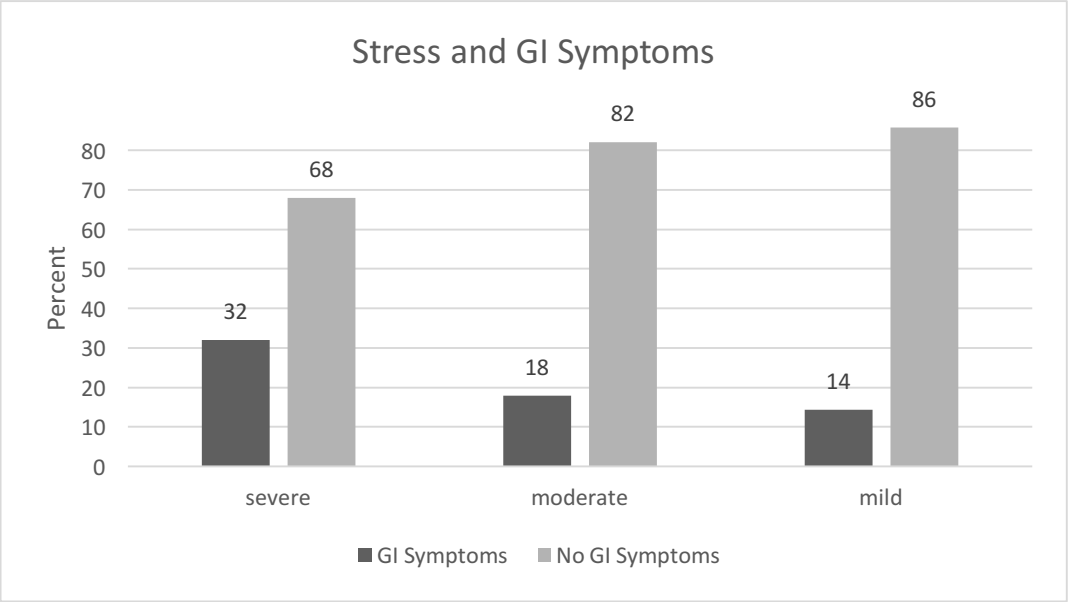
Table 7: Raw Food Consumption Compared with GI Symptoms

Raw Food Consumption and GI Symptoms						
		How often do you consume raw sushi or raw meat?				Total
		Often	Occasionally	Rarely	Never	
GI Symptoms Present	yes	0	5	4	5	14
	no	2	17	16	11	46
Total		2	22	20	16	60

Stress

The amount of stress participants experienced in the last six months was compared with the frequency of GI symptoms experienced. Stress was classified as severe, moderate, and mild. The results are expressed below in *Table 8*.

Figure 2: Stress Compared with. GI Symptoms



Analysis of Variance

An analysis of variance (ANOVA) was performed to compare the means of groups of participants from the study. Proportions of variability were investigated for variables concerning GI symptoms, smoking, caffeine, NSAIDs, alcohol, handwashing, food, and stress. The ratio of explained variance to unexplained variance is represented through the variable F. The factors listed below are those that demonstrated noticeable trends upon initial analysis and were furthered investigated through ANOVA. The factors that did not demonstrate noticeable trends and were statistically significant were not included below.

Effect of Age on GI Symptoms

One-way ANOVA was computed to compare GI symptoms among different age groups. A significant difference was found among the different age groups ($F(6,53)=2.31$, $p<0.05$). Upper gastrointestinal symptoms were converted into a scored system where 0 represents no

reported GI symptoms, and 1-5 represent the number of GI symptoms reported. The mean score below demonstrates the mean amount of GI symptoms experienced by that group.

Table 8: ANOVA for Age Compared with GI Symptoms

	Sum of Squares	df	Mean Square	F	P-value
Between Groups	4.27	6	0.712	2.31	0.047
Within Groups	16.33	53	0.308		
Total	20.6	59			

Table 9: Mean Values of GI Symptom Score for Each Age Group

Age	Mean	N
18-22	0.2439	41
23-27	0.3077	13
28-32	2	1
33-39	0	1
40-49	0	2
50-59	1	1
>59	1	1

Effect of Caffeine on GI Symptoms

A one-way ANOVA compared the mean amount of GI symptoms participants experienced with the presence of caffeine consumption No significant difference was found (F

(3,56)=0.13, p>0.05) between the mean of GI symptoms experienced and amounts of caffeine consumed per day

Effect of Alcohol on GI Symptoms

A one-way ANOVA compared the mean amount of GI symptoms participants experienced with the presence of alcohol consumption. No significant difference was found (F (1,58)=0.86, p>0.05).

Effect of Stress on GI Symptoms

A one-way ANOVA compared the mean amount of GI symptoms participants experienced with the level of stress experienced in the last six months. No significant difference was found (F (2,57)=1.26, p>0.05) between the mean of GI symptoms experienced and the severe, moderate, and mild levels of stress.

Levels of Stress Between Genders

The levels of stress experienced by participants in the last six months were compared between genders to identify any differences. A significant difference was found between genders and the severe, moderate, and mild groups of stress (F (1,58)=5.15, p<0.05).

Table 10: ANOVA for Stress Levels Compared Between Genders

		Sum of Squares	df	Mean Square	F	P-value
Stress levels for past six months	Between Groups	2.168	1	2.168	5.148	0.027
	Within Groups	24.432	58	0.421		
	Total	26.6	59			

Table 11: Stress Levels Over the Past Six Months for Males and Females

Gender		N	Percent
Male	severe	8	27.6
	moderate	16	55.2
	mild	5	17.2
	Total	29	100
Female	severe	17	54.8
	moderate	12	38.7
	mild	2	6.5
	Total	31	100

DISCUSSION

The *H. pylori* infection rate of 1.75% in this study was an unexpected finding. Only one individual out of the 57 tested gave a positive result. The infection rate was expected to be closer to 10%-20%, which would be around 5-11 participants. Because the infection rate was so low, associations were unable to be drawn between *H. pylori* infection and specific risk factors. Several factors may explain why the infection rate was found to be as low as it was. First, the sample size of this study was small, with 57 blood tests administered. With a larger sample size, a more accurate representation of the UCF population could have been obtained. Also, the participants in the study were recruited outside of the College of Health and Public Affairs. It is possible that participants who associate with this building are more likely to care for their health and take daily practical steps to prevent disease.

Although the sample did not perfectly represent the UCF population, it is possible that infection rates have dropped in the United States. Prevalence studies of *H. pylori* have not been very popular in the last 10 years, so it may be true that infection rates have significantly decreased. The discoveries of *H. pylori* and its association with diseases such as stomach ulcers has only been known for the past 35 years. An increase in awareness and treatment efficacy may have caused infection rates to decrease in the United States. This study cannot confirm or deny those possibilities.

The racial distribution of the acquired sample was a relatively accurate representation of UCF's student body, as well as the gender distribution. The majority (68%) of participants were in the age range of 18-22. This was expected, as UCF is composed mostly of undergraduate students. A larger proportion of juniors and seniors participated in the study. This is not

surprising as UCF contains more upper classmen than freshman and sophomores. A small proportion of the sample was composed of UCF staff and faculty. This may be due to the fact that the number of students far outweighs the number of faculty and staff at UCF. Recruitment procedures to include more faculty and staff could have been taken to obtain a better representation.

One goal of this study was to identify any associations between family history, diagnosed illnesses, GI symptoms, and *H. pylori* infection. These associations were unable to be identified due to the small number of participants who tested positive for *H. pylori* infection. Because the infection rate was so low, no association was identified between *H. pylori* infection and age, alcohol, stress, caffeine, NSAID use, raw sushi/raw meat consumption, and handwashing frequency in this sample.

After further analysis with ANOVA, this sample demonstrated a significant relationship between age and the presence of GI symptoms. There was no significant relationship between GI symptoms and alcohol, stress, caffeine, smoking status, NSAID use, raw sushi/raw meat consumption, or handwashing frequency. Although no association was drawn between *H. pylori* and many of the factors investigated, there were noticeable trends between GI symptoms and age, alcohol, and stress.

The group of participants who claimed to abstain from alcohol consumption appeared to have more GI symptoms than the group that did consume alcohol. This trend was not anticipated. Alcohol has been thought to show a protective effect against *H. pylori* infection, but not against upper GI symptoms. Although this trend did present from the data collected, it is important to note that only 23% of the sample claimed to never drink alcohol. Obtaining a larger group of

non-alcohol drinkers would help further identify any relationship between alcohol consumption and GI symptoms.

Stress was another factor that did not demonstrate a significant relationship between levels of stress and GI symptoms, but did present a trend. More specifically, it was found that as higher levels of stress were experienced in the last six months, a higher amount of GI symptoms were reported. This trend was anticipated as stress has been shown to decrease an individual's mental and physical health. More specifically stress has been shown to increase an individual's risk for several different GI diseases including gastroesophageal reflux disease (GERD), peptic ulcer disease, functional dyspepsia, inflammatory bowel disease, and irritable bowel disease [23].

Levels of stress were also compared between male and females and showed a statistically significant relationship. Twice as many females reported experiencing severe levels of stress in the last six months when compared to males.

Limitations

Several study limitations must be considered. The sample size acquired was small, and restricted what could be identified about the study population. The distribution of students, faculty, and staff was skewed, thus limiting equal analysis of all groups. In addition, only one location of participant recruitment was used, so the UCF population was not perfectly represented. Also, this was a cross-sectional study, and although associations can be identified, causal relationships cannot.

By using a survey to assess the participants, there is a possibility that a response bias and misclassification bias are present. Individuals may misunderstand questions or report an answer

that inaccurately reflects what is true of them. Acquiring valid and reliable data through a survey can be particularly challenging.

Further, the screening kit used is not considered diagnostic and possesses some margin for error. It is possible the blood test may report false-positives or false-negatives, of which we would be unaware.

Future Research

Because infection rates among domestic students were so low, and due to the high prevalence of *H. pylori* in many foreign countries, it seems to be of much benefit to repeat a similar study as this among international students at other universities in the United States. As Hillard and Kashup pointed out in their 2016 study, the U.S. is host to many students traveling from nations with high infection rates. Conducting a cross-sectional study among international students may yield higher infection rates and present the opportunity to hone in on certain risk factors in which international students may engage.

More accurate screening methods could also be considered, although, each method has its disadvantages. The antibody blood test used in this study was primarily chosen due to cost, efficiency, and convenience. Using a test such as a C^{13}-urea breath test would produce more accurate results, but takes much longer to perform and would likely contribute to less participation in your study by the population.

CONCLUSION

This study examined the prevalence of *H. pylori* in a unique population. Although the sample size was small, the study sample indicated that *H. pylori* infection rates may have decreased in the last few years, or may be lower in the college-aged individual compared to the rest of the population. Important trends were also identified between age, alcohol consumption, stress levels, and the presence of upper gastrointestinal symptoms. These findings can be used to leverage what is known about *H. pylori* and how steps can be taken to move towards eradication of the bacteria in highly affected areas. This study helped fill the gap found in scientific literature involving up to date prevalence of *H. pylori* in the United States as well as identifying associations between health-related habits and gastrointestinal symptoms in the college-aged population. If future prevalence studies are conducted and infection rates among Americans prove to be considerably lower than other countries, it may be of value to consider how we can offer the best medical care to foreign individuals residing in the United States who possess a high likelihood of *H. pylori* infection.

APPENDIX: SURVEY

Eligibility

1. How old are you?
   A) <18
   B) 18-22
   C) 23-27
   D) 28-32
   E) 33-39
   F) 40-49
   G) 50-59
   H) ≥60

2. Are you, or is there any possibility that you are pregnant?
   A) Yes
   B) No

3. How are you affiliated with UCF?
   A) Undergraduate Student
   B) Graduate Student
   C) Faculty
   D) Staff
   E) Not affiliated
   F) Other

Demographic and General Health

4. What is your gender?
   A) Female
   B) Male
   C) Other

5. How do you usually describe yourself? *(Mark all that apply.)*
   A) White, Non-Hispanic
   B) Black, Non-Hispanic
   C) Hispanic or Latino
   D) Asian or Pacific-Islander
   E) American Indian, Alaskan Native, or Native Hawaiian
   F) Biracial or Multiracial
   G) Other _____

6. If you are a student, what is your status at UCF?
   A) Freshman (1-30 credit hours)
   B) Sophomore (31-60 credit hours)
   C) Junior (61-90 credit hours)

D) Senior (91-120+ credit hours)
E) Graduate or Professional Student
G) Non-Degree Seeking Student

7. Have any of your family members been diagnosed by a healthcare provider with any of the following diseases? *(Mark all that apply.)*
   A) Gastric Ulcer
   B) Gastritis
   C) Gastroesophageal Reflux Disease (GERD)
   D) Heart Disease
   E) Diabetes
   F) Thyroid Disease
   G) Hypertension
   H) Irritable Bowel Syndrome (IBS)
   I) Crohn's Disease
   J) Iron Deficiency/Iron Deficiency Anemia
   K) Other _____

8. Have you been diagnosed by a healthcare provider with any of the following diseases? *(Mark all that apply.)*
   A) Gastric Ulcer
   B) Gastritis
   C) Gastroesophageal Reflux Disease (GERD)
   D) Heart Disease
   E) Diabetes
   F) Thyroid Disease
   G) Hypertension
   H) Irritable Bowel Syndrome (IBS)
   I) Crohn's Disease
   J) Iron Deficiency/Iron Deficiency Anemia
   K) Other _____

9. Do you have any of the following symptoms?
   A) Aching/burning in your abdomen or acid reflux symptoms
   B) Nausea
   C) Abdominal gas symptoms such as frequent burping
   D) Early satiety or feeling full shortly after you start eating
   E) General abdominal discomfort

10. What is your tobacco-smoking status?
    A) Nonsmoker
    B) Previous smoker
    C) Current smoker

11. On average, how many caffeinated drinks do you consume per day?
    A) 0
    B) 1-2
    C) 3-4
    D) 5+

12. How often do you take non-steroidal anti-inflammatory drugs (aspirin, ibuprofen, naproxen, Motrin, Advil, Aleve)?
    A) Often
    B) Rarely
    C) Never

13. How often do you consume alcoholic beverages?
    A) Often
    B) Occasionally
    C) Rarely
    D) Never

14. How often do you wash your hands before eating?
    A) Always
    B) Most of the time
    C) Sometimes
    D) Never

15. How often do you wash your hands after using the restroom?
    A) Always
    B) Most of the time
    C) Sometimes
    D) Never

16. How often do you consume raw sushi/raw meat?
    A) Often
    B) Occasionally
    C) Rarely
    D) Never

17. Within the last 6 months, how would you rate the overall level of stress you have experienced?
    A) Tremendous stress
    B) More than average stress
    C) Average stress
    D) Less than average stress
    E) No stress

18. When you are feeling more than average stress, which of the following applies?
    A) I make worse health-related choices than usual
    B) I make better health-related choices than usual
    C) I make about the same health-related choices

REFERENCES

[1] Marshall, B., & Warren, J. (1984). Unidentified curved bacilli in the stomach of patients with gastritis and peptic ulceration. *The Lancet, 323*(8390), 1311-1315.

[2] Malfertheiner P, Chan FK, McColl KE. (2009). Peptic ulcer disease. *The Lancet*, 374(9699), 1449–1461.

[3] Piazuelo, M.B., Epplein, M, Correa P. (2010). Gastric cancer: an infectious disease. *Infectious Disease Clinics of North America*, 24(4), 853–869.

[4] Cave, David. (1997). How is Helicobacter pylori transmitted? *Gastroenterology,* 113(6), S9-S14.

[5] Magalhães Queiroz, D. M., & Luzza, F. (2006). Epidemiology of Helicobacter pylori infection. *Helicobacter,* 11(S1), 1-5.

[6] Perez-Perez, G. I., Rothenbacher, D. and Brenner, H. (2004), Epidemiology of Helicobacter pylori infection. *Helicobacter*, 9(S1), 1–6.

[7] Rothenbacher, D., & Brenner, H. (2003). Burden of Helicobacter pylori and H. pylori-related diseases in developed countries: recent developments and future implications. *Microbes and Infection,* 5(8), 693-703.

[8] Eusebi LH, Zagari RM, Bazzoli F. (2014). Epidemiology of Helicobacter pylori infection. *Helicobacter*. 19 (S1) 1–5.

[9] Forbes, G., Glaser, M., Cullen, D., Collins, B., Warren, J., Christiansen, K., & Marshall, B. (1994). Duodenal ulcer treated with Helicobacter pylori eradication: seven-year follow-up. *The Lancet,* 343(8892), 258-260.

[10] Sanders, M.K. & Peura, D.A. (2002). Helicobacter pylori-associated diseases. *Current Gastroenterology Reports,* 4(6), 448-454.

[11] Kim, N. (2016). Synopsis of H. pylori-associated diseases. *Helicobacter pylori* (175-185). Singapore: Springer.

[12] Stewart BW, Wild CP. (2014). *World Cancer Report*. Lyon, France: World Health Organization. 19.

[13] Kusters JG, van Vliet AH, Kuipers EJ. (2006). Pathogenesis of Helicobacter pylori infection. *Clinical Microbiology Review*, 19(3), 449–490.

[14] Ozaydin, N., Turkyilmaz, S. A., & Cali, S. (2013). Prevalence and risk factors of Helicobacter pylori in Turkey: a nationally-representative, cross-sectional, screening with the 13 C-Urea breath test. *BMC Public Health,* 13, 1215.

[15] Graham, D. Y., Malaty, H. M., Evans, D. G., Evans, D. J., Klein, P. D., & Adam, E. (1991). Epidemiology of Helicobacter pylori in an asymptomatic population in the United States. *Gastroenterology,* 100(6), 1495-1501.

[16] Nguyen, T., Ramsey, D., Graham, D., Shaib, Y., Shiota, S., Velez, M., Cole, R., Anand, B., Vela, M., El-Serag, H. B. (2015). The prevalence of Helicobacter pylori remains high in African-American and Hispanic veterans. *Helicobacter, 20*(4), 305-315.

[17] Brenner, H., Rothenbacher, D., Bode, G., & Adler, G. (1997). Relation of smoking and alcohol and coffee consumption to active Helicobacter pylori infection: cross-sectional study. *The Bmj*, 315(7121), 1489-1492.

[18] Parsonnet, J., Blaser, M. J., Perez-Perez, G. I., Hargrett-Bean, N., & Tauxe, R. V. (1992). Symptoms and risk factors of Helicobacter pylori infection in a cohort of epidemiologists. *Gastroenterology*, 102(1), 41-46.

[19] Liu, S., Han, X., Sun, J., Chen, G., Zhou, X., & Zhang, G. (2016). Alcohol intake and helicobacter pylori infection: A dose–response meta-analysis of observational studies. *Infectious Diseases, 48*(4), 303-309.

[20] Lee, Y. Y., Ismail, A. W., Mustaffa, N., Musa, K. I., Majid, N. A., Choo, K. E., Raj, S.M., Derakhshan, M.A., Malaty, M.T., Graham, D. Y. (2012). Sociocultural and dietary practices among Malay subjects in the North-Eastern region of peninsular Malaysia: A region of low prevalence of Helicobacter pylori infection. *Helicobacter, 17*(1), 54-61.

[21] Meng, X., Zhang, H., Law, J., Tsang, R., & Tsang, T. (2008). Detection of Helicobacter pylori from food sources by a novel multiplex PCR assay. *Journal of Food Safety, 28*(4), 609-619.

[22] Toussaint, L., Shields, G. S., Dorn, G., & Slavich, G. M. (2014). Effects of lifetime stress exposure on mental and physical health in young adulthood: How stress degrades and forgiveness protects health. *Journal of Health Psychology, 21*(6), 1004-1014.

[23] Konturek, P.C., Brzozowski, T., & Konturek, S.J. (2011). Stress and the gut: pathophysiology, clinical consequences, diagnostic approach and treatment options. *The Journal of Physiology and Pharmacology*, 62(6), 591-599.

[24] Genta, R. M. (2002). After gastritis—an imaginary journey into a Helicobacter-free world. *Alimentary Pharmacology and Therapeutics.* 16(S4)**,** 89-94.

[25] Hillard, J., Kashup, S., (2016). Managing Helicobacter pylori in college health, with special considerations for international students. *Journal of American College Health*, 64(5), 404-408.

[26] Gallucci, A.R., Martin, R.J. & Morgan, G.B. (2016). The consumption of energy drinks among a sample of college students and college student athletes. *Journal Community Health*, 41, 109-118.