



A Closer Lens on Gut Health, Stress, Mental Health in the Middle East: A Focus on Kuwait

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A Closer Lens on Gut Health, Stress, Mental Health in the Middle East: A Focus on Kuwait

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Abstract

Generalized Anxiety Disorder (GAD), is a highly prevalent and disruptive disorder as it is highly resistant to both pharmacological and psychological treatments (Borkovec et al., 2002), and has a high financial burden on both the patient and primary and mental health care (Dibonaventura et al., 2014). While Cognitive Behavioral Therapy (CBT) is considered the most effective treatment to deal with GAD, unfortunately, it is not always effective as less than 50% of the patients showed progress in follow-up assessments (Borkovec & Ruscio, 2001). There is a misconception that anxiety and stress are similar or even associated together; meaning if a person experiences one then by default he/she must have the other. While dealing with anxiety can be stressful, there is a defined fine line between both terms and an unclear relationship besides elucidating similarities in symptoms. The primary purpose of this study is to examine the association between generalized anxiety, stress, and gut health. If there is an association between all three factors, then it is possible that the tools for treating GAD are not entirely psychological but quite possibly a combination of psychological and physiological treatments. This study has been completed in Kuwait by 70 participants ages 18-65 who voluntarily took part in this online study powered by Qualtrics, an online encrypted and password protected survey builder.

Dedication

This thesis is dedicated to my, Tettah Amna Saleem

Acknowledgments

I wish to begin by acknowledging with respect the participants who voluntarily took part in this study, thank you for your time and trust. I would like to express my deepest gratitude to my supervisor, Dr. Stephanie Maddox, for her unwavering support. Thank you for giving me a careful balance of freedom and guidance. I would also like to thank Dr. Adrienne Tierney for providing me with endless opportunities to grow as a writer and a researcher. Thank you both for your invaluable insight, feedback, and discussion. It has truly been a privilege to learn from and work with you.

To my husband, Tarek, thank you for your love and support. I am so grateful to have experienced the highs and lows of this journey with you by my side, and I can't wait to unwrap the next chapter in life together. Finally, unexplainable gratitude to my parents, Nael and Fawzieh. Thank you for your unconditional love and support. Thank you for encouraging Hisham, Yazan, Rayan and myself to follow our dreams even if it meant moving thousands of miles away. You have raised us in a warm, nurturing, humble home and taught us resilience, bravery and kindness. We are because of you.

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Chapter I. About Chapters

There are three chapters in this dissertation. Each chapter will decipher an integral part of this study. Chapter I will explain all chapters proceeding along with introducing definitions of terms that are significant to understanding this study. These terms include: Generalized Anxiety Disorder (GAD), chronic stress, overmedicating, proper nutrition, and gut-brain axis (please find list of terms and definition below).

The second chapter, Chapter II, will include an introduction to the topic and the research's question and hypothesis followed by a literature review overviewing previously published work on Kuwait, and the Gulf Region, to understand Kuwait's residents' attitude and beliefs on mental health, their lifestyle including: physical activity, dietary habits, and usage of medication such as antibiotics. In addition, a cohort study of 25 Kuwaiti participants, examining the gut microbiome is discussed. Chapter Two will also break down the communication between the gut-brain axis; meanwhile explaining the relationship between stress and gut health. This chapter will also look at how factors such as overmedication and poor nutrition affects gut health; whilst reviewing current research on the relationship between gut health and anxiety. All of these subtopics in this chapter are vital for this research as they helped design and understand the research design and methods in chapter three.

The third chapter, Chapter III, will be devoted to this research's design, and methodology. An analysis of the results will be reviewed along with tables and figures to provide a visual analysis. Further, the chapter also includes a discussion deciphering the

results and their analysis in connection to previous research along with future implication and study limitations.

Definition of Terms

Generalized Anxiety Disorder (GAD): GAD encompasses pathological forms of worry and chronic anxiety, which constitutes excessive worry, nervousness, and unease about something with an uncertain outcome (APA, 2013). The uncertainty one feels can be related to health, work, family, relationships, and additional reasons which may be irrational (APA, 2013).

Chronic stress: Sustained threat to the homeostasis of an organism. The threat felt may be real (physical) or perceived (psychological) and posed by events externally or internally (Chandola et al., 2006). Chronic stress may lead to high levels of cortisol (stress hormone) and low levels of serotonin and dopamine, which have been linked to depression (Hannibal & Bishop, 2014).

Overmedicating: The use and prescription of antibiotics and antidepressants, and their effect on the gut microbiota. The health effects of the repetitive use of antibiotics on an individual's rich gut bacteria environment has been widely studied. According to Yoon and Yoon (2018), antibiotics can play a significant role in causing an imbalance of the intestinal microbiota and a reduction in the diversity and abundance of intestinal microbiota. Furthermore, these changes caused by antibiotics are not fully reversed, even after several months of discontinuation of dosing.

Proper Nutrition: In this study, "proper nutrition" will encompass three main areas: food processing (the way food is processed and translated when it is in contact with the gut microbiota), nutrients (protein, carbohydrates, fat, water, vitamins, and

minerals), and bioavailability (how much of these proper nutrients is absorbed) (Ercolini & Fodliao, 2018). These are important factors, as diet plays a vital role in shaping the gut profile and function (Ercolini & Fodliao, 2018).

Gut-brain axis: The bidirectional communication channel between the central nervous system (CNS) and gut microbiota (Clapp et al., 2017). The connection between these two organs is codependent on each other and interchangeable, meaning that a healthy gut leads to a healthy brain and vice versa (Clapp et al., 2017). Interestingly, the human gut contains millions of neurons, which are connected to the brain through the vagus nerves sending signals in both directions (Breit et al., 2018).

Chapter II. Introduction

Generalized Anxiety Disorder (GAD) encompasses pathological forms of worry and chronic anxiety, which constitutes excessive nervousness, worry and unease, about something with an uncertain outcome (APA, 2013). Worries may be related to one's health, family, relationships, financial status, work, or even school. GAD is a highly prevalent disorder; the most current Diagnostic and Statistical Manual of Mental Disorder (DSM) states that GAD has a 2.9% prevalence rate over 12 months among adults (APA, 2013). A disorder this prevalent and disruptive, makes dealing with GAD daunting for two main reasons. First, it is highly resistant to both pharmacological and psychological treatments (Borkovec et al., 2002), and second, it has a high financial burden on both the patient and primary and mental health care (Dibonaventura et al., 2014). While Cognitive Behavioral Therapy (CBT) is considered the most effective treatment to deal with GAD, unfortunately, it is not always effective, as less than 50% of the patients showed progress in follow-up assessments (Borkovec & Ruscio, 2001). Therefore, understanding different mechanisms which can lead to generalized anxiety can be crucial to treating the disorder.

From the research, we now know there is a bidirectional communication channel between the gut and brain called the gut brain-axis (Clapp et al., 2017). As reviewed in Carabotti et al. (2015), several animal studies have eluded that manipulation of the gut microbiota affects the brain neurochemistry via neurotransmitter signaling, and through changes in the level of brain-derived neurotrophic factor (BDNF). Therefore, the gut microbiota regulates diverse brain functions (i.e executive function, cognition, mood,

emotional regulation, stress response, pain and social behavior) by modulating the brain's neurochemical activity (Agusti et al., 2018).

Many studies discuss the vital role of intestinal microorganisms on human behavior. According to Agusti et al. (2018), patients with more than one psychiatric disorder (i.e. depression and anxiety) and neurologic disorders (i.e. autism disorder), are likely to have significant gastrointestinal comorbidities. What has been concluded from past research, is that the majority of the population has inadequate beneficial (or good) bacteria, an abundance of damaging (harmful) bacteria; hence a lack of bacterial diversity (Agusti et al., 2018). Problems in gut health are potentially the result of three things: chronic stress which has the ability to alter and even change the bacterial composition and (Konturek et al., 2011), poor diet causing a lack of proper nutrients, and over-medicating with antibiotics and antidepressants (Blaser, 2011). Through these findings, researchers have been able to identify a relationship between gut health and stress (Duran-Pinedo et al., 2018).

What we have yet to determine and comprehend from research, is the relationship between stress and anxiety through gut health. There is a misconception that anxiety and stress are similar or even associated together; meaning if an individual experiences one, by default, he or she must have the other. However, there is a defined line between both terms and an unclear relationship besides elucidating similarities in symptoms. Someone who experiences anxiety, can also experience continuous and excessive worries which feel impossible to let go of (APA, 2013). On the other hand, stress, depending on its severity, can be defined as a sustained threat to the homeostasis of an organism usually induced by external and internal factors (Chandola et., 2006).

Understanding the relationship between mental health, gut health and stress is the primary purpose of this study. More simply, I propose the following equation: if chronic stress alters gut health, and altered gut health affects mental health, it is safe to assume that stress, anxiety and gut health are inadvertently related via the gut. In essence, I hypothesize a relationship between anxiety, chronic stress and gut health exists. If this is the case, then the supposition can be made that the tools for treating GAD are not entirely psychological but can incorporate a combination of psychological and physiological. Given that chronic stress, pharmaceutical treatments and poor dietary habits foster a negative relationship with gut health. It is possible that a prolonged administration of medicines and a lack of healthy dietary changes can correlate with anxiety as well. Also given that Kuwait currently holds one of the top ten highest obesity rates worldwide, we hope this study will have broader ramifications for other countries experiencing obesity as well.

To understand the association between stress, anxiety and gut health in Kuwaiti residents a minimum of 63 participants between the ages of 18-65 of different backgrounds were needed for this study. Participants are voluntarily asked to take part in the online study powered by Qualtrics, an online encrypted and password protected survey builder. This online study took participants around 25-30 minutes to complete. During this time, participants may take breaks and come back to the study whenever they like. While we cannot promise any benefits to participants or others from taking part in this research, possible direct benefits to participants may include: (a) firsthand experience with learning how psychology research is conducted and having the opportunity to be introduced to new inventories assessing multiple dimensions within the mental health and

wellness industries, (b) awareness of the gut-brain axis, and (c) being part of a research which advocates innovative ways to treat Generalized Anxiety Disorder.

Literature Review

Mental Health in Kuwait. Kuwait is a small, rich Muslim, Arab country in the southwest Asia North African (SWANA) region, bordering the Persian Gulf, Iraq and Saudi Arabia. Kuwait has a population of 4,464,521, of which approximately 1,365,171 are Kuwaiti nationals and 3,099,350 are non-Kuwaiti Nationals (Central Statistical Bureau, 2020). Arabic is the national language, but English is widely spoken, as only 31% of the population are Kuwaiti nationals, and the remaining populace consists of expatriates of Arab and non-Arab backgrounds (Central Statistical Bureau, 2020).

Characteristically, Kuwait has a collectivist, interdependent, and conservative culture. The culture influences traditions, customs and individual behaviors (Almazeedi & Alsuwaidan, 2014). The culture also plays a vital role when it comes to the nuances around mental illnesses, and the stigma attached to mental health in general (Almazeedi & Alsuwaidan, 2014). In Kuwait, mental illness remains stigmatized both internally and publicly, with many choosing to avoid seeking treatment. Corrigan et al. (2001) explains the difference between public and self-stigma. Public-stigma is described as society's active role in imposing prejudicial beliefs onto a particular group, whereas self-stigma is described as the self-induced internalization of societal prejudices in fear of shame (Corrigan et al., 2001). Patel et al. (2007) argue stigma surrounding mental health usually comes from the fear of being unable to find employment, attend or even finish school,

start a family, live independently, or simply being incapable of handling the financial burden of psychological treatment without insurance.

In their article titled Integrating Kuwait's Mental Health System to end stigma: a call to action, Almazeedi and Alsuwaidan (2014) share an anecdote of a young woman who mentions being more comfortable with continuously suffering from her mental illness, rather than going to Kuwait Psychological Medicine Hospital for fear of "tainting" her reputation along with her family's. Her fear was exacerbated by the fact that hospital treatment could be documented on her national health record, which could potentially impact her life from her odds of getting married, to feeling accepted in certain social circles. While research on the extent of stigma in Kuwait has only been anecdotal, peer-reviewed primary sources can be found on stigma found in neighboring and regional countries, with similar cultures to Kuwait.

A research undertaken in Qatar, sought to investigate the attitude towards and knowledge of mental health, and found that 48.3% of the participants believed mental illness to be a punishment from God, and 38.7% thought mental illness was due to possession by an evil spirit (Ghuloum et al., 2010). Meaning that participants associated mental health with religion, whereas a mental health disorder is a byproduct of committing sin. Another study conducted in the United Arab Emirates (UAE) on a sample of 325 parents, showed only 38% of respondents would seek services for their children, even when presented with obvious mental health issues (Eapen & Ghubash, 2004). Given the similarities between these regional locations, it seems worth postulating that while stigmas around mental health would likely be similar in Kuwait, there would also be the added pressure of family reputation, lack of knowledge on the onset of mental

disorders, and strong beliefs in the cross pollination of religion and the onset of psychiatric symptoms.

As previously mentioned, mental health disorders are thought to negatively impact the family's reputation. Consequently, to maintain a family's stature in certain communities, family members who experience mental illness are sometimes hidden in isolation within their own homes by relatives. Dalky (2012) argues families believe this will ensure their safety and discourage them from seeking treatment. Fear and shame have also been found to serve as effective barriers to seeking mental health care. The interdependency and emphasis on family integration within Arab communities, creates room for valuing the prioritization of collective achievements, rather than individual achievement (Okasha, 1999). This means the perception of society (or public stigma) can serve as a primary influence of individual behavior, lifestyle and choices, which can lead them to feel shame. The shame of seeking help then becomes associated with psychological suffering, which can be internalized and reflected not only on oneself, but on one's entire family. Consequently, the stakes for seeking psychological care are weakened.

Hamid and Furnham (2012) also found another factor which can be of concern, when it comes to the negative attitudes towards seeking mental health care. They conducted a study on Arabs living in the U.K., and found that besides fear and shame, a significant portion of participants were concerned about breach of confidentiality. There was concern by participants that if they do decide to see a professional, their mental illness would be shared, and they would be defined by their experiences and illness.

According to Almazeedi and Alsuwaidan (2014), the best possible solution to overcome the negative attitudes towards mental health in Kuwait, would be to make changes in Kuwait's health care system which would not only reduce barriers developed by patients who feel fear or shame, but also normalize the concept of seeking treatment or therapy. For example, breaking down the silos between primary care and mental health providers, and allowing for them to work together in settings residents are comfortable with. While this study is looking at the relationship between mental health, stress and gut health, an anticipated byproduct is to help bridge the gap between mental health providers and primary care doctors to get to the root cause of patient concerns while providing optimal treatment.

While not many research studies have been conducted on mental health prevalence in Kuwait, a few have investigated psychiatric disorders at the primary care level. The first study by Al-Otaibi et al., (2007) investigated the prevalence of depressive disorders and the influence of sociodemographic characteristics on primary healthcare (PHC) settings in Kuwait. Researchers attempted a cross-sectional survey in PHC settings, using the revised Beck Depression Inventory (BDI II) consisting of twenty-one items reflecting the depressive disorder independently, along with a sociodemographic questionnaire including questions such as sex, age, marital status, children, occupation, educational status, chronic diseases and social problems. Their sample consisted of 2,320 patients, of which 1,082 were males and 1,237 were females all within the ages of 21-64 years old. The individuals were of Kuwaiti nationality, randomly selected from 18 PHC centers covering all Kuwait governorates. The results concluded a prevalence of 37.1% (860) participants screened positive for depressive symptoms, with 352 (15.3%) male and

508 (21.7%) female. Of all participants, 163 (7.0%) were severely depressed, 314 (13.5%) moderately depressed, and 383 (16.5%) mildly depressed. Depressive disorder was found to be more prevalent amongst women than men, young than old, more among highly educated individuals, working participants, married individuals and individuals with three or more children. The study suggests that depressive disorder is a highly prevalent condition among the Kuwaiti patients attending PHC settings, but not many of those surveyed are willing to address their depression or seek treatment due to fear and shame.

Another study by Alkhadhari et al. (2016), which also serves as the first cross-sectional epidemiological study carried out in the primary care settings in Kuwait, investigated and identified the potential risk factors for common psychiatric disorders at the primary clinic level. The researchers worked with 1046 patients, with 59% identifying as female and 77% as Kuwaiti nationals. Most of the patients who were reported to have experienced a psychiatric disorder in the study, were older females (with a median age 38.39) of Kuwaiti nationality, with a lower level of education. In general, psychiatric morbidity was found prevalent in 42.3% of 1046 patients of which 33.4% experienced somatization, 23% experienced depression, and 17.7% experienced anxiety disorder. Comorbidity between the three disorders were found in 20.4% of the patients, of which 11% had two of the three psychiatrist disorders and 10.4% had all three. The researchers concluded the rates of psychiatric morbidity were three to five times higher in Kuwaitis than non-Kuwaitis. When compared to similar epidemiological studies using the Patient Health Questionnaire (PHQ) around the world, the 42.3%-point prevalence of psychiatric disorders in this study's sample is significantly higher.

When deciphering the possible explanations for these results outside of cultural and social stigma, researchers have postulated that physicians might be unable to provide psychiatric services due to a lack of training and experience (Almazeedi & Alsuwaidan, 2014). They might find it difficult to diagnose or might overlook some of the symptoms which would signify mental health conditions. Medical practitioners might also struggle with convincing patients that seeing a psychiatrist in a separate location than primary care clinics they are comfortable visiting, will help them with their symptoms. Another reason that might explain these results, and likely why Alkhadhari et al. (2016) highlighted a high rate of somatization disorder, may be that that somatic symptoms are generally considered serious and worthy of attention, while emotional ones are regarded as signs of weakness of personality or as mentioned about weakness of faith. Also, patients experiencing mental illness, might express psychological distress in physical terms, which causes doctors to exhaustively look for diagnoses (El-Islam, 2008). While this might look like a step backward in reducing the stigma around mental health, it is worth considering how physical symptoms can also be attributed to the mind-body connection, specifically how physical stress on the body, gut health and mental health are connected.

The Lifestyle of Kuwaiti Residents

Given that physical illness and vigorous visits to primary care centers are more acceptable, it is easy to presume that research on gastroenterology, diet and the overall physical health of Kuwaiti residents is readily more available. Unfortunately, there is still limited academic research on the subject, which is why this research paper seeks to examine the relationship between, stress, gut health and mental health, taking into consideration the factors which play a significant role in shaping the gut microbiome.

Research on gut health is generally considered a new field of study, both in Kuwait and the region. The next few paragraphs will explore the sedentary lifestyle, diet, and stress levels in Kuwait.

In a study conducted by Alfadhli et al. (2016), the disparity between lifestyle practices and the beliefs of people living in Kuwait, were examined in accordance with evidence-based health recommendations. The research found that the disparity between beliefs and practices were high, especially when comparing against those evidence-based health recommendations (Alfadhli et al., 2016). Meaning the discrepancy or gap between participant beliefs, practices and optimal health recommendations, concluded with a significant finding for future implications. For example, while all participants responded, only 44 participants out of 100 (44%) indicated they dedicated time for regular physical activity (Alfadhli et al., 2016). Of the 44 participants only 20 (20%) reported exercising at the evidence-based level of type, intensity, duration, and frequency consistent with optimal health (Alfadhli et al., 2016). What this concludes is that while some people engaged in physical activity, it was not enough to achieve the benefits that come from physical activity.

Another study by Allafi et al. (2013), looked at adolescent physical activity, sedentary behaviors and dietary habits among Kuwaiti adolescents in a secondary school. The research found that the majority of surveyed Kuwaiti adolescents, particularly girls, do not perform adequate physical activity (Allafi et al., 2013). They spend more time on sedentary activities such as television and/or social media, and often have unhealthy relationships with food and general dietary habits (Allafi et al., 2013). For example, respondents were found to skip breakfast, not eat well-rounded diets (e.g. one which

integrates vegetables and fruits), and would drink sugary beverages more than three days a week (Allafi et al., 2014).

As for those in the professional environment, research concluded that work in the public sector starts early, between seven to eight in the morning (Behbehani, 2014). The nature of these office jobs is described to be sedentary, as most work is done at the desk and employees spend around six hours seated with very minimal movement (Behbehani, 2014). Additionally, social and environmental factors also play a vital role in sustaining this inactive lifestyle (Behbehani, 2014). For example, looking at daily usage of vehicles which could be construed by multiple reasons. The first one is due to climate restrictions, Kuwait experiences excruciating heat where it is nearly impossible to walk outdoors for longer than five minutes, causing people to resort to using private transportation. Second, due to urban planning, the infrastructure is not designed in a way which encourages pedestrians to walk, or even bike (Behbehani, 2014). Another factor for this inactive lifestyle, is the number of labor-saving devices and hand-free services which exist regionally (Behbehani, 2014). It is common for Kuwaiti residents to have housekeepers, drivers, cooks, which limits the individual's motivation or will to move and take on these activities. The lifestyle is highly dependent on residential and recreational service workers, who assist in all primal needs.

Behbehani's (2014) article, discusses multiple studies carried out to determine the cultural factors associated with the adherence of Kuwaiti parents to such lifestyle choices. Behbehani mentions that 60% of the patients in the study were not abiding by recommendations put forth for achieving optimal dietary needs or physical activity.

In terms of exercise, one common reason individuals were not meeting the recommended dose of exercise, is due to their belief that they do not have to fit in exercising. As for dietary recommendations, many found it difficult to follow said recommendations, due to internal struggles around willingness, and external struggles to socially comply with a certain lifestyle diet regimen not practiced socially in the household and in social gatherings. Another plausible reason is that parents are not as involved with their children's regimen, whether it's medical, or related to exercise and/or dietary needs. Looking at these three reasons, one can infer that parents' adherence to a sedentary lifestyle is dependent on prioritization. Social constructs and gatherings seem to hold a higher prioritization than exercise, whilst the dependence on external services, such as nannies and maids help parents focus more on integrating within the social needs.

According to the Kuwaiti National Nutrition Surveillance System (KNSS) annual report (2019), Kuwait currently holds one of the top ten highest obesity rates worldwide. After a statistical analysis, researchers reported that an overall prevalence of overweight and obesity among adults was 78% (Kuwait Nutrition Surveillance System, 2019). The high percentage can be explained by multiple factors to be detailed below, including reduced physical activity, the habit of eating out, and increased consumption of energy dense foods.

As previously referenced, the unhealthy relationship with food and dietary habits such as skipping breakfast, not eating a well-rounded nutritious diet with vegetables and fiber, and overdrinking sugary beverages more than three days a week is common amongst surveyed members of the Kuwaiti population. Another study looking at the relationship between stress and dietary habits also found that when taking into

consideration stress levels, females are significantly more likely to consume unhealthy and energy dense foods, than unstressed females. The analysis confirms, females were 1.75 times more likely to consume fast foods, 2.00 times more likely to snack and 2.28 times more likely to drink sugary beverages, than unstressed female students. (Ahmed et al., 2014) While an explanation of why females are more likely to associate stress with unhealthy eating habits is not provided in this study, the correlation between stress and consumption of unhealthy dietary foods is strong. The relationship between stress and gut health will be explained in the next chapter, whereas other factors contributing to Kuwait's diet culture will be examined in the next paragraphs.

One factor to take into consideration when seeking to explain Kuwait's diet culture and habits, is the readily available services which eases the process of ordering and consuming junk food. Online and mobile food ordering is increasing in popularity among both customers and food establishments. Kuwait now has multiple online services which allow residents and visitors to order food with a few clicks. Services such as Deliveroo, Talabat, and Carriage all operate online, and provide customers the opportunity to experience speed, ease and comfort. In general, the regional habit of consuming fast food continues to grow.

AlMansour et al. (2020) investigates consumer dietary behavior and their developing attitudes towards the online food delivery applications available in Kuwait. In their literature review, the researchers found that around 6 million dollars per day were spent by Kuwaitis in restaurants, and the following year concluded an estimate of more than 5,000 restaurants in Kuwait were visited by over 650,000 people daily (AlMansour et al., 2020). The researchers believed that with these numbers, an exponential growth is

expected to take place in the near future, especially with online food ordering apps who recognize the expenditures being made in restaurants (AlMansour et al., 2020). As a result, more restaurants might be attracted by the service these online applications can provide and will decide to get on board and either switch to or simultaneously offer app-based ordering.

Before the paper examines the negative effects antibiotics have on gut health in the next couple of paragraphs, this paragraph will examine the knowledge, practices and attitudes Kuwaiti residents have towards antibiotics. In their 2015 article, Awad and Abboud (2015) perform a quantitative cross-sectional study to understand Kuwait's public knowledge and attitude towards antibiotics. The study sampled 680 random participants, who agreed to voluntarily take part in the self-administered questionnaire. The questionnaire was divided into three components: 1) participant knowledge (e.g. knowledge on the side effects and the mechanism to how antibiotics work), 2) participant attitude (e.g. how often they finished an antibiotic course and how often they self-medicated by buying antibiotics over the counter), and 3) participant relationships with doctors, and whether prescribing physicians would explain proper use of antibiotics (Awad & Abboud, 2015). Results confirmed a highly prevalent number of inappropriate antibiotics usage, with participants showing limited knowledge, and physicians over-prescribing antibiotics.

When analyzing respondents' knowledge, nearly 47% of participants had no previous knowledge on how antibiotics work, how much should be consumed, or even the normal duration of treatment (Awad & Abboud, 2015). Researchers found that with the 72.8% of respondents who had been prescribed antibiotics within the past twelve

months, only 64% of those respondents completed the full antibiotic course (Awad & Abboud, 2015). When analyzing participant attitudes towards antibiotics usage, the researchers concluded that a little over 25% of the participants used antibiotics without a doctor's prescription to treat seasonal acute common colds, sore throats and coughs. Surprisingly, those who were previously prescribed antibiotics also showed inappropriate attitudes towards antibiotic usage, such as self-medicating. These actions could be explained by participants readily having antibiotics from previous doctor visits or learned habits of previous prescription; meaning that since doctors previously prescribed the medication for similar symptoms, it is the right course of treatment. Within the next couple of paragraphs, the effects that inappropriate usage of antibiotics can have in shaping the diversity of the gut microbiome will be explained.

Meanwhile, only one study analyzing Kuwaiti Arabs microbiomes is available. The research was conducted on a cohort study of 25 recruited Kuwaiti participants, with a gut flora analysis completed, analyzed and discussed by Plummer et al. (2020). Of the 25 participants, a little over half of them were overweight or considered obese, but this is considered normal and relative to the overall Kuwaiti population. All participants were over 18 years old. In the analysis, the two most dominant phyla detected were Firmicutes and Bacteroidetes. Bacteria from both phyla are most commonly found in the gastrointestinal tract, representing most of the gut microbiota population (Stojanov et al., 2020). The phylum Firmicutes mostly made up of probiotics includes some known genera such as *Bacillus*, and *Lactobacillus* (found in yoghurt), and *Ruminococcus* (Stojanov et al., 2020), while the phylum Bacteroidetes includes genera such as *Parabacteroides*, and *Prevotella* (Stojanov et al., 2020). Without getting lost in the

bacteria classification, it is important to understand that a ratio between the two phylas Firmicutes/Bacteroidetes (F/B) has been associated with maintaining a fortified gut microbiome. Any changes to this ratio can be the cause and effect, or even an indicator of different diseases (Stojanov et al., 2020). For example, an analysis which shows an increase or a decrease in the ratio of the phyla species may either lead to obesity or bowel inflammation such Inflammatory Bowel Disease (BDI) (Stojanov et al., 2020).

When taking into consideration the data collected by Plummer et al. (2020), the analysis showed that Bacteroides was the most abundant genus in 22 of 25 participants, specifically the Bacteroides dorei/vulgatus group which was detected in all 25 individuals. Researchers believe this is attributed to the adaptation of the ‘western diet’ which is based on “high dietary intake of saturated fats and sucrose and low intake of fiber” (Statovci et al., 2017). Knowing that a dysbiosis in the ratio of Firmicutes/Bacteroidetes can lead to obesity and cause excess weight, may also be a plausible reason to why the majority of participants were described as being overweight or obese. Now that Kuwait’s residents’ lifestyle and health status has been discussed the next paragraphs will talk about how the mind and body are connected by deciphering the gut-brain axis.

The Gut-brain Axis Explained

The gut-brain axis is the bidirectional relationship between the gut and the brain, and these two organs communicate using multiple channels. Each one of these channels has its own system allowing the communication to take place. The first and most important communication channel is carried through the vagus nerve and the spinal cord, which allows neurons to travel between the gut-brain axis (Bonaz et al., 2018). The

second channel of communication is completed through the immune system, which allows cytokines (protein) to travel through the body (Bonaz et al., 2018). The third channel of communication is operated through the metabolic pathway, which allows amino acids and short fatty acids to transport (Bonaz et al., 2018) The fourth communication channel is operated by the hypothalamic-pituitary-adrenal (HPA Axis) which allows hormones (i.e cortisol) to travel between the gut-brain axis (Bonaz et al., 2018).

Through these four channels, the gut and brain are codependent; the gut transmits signals of information, updating the brain. In return the brain monitors and adapts (Bonaz et al., 2018). This codependent relationship can be further explained by understanding the anatomy of the gut microbiota, the gut nervous system, the vagus nerve, and the communication channel between the gut microbiota and the brain.

The human gut is one of the most fascinating yet complex organs (Shetty et al., 2013). It is home to around ten bacterial microorganisms, with most residing in the colon (Bonaz et al., 2018). It weighs around 1 kilogram (Bonaz et al., 2018), has its own endocrine cells, and consists of about 80% of the body's immune cells (Furness et al., 1999). The gut also has its own nervous system called the Enteric Nervous System, better known as the "second brain" (Bonaz et al., 2018). The Enteric Nervous System (ENS) is one of three main systems which fall under the umbrella of the Autonomic Nervous System (ANS). This system also includes the Sympathetic Nervous System and the Parasympathetic Nervous System (Mayer, 2011; McCorry, 2007). The ANS is also known as the involuntary nervous system, because it controls unconscious and automatic visceral activities to ensure proper body stability (McCorry, 2007). A few of the activities

the ANS takes care of involve heart regulation, digestion, and ensuring normal levels of blood pressure (McCorry, 2007). The ANS itself is subdivided into three nerve systems, the first of which is the Sympathetic Nervous System. The sympathetic nervous system's main function is the “fight-or-flight” responses people may face, when anticipating danger. Symptoms like elevated heart rate, blood pressure, and respiratory rate, are common (McCorry, 2007). The second system is the Parasympathetic Nervous System (voluntary nervous system), which controls activities such as digestion, excretion, and sexual arousal (McCorry, 2007).

The third system is the Enteric Nervous System. It is important to note that the gut has its own nervous system, which operates much like the brain and is independent of the brain. Comparing the ENS to a brain may be an overstatement, however, this vast system of neurons can perform functions independently from the CNS. In other words, the ENS does not depend on the function of the brain to send signals or delegate tasks. As an example, the ENS modulates the exchange of fluids and blood flow in the gut. Or put more simply, once food is ingested, the digestive system converts it to energy and gets rid of the excess by pushing it through the small intestine (Kunze & Furness, 1999). This is done through the contracting and relaxing of muscles in the gut (Kunze & Furness, 1999). The brain does not have to think about this process actively and consciously, because the ENS autonomously holds the domain.

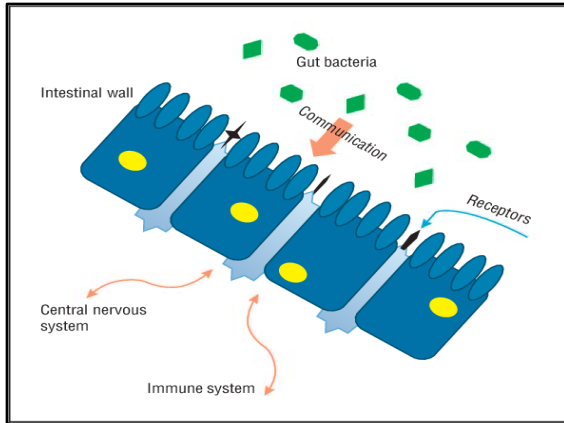


Figure 1. Enteric Nervous System (ENS).

The ENS is considered a nodal point in the communication between the gut and central nervous system. Cells in the gut, known as intestinal epithelial cells, possess receptors (shown in black) which interact with the gut bacteria (shown in green). This interaction initiates signals to the central nervous system through the vagus nerve pathways and the immune system (curved arrows). These signals take place via toll-like receptor pathways (Adapted from Douglas-Escobar, Elliot, & Neu, 2013)

The communication within the gut-brain axis is carried out through the vagus nerve, meaning, the vagus nerve is the most prominent communication channel between the brain and the gut. The vagus nerve stretches from the brainstem and sets its terminals in the colon. Those terminals extend throughout the intestinal wall and communicate with neurons, endocrine cells, and immune cells (Furness et al., 1999). These three spotters reside in the gut mucosa, are in contact with the vagus nerve, which is made up of 80% afferent and 20% efferent neurons (Bonaz et al., 2017). While afferent neurons send messages pertaining the physiological status of the gut and the dietary components to the brain; efferent neurons are responsible for carrying the brain's response to these messages and sending them back to the gut (Bonaz et al., 2017; Breit et al., 2018). The vagus nerve is involved in a variety of processes such as heartbeat

regulation, blood pressure, and its role in digestion, by stimulating the involuntary contractions in the digestive tract (Breit et al., 2018). This gets food from point A (esophagus) to point B (small intestines) with the conversion of food into energy along the way (Breit et al., 2018).

Communication between the Gut Microbiota and the Brain

The gut microbiota and brain connection begin its adaptation early in fetus development. The fetus is exposed to bacteria and microorganisms while still developing in the womb (Liang et al., 2018). This allows the fetus' gut to undergo bacterial colonization through its exposure to the mother's existing gut diversity, as well as their diet. During infancy, the gut microbiota develops and starts to evolve when exposed to environmental factors, including personal hygiene and the use of antibiotics. By the time a child turns two and a half years old, its gut is fully developed and starts to look and function like that of an adult (Quigley, 2013).

During this period of development, the brain is preparing itself to communicate with the gut (Liang et al., 2018). This mutual parallel development influences the development of the brain and the way it carries out behaviors (Liang et al., 2018). As the two parts of this gut-brain relationship develop, the gut microbiota can now regulate and influence the composition and functions of the gut-brain axis (Liang et al., 2018). Any disruption in the development of the gut such as chronic stress, poor diet, or overmedication may hinder this gut-brain relationship (Carlson et al., 2018). According to Carlson et al. (2018), neurodevelopmental disorders and psychological disorders can arise from the abnormal development of the gut microbiota. Thus, understanding how the

various disturbances (i.e. stress, poor diet, and use of antibiotics) can affect the gut will be crucial to understand how stress and anxiety are moderated through gut health.

The Relationship between Gut Health and Stress

Stress and gut health, simply put, are co-dependent. In the past couple of decades, the relationship between stress and gut health has been researched extensively, uncovering two primary findings. First, stress can alter the gut's bacteria (Bridgewater et al., 2017), meaning that while stress was previously considered a mental state, it inherently has physical effects. Second, that the gut influences the body's stress levels, meaning that altered gut health may lead to stress. These two findings are relevant to this study, because they establish the first part of this research equation, which is that the relationship between stress and gut health is co-dependent.

Stress is known as a prerequisite for 70% of chronic illnesses, and while small doses of stress help a person acclimate to environmental cues, prolonged chronic stress (maladaptive changes to human homeostasis by repetitive exposure to stress stimuli) can cause physiological impairments to one's health (Lee et al., 2015). According to Duran-Pinedo, Solbiati, and Frias-Lopez (2018), the type or length of stress experienced may have varied impacts on the body. For example, when comparing acute stress to prolonged stress, exposure to prolonged stress may result in the alteration of the population of bacteria in the gut microbiome (Duran-Pinedo et al., 2018). This alteration can be further explained by understanding the role that cortisol, the stress hormone, plays in the human body.

Cortisol is activated by the central nervous system through the hypothalamus and the pituitary gland, and then released by the adrenal cortex, which is located on top of

each kidney (Duran-Pinedo et al., 2018). The hypothalamus, pituitary gland, and the adrenal cortex communicate together through the HPA Axis. When stimulated by stress, the hypothalamus releases two hormones, Corticotropin-Releasing Hormone (CRH) and Arginine Vasopressin (AVP), which send a message to the pituitary gland to itself release a hormone called Adrenocorticotropin (Duran-Pinedo et al., 2018). As a result, this hormone then activates the adrenal cortex to produce the stress hormone cortisol (Duran-Pinedo et al., 2018).

As with the human sleep cycle, cortisol secretion has its own regulated cycle where cortisol levels in the blood peak during the early morning and gradually start to decrease by the evening (Lee et al., 2015). If this rhythmic cycle is interrupted and the prolonging of high levels of cortisol occurs, a change in the kind of bacteria that live in the gut may occur (Lee et al., 2015). This finding is vital to our research because it proves the first part of the equation, that chronic stress disrupts the gut's bacteria population.

A recent experimental study by Bridgewater et al. (2017) looked at whether stress and obesity can impact the interrelationships between obesity, stress, and gut microbiota. Some mice had their weight increased by a high-fat diet. Other mice were subjected to chronic unpredictable mild stress, such as living in cages with damp bedding for 18 hours or being forced to swim for 5 minutes in cold water. The results of this experiment showed that both a high-fat diet and exposure to stress can affect gut bacteria. Building on the notion that stress affects gut bacteria, this study demonstrates that indulging in a poor diet also plays a key role in the alteration of the gut bacteria which can manifest as a psychological disorder.

Another study by Galley et al., (2014) yielded similar results when they exposed young mice to an older aggressive mouse to mimic a single two-hour exposure to a social stressor. The researchers then assessed the community profile of the microbiota in response to the stressor and their data analysis indicated a measurable change in the microbiota community profile due to the test mice' exposure to social stress (Galley et al., 2014). Similar findings were found by Werbner et al. (2019) who exposed a group of mice to a group of more aggressive mice. However, instead of a two-hour stressor event, these mice were exposed to ongoing stress for 10 consecutive days (Werbner et al., 2019). A control group of mice was left alone for the same time period. As with the previously discussed study, the results showed a clear difference in the bacterial composition of the two groups of mice.

The studies mentioned above all share one thing in common; when the brain senses chronic stress it activates the autonomic nervous system, which is in communication with the enteric system (ENS). Besides causing an individual to 'feel' butterflies in their stomach, a stressed ENS can disturb and damage the composition and function of a gut's bacteria. However, we also know that communication is a two-way dialogue, and that gut bacteria themselves can influence stress levels.

A critical study conducted by Sudo et al. (2004) looked at two groups of germ-free (GF) mice and their responses to stress. One group of mice possessed a recolonized gut, and the other group was treated with probiotics. Through this experiment, they discovered that GF mice with a recolonized gut have an exaggerated HPA axis response to stress, whereas the group of GF mice who were treated with probiotics had a normal response rate. What this study implies is that the microbiota plays an important role in the

development of stress response; meaning that regardless of whether stress or gut health issues come first, they are both able to affect one another.

Additionally, stress can influence the gut microbiota's composition, which, in return, can stimulate the HPA axis to release stress hormones (Cussotto et al., 2018). This means that the microbiota not only has an ability to regulate stress responses, but it is also affected by those responses. While stress can play a pivotal role in altering the gut microbiota, research has also shown that two other factors, namely overmedicating and poor diet, may also contribute to this paradigm shift in neuroscience and psychiatry.

Relationship among Overmedicating, Nutrition, and Gut Health

Stress, and both nutritional and medication intake play essential roles in shaping the microbiome composition and function. In fact, the gut microbiota of a healthy individual differs in the varying sections of the gastrointestinal tract, and changes over time due to aging and the environmental factors of diet, lifestyle, and antibiotic consumption.

As depicted above, nutritional components, such as probiotics, and medicines, such as antibiotics (Blaser, 2011), can affect the vagus nerve activity. Several animal studies provide experimental evidence that the communication between the gut microbiota and the brain is carried through the vagus nerve. According to past research, antibiotics seem to be the most invasive treatment when it comes to gut health (Jakobsson et al. 2010). In a study conducted by Jakobsson et al. (2010), the researchers came to two primary conclusions. The first is that exposure to antibiotics immediately after birth leads to changes in the abundance and diversity of intestinal microbiota (Jakobsson et al., 2010). The second finding showed that antibiotics, regardless of which type had been

used, directly affect the gut microbiota and cause significant changes in certain bacteria, such as Actinobacteria, found in both the throat and feces (Jakobsson et al., 2010). Their study further concluded that even though the diversity of the microbiota started to recover to resemble its pretreatment state, in some cases the microbiota could remain distressed for up to four years post-treatment (Jakobsson et al., 2010). This implies that the overprescribing of antibiotics plays a significant role in influencing the gut microbiota composition. This finding is also important because overmedicating is one of the predictors in this study that will help demonstrate the relationship between stress and anxiety in gut health. Not only does this finding indicate that overmedicating can affect gut diversity, but it also explains how physiological stress (the main predictor of this study) on the body that comes from overmedicating once again can alter the gut microbiota. Therefore, knowing whether overmedicating is also a common predictor when surveying participants becomes necessary.

Along with overmedicating on antibiotics, the types of nutrients entering your body may also impact the gut microbiota. Understanding the anatomy of the gastric intestinal lining, which is made up of very thin layers of cells, is necessary. The intestinal lining acts as a barrier between the gut and bloodstream to prevent potentially harmful substances from entering the body (Mu et al., 2017). One way to think about it is to compare it to a mesh. As food enters the body this mesh filters out all the harmful bacteria. If too much of the harmful bacteria is injected at once then the holes in the mesh start to open up, allowing harmful bacteria to enter causing a leaky gut. A leaky gut, if not treated, may cause illness due to molecules such as bacteria, toxins, or even certain

food particles leaking outward, through the gut lining, and into the intestines, or the thin gut walls, and shocking the immune system (Mu et al., 2017).

As previously mentioned, stress, overmedication, and a poor diet play a pivotal role in altering the composition of the microbiota that may induce psychological disorders. As with overmedication, having a poor diet also puts the body into physical stress, from conditions such as the leaky gut. However, assessing participants' diets are also critical to understanding the relationship between gut health and anxiety. Coherently, stress along with nutrition and overmedication can contribute to the alteration of gut microbiota. which is the first part of the equation to understand the relationship between stress and anxiety. However, it is also vital to understand the second part of this equation, the relationship between gut health and anxiety, to find out whether it plays a key role in the relationship between stress and anxiety.

Relationship between the Gut and Anxiety

For decades, we thought that information flowed downwards from the brain to the gut: our brain told our gut what to do and our gut complied with the orders. Now we know that information between the brain and the gut is interchangeable; meaning that not only is information going downwards but it is also traveling the other way through different communication channels, like the vagus nerve. For example, the previously mentioned vagus nerve runs from one's brain all the way down through the heart, telling the heart to beat, innervates the heart, and lastly parks its terminals in the colon (Câmara & Griessenauer, 2015). This pathway of communication, where information such as bacteria in our gut sends signals upwards too, is very important for this study because it

contributes to the second part of the equation: the gut has the ability to communicate upwards and induce neuropsychological symptoms such as anxiety. This was our primary focus in this study. It means that if gut health, which may have been compromised by exposure to chronic stress, can manifest as a psychological disorder, then the expected results should show a significant relationship between stress and anxiety through gut health.

Studies on the relationship between gut health and its ability to cause anxiety are limited. However, while this is an evolving field of research some research has found that a relationship may be due to two reasons: a leaky gut, and chronic inflammation. One way the gut microbiome can contribute to anxiety is through the development of the leaky gut. Researchers found that a change in the composition of the gut microbiome, can in fact lead to a leaky gut (Mu et al., 2017). As mentioned above, when the lining of the gut is compromised and various pathogens, bacteria, proteins, and toxins start to enter the bloodstream, a leaky gut occurs (Mu et al., 2017). The development of a leaky gut not only causes problems within the gut microbiota, but also disrupts the communication between the central nervous system and the ENS, and as a result, a dysfunction in the gut-brain axis occurs, causing reduced cognitive function and emotional responses (Agusti et al., 2018).

Another way the gut microbiome can contribute to the development of anxiety is through chronic inflammation and inflammation responses. Chronic inflammation occurs when harmful bacteria outweigh beneficial inhabitants (Yarandi et al., 2016). As the harmful bacteria overtake the helpful colonies found in the gut, they dominate, outweigh and consume all the necessary resources needed to sustain a healthy gut (Yarandi et al.,

2016). Once the ‘normal’, or essential bacteria are outweighed, a dysregulation in the body’s inflammatory response occurs, which activates the vagus nerve and impacts brain function (Yarandi et al., 2016). These harmful bacteria can create peptides known as fatty acids that not only convey stress signals throughout the body, but also cause inflammation in the central nervous system, resulting in a miscommunication in signaling which can lead to neuropsychological symptoms (Yarandi et al., 2016). This means that if the gut’s profile is mostly composed of bad bacteria and fatty acid peptides, then the probability of experiencing anxiety or depression is much more likely. Therefore, having a healthy gut is vital and targeting the gut microbiota may lead to greater improvements in patients who are experiencing anxiety or anxiety-like symptoms.

While few studies have been conducted on the direct relationship between gut health and anxiety in specific, numerous studies, regardless of their study design, found that enteric microbiota, which relate to the intestine, have a significant impact on the gut-brain axis (Carabotti et al., 2015). This impact does not only affect the local intestinal cells and enteric nervous system, but also the central nervous system via neuroendocrine and metabolic pathways (Carabotti et al., 2015). This means that the impact goes beyond the intestinal region and ultimately expands to the brain. One experiment conducted by Bravo et al. (2011) looked at the long-term effects of probiotics such as *Lactobacillus rhamnosus* on mice. The results concluded that probiotics caused changes in brain neurotransmitters and revealed shrinkage in anxiety and depressive behaviors.

Another experiment performed on both animals and humans by Messaoudi et al. (2011) found that a probiotic formulation (PF) decreased stress-induced gastrointestinal discomfort. This encouraged the same researchers to study the effects PF had on

anxiolytic-like activity in rats and anxiety, stress, depression, and coping strategies in humans. For the rat studies, the researchers gave their patients PF for two weeks and tested for anti-anxiety agents, using a test called Conditioned Defensive Burying, where rats were shocked by a wire pod, and in response, the rats responded by burying the pod. In humans, they randomized the subjects to either receive a placebo or PF over a 30-day period, and used HSCL-90, HADS, CCL, and UFC as assessments to assess their gut health and overall health. The results yielded a significant reduction of anxiety in rats and alleviated psychological distress in humans. Although the results in rats and humans were not identical, they both imply that supplementing with probiotics can affect the gut composition which may, in turn, manifest as psychological distress and or even anxiety.

Additionally, Desbonnet et al. (2010) assessed the role of probiotics in the rat separation (MS) model. In this model, newborn rats are separated from their mothers and left to grow. This model, frequently used in literature, was used because it is known to reduce the motivation of rats, as opposed to rats that grow with their mother. The researchers got these MS rats and separated them into two groups, with one group given probiotics and the other the control group. They then subjected both groups of rats to participate in a forced swim test to assess their motivation. The researchers measured the number of cytokines (substances secreted by the immune cells) released in the rats' blood samples. They also measured monoamine levels in the brain neurotransmitters that enhance the feeling of pleasure and happiness, and the HPA axis. The results indicated that non-treated MS mice showed less motivation because their swimming behavior was low, low noradrenaline, which is a type of monoamine, and High IL6, which is a

cytokine, indicating that the immune system was secreting high IL6, a sign of distress (Desbonnet et al., 2010).

A case study by Schnorr and Bachner (2016) showed that the consumption of foods containing probiotics has a plausible effect on patients with anxiety. The participants of their study experienced an increase in sleep time after consuming foods containing probiotics for three weeks and a change in gut microbiota after two to three weeks. Their results also indicated a decrease in the patients' Beck Anxiety Inventory scores by the second week.

If we think about a condition like anxiety which is very multifactorial, a plethora of studies yielding results that taking probiotics can help with anxiety is profound. This shows that the gut microbiota, the microbes that live in the gut, are communicating with the brain and play a vital role in the development of psychology. However, one important missing factor which I hope to find while conducting this research is whether there is an association between stress, anxiety, and overall gut health.

While most research studies in this area are done on rodents, relatively few have been conducted to validate these findings in humans. Therefore, this research will focus on deciphering the relationship between stress and anxiety in humans, by administering a questionnaire that covers areas such as stress, gut health, diet, and overmedication on volunteers with self-reported diagnoses in generalized anxiety disorder, participants with self-reported diagnosis in other clinical disorders, as well as non-clinical participants.

Chapter III. Research Method

Participants

Participants in this study are local citizens living in Kuwait between the ages of 18 to 65, as the human digestive system develops during infancy and deteriorates exponentially by the age of 65 (Dumic et al., 2019). The participants included in this study are 17 males and 53 females. All participants are proficient in either Arabic and/or English language. Ethics approval was obtained before we began recruiting participants. The study was advertised through social media: Instagram, Facebook, WhatsApp and Twitter which included study flyers and a link that directed interested participants to the study questionnaires powered by Qualtrics.

According to G*Power 3.1 with an effect size of 0.5, an alpha of 0.05, and a power of 0.80 a, 63 participants were required for this study. The final sample satisfied these requirements. Participants were divided into four groups after data collection was completed based on their self-reported diagnosis in mental health disorders and gastrointestinal issues; along with complimentary self-administered assessments pertaining to mental health, gut health and stress. The four groups participants were categorized in are: participants diagnosed with anxiety, participants diagnosed with depression, participants diagnosed with more than one clinical disorders, and lastly non-clinical participants (participants who have not recorded any diagnosis).

Materials and Measures

The relationship between gut health, mental health and stress will be measured using an online survey administration tool. The questionnaires consist of a predefined

series of questions that were used to collect information from individuals focused on stress, depression, anxiety, medication, lifestyle, and gut health. The primary outcome measures were self-reported measurements of stress, mental health, and gut health. Stress refers to sustained threat to the homeostasis of an organism, while anxiety refers to excessive worries and fear one continuously experiences that feel impossible to let go of, and gut health refers to the balance and function of microorganisms living in the gastrointestinal tract. The secondary outcome measures were medication, lifestyle, and somatic awareness.

Stress.

Participants' stress levels were assessed using the Perceived Stress Scale (PSS) by Sheldon Cohen et al. (1983). The questions in the PSS were designed to measure how unpredictable, uncontrollable, and overloaded respondents find their lives. The scale also includes a number of direct questions on current levels of experienced stress. Scoring is measured through reverse responses (e.g., 0 = 4, 1 = 3, 2 = 2, 3 = 1 & 4 = 0) to the four positively stated items (items 4, 5, 7, & 8) and then the sum across all scale items is calculated. This test does not serve to diagnose but rather give an idea of which category you fall into: low stress, moderate stress, and high stress. The sums are defined by determining how close they are to the maximum number (56) that can be received on this specific scale.

Gut Health.

Gut health was assessed by using the Leaky Gut & Small Intestinal Health Questionnaire by Dr. Jack Tipton and Leeds Short Form (LDQ-SF) Dyspepsia Questionnaire-Short Form (LDQ-SF). Leaky Gut & Small Intestinal Health

Questionnaire (Tips, 2013) is a questionnaire based on questions a practitioner can use to determine if further testing for leaky gut is warranted. This test itself has been distributed to 153 licensed practitioners who use it for screening purposes prior to ordering leaky gut tests from labs. This assessment was chosen because all possible symptoms associated with gut health are included in the questionnaire including questions about nutrition (lifestyle) and overmedication which are both known to alter gut health. Scoring and results are based on how many questions participants answer yes to. A score of 15 or more means that they are highly likely to have a gut health problem. A score of [9 to 14] = Likely, and [8 or less] = may not be a significant factor.

Leeds Short Form (LDQ-SF) Dyspepsia Questionnaire-Short Form (LDQ-SF) was developed by shortening and revising the previously validated LDQ which consisted of eight questions relating to dyspeptic symptoms, and one question about highlighting the most predominant symptom the patient experiences (Moayyedi et al., 1998). It looks at reflux-like symptoms including heartburn and regurgitation; those with predominant ulcer-like symptoms such as epigastric pain; those with predominant dysmotility (impairment of the digestive muscles) symptoms like nausea and those who do not experience any predominant symptoms (Moayyedi et al., 1998). The Leeds Short-Form Dyspepsia Questionnaire scale has excellent internal consistency and reliability with a Pearson coefficient for test-retest reliability of 0.93 and a Cronbach's alpha coefficient 0.90 when the questionnaire was tested for its validity (Moayyedi et al., 1998). Scores are determined by the sum of all questions.

Mental Health.

To assess mental health participants were asked to complete Beck's Anxiety Inventory (BAI) and Beck's Depression Inventory (BDI). The Beck Anxiety Inventory (BAI) was revised and published in 1993 with some changes in scoring (Beck et al., 1993). The inventory consists of 21 items better known as anxiety symptoms. Each item included in the inventory is accompanied by a Likert scale ranging from 0 to 3 and raw scores ranging from 0 to 63. A BAI score of (0 to 7) is classified as minimal anxiety, a score of (8 to 15) is considered mild anxiety, whereas moderate anxiety entails a score ranging from (16 to 25), and severe anxiety (30 to 63) (Beck et al., 1993). The Beck Depression Inventory (BDI), similarly to the BAI, consists of self-report rating inventory that measures characteristic attitudes and symptoms of depression (Beck et al., 1988).

Secondary Measures.

The General Demographic and Medical History Survey was used to measure participants' medication and lifestyle. Participants filled in a general demographic survey that encompasses questions on their overall profile. Whether a participant has been diagnosed with a clinical disorder or not will determine what group the participant will fall under: individuals with anxiety, individuals with other clinical disorders, and non-clinical individuals. Questions include biological sex, age in years, BMI, ethnicity, and level of education. Participants also participated in a general medical history survey that encompasses general questions about previous and current health conditions, psychiatric conditions, medication and supplement history, personal habits, and exercise habits.

Design and Procedure

Participation in this study is voluntary. Participants were recruited online through social media. This study was conducted in Kuwait, a small country located in the Middle East. Participants in this study must be living in Kuwait, and within the age range of 18 - 65 years old. Participants must also be proficient in either Arabic and/or English language. To ensure residence, participants completed an eligibility questionnaire screening for age, residency, and language proficiency. Participants who are eligible were directed automatically to the study survey on Qualtrics, an online encrypted and password protected survey builder.

Following this step, participants who were screened eligible continued with the questionnaire which encompasses the consent form; participants were required to electronically sign off their consent confirming both their willingness to participate and their comprehension of the procedures and purpose of this study. Once participants have completed the consent form, they automatically started the general demographic survey which was followed by the Medical History survey. Upon completion of these two surveys, participants then completed a 25–30 minute questionnaire made up of these 6 inventories: (1) Beck Anxiety Inventory, (2) Beck Depression Index, (3) Perceived Stress Scale (4) Leaky Gut & Small Intestinal Health Questionnaire, (5) Leeds Short Form (LDQ-SF) Dyspepsia Questionnaire -Short Form, and (6) Multidimensional Assessment of Interoceptive.

Once all data was collected participants were divided into three groups based on their self-reported mental health diagnosis. The three groups that participants were categorized in are: participants that self-reported a diagnosis in Anxiety, participants

diagnosed with depression, participants diagnosed with more than one disorder, and lastly non-clinical participants (participants who have not recorded any diagnosis).

For this correlation study, the primary hypothesis of a relationship between gut health, mental health, and stress was assessed using a multiple linear regression analysis using Pearson correlation coefficient on Python's SciPy library. The statistical significance of the coefficient was assessed using a t test.

Chapter IV. Results

Collected Data

Sociodemographic.

Seventy participants of which 17 (24.28%) were biologically male and 53 (75.71%) were biologically female. Ages of participants varied from 18-65 years. Whereas the mean age is 33 years old. As for ethnicity, most of the participants (50; 78.67%) described themselves as Middle Easterners, 3(4.00%) of participants described themselves as North African, 3(4.00%) of participants Asian, 6(8.00%) of Hispanic or Latino origin, 3(4.00%) participants were of white origins. One person preferred not to mention.

Education level.

About 8.0% of participants defined their highest level of education as completing a high school diploma or equivalent; whereas 1.18% completed vocational training; 2.35% attended some college, and 48.23% completed a bachelor's degree. As for post-graduate studies 3.53% did some postgraduate qualification, and around 28.9% completed a master's degree. Only 1.20% completed a specialist degree, whilst 4.82% of participants completed an applied or professional doctoral degree and finally 1.20 % completed a doctorate degree. One participant chose other qualifications such as a Fashion design degree.

Medical History.

Medical history was completed to understand participants' backgrounds and experiences with different medical and psychological conditions; along with the medication/supplements that they have and/or are currently taking. Around 3.90% of the

participants are diagnosed with a sensory impairment (e.g hearing or visual), 9.09% of the participants are diagnosed with a learning disability (common answer ADHD), 19.48% of participants reported a diagnosis with a mental health disorder, and 7.79% of the participants reported a diagnosis in one of the following: Kidney problems, deafness caused by nerve damage, and Tuberculosis. As for medication only 2 participants reported to have currently taken an antibiotic course, whereas 31 reported to have previously taken antibiotics. In general, most participants are currently taking vitamins followed by natural supplements, whereas in the past most or have taken vitamins followed by over-the-counter medication.

Body Mass Index (BMI).

When looking at the data collected to measure participants BMI, the $M=23.44$ were (62.8%) scored a normal BMI score, and (7%) of the sample pool were underweight and around 30.2% were either obese or overweight.

Lifestyle.

Participants' lifestyle was assessed by including questions regarding the average hours spent on sleep per day, the amount of alcohol and cigarettes (including e-cigs) consumed in the past 12 months. Additionally, participants were also asked about the number of hours spent on moderate physical activity per day and week, similarly with rigorous physical activities. How many hours a week are spent working, and how sedentary or active do they consider their work to be.

Participants spent around an average of 7 to 8 hours of a day sleeping. In terms of Alcohol and cigarettes, 33 participants consumed alcohol during the last 12 months of this study, while 15 have not consumed alcohol within the past year, and 22 participants

never consumed alcohol. As for cigarettes, 40 participants smoked in the past 12 months, 13 have not, and 17 never smoked. When looking at hours and days spent on moderate physical activities; 21 (30.0%) participants spent less than one hour doing moderate physical activities such as walking a day; 35 (50.0%) spent 1-2 hours, and 14 (20.0%) spent more than two hours. In terms of the number of days per week spent doing moderate activities, 4 (5.71%) participants spent only one day of the week, whereas 15 (21.43%) spent 1-2 days, and 17 (24.29%) spent 2-3 days and 34 (48.57%) spent more than 3 days away.

When looking at hours and days spent on rigorous physical activities; 35(50.0%) participants spent less than one hour doing moderate physical activities such as walking a day; 30 (42.86%) spent 1-2 hours, and 5 (7.14%) spent more than two hours. In terms of the number of days per week spent doing moderate activities, 16 (22.86%) participants spent only one day of the week, whereas 13 (18.57%) spent 1-2 days, and 19 (27.14%) spent 2-3 days and 22 (31.43%) spent more than 3 days away.

As for work spent at work and the nature of their jobs, almost 66% of the participants spent 35 hour or more at work. As for the nature of their work, 38.57% of the participants described their job as active, whilst 31.43% described their work life to be sedentary. About 11% found their job to be very active involving lots of movement, and 18.57% of the participants found the majority-to-all their work hours spent engaged in sedentary work.

Mental Health Assessments.

To look at mental health, the questionnaire asked participants direct questions regarding previous diagnosis and administered two complimentary assessments (BDI,

BAI). Regarding previous or current diagnoses, 12 participants reported to have anxiety disorder, 4 reported to have depression, and 16 reported to have comorbid disorders, of which all 16 reported to have anxiety and depression, while a few received a third diagnosis. Only 22.86% of the participants who received a diagnosis are currently working with a professional (i.e., psychiatrist, psychologist, or social worker). Of the 32 participants who reported a diagnosis, 16 have been prescribed medication.

As for the BDI 43 participants put 70 obtained a total score between (0-13; minimal range for depression), while 14 participants obtained a score between (14-19; mild range for depression); 9 participants obtained a total score within the moderate range of depression (16-25) and 4 participants obtained a score ranging from (26-63) indicating they have been experiencing severe depression.

When breaking down the data for the BAI, 20 participants obtained a total score between (0-7) indicating a minimal range for anxiety, while 14 participants obtained a score between (8-15; mild range for anxiety); 18 participants obtained a total score within the moderate range (16-25) and 18 participants obtained a score ranging from (26-63) indicating they have been experiencing severe anxiety.

Stress.

When assessing participants' perceived stress, to get an idea of which category they would fall into, (low stress, moderate stress, and high stress), the sum of their scores were taken into consideration. Of the sample population of this study 12 participants scored between the ranges of (0-18), whereas 46 participants received a score between (19-37) and 12 participants received a score between (38-56). Their level of perceived stress is defined by determining how close they are to the maximum number (56).

Gut Health.

Along with asking participants directly about their experiences with gastrointestinal issues two complimentary assessments were administered. The Leaky Gut Questionnaire and The Short-Form Leeds Dyspepsia Questionnaire. For the Leaky Gut Questionnaire most participants scores reported are enough to warrant a further testing for leaky gut, as 70% of participants scored highly likely, whereas 22.5% scored concluded that it may not be a significant factor, and 32.5 % of the participants scored a moderate score of likely to be a factor of leaky gut. When looking at Short-Form Leeds Dyspepsia Questionnaire, most participants experienced mild dyspepsia, whereas 22.85% of participants experienced moderate symptoms; 7% experienced severe symptoms; 28.57% experienced very mild symptoms of dyspepsia, and only 17.5% have not experienced any dyspeptic symptoms.

Group 1. Participants diagnosed with Anxiety

The first group included participants who were diagnosed with anxiety by a specialist. A number of 12 participants received a diagnosis. As a complimentary assessment the BAI was administered on 12 participants which 3 obtained a total score between (0-7; minimal range for anxiety), while 2 participants obtained a score between (8-15; mild range for anxiety); 4 participants obtained a total score within the moderate range (16-25) and 3 participants obtained a score ranging from 26-63 indicating they have been experiencing severe anxiety. Out of the 12 participants 5 reported gastrointestinal issues.

On the leaky gut questionnaire 8 participants earned a highly likely score which indicates that symptoms they reported are enough to warrant a further testing for leaky gut, while 2 participants earned a “likely” score; and 2 were found to have insignificant symptoms to require further testing for leaky gut. As for the Lead Dyspepsia Questionnaire (which looks at severity and common symptoms of dyspepsia such as indigestion, heartburn, regurgitation, nausea) most participants reported to have “very mild dyspepsia”; 3 participants were found to have never experienced any symptoms of dyspepsia, whereas 2 participants experienced “mild dyspepsia”, 2 experienced “moderate dyspepsia” and 1 experienced “severe dyspepsia”.

When assessing their lifestyle and nature of work 1 out of 12 described their worklife to be very active, 6 described their work-life being active and 4 mentioned their worklife to be sedentary. As for perceived stress, participants were categorized by their scores into three groups, where only two were applicable for this group of participants. None of the participants received a low stress score, 9 fell in the moderate stress category, while 3 fell in the high stress category.

Group 2. Participants diagnosed with Depression

The second group included participants who were diagnosed with depression by a specialist. Of 70 participants 4 participants reported a diagnosis. As a complimentary assessment the BDI was administered on 14 participants which 1 obtained a total score between (0-13; minimal range for depression), while 2 participants obtained a score between (14-19; mild range for depression); 1 participant obtained a total score within the

moderate range of depression (16-25) and none of the participants obtained a score ranging from (26-63) indicating they have been experiencing severe depression.

Out of the 4 participants 1 reported gastrointestinal issues. On the leaky gut questionnaire 3 participants earned a “highly likely” score, while only 1 participant earned a “likely” score; and none were found to have insignificant symptoms to require further testing for leaky gut. As for the Lead Dyspepsia Questionnaire each participants obtained a different score, all indicating some experience of dyspepsia; only 1 is experiencing “very mild dyspepsia”, whereas 1 participants experiences “mild dyspepsia”; 1 experiences “moderate dyspepsia” and 1 experiences “severe dyspepsia”.

When assessing their lifestyle and nature of work 2 out of 4 described their worklife to be active, 1 described their work-life being sedentary, and 1 mentioned their worklife to be very sedentary. As for perceived stress, participants were categorized by their scores into three groups, where only two were applicable for this group of participants. None of the participants received a low stress score, 4 fell in the moderate stress category, while 1 fell in the high stress category.

Group 3. Participants with Comorbidity of Mental Health Disorders

The third group includes participants who have more than two mental health disorders by a specialist. Of 70 participants 16 participants reported a diagnosis of more than one mental health disorder. To complement the diagnoses both the BDI and the BAI were assigned to all 16 participants. When looking at participants’ experience with depression, 5 obtained a total score between (0-13; minimal range for depression), while 3 participants obtained a score between (14-19; mild range for depression); 5 participants

obtained a total score within the moderate range of depression (16-25) and 3 participants obtained a score ranging from (26-63) indicating they have been experiencing severe depression. As for the BAI, none of the participants obtained a total score between (0-7; minimal range for anxiety), while 3 participants obtained a score between (8-15; mild range for anxiety); 3 participants obtained a total score within the moderate range (16-25) and 10 participants obtained a score ranging from 26-63 indicating they have been experiencing severe anxiety.

Out of the 16 participants in this group 12 reported gastrointestinal issues. On the leaky gut questionnaire all 16 participants in this group earned a “highly likely” score. As for the Short Leed Dyspepsia Questionnaire participants scores varied between the severity and frequency of their symptoms. Most participants in this group ,7 participants, experience mild dyspepsia; only 2 experience “very mild dyspepsia”, whereas 5 participants experience “moderate dyspepsia”; and lastly, 2 experiences “severe dyspepsia”.

When assessing their lifestyle and nature of work 5 out of 16 described their work-life to be active, 5 described their work-life being sedentary, and 3 mentioned their work life to be very sedentary, and 3 described it as “very active”. As for perceived stress, participants were categorized by their scores into three groups, where only two were applicable for this group of participants. None of the participants received a low stress score, 11 fell in the moderate stress category, while 5 fell in the high stress category.

Group 4. Participants Who Have No Known Clinical Disorders

The fourth group includes participants who have no known clinical disorders by a specialist. Of 70 participants 38 participants did not report any clinical diagnoses. The BDI and the BAI were assigned to all 36 participants. When looking at participants' experience with depression, 28 obtained a total score between (0-13; minimal range for depression), while 7 participants obtained a score between (14-19; mild range for depression); 2 participants obtained a total score within the moderate range of depression (16-25) and 1 participant obtained a score ranging from (26-63) indicating they have been experiencing severe depression. As for the BAI, 17 participants obtained a total score between (0-7; minimal range for anxiety), while 10 participants obtained a score between (8-15; mild range for anxiety); 7 participants obtained a total score within the moderate range (16-25) and 4 participants obtained a score ranging from 26-63 indicating they have been experiencing severe anxiety.

Out of the 38 participants in this group 15 reported gastrointestinal issues. On the Leaky Gut Questionnaire 22 participants earned a "highly likely" score, while 9 participants earned a "likely" score; and 7 were found to have insignificant symptoms to require further testing for leaky gut. As for the Lead Dyspepsia Questionnaire 4 participants have not experienced any dyspepsia symptoms. Out of 38 participants, 12 experience "very mild dyspepsia", whereas 12 participants experience "mild dyspepsia"; 8 experience "moderate dyspepsia" and 2 experience "severe dyspepsia".

When assessing their lifestyle and nature of work 14 out of 38 described their work life to be "active"; whilst 4 described it to be "very active", meanwhile 11 described their work-life being sedentary, and 4 mentioned their work life to be "very sedentary". As for perceived stress, participants were categorized by their scores into three groups. Only 1

participant received a low stress score, 31 fell in the moderate stress category, while 6 fell in the high stress category.

Statistical Analysis

As a part of the analysis the goal is to determine the correlation between the gut health and the self-assessments that the participants conducted. The results in (Table 1) show that the results of gastric problems are correlated with the results of the leaky gut questionnaire with a Pearson coefficient of $r = 0.3402$ and a $p = 0.004$. Furthermore, the results of the LDQ questionnaire result showed a correlation with gastric problems with a $r = 0.2749$ and a $p=0.0222$. However, the correlation between the PSS questionnaire and reporting a gastric problem did not show a statistical significance as the p-value and the Pearson correlation is [$p=0.2262$; $r = 0.14758$].

Table 1. Relationship between Gastrointestinal Problems and Self-assessments.

Reported Gastrointestinal Problems vs Self-assessments	Coefficient	p value
Leaky Gut Questionnaire	0.340271528	0.004226147
Leeds Short Form (LDQ-SF) Dyspepsia Questionnaire	0.274911114	0.022248082
Percieved Stress Scale	0.147581513	0.226222173

This table displays an overview of the relationship between gastrointestinal problems and self-assessments that measure gastrointestinal symptoms and perceived stress.

A multiple linear regression analysis to investigate the relationship between a diagnosis of anxiety (BAI), gut health (Gastro Problems, Leaky Gut Questionnaire, LDQ-SF) and stress (PSS) was conducted. Significant regression equation for predicting anxiety using $(F(6,43)=2.257, p<.05)$, with an R^2 of 0.239519 is:

Predicted anxiety is equal to $0.352854 + 0.003618$ (Gastro Problems) - 0.15354 (LDQ-SF) + 0.019758 (Leaky Gut Questionnaire) - 0.11061 (PSS) + 0.203613 (BDI) + 0.133099 (BAI).

Gastro Problems is coded as 0 = No, 1= Yes. The LDQ-SF is coded as 0 = No, 1= Very Mild, 2 = Mild, 3 = Moderate, 4 = Severe. The Leaky Gut Questionnaire was coded as 0 = May Not be a Significant Factor, 1= Likely, 2 = Highly Likely. As for the 0 = Low stress, 1= Moderate Stress, 2 = High Stress. Both the BDI and BAI are coded as 0 = Minimal, 1= Mild, 2 = Moderate, 3 = Sever.

Table 2. Regression Analysis for Participants with an Anxiety Diagnosis.

<i>Regression Statistics</i>	
Multiple R	0.489406
R Square	0.239518
Adjusted R Square	0.133405
Standard Error	0.401612
Observations	50

<i>ANOVA</i>					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	6	2.184413	0.364	2.257	0.055589
Residual	43	6.935586	0.161		
Total	49	9.12			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>p-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 80.0%</i>	<i>Upper 80.0%</i>
Intercept	0.352854	0.199772	1.766	0.084	0.050024	0.755733	0.092840	0.612868
Gastro Problems	0.003617	0.123969	0.029	0.976	0.246390	0.253626	0.157735	0.164970
LDQ	0.153536	0.066221	2.318	0.025	0.287083	0.019988	0.239726	0.067346
Gut	0.019758	0.092651	0.213	0.832	0.167092	0.206608	0.100833	0.140349
PSS	0.110610	0.155309	0.712	0.480	0.423821	0.202601	0.312753	0.091532
BDI	0.203613	0.099997	2.036	0.047	0.001949	0.405276	0.073461	0.333764
BAI	0.133098	0.072788	1.828	0.074	0.013693	0.279891	0.038360	0.227837

Regression analysis performed to identify the relationships between a given diagnosis of anxiety and the self-assessments test performed by people. Each coefficient represents how much a given assessments contributes into classifying if the person has a diagnosis or not.

A multiple linear regression analysis to investigate the relationship between a diagnosis of depression (BDI), gut health (Gastro Problems, Leaky Gut Questionnaire, LDQ-SF) and stress (PSS) was conducted. A significant regression equation was found ($F(6,35)=1.2648$, $p<.2985$), with an R^2 of 0.178191. Participants predicted Depression is equal to $-0.051 - 0.21607(\text{Gastro Problems}) + 0.03737(\text{LDQ-SF}) + 0.055945 (\text{Leaky Gut Questionnaire}) + 0.051546(\text{PSS}) + 0.075429 (\text{BDI}) - 0.01582 (\text{BAI})$, where Gastro Problems is coded as 0=No, 1= Yes, and LDQ-SF is coded as 0 = No, 1= Very Mild, 2 = Mild, 3 = Moderate, 4 = Severe, and Leaky Gut was coded as 0 = May Not be a Significant Factor, 1= Likely, 2 = Highly Likely, and PSS coded as 0 = Low stress, 1= Moderate Stress, 2 = High Stress, and BDI is coded 0 = Minimal, 1= Mild, 2 = Moderate, 3 = Severe, and BAI is coded 0 = Minimal, 1= Mild, 2 = Moderate, 3 = Sever. None of the Independent variables produced a significant predictor of depression.

Table 3. Regression Analysis for Participants with a Depression Diagnosis.

<i>Regression Statistics</i>	
Multiple R	0.42212
R Square	0.17819
Adjusted R Square	0.03730
Standard Error	0.29150
Observations	42

<i>ANOVA</i>					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	6	0.644882	0.1074	1.2648	0.29855
Residual	35	2.974166	0.0849		
Total	41	3.619048			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>p-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 80.0%</i>	<i>Upper 80.0%</i>
Intercept	-0.051	0.161017	0.3167	0.7533	-0.37788	0.27587	-0.26132	0.159319
Gastro Problems	-0.21607	0.102817	2.1014	0.0428	-0.4248	0.00734	-0.35037	-0.08177
LDQ	0.03737	0.054464	0.6861	0.4971	-0.0732	0.14793	-0.03377	0.108512
Gut	0.05594	0.076746	0.7289	0.4708	-0.09986	0.21174	-0.0443	0.156192
PSS	0.05154	0.116643	0.4419	0.6612	-0.18525	0.28834	-0.10081	0.203906
BDI	0.07542	0.076897	0.9809	0.3333	-0.08068	0.23153	-0.02502	0.175872
BAI	-0.01582	0.056838	0.2783	0.7824	-0.13121	0.09956	-0.09006	0.058424

Regression analysis performed to identify the relationship between a diagnosis of the depression and the self-assessments completed by participants. Each coefficient represents how much a given assessment contributes into classifying reported disorders.

A multiple linear regression analysis to investigate the relationship between having more than one mental health disorder (BDI & BAI), gut health (Gastro Problems, Leaky Gut Questionnaire, LDQ-SF) and stress (PSS) was conducted. A significant regression equation was found ($F(6,47)=5.170165$, $p<.000$), with an R^2 of 0.397598. Participants predicted Mental health disorders is equal to $-0.10742 + 0.156066$ (Gastro Problems) -0.0467 (LDQ-SF) $+ 0.080023$ (Leaky Gut Questionnaire) $+ 0.012285$ (PSS) $+ 0.069079$ (BDI) $+ 0.167851$ (BAI). Coded exactly the same as the previous two regression analysis in this study. The two independent variables Gastrointestinal Problems and BAI produced a significant predictor of having comorbidity of mental health disorders.

Table 4. Regression Analysis for Participants with More than 1 Diagnosis.

<i>Regression Statistics</i>	
Multiple R	0.63055
R Square	0.39759
Adjusted R Square	0.32069
Standard Error	0.37988
Observations	54

<i>ANOVA</i>					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	6	4.476659	0.7461	5.1701	0.0003752
Residual	47	6.7826	0.1443		
Total	53	11.25926			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>p-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 80.0%</i>	<i>Upper 80.0%</i>
Intercept	-0.10742	0.195226	0.550	0.584	0.5001627	0.28532	-0.36118	0.14634
Gastro Problems	0.15606	0.118136	1.321	0.192	0.0815929	0.39372	0.00251	0.309622
LDQ	-0.0467	0.063459	0.735	0.465	0.1743626	0.08096	-0.12919	0.035785
Gut	0.08002	0.095212	0.840	0.404	0.1115198	0.27156	-0.04374	0.203782
PSS	0.01228	0.129547	0.094	0.924	0.2483307	0.2729	-0.1561	0.180673
BDI	0.06907	0.074044	0.932	0.355	0.0798778	0.21803	-0.02716	0.165323
BAI	0.16785	0.067106	2.501	0.015	0.0328508	0.30285	0.080625	0.255077

The higher the coefficient is the more the assessments contribute to the classification process.

Chapter V. Discussion

General Discussion

The purpose of this research study was to find out whether a relationship exists between, mental health disorders, gut health, and stress in Kuwait. The sample population of this study was conducted on 70 participants from diverse backgrounds. To mimic the Kuwaiti population, which 3,099,350 of its population are non-Kuwaiti nationals, this study was distributed at random to participants of diversified demographics, lifestyles, ethnicities, & backgrounds. The sample's average BMI was calculated to determine whether the sample size fits, as around 70% of Kuwait's population is reported to be either overweight or obese. Contradictory to previous research, most of the participants (62.8%) scored a normal BMI score, and 7% of the sample pool were underweight.

In terms of lifestyle, attitudes and beliefs towards medicine we were surprised to see that many of the participants are currently taking natural supplements, whereas the prevalence of previous antibiotics usage was not surprising and aligned with previous studies mentioned in the literature review (Awad and Abboud, 2015). As for the percentage of the participants who experienced a minimal range of anxiety vs severe anxiety was similar to previous literature, which is not surprising considering that 28 participants out of 70 reported an anxiety disorder diagnosis. However, some participants who scored high on the BAI did not report a diagnosis which may mean that they either: 1) still adhere to the stigma around mental health, 2) mistake it for a somatic disorder, or 3) were simply feeling anxious at the time of taking the assessment. For stress it comes to no surprise that 46 participants are feeling moderately stressed, given that the study was administered during a global pandemic. When looking at gastrointestinal issues 33

participants reported to have experienced gastrointestinal issues said yes. The linear regression statistical analysis showed no significant relationship between anxiety, stress, and gut health or between depression, stress, and gut health. The hypothesis was rejected, as a relation was not indicative.

However, a relationship between having comorbidity of mental health disorders and gut health was found when a multiple linear regression analysis to investigate the relationship between having more than one mental health disorder (BDI & BAI), gut health (Gastro Problems, Leaky Gut Questionnaire, LDQ-SF) and stress (PSS) was conducted. All the participants in group three reported to have both depression, anxiety diagnosis. While the BDI was not a significant factor the BAI had a $P=0.0159$ which concludes to be a significant predictor. This means that the participants who reported to have anxiety and depression also scored high on the BAI, and reported experience gastrointestinal discomfort. While we cannot infer a causation or be sure of a direct relationship, this finding is relevant in other research studies that concluded a relationship between mental health and gut health, wherein a compromised gut health can manifest as anxiety-like symptoms (Yarandi et al., 2016). Meaning that even if we do not have consensus on a direct relationship between gut health causing an anxiety disorder, it may be that having a compromised gut health can manifest into feelings of anxiety. Similar to Agusti et al. (2018) findings which concluded patients with more than one psychiatric disorder (i.e., depression and anxiety) are likely to have significant gastrointestinal comorbidities. However, we may benefit from further research within the region and specifically Kuwait on the effects gut health has on our body and vice versa in terms of the effect mental health has on our body. While a little over 45% of the participants

recorded a mental health diagnosis, stigma surrounding mental health still exists in the region, and a solution as mentioned above by Almazeedi and Alsuwaidan (2014), the best possible solution to overcome the negative attitudes towards mental health in Kuwait, would be to make changes in Kuwait's health care system, which would not only reduce barriers developed by patients who feel fear or shame, but also normalize the concept of seeking treatment or therapy (i.e. bridging the gap between primary care and mental health providers).

Research Limitations and Future Implications

The aim of this study was to find out whether there is correlation between mental health, gut health, and anxiety. I believe the findings of this study will hopefully provide a comprehensive understanding of the different mechanisms that can lead to our understanding of how anxiety is developed or be treated. Which in return can be a steppingstone in finding an affordable yet more effective treatment for those that have GAD or are suspected of having GAD. Even though the study did not conclude a direct relationship between anxiety, gut health, and stress, a significant relationship was evident between those who have comorbid disorders and self-reported gastrointestinal problems. I urge people working in the field of psychology to direct their patients with GAD, to gastroenterologists or primary care physicians to rule out any underlying issues. I also believe a bigger sample may result in more findings in the future. Furthermore, as with every study, there are some limitations. Limitations that may interfere with the study are misleading information from self-reporting, a participant from the general population having a psychological disorder without knowing or prefers to hide due to stigma

surrounding mental health within the region, and the possibility of people not wanting to partake in a study related to their personal mental well-being and health.

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