1.0 Introduction
In order to maintain good health and prevent disease, doctors and national health campaigners emphasize the importance of adequate nutrition and regular physical activity. In mainstream media and social circles, health is synonymous with eating well and exercising. However, there are other intangible factors that don’t receive the same attention yet they can have a profound effect on the body. Among these, stress is one factor that can single-handedly cause or promote health problems.

The topic of my dissertation is psychological stress as a cause of digestive health problems and the far reaching implications this has for an individual given its prevalence in today’s world. Despite a healthy diet and exercise, stress has the potential to disrupt normal functioning of the digestive system, which in turn can disrupt other bodily functions manifesting as headaches, fatigue, malaise, constant bloating and low energy. These symptoms are experienced by the vast majority of individuals approaching Complementary and Alternative Medicine (CAM) modalities such as Naturopathy. In more chronic cases, stress can become a direct or indirect causal link, e.g. Irritable Bowel Syndrome and Ulcerative Colitis. I will also be touching on public health campaigns and how the message they are currently sending is incomplete. A good diet along with good digestion is the complete message and stress management is an important factor in maintaining good digestion. Health campaigns can successfully be used to raise awareness of this connection.

I believe this paper will be of interest to any person from any background because digestive health lies at the centre of an individual’s well-being. The digestive system is the only means by which we nourish the body to keep the rest of the systems functioning. The other primary function of the digestive system is to serve as the protective barrier between harmful bacteria and the rest of the body. Interestingly, seventy percent of the body’s immune system is contained in the gastrointestinal tract. Therefore, protecting this system from disruption, especially due to stress, is critical to good health.

2.0 What is stress?
According to the American Institute of Stress (2013), the definition for stress was first presented by Hans Selye in 1936. He described it in the following words, “the non-specific response of the body to any demand for change”. Selye had conducted various studies using animals and putting them through various physiological and psychological challenges that created stress. In all the studies, he concluded that the animals showed similar pathologic changes of stomach ulcerations, shrinkage of lymphoid tissue and enlargement of the adrenals. Not before long, he established that constant stress could cause these animals to develop various diseases similar to those seen in humans, such as heart attacks, stroke, kidney disease and rheumatoid arthritis.

Despite the above, a black-and-white definition of stress remained subjective and Selye went on to clarify the types of stress so as to show that it does not necessarily have a negative connotation. A certain amount of stress is considered healthy for humans. However, beyond that level it can become disruptive to health as shown in the diagram below:

The Global Organisation for Stress (2013) also states that there is no formal definition of stress and presents six different definitions on their website. It mentions the researcher Tom Cox who concluded in 1985 that the concept of stress is subjective because it is not adequately defined. The overall meaning is well comprehended by the medical community but the official clinical definition is not.

Let us look at the six definitions presented:
1. Kernerman English Learner’s Dictionary (1986-2008): “the worry experienced by a person in particular circumstances or the state of anxiety caused by this”.
2. Merriam-Webster Online Dictionary (2009): “a physical, chemical, or emotional factor that causes bodily or mental tension and may be a factor in disease causation…and a state resulting from a stress is one of bodily or mental tension resulting from factors that tend to alter an existent equilibrium”.
3. Encarta® World English Dictionary [North American Edition] (2009): “strain felt by somebody: mental, emotional, or physical strain caused, e.g. by anxiety or overwork. It may cause such symptoms as raised blood pressure or depression”.
4. American Heritage® Dictionary of the English Language (2009): “a mentally or emotionally disruptive or upsetting condition occurring in response to adverse external influences and capable of affecting physical health, usually characterized by increased heart rate, a rise in blood pressure, muscular tension, irritability and depression”.
5. Gale Encyclopaedia of Mental Disorders (2003): “stress is a term that refers to the sum of the physical, mental and emotional strains or tensions on a person. Feelings of stress in humans result from interactions between persons and their environment that are perceived as straining or exceeding their adaptive capacities and threatening their well-being. The element of perception indicates that human stress responses reflect differences in personality as well as differences in physical strength or health”.
6. Wikipedia: “stress is a biological term which refers to the consequences of the failure of a human or animal to respond appropriately to emotional or physical threats to the organism, whether actual or imagined. It is the autonomic response to environmental stimulus…it includes a state of alarm and adrenaline production, short-term resistance as a coping mechanism, and exhaustion. Common stress symptoms include irritability, muscular tension, inability to concentrate and a variety of physical reactions, such as headaches and elevated heart rate”.

So when it is not clearly defined, how does one manage stress? As noted by the diagram presented earlier, when an individual starts to experience exhaustion and ill-health they have probably stretched themselves too far. However, it is worth noting here that the already subjective definition of stress falls prey to one’s perception. What one individual perceives as stressful, another may perceive as stimulating. The American Institute of Stress agrees and gives the example of the roller-coaster ride. It can be a thrilling experience for some and a distressing experience for others but most importantly, as far as control over their situation is concerned, both of these two groups have the same degree of control (or lack thereof) over their safety. Yet their perceptions and expectations are varied.

Another notion worth exploring here is that stress is very prevalent in the society today. Here are some statistics from the Global Organization for Stress:
- Stress is a top health concern for U.S. teens between 9th and 12th grade. Psychologists say that if they don’t learn healthy ways to manage that stress now, it could have serious long-term health implications – American Psychological Association.
- Stress levels in the workplace are rising, with 6 in 10 workers in major global economies experiencing increased workplace stress with China (86%) having the highest rise in workplace stress – The Regus Group.
- Alarmingly 91% of adult Australians feel stressed in at least one important area of their lives. Almost 50% feel very stressed about one part of their life – Lifeline Australia.
- 80% of workers feel stressed on the job and nearly half say they need help in learning how to manage stress. 42% say their co-workers need such help – American Institute of Stress.
- Australian employees are absent for an average of 3.2 working days each year due to stress. This workplace stress costs the Australian economy approximately $14.2 billion – Medibank.
- An estimated 442,000 individuals in Britain, who worked in 2007/08, believed that they were experiencing work-related stress at a level that was making them ill – Labour Force Survey.
- Approximately 13.7 million working days are lost each year in the UK as a result of work-related illness at a cost of £28.3 billion per year – National Institute for Health and Clinical Excellence.

### 3.0 Physiological effects of stress on the digestive system
Research shows that stress affects the digestive system in more ways than one. Before we explore these, it important to understand that digestive health and the immune system are simultaneously connected.
The digestive tract is the collection of organs that takes in food, digests it to extract energy and nutrients and expels the remaining waste. In addition to the digestion of food, one of its other primary functions is to defend against harmful bacteria and infections. In an average adult, the gastrointestinal tract is 28 feet long, and contains seventy-percent of the body's immune system. The immune system is made up of special cells, proteins, tissues and organs which defend the body against invasion of harmful bacteria and germs, infections and diseases. One of the immune system's primary defences is the good bacteria, known as intestinal microflora, which prevent the overgrowth of potentially harmful bacteria in the intestines and also form a barrier on the intestinal wall so that harmful bacteria and germs cannot enter into the blood and lymph systems.

Based on the above, in order to have a properly functioning immune system, one must have a healthy digestive system. Maintaining a healthy balance of intestinal microflora is one of the best ways to build and enhance digestive health and thus the immune system. The composition of microflora differs from person to person and depends on age, diet and environment and this is where stress can play a crucial role.

According to Bailey & Coe (1999), stress can result in shedding of good microflora. They conducted a study of primates after the stress of maternal separation and noted that the experience altered the integrity of indigenous microflora for several days, inhibited gastric acid release, altered motility of the gastrointestinal tract and increased duodenal bicarbonate production. All this, in turn, led to good microflora detaching itself from the walls and shedding through the tract. The shedding was confirmed by the presence of the microflora in the faeces of the animals. Another study of Soviet cosmonauts conducted by Lizko (1987) confirmed this for humans much before Baily & Coe where it was observed that when the cosmonauts returned from space flight, which can be a stressful experience, their faeces had high concentrations of good microflora, namely Lactobilli and Bifidobacteria. For the record, shedding of good microflora lowers the defence system and greatly decreases resistance to pathogenic organisms.

According to another study conducted by Drummond (1997), it was demonstrated that stress can lead to the suppression of mucosal immunity. The study involved ninety children across the ages of eight to nine. Half the sample was a control group in good health and the other half were children that had recurring cases of cold and flu, a typical characteristic of a weak immune system. Stressful life events were found to be the case for those who had low salivary concentration of sIgA, a substance which can be used to measure mucosal immunity, thereby diminishing resistance to intestinal colonization by pathogenic organisms. Student populations were tested before and after examinations in another study led by Jemmott (1989). Results indicated that salivary concentrations of sIgA fell considerably leading up to the stress associated with exams and returned to normal afterwards. During the time they were low, there was a heightened possibility for colonization by harmful bacteria to occur.

According to Holderman (1976), human faecal flora changes were noted in response to anger or fearful situations. It was concluded that when stress induces such responses, there is no doubt an alternation in the intestinal environment.

Stress has also been associated with enhanced survival of pathogens. Certain neurochemicals released by the brain have the ability to directly enhance the growth of pathogenic organisms according to Ernst & Lyte (1992) who have demonstrated through their research that, “Exposure to stress has been documented to result in dramatic and sustained increases in catecholamine levels. This high concentration of catecholamines, especially norepinephrine, may result in increased growth of PPMs (Potentially Pathogenic Microorganisms) in the intestines”. The mechanism behind this is known as the Gut-Brain-Axis – the signalling pathways from the central nervous system to the gut that trigger gut defence properties. This will be explored further in the next section.

According to Caso et al. (2008) stress can lead to the development of gastric ulcers, altered gastrointestinal motility and ion secretion, increased permeability leading to the passage of antigens to the lamina propria and bacterial translocation. Stress can also synergize with other pathogenic factors such as Helicobacter pylori, anti-inflammatory drugs and colitis inducing chemicals to produce gastrointestinal disease. Moeser’s (2009) research on pigs has demonstrated that the immunological barrier components are under neuroendocrine control and therefore can be altered by stress.

According to Harelak and Myers (2004), alterations in the bowel flora and its activities are now believed to be contributing factors to many chronic and degenerative diseases. Irritable bowel syndrome, inflammatory bowel disease, rheumatoid arthritis, and ankylosing spondylitis have all been linked to alterations in the intestinal microflora. The intestinal dysbiosis hypothesis suggests a number of factors
associated with modern Western living have a negative impact on the microflora of the gastrointestinal tract, including psychological stress.

The implications of the above are far reaching. Lazarides (2012) stresses on the importance of digestion and preventing any disruptions to it, "It is the first and foremost principle of natural medicine that good health begins not just with a good diet but with good digestion". If digestion is not optimal, as is the case due to stress, fewer nutrients are absorbed due to alteration of the intestinal environment. When nutrients are lacking, the production of digestive enzymes gets affected which in turn continues to undermine digestive ability. As undigested food particles travel through the digestive system where undesirable bacteria seize and consume it, it is not long before this cycle starts to reinforce itself. Undesirable bacterial populations begin to multiply and colonize parts of the intestine where there should be none. These bacteria potentially become a cause of inflammation, inhibiting functions of the intestinal walls. They start producing harmful by-products known as endotoxins that can enter the blood stream through an inflamed gut wall.

Some of these toxins can interfere with the nervous system and with energy production through the Krebs cycle while others can manifest as lethargy. The many symptoms of endotoxins include nagging headaches, behavioural disturbances, malaise, inappropriate drowsiness, weakness and fatigue. In severe cases, where these symptoms are chronic, the individual may end up with a much more acute condition such as Chronic Fatigue Syndrome. As more and more toxins and undigested food particles escape from the 'leaky' gut walls, the liver can become overloaded with detoxification work and the adrenal glands can become overworked as they attempt to control the inflammatory reactions. Lazarides (2012) goes on to explain, "Undigested particles can travel around the bloodstream and settle into the body’s tissue spaces, where they become known as ‘metabolic sediment’. This sets the scene for lymphatic obstruction, impairment of microcirculation, impairment of cell oxygenation and nutrient/waste transport and chronic activation of the immune system – the start of autoimmune diseases”.

4.0 A Naturopathic perspective

In the previous section, we explored research that provided evidence for certain physiological effects associated with stress. These observations are in fact a manifestation only. From a naturopathic perspective, it is the interplay between the nervous system and the digestive system that lies in the backdrop of these observations. A couple of the researchers, namely Moeser (2009) and Ernst & Lyte (1992), touched briefly on a holistic approach to help explain how exactly stress could result in disruptions in the digestive system. They referred to this as the Gut-Brain-Axis. The human nervous system controls functioning of the entire body through various functional sections all of which are deeply interrelated (De Graff & Rhees, 2010). To gain a high level understanding, let us look at these sections:

1. Central nervous system consists of the brain and spinal cord and is protected by bone.
2. Peripheral nervous system consists of nerves that are long fibres connecting the brain and spinal cord to the rest of the body. This is further broken down into:
   a. Somatic nervous system which is under conscious control and is used for voluntary action.
   b. Autonomic system which is under subconscious control and is responsible for homeostasis – the scientific term for maintaining equilibrium of bodily functions regardless of external factors, e.g. controlling cardiovascular, digestive and respiratory functions. It further consists of:
      - Sympathetic nervous system that reacts to stress and prepares for danger while halting processes for growth and repair.
      - Parasympathetic nervous system that brings the body to calm for rest and digestion of food, while halting processes for handling action, danger or stress
      - Enteric nervous system which is the local nervous system of the gastrointestinal tract.
   Team Chiropractic (2007) draws a helpful analogy to the sympathetic and parasympathetic systems describing the sympathetic division as the accelerator and the parasympathetic division as the brake. Needless to say, when the subconscious mind perceives stress, the Sympathetic Nervous System or SNS is activated. The SNS is best known for mediating the neuronal and hormonal stress response commonly known as the ‘fight or flight’ response. Messages from SNS can trigger changes in different parts of the body simultaneously including decreases in the motility or movements of the large intestine and diverting blood flow away from the gastro-intestinal tract via the Enteric Nervous System. There are many other examples of changes triggered by SNS to help the body respond to the threat (e.g. dilate
pupils, increase heart rate) but the point worth noting here is that it is through the Sympathetic and Enteric Nervous systems that digestion gets affected by stress. On the other hand, when person is free of stress the Parasympathetic Nervous System or PNS is activated. This is also known as the 'rest and digest' system that conserves energy as it slows the heart rate, increases gut motility, and relaxes sphincter muscles (like the iris of the eye, or the muscles that close off the stomach) throughout the body. It stimulates salivary gland secretion, accelerates gut motility, mediates digestion of food and indirectly the absorption of nutrients. In other words, it promotes optimal digestion.

It is also worth discussing here the role of Hydrochloric Acid or HCl. Typically, when food is consumed HCl is secreted in the digestive juices of the stomach while a mucus lining and circulation of blood protects the stomach wall from this highly acidic substance. The end-to-end digestion of food takes place across several organs including the mouth, oesophagus, stomach, small intestine, the large intestine, rectum and anus. The entire process takes huge amounts of energy. When the individual is stressed and the body activates the SNS, digestive processes are halted in an effort to conserve energy. As result, salivary secretions are reduced, blood flow is directed away from the stomach, digestive juices including HCl are under secreted and the mucus lining secretions are also reduced. In the absence or lack of sufficient HCl, known as hypochlorhydria, the whole digestive function is compromised as it is the main agent of gastric juices excreted in order to break down food and process it for nutrient absorption. Low HCl results in undigested food particles, which may become antigenic contributing to a leaky gut, food sensitivities and autoimmunity. According to Aquila (2009), another major role of HCl is to assist digestion further down the gastrointestinal tract by acting as an antiseptic in the stomach. This occurs through actually killing microorganisms that enter the body through food consumed. This function of HCl is of critical importance in order to prevent occurrences of yeast, bacterial, viral and parasitic infections. The incidence of stress has the potential to inhibit the secretion of HCl and thereby promote the survival of such organisms.

On the other hand, too much HCl, known as hyperchlorhydria, can also do significant damage. The findings by Caso et al (2008) regarding gastric ulcers could potentially be explained by the presence of excess HCl. The suppression of stomach acid during a stressful period eventually results in a rebound effect later on. As explained by Sundene (2009), digestive juices including HCl “will only be suppressed for so long before the body produces more in a natural feedback loop”. The under secretion of HCl creates a high pH in the stomach not conducive to digestion and when the stomach recognises this, it over compensates for this by producing excess HCl to lower the pH even at times when it is not required, e.g. in between a meal or during sleep. Many individuals may experience this after an especially stressful day in the form of acid reflux as their body finally relaxes and has the opportunity to produce stomach acid. However, the secretion of the protective mucus coating is not in corresponding proportion to this and as a result, the corrosive stomach acid becomes too strong for the stomach wall. It is also likely that the over secretion of HCl is at odds with blood flow circulation at that time such that the flushing away of HCl is not adequate. Such a scenario would potentially result in excess HCl build-up that will start to break down the stomach lining in the same way that it attacks food resulting in an ulcer. As evident from the above, both the excess and lack of HCl can be detrimental to the processes that lie at the centre of digestive health.

Other than the Gut-Brain-Axis, there is another factor that could have played a role in some of the observations seen in the previous section. Cortisol is one of the primary hormones involved in the response to stress and when this is released, it lowers the activity of the immune system in the blood. It does this by preventing T-cells from replicating. T-cells promote the production of white blood cells that are the main agents of the immune function activated to fight antigens. With the immune defences down, pathogen populations are able to grow and thrive more easily than would otherwise be possible – another finding confirmed by research. An imbalance in micro flora populations can take place due to prolonged stress and it is driven by the exponential growth of undesirable bacteria when the body’s defences are down.

The above explanations are an attempt to connect the dots and back-track the interplay between stress and digestion. A vast body of research has already established an association between these two and so it helps to think about what steps can be taken to mitigate the damaging effects of stress.

5.0 Public health campaigns and their potential
One of the ways to change the behaviour of a large number of people is to engage in communication campaigns. “Communication campaigns are an organized communication activity, directed at a particular population for a particular period of time, to achieve a particular goal” (Snyder, 2007). National health communication campaigns have been used by many countries to address health issues and Snyder’s research shows that such campaigns can successfully change behaviours. Based on the above, national health campaigns can be a very effective tool for bringing stress management into the limelight as a health issue. This can help to close the current gap observed in the developed world. The mainstream message is to consume a good diet and exercise. The missing element is good digestion and factors that influence digestion such as stress are an important consideration. While there can be many agents other than stress that affect digestion, they are outside the scope of this discussion.

In the developing world, national health boards are still preoccupied with ensuring the basic foundations for a health system. For this reason, this study is only looking at public health campaigns in the developed world. To appreciate the current gap in such communications, let us look at the campaigns focussed on a good diet and physical activity presently running in the western nations.

Campaigns focussed on consuming a good diet place a direct emphasis on the benefits of eating fruits and vegetables. There are different variations of the same campaign in the following countries:

- Australia – “Go for 2 and 5” a campaign which aims for two servings of fruit and five servings of vegetables every day.
- England – “5 A Day” campaign which aims for a total of five 80 gram helpings of fruit and vegetables per day.
- New Zealand – “5+ A Day” campaign which aims for five handfuls or more of fruits and vegetables every day.
- United States – “Fruits & Veggies – More Matters” campaign which aims for half the plate at every meal to comprise fruits and vegetables.
- Canada – “Fruits and Veggies – Mix it up!” campaign which provides a daily servings guide by age and gender.

There are also campaigns around staying active and making physical activity a part of daily life:

- Australia – A Healthy & Active Australia
- Canada – Eat Well and Be Active Toolkit
- England – Get a Life, Get Active
- New Zealand – Push Play
- United States – Go4Life

It would be fair to say that there is a lack of main-stream campaigns that highlight the importance of good digestion and stress management as a substantial preventative measure for health and well-being. The National Stress Awareness Day held annually in the UK with its 14th occurrence in November 2012 is perhaps an exception in the sense that it brings some awareness even though its focus is on work-related stress only.

According to Snyder (2007) the average health campaign affects the intervention community by about 5 percentage points and nutrition campaigns for fruit and vegetable consumption have been more successful on average than for other health topics. This shows that the general public is keen to make the difference. He also states that nutrition campaigns that pay attention to the specific behavioural goals of the intervention, target populations, communication activities and channels, message content and presentation and techniques for feedback and evaluation are more likely to change behaviours. Hence evidence suggests that communication campaigns can be used as an effective tool to emphasize the importance of good digestion and its link with total well-being and stress management.

6.0 Conclusion

In order to survive, we all need energy and to get energy we must consume nutrients. After digestion and absorption, nutrients are distributed and taken up or assimilated by the cells of the body’s various tissues. So if an individual with no other health complications ensure adequate nutrient intake, it is likely that the various systems of the body will function optimally. This statement is incomplete based on the above insights. It is not enough to provide all the necessary nutrients – one must also ensure that these nutrients are getting absorbed and any potential harmful elements are getting blocked from entering the
blood stream. As evident from the studies mentioned, stress can undermine this process independently of any other factors through the Brain-Gut Axis.

Many practitioners in the Alternative and Complementary Medicine (CAM) field regularly come across individuals, whose health problems are, in substantial part, a manifestation of their mental well-being, digestive problems being a primary example. The CAM industry has grown 62% in Australia since 1993 and similar findings have been made in the United States and Great Britain (Coulter & Willis, 2004). It is an interesting trend to note and how it corresponds with the fact that stress levels have also become more prevalent in the modern world during the same period.

The Institute for Complementary and Natural Medicine (2013) proposes a fundamental explanation for the above as follows, "Most therapies have a holistic approach which believes that health flows from the harmonious balance of our physical, psychological and spiritual states. A disruption in any of these spheres can impact on one or both of the others." This is exactly what has been confirmed by research cited in this paper demonstrating the disruptions caused by stress.

The impact of stress on the digestive system is unmistakable and it has far reaching implications for an individual’s health and well-being. Given the prevalence of stress in today’s society, there is now more than ever a need to give the complete message on healthy living in addition to good diet and active lifestyle and that message is that optimal digestion needs to be maintained with a particular emphasis on stress management as a means to preventing disruptions. This message can be delivered successfully in the developed world via carefully designed national health campaigns.

7.0 References


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