

Biology and Anxiety

Yugum Chaudhary, Sejal Malik

Abstract— Anxiety is one of the major issues in the 21st century. It has no fixed pattern or source and can happen to anybody at any age. When it comes to biology, numerous evidences can be seen till date which links biology to anxiety. The boundaries between biology and behavior are arbitrary and changing. Even though a clear link between inflammation and anxiety has been established. But when we see a larger picture, it is not the inflammation that leads to anxiety but the oxidative stress on the brain that leads to the activation of the anxiety system. An anxiety condition isn't developed or caused by a single factor but a combination of things. In this paper we did a survey on a large population to study the effect of various physiochemical factors on anxiety. We used Beck's anxiety inventory to test the level of anxiety in various people. Our test showed that out of the 137 people tested, 58% of people were in a low anxiety range, 23% had moderate anxiety, and 19% had high anxiety. Our study proved that people who sleep for less than 6 hrs showed high levels of anxiety when compared with people who sleep for more than 8 hrs. We also studied many more factors such as Caffeine, Yohimbine, Insulin, Carbon dioxide and carbon monoxide, Alcohol usage, Oxidative substances. The biological relation between these factors and anxiety have been explained further in the text that follows. In addition, we have also discussed about all the biochemical factors.

Index Terms— Anxiety, Biochemistry, Biology, Brain chemistry, Human psychology, Neural Inflammation, Neuropsychology.

1 INTRODUCTION

Nowadays, anxiety is a big issue faced by a lot of people. When asked about anxiety, we get a plethora of responses with each response varying from each person asked. Symptoms of anxiety vary from person to person.

The following examples gives us an insight on the way anxiety is experienced in different ways by different people: -

CASE 1- Rohan is a 25-year-old computer engineer, who constantly works under great stress and pressure. He is a believer that all this stress and hypertension will give him success in life. Recently, when he was grabbing some groceries from the local store, he began to sweat profusely and his heart started to race, for him it felt like he was losing control of his very own body. After this firsthand experience, he again faced these conditions on a variety of occasions.

CASE 2- Sanjana is a 47-year-old chartered accountant, she is constantly worrying about her life and her future. either she is concerned about not doing well in her job or what will happen to her pretty face with increasing age? She just can't seem to control her worries.

CASE 3- lastly, we have Jake, he is an engineering student in one of the prestigious institutes, he experiences anxiety early in the morning which gradually fades away as the day kicks in with him being extremely busy in his day to day chores.

All these examples have made clear that anxiety has no fixed pattern, it has a variety of symptoms and one can face anxiety at any stage of their lives. There can be numerous definitions to what anxiety is but in layman terms it is our body's natural response towards excessive stress.

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2 DIFFERENT TYPES OF ANXIETY DISORDERS

2.1 Generalised anxiety disorder

It is the most common and is characterized by excessive worry about everyday things, which normally are not a source of constant dread for most other people.

2.2 Obsessive Compulsive Disorder (OCD)

It is another type which results in repeated, unwanted thoughts and rituals that interfere with everyday living.

2.3 Panic Disorder

It is characterized by panic attacks. Panic attacks are sudden waves of terror in which your body may convulse, you may experience difficulty breathing, and you may think you are dying. Panic attacks usually subside after about half an hour, but they can leave you feeling fatigued and unable to continue with your day.

2.4 Post-Traumatic Stress Disorder (PTSD)

It can develop after you have experienced something out of the ordinary that has "shocked" your world. You may relive this event in the form of daydreams or nightmares, and you may be unable to conduct normal affairs due to the bouts of anger and depression.

2.5 Social Anxiety Disorder

This one can leave you unable to leave your house for fear of being judged by others. Not only is it difficult for people with a social phobia to maintain friendships, but it may also be hard to hold down a job, go grocery shopping, or even collect mail from the mailbox.

3 ANXIETY IN THE HUMAN BODY

The human body is an amazing and very complex organism. The intricacies of our bodies, especially our brains, are presumed to be involved in the origins and maintenance of anxiety disorders. It is mainly caused due to the chemical imbalances in our brain. Anxiety and neurobiology have been linked since the start of the 18th century and numerous evidences can be seen till date which links both of them. The boundaries between biology and behavior are arbitrary and changing. Since not enough research has been done showing links between biology and anxiety. With time as we develop more knowledge on this topic, modern psychiatry will change drastically and will have a more biological approach.

The problem of anxiety may initiate as early as birth. At birth, there are noticeable temperamental differences. The reason behind these differences are genetic in origin. Some babies are affected by stress more than other babies. These differences do not disappear as the child grows but they may enhance with time. People born with these extra-sensitive temperaments are at a greater risk in developing anxiety-related disorders. People with these extra-sensitive temperaments may experience greater intensity, frequency, and duration of anxiety symptoms, than people with less-sensitive temperaments.

Through all the research papers published till date on this topic, we are able to find a clear link between inflammation and anxiety. For a long time, inflammation in the CNS was largely considered as a bleedover of peripheral immune responses to pathogens invading the CNS or an element of some type of CNS autoimmune diseases. It was generally believed that the blood-brain barrier (BBB) prevented access of immune cells to the brain and, as a result, the immune system and CNS were believed to be relatively independent of each other. This view of inflammation is now drastically changed. It has become quite clear that BBB permeability is modulated, and trafficking of peripheral macrophages and leukocytes into the brain parenchyma occurs in a tightly regulated manner and helps promote brain homeostasis and prevent neuronal death [1]

When we see a larger picture, it is not the inflammation that leads to anxiety but the oxidative stress in the brain that leads to the activation of the anxiety system. Interestingly it has been shown that, induction of oxidative stress via a non-pharmacological method also leads to anxiety-like behavior in rats. In another study, oxidative stress in the adult rat hippocampus was reported to be anxiogenic amenable to pharmacological intervention. Increasing evidence suggests a central role for oxidative and nitrosative stress elicited via generation of reactive oxygen species (ROS) and reactive nitrogen species (RNS), in a variety of congenital and acquired disorders of the central nervous system (CNS). [1]

Moreover, it also is now well established that cytokines modulate neuronal activity in specific brain regions such as the amygdala, hippocampus, hypothalamus, and the cerebral cortex. It is quite apparent that psychological stress, infection, or inflammation within the brain or the periphery can

modulate cytokine expression within the CNS. [1]

4 BIO-CHEMICALS AFFECTING ANXIETY

4.1 C-REACTIVE PROTEIN (CRP)

CRP is an important marker of inflammation. Six large studies have investigated the relation between anxiety disorders and CRP; all found that anxiety disorders are significantly associated with increased CRP levels, indicative of a low-grade inflammation. It was noticed that the level of CRP was higher in men than in women. It was also seen that CRP was an important factor in inducing later age onset of anxiety disorder. Also, persons with social anxiety had lower levels of CRP as compared to people with other types of anxiety.[2]

4.2 CYTOKINE INTERLEUKIN-6 (IL-6)

Interleukin-6 is part of a group of small molecules, known as cytokines, that are important for cell signaling in the immune system. Studies have shown that elevated levels of interleukin-6 are consistently found in individuals suffering from mood disorders like depression and anxiety. Moreover, studies have also shown that levels of this pro-inflammatory compound were higher in the morning in anxious people. It is an important target biomolecule for psychoneuroimmunological study because of the important role this cytokine plays in regulating the immune response. There was no as such sex interaction of this molecule.[3]

4.3 CORTISOL

This is also referred to as the stress hormone. When it comes to anxiety the daily cortisol production is unbalanced. Lower levels of cortisol were seen in the morning in anxious people. This lower level also leads to an increase in IL-6 levels in the morning.

4.4 TUMOUR NECROSIS FACTOR- α (TNF- α)

Tumor necrosis factor alpha (TNF- α) is known for its role in inflammation and pain, which are strongly associated with mood disorders such as anxiety and depression. It was seen that the levels of TNF- α were increased in an anxious person.[4]

4.5 GLYOXALASE(GLO)-1

Glyoxalase 1 (Glo1) expression has previously been associated with anxiety in mice; however, its role in anxiety is controversial, and the underlying mechanism is unknown. Its level decreases with increase in levels of anxiety. It is an antioxidant enzyme present in our brain. It has a negative relationship with anxiety like symptoms. GLO1 increases anxiety by reducing levels of MG, thereby decreasing GABA receptor activation.[5]

4.6 GLUTATHIONE REDUCTASE (GSR)-1

It is also an antioxidant enzyme. Level of this enzyme also decreases with increase in anxiety as the oxidative stress

increases with anxiety.

4.7 BRAIN DERIVED NEUROTROPHIC FACTOR(BDNF)

During chronic anxiety, BDNF levels are downregulated due to calpain dependent degradation of its upstream regulators CAMKIV & CREB. Whereas BDNF levels increase during acute anxiety as an immediate protective response against glycation. It has been proved that decreased BDNF levels lead to an increase in anxiety.

4.8 NF γ B

Calpain dependent NF γ B activation has been reported in anxiety patients. This factor also leads to activation of AT1 receptors. Though the activation was seen only in selected areas of the brain which includes hippocampus, amygdala, and locus coeruleus.

5 PHYSICAL FACTORS AFFECTING ANXIETY

An anxiety condition isn't developed or caused by a single factor but a combination of things.

5.1 HEREDITARY FACTORS

Anxiety as a disorder is something which can be genetic and can be inherited via family traits. The case of this happening has very low probability and having a parent or close relative experience anxiety or other mental health condition doesn't mean you'll for sure develop anxiety.

5.2 PERSONALITY FACTORS

Many researches have shown that people with specific personality traits may be more prone to anxiety. For example, people who are perfectionists, timid, inhibited, lack self-esteem or want to control everything, sometimes develop anxiety at a very early stage in their life.

5.3 ENVIRONMENT FACTORS

The environment we live in also can become a cause for our anxiety. If we live in stressful surroundings where we are constantly bombarded with negative thoughts such as fights, bullying etc. Such an environment can lead to anxious conditions too.

5.4 HEALTH FACTORS

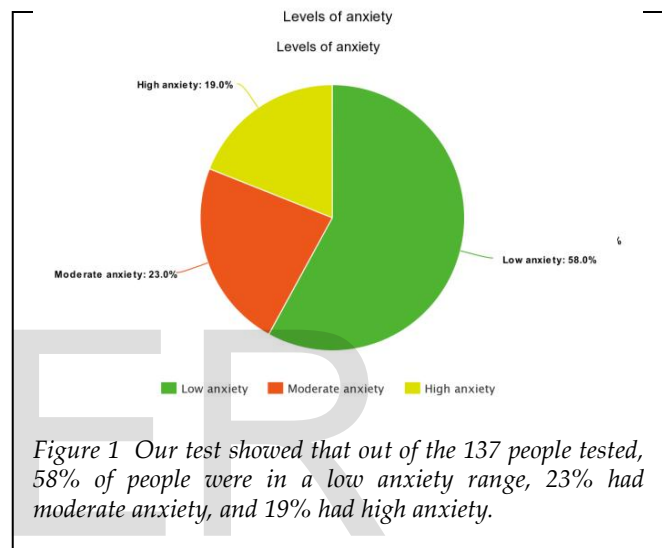
Chronic physical illness also contributes to anxiety conditions. Common chronic conditions associated with anxiety include diabetes, asthma, hypertension and heart disease. Some physical conditions can act like anxiety conditions, like an overactive thyroid. It is advised to see a doctor and be sure if it's a medical cause of anxiety or not.

6 PHYSIO-CHEMICAL FACTORS AFFECTING ANXIETY

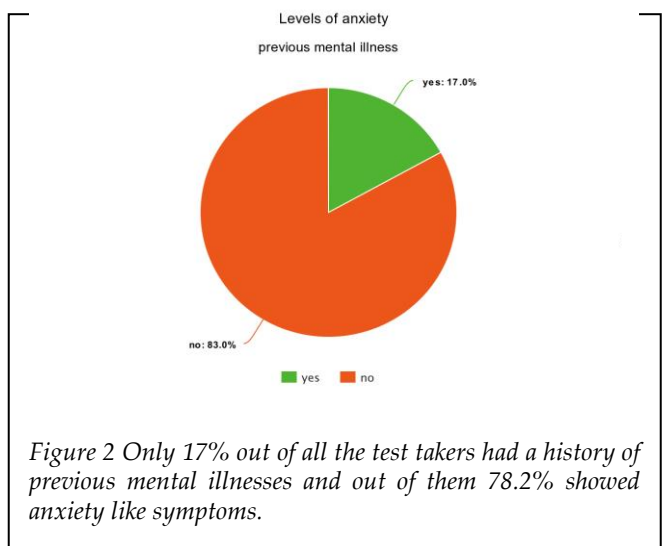
ANALYSIS OF OUR SURVEY

We used Beck's anxiety inventory to test the level of anxiety in various people. It is a 21-question multiple-choice self-report inventory that is used for measuring the severity of anxiety in children and adults. The questions used in this measure ask about common symptoms of anxiety that the subject has had during the past week (such as numbness and tingling, sweating not due to heat, and fear of the worst happening). It is designed for individuals who are of 17 years of age or older and takes 5 to 10 minutes to complete. It shows results on a 3-parameter basis which includes- low, moderate & high anxiety.

Our test showed that out of the 137 people tested, 58% of people were in a low anxiety range, 23% had moderate anxiety, and 19% had high anxiety.

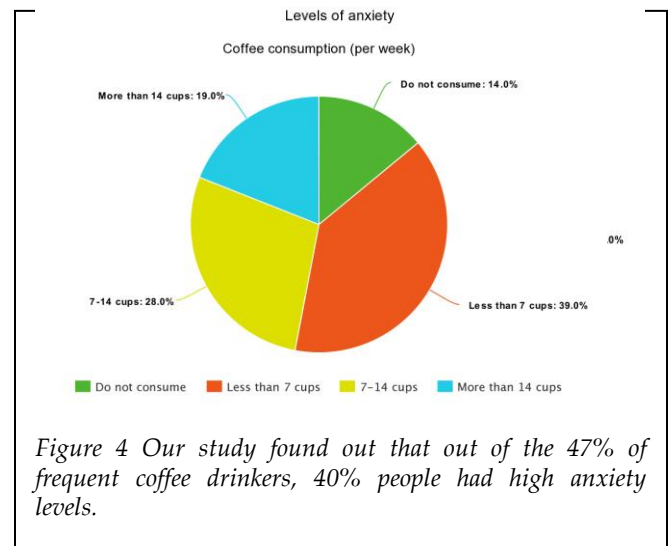
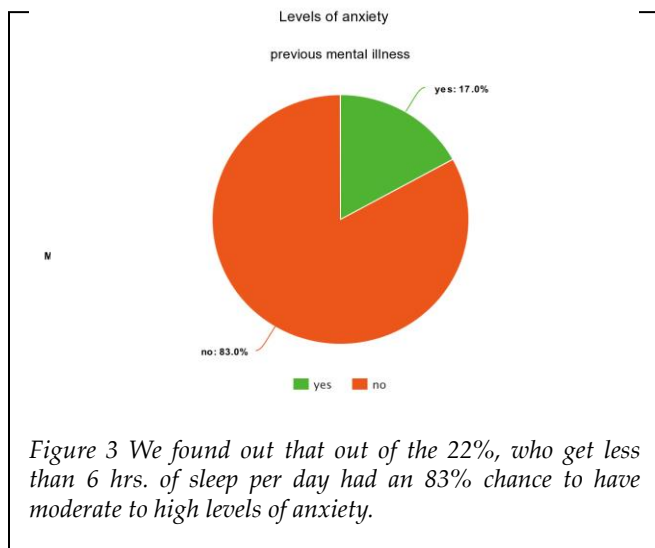


Only 17% out of all the test takers had a history of previous mental illnesses and out of them 78.2% showed anxiety like symptoms.



Our study proved that people who sleep for less than 6 hrs. showed high levels of anxiety when compared with people who sleep for more than 8 hrs. We found out that out of the

22%, who get less than 6 hrs. of sleep per day had an 83% chance to have moderate to high levels of anxiety.



The audience of the test was diverse, it included people from a variety of professions and age groups. Though the majority of test takers were students from the age group of 17 to 25, who are most prone to mental illnesses such as anxiety. Basically, the criteria of the test were based on some factors, which play a major role in causing anxiety. These factors were Caffeine, Yohimbine, Insulin, Carbon dioxide and carbon monoxide, Ethanol, Oxidative substances. The biological relation between these factors and anxiety have been explained further in the text that follows. In addition, we have also discussed the result of the test conducted.

6.1 Caffeine

Patients with a history of panic disorder have an increased sensitivity to the effects of one cup of coffee. Caffeine is a stimulant and that can be bad news for someone with anxiety. Caffeine's jittery effects on our body are similar to those of a frightening event. That's because caffeine stimulates our "fight or flight" response, and studies show that this can make anxiety worse and can even trigger an anxiety attack.

Our study found out that out of the 47% of frequent coffee drinkers, 40% people had high anxiety levels.

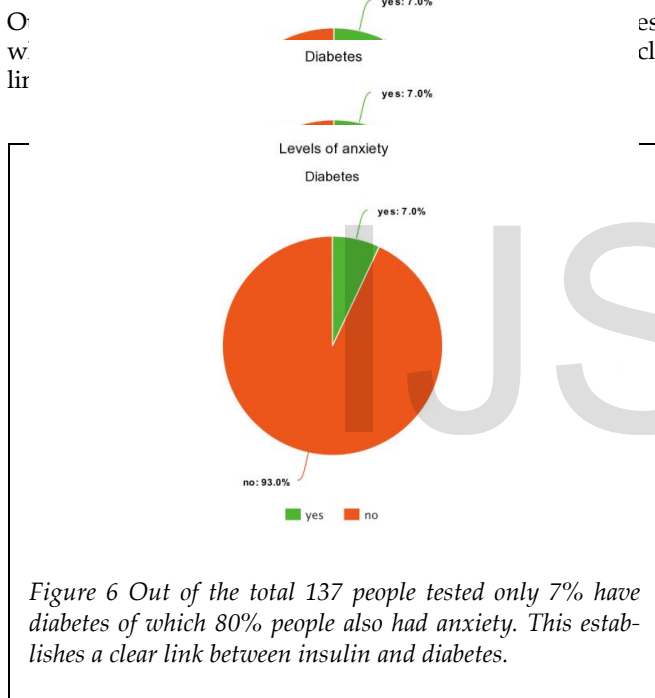
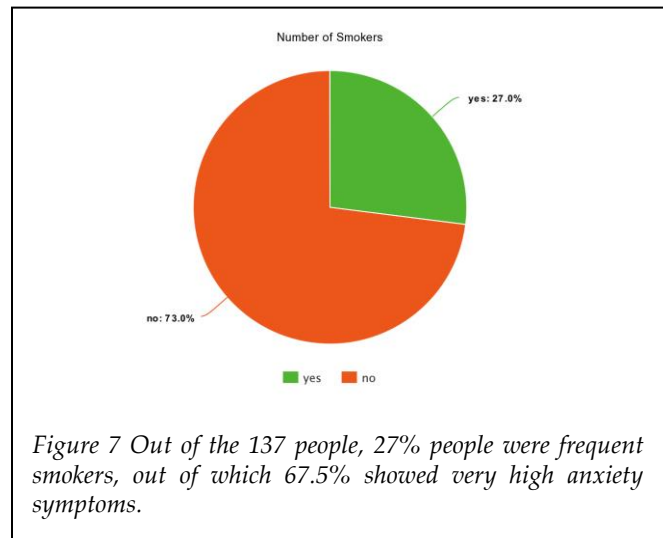
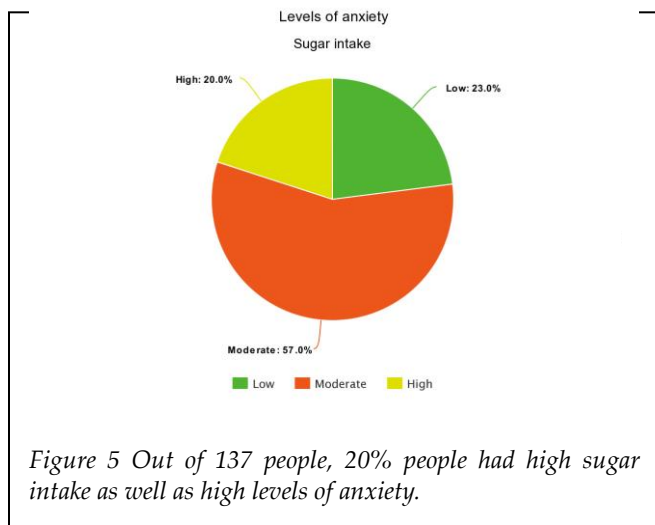
6.2 Yohimbine

Yohimbine, an alpha2-antagonist that disinhibits central noradrenergic neurotransmitter activity, is seen to induce panic attacks in people. Yohimbine also increases plasma MHPG, cortisol, systolic blood pressure, and heart rate in patients with inducible panic.

6.3 Insulin

Insulin is a hormone produced by beta cells of the pancreatic islets which regulates the metabolism of carbohydrates, fats and protein by promoting the absorption of glucose from the blood into liver, fat and skeletal muscle cells. It helps in absorbing excess glucose in the bloodstream and stabilize blood sugar levels. When we consume a large amount of processed sugar it leads to an increase in insulin level which further triggers feelings of worry, irritability, and sadness - which can be a double whammy if you also deal with depression or anxiety. A sugar rush makes your body work harder to reach back to normal levels. This roller coaster of ups and downs can leave you feeling nervous, foggy, irritable, jittery, and drained. If you have anxiety or depression, those symptoms are likely ones you already deal with on a daily basis, sugar will exacerbate them.

Various studies show that high levels of sugar intake lead to an increase in the level of insulin in the human body. Out of 137 people, 20% people had high sugar intake as well as high levels of anxiety.

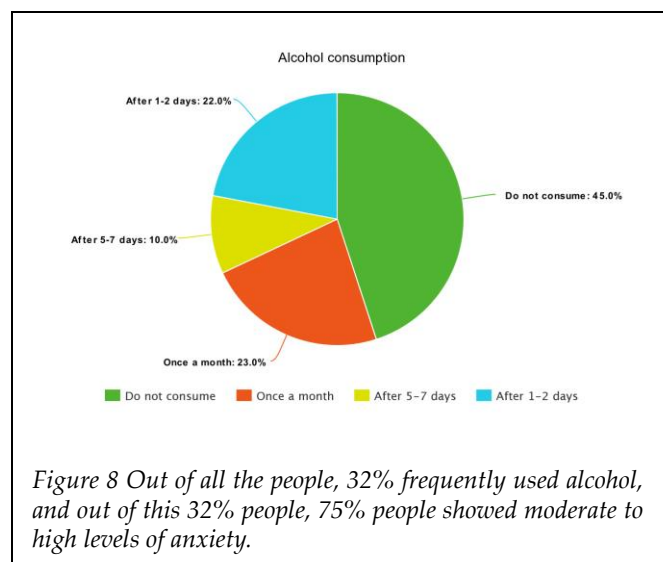


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6.6 Ethanol

Many researches have shown a strong link between alcohol and anxiety. It has been proved that people having issues with alcohol have 3-folds more chances of having anxiety issues during their lives. But that's not about it: Alcohol abuse definitely leads to anxiety disorders and attacks. No matter which problem comes first, the combination of alcohol and anxiety can become a vicious cycle.

Out of all the people, 32% frequently used alcohol, and out of this 32% people, 75% people showed moderate to high levels of anxiety.



6.5 CO2/CO

Studies proved that, most patients with panic disorder experience a panic attack when they breath air in, containing 35% carbon dioxide, while healthy humans won't. CO is the most common cause of poisoning in the United States and may result in neuropathologic changes and cognitive and neurologic diseases.CO poisoning results in significant depression and anxiety that stays to at least 12 months.

Out of the 137 people, 27% people were frequent smokers, out of which 67.5% showed very high anxiety symptoms. This concludes smoking causes anxiety due to an increase in CO2/CO levels in our body.

6.7 Oxidative Substances

These substances include sunflower oil, butter, and margarine as these agents increase the levels of free-radicals and ROS agents in our body. Low-density lipoproteins (LDLs) are the



LDL is a complex process during which both the protein and the lipids undergo oxidative changes that can cause cholesterol accumulation.

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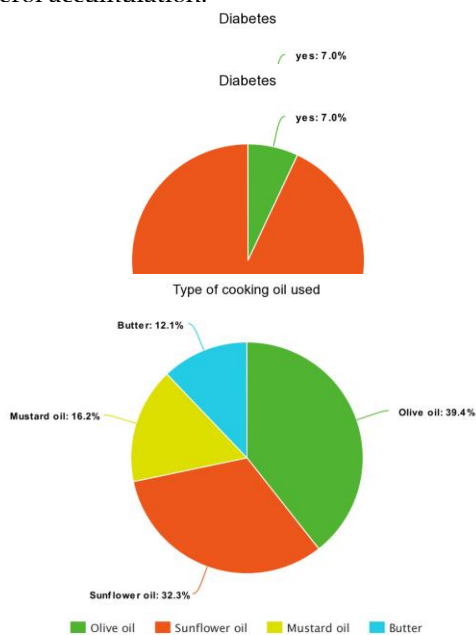


Figure 9 Butter and Sunflower oil are high cholesterol oils whereas olive oil and mustard oils are low cholesterol oils.

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CONCLUSION

Human body is a complex system, especially our brain. Brain is used in almost every activity we do in a day, but at the same time it needs a break too. Unfortunately, the life of today is full of stress, work-pressure and/or family-pressure. Because of such a hectic lifestyle, people usually develop and then suffer from anxiety. So, anxiety is nothing but an unpleasant state of mind. Anxiety can happen because of a variety of physical and chemical associated factors.

We have tried to cover all the major biochemical factors that help induce anxiety like symptoms in humans and sometimes also in animals. Except these chemical factors there are some physicochemical factors as well like caffeine, co2 levels etc. To explain these in detail, we conducted a massive survey with xxx participants. It concluded that this much had high anxiety blah blah. So basically, with the help of our survey we tried to prove the theoretical aspects of anxiety.

With the help of this research paper we have tried to simplify all the links present between biology and anxiety.

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