# Hangry and Hanxious, parts 1 & 2

March 1, 2024 - Welcome video:
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Links to podcast audio:

- 4. Part 1: Hangry or hanxious?
  https://anchor.fm/jennifer-depew/episodes/Hangry-and-hanxious-ea004k
- 5. Trailer - Hangry & Hanxious, Part 2, Overview.
  https://anchor.fm/jennifer-depew/episodes/Hangry--hanxious--part-2-ea041l
- 5. Main - NMDA Receptors & Dopamine
  https://anchor.fm/jennifer-depew/episodes/NMDA-receptors--Dopamine-ea2csv
- 5. Bonus - Intermittent Fasting, benefits & cautions.
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# 4. Part 1: Hangry or hanxious?

How are you feeling? Do people really want to know? Do you even know?

After talking about climate despair and the need to move through the grieving process to acceptance and action, I'm feeling a little angry and anxious, irritated and maybe hungry.

The word *hangry* has been used by many people for that hungry angry feeling. You missed lunch and now traffic is taking a long time before you can reach dinner - Hangry time. For some people it might be hungry anxious - Hanxious time. Need a snack, as soon as possible, or tears may happen for no particular reason.

Recognizing feelings, having a word to describe them, can help you plan ahead and in this case Plan ahead, pack a snack! Protein rich almonds, cashews, or flavorful fennel seeds can be shelf stable items to have ready to go  in your car or daybag.

## Hangry or hanxious? It may be a lack of magnesium.

Excess calcium and too much stress can add to the effects of a low magnesium level. Magnesium deficiency symptoms can affect mood and cause other physical symptoms like pain. Chronic low intake of magnesium foods or a short term drop in magnesium levels may cause symptoms of deficiency. (22)

A short term drop in magnesium level might occur when drinking alcohol in excess or chronically, and it may be a reason for the proverbial bar fight. (28) Bar snacks like popcorn or peanuts would help replace magnesium that is lost in increased urinary output caused by the diuretic effect of alcohol. (24) Adequate water can help mood too, but that is a topic for a different day.

Symptoms of magnesium deficiency can include agitation, anxiety, confusion, anger and irritability. Sleeplessness and lack of energy or mania and hyperexcitability may occur. (2) Depression, and mood swings can also be symptoms. Headache, muscle cramps or other pain might be worse when there is low magnesium levels. ( 1)

## In addition to low magnesium levels, low blood sugar levels, or Reactive hypoglycemia, might be an underlying factor in why some people are more prone to feeling *hanxious or hangry*.

Reactive hypoglycemia can cause a sudden change of mood following a snack or meal of mostly refined carbohydrates. Sugar, white flour or other simple starches are digested very quickly and can cause a sudden increase in blood sugar levels. For some people the body then over responds with an excessive amount of insulin and then too much blood sugar is moved into fat cells leaving a sudden drop in the blood sugar level, to a very low level.

The high blood sugar level may cause a very positive, bubbly, giddy mood and then the rapid change to low blood sugar level might cause disorientation, feeling dizzy or even fainting, or it might just cause anxiety or tearfulness, or possibly irritability or anger. (3) This type of rapid change in blood sugar levels may be diagnosed as reactive hypoglycemia if it is a frequent problem.

Artificial sweeteners might also be a cause of reactive hypoglycemia type responses - the body may respond to the sweet taste of the artificial sweetener with increased insulin in the blood, ready to cope with the expected carbohydrate load. With the artificial sweetener product however there isn't extra carbohydrate in the meal and a drop in blood sugar might result from the extra insulin, leaving symptoms of low blood sugar and also possibly an increase in appetite. Artificial sweeteners have not been found to help reduce weight as increased snacking tends to occur. (25, 26)

## Diet solutions for the short term, to help treat low blood sugar, and for the long term to help prevent low blood sugar, are slightly different but with similarities.

The dietary solution for reactive hypoglycemia or other episodes of low blood sugar, for those immediate feelings of *hanxious or hangry* in the short term, is to have a small amount of simple sugar, like a handful of jelly beans or a few plain saltine type crackers, wait a few minutes, like twenty minutes, for it to digest and to feel a little bit better, and then have a more substantial snack that combines some protein with carbohydrates and fats. Cottage cheese might be an example, or toast with peanut butter. The simple sugar snack gets your blood sugar back up to normal, then the protein rich snack, 20 minutes later stabilizes it, ideally. See a health care professional for individual health care purposes.

The dietary solution over the long run is to eat regularly snacks and meals that have a mixture of protein, fats and more complex carbohydrates. Whole grains or whole fruit and less processed starchy vegetables have fiber which slows down the digestion process. A baked potato with the skin is fiber rich and digested more slowly than a potato starch product.

Complex carbohydrates are long chains of individual sugars rather than being made up of individual or paired sugars, as in table sugar. Fiber refers to the long chains of sugars that are bonded in a way that humans can't digest. The different types of bonds within cellulose and other plant fibers can be digested by some types of bacteria.

Wandering back to the point - for human digestion - have snacks that contain a mix of protein, fats and carbohydrates for stable blood sugar and a stable mood.

- Trail mix that contains peanuts, almonds, or other nuts and seeds, or coconut flakes, along with dried fruit or other whole grain granola would provide a mixture of protein, fats, and whole grains.
- Celery and peanut butter with raisins - or *Ants on a Log* to the toddlers in the room, would also provide protein, fats, and fiber along with simpler carbohydrates in the fruit sugar.
- Beans and rice or tortilla chips include protein, fat, and fiber, brown rice or whole grain corn chips would provide more fiber than white rice or refined corn flour chips. Add lettuce, and salsa for more trace nutrients and fiber, and a slice of avocado would add healthy fats.

Beans, nuts, seeds, and whole grains are all good sources of magnesium too.

- The older kids in the room might remember boxes of Cracker Jacks - a snack food of caramel popcorn with peanuts, that also had a toy surprise in the box. Cracker Jacks are still available - providing magnesium, protein, and fat and complex carbohydrates in the form of a whole grain - popcorn, along with some simple carbohydrate and fat in the caramel coating.

## Plan ahead, pack a snack!

People who don't eat meals regularly or who purposely are fasting for religious or dietary reasons may be more likely to have low blood sugar episodes. Making the first meal after a long fast something that has protein, fat, and complex carbohydrates would help prevent an increase in blood sugar level followed by a drop to a hypoglycemic low level - and prevent hangry or hanxious feelings hopefully.

Fasting intermittently, eating caloric foods and beverages for only a certain number of hours each day, or eating fewer calories in total for a day or two per week may have health benefits, and positive mood benefits for some people. Others however may need caution as hanxious and hangry maybe more of a risk for them.

Protective effects against Alzheimer's dementia may be a benefit of not overeating, or not overeating carbohydrates and glutamates more specifically. Mood swings, NMDA receptors, appetite and intermittent fasting will be discussed in more detail in the next episode of the series.

Thanks for listening! I'm looking forward to hearing how you are feeling! Email jen@peace-is-happy.org

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# 5. Hangry & Hanxious, Part 2: Overview

Intermittent fasting, mood disorders, NMDA receptors and glutamates.

# Trailer/overview

How are you feeling? Do people really want to know? And do you even know?

The word hangry is used to describe that hungry angry feeling that may happen when it has been too long since you last ate. In the last episode hanxious was introduced as a word to describe the anxious or tearful feeling that may occur when you're overly hungry.

Low magnesium levels, and/or low blood sugar levels, may be underlying factors in hangry or hanxious feelings that are associated with not having eaten for a while. That was discussed in the last episode, *Hangry and Hanxious*.

There can be another type of situation though that may cause hangry or hanxious feelings, that would be after having eaten something, rather than it having been too long since the last meal.

Some free amino acids can cause mood changes and have excitatory or inhibitory effects in the brain. Foods containing glutamates as flavorings, like spicy chips, or aspartates in the artificial sweetener aspartame or Neotame can cause excitatory effects, possibly including hanxious or hangry feelings, especially if eaten in excess or at the same time as there being low magnesium levels or dehydration, being overly thirsty.

A variety of processed foods may contain Neotame without it being required to be listed on the ingredient label and artificially sweetened beverages may contain aspartame which would be listed on the label. Glutamates might be listed on the label with a variety of different words, a reference list would be needed, see the link, (44), but it might also be contained within a food as an ingredient simply called "*natural flavorings*." (44) So it can be hard to avoid glutamates and aspartates in the modern food world.

With either type of hangry or hanxious situation excess stress, physical or emotional, could add to the problem and excess available calcium in ratio to magnesium in the diet, may also add to the likelihood of hangry or hanxious feelings, whether due to low magnesium, or low blood sugar, and/or an excess of dietary glutamate or aspartate being present, a combination of problems might be occurring. Symptoms might vary for different people from hanxious, low energy and depressed, to hangry, hyperexcitable and high energy that may suddenly drop to low energy later on.

Glutamate and aspartate are common food ingredients that may overstimulate the mood - hangry or hanxious, or just hyperexcitable in some way.

As free amino acids, glutamate and aspartate can have excitatory properties in the brain and are normally present in the brain, but probably not at the levels that can be consumed with processed foods. Typically there would not be a lot of free amino acids in a whole food diet. Cheese, yogurt, tofu and soy sauce are fermented foods that would naturally contain free amino acids. Lists of possible sources are a guide for caution but trust your body symptoms. The goal is to reduce the amount in your diet, excluding all is unlikely. (44, 46)

Amino acids are part of longer protein chains, generally, and they may be present when the protein is digested into smaller chains of amino acids, or digested fully into single units - free amino acids. Fermented foods are a natural source because the fermentation is a digestive process by bacteria or yeast, breaking down the protein or other molecules within a food into smaller units. Wine is a fermented product that not only has alcohol but it also contains free amino acids, and they may add to laughter and a good mood, or to a drunken depression, depending on the amount of alcohol used and the person's attitude. Alcohol also contains free amino acids that have inhibitory effects, glycine for example has a calming effect.

Snack foods or beverages that contain large amounts of the appetite stimulating and excitatory glutamate or aspartate, might lead to addictive use of the product. The excitatory signals that glutamate and aspartate can cause, include positive mood changes - giddy and high energy, not just hangry or hanxious - and the increased appetite that can occur combined with an increase in impulsiveness that is often linked to elevated dopamine levels, may lead to overeating, and follow with craving more of the substance again once the elevated dopamine levels drop. The elevated dopamine level underlying the mood and appetite changes can have an addictive risk.

Dopamine is the brain neurotransmitter associated with positive reward feelings. It is easy for people to become used to the excited state of the elevated dopamine level and to seek out more of whatever substance or activity had caused the increase. Over the long term normal pleasures can become less stimulating, less enjoyable compared to the hyper-stimulated dopamine level. The elevated dopamine level may be caused by a large amount of dietary glutamates or aspartate activating the NMDA receptors - the *N*-methyl-d-aspartate receptors. But there are many ways that dopamine levels may be increased besides dietary glutamate and aspartate and any of them may lead to addictive patterns of behavior, seeking more of whatever the stimulus was, whether it was alcohol or a drug, or listening to music. (31, 32) Over time paranoia, and excessive anxiety, may become more of a concern with elevated dopamine levels as fear may also be an emotion associated with the neurotransmitter. (47)

### Dopamine may feel exciting, but better health seems to have more Serotonin and less Dopamine.

Serotonin is a brain neurotransmitter involved in more calm, happy, contented feelings and it increases at times when there is less dopamine activity. (31, 32) Happy feelings and being healthy may be associated with each other directly, by serotonin. Inflammation from stress or infection can lead to lower levels of serotonin along with increased NMDA receptor activity and increased levels of dopamine, (35) So we tend to have more serotonin, or more dopamine, but not both at the same time. Low magnesium levels are also associated with low serotonin levels, (36), and would make it more likely for there to be increased NMDA receptor activity with elevated dopamine levels.

### The reason magnesium is essential for a stable mood is its role in the control of NMDA brain receptors.

We will get into more detail about NMDA receptors in the next section; and the potential benefits of intermittent fasting and who might need to use caution, to prevent hangry and hanxious mood changes, will be discussed in the Bonus section. Thanks for listening! I hope to hear how you are feeling, email jen@peace-is-happy.org.

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# 5. Main - NMDA receptors & Dopamine

How are you feeling? Do people really want to know? And do you even know?

Hangry and hanxious feelings can have multiple underlying factors that may involve overactivating NMDA brain receptors. Part one, the Trailer, provided an overview. This main section will provide more detail about the neuroscience of NMDA receptors and their possible role in Alzheimer's dementia risk. And the Bonus section will provide some benefits and cautions about intermittent fasting and provide some diet resources for safely eating a lower carbohydrate or intermittent fasting meal plan.

## The reason magnesium is essential for a stable mood is its role in the control of NMDA brain receptors.

Why should we care about NMDA receptors?
Because they are involved in roughly 70% of brain activity. (38)

Overactivity of NMDA receptors may add to angry (28) and anxious (29) feelings when hungry - especially if low in magnesium which is an electrically active ion that can block NMDA activity. NMDA receptors are also involved in appetite, tending to increase appetite, to cause hungry feelings, but can also cause suppressed appetite in some dietary situations, and as long as the amino acids glycine and D-serine are available to give inhibitory effects, along with the amino acids glutamate or aspartate to activate the receptor.

The NMDA receptor needs a molecule of glutamate or aspartate to fit in one location and a molecule of glycine or D-serine to fit in another location on a portion of the receptor that extends outside of the cell membrane. A magnesium ion can block the channel portion of the receptor that extends through the membrane. When both of the exterior locations have an amino acid in place the channel opens and allows calcium or sodium ions to enter the cell. (30) Too much electrically active calcium entry into the cell can over-activate the cell or the mitochondria within the cell, causing symptoms that may include anger or anxiety, and progress to headache, and possibly eventually cell death, or mitochondria death or damage. (37) This is known as excitotoxicity and glutamate and aspartate are considered excitotoxins. (27, 30)

During normal aging brain cells may lose connections to each other, causing forgetfulness, but the cells remain alive. In Alzheimer's dementia excess protein tangles lead to fibrotic inflammation which can eventually lead to brain cell death. The cell death tends to occur in particular areas of the brain that are essential for remembering current daily events. NMDA receptor overactivity may be involved in risk of Alzheimer's dementia and some other neurological conditions. (17) Medications that inhibit NMDA receptor activity have shown benefit for slowing progression of the brain cell changes characteristic of Alzheimer's dementia, (18) that lead to cell death eventually.

Brain cells generally don't die, and therefore don't need to regrow, and tend to not regrow. New connections can be made between existing brain cells when a skill is practiced and relearned after stroke or trauma damage.

In normal health the protein tangles and fibrotic inflammation wouldn't build up to the point of cell death. White blood cells would recycle excess protein or damaged cells and reuse the nutrients and excrete the waste with processes called apoptosis and autophagy. Intermittent fasting or moderate calorie or carbohydrate restriction may have

health benefits by promoting the white blood cell's autophagy function. This could provide protective effects against developing Alzheimer's dementia, and possibly cancer by protecting mitochondria. (41) More about intermittent fasting will be included in the next section.

NMDA overactivity, which can be due to excess glutamate, aspartate, or calcium combined with low magnesium levels (27), may also be involved in the increased risk of dementia seen in people with bipolar disorder or depression. (8, 12) NMDA receptor inhibition from lithium medications is thought to help protect the brain for patients with bipolar disorder, (15), however if dose becomes too high, which might occur during fasting (7) or dehydration, then symptoms of lithium overdose may occur. (11) Elevated levels of the mineral can cause digestive symptoms and other physical symptoms and at higher levels confusion and delirium may occur. (23)

Lithium is used as a mood stabilizing medication for bipolar disorder. It may function by increasing magnesium availability for use as an NMDA blocker, (13) or by combining with magnesium in NMDA receptors which may cause a 40% increase of activity of the receptor, (14), but it can also help inhibit activity. (15)

Medications that target NMDA receptor activity tend to have serious side effects as the NMDA receptors are involved in so much of normal brain activity. (38)

## Why should we care about NMDA receptors? We can't live without them.

Damage to NMDA receptors specifically, loss of them from brain cell membranes, can cause distorted perception, hallucinations, and eventually catatonia and death. This was discovered when a rare type of autoimmune disorder was identified that targets NMDA receptors. Patients can be helped, with mental and physical function returned close to their previous function, if the underlying autoimmune reason is identified and treated in time. Immunosuppressants and even blood transfusions to remove the autoimmune antibodies can help end the autoimmune attack on the NMDA receptors.

Symptoms can include hallucinations and other distortions of perception and physical function during the earlier stage of the disease process. The condition is rare and often misdiagnosed as some other psychiatric condition. (19)

A first hand account of what anti-NMDA encephalitis is like and the frustration of misdiagnosis is available in a book by journalist and survivor, Susannah Cahalan: *Brain on Fire, My Month of Madness*, (Review: 39, Book: 40).

## Magnesium is the natural inhibitor of NMDA receptors.

The NMDA receptors are membrane channels that allow entry of the electrically active calcium or sodium ions into the cell, when the amino acids glutamate or aspartate and glycine are available at the cell surface to activate the receptor. Magnesium is needed

to block entry of calcium or sodium into the cell through the NMDA receptor channels; too much calcium in a brain cell can cause overactivity to the point of cell death, called excitotoxicity. (27, 30)

Within a brain cell calcium is excitatory, causing chemical reaction pathways to start - like an On switch within the cell. Too much activity, too much calcium within the cell, can cause cell death eventually. Toxic level of activation - excitotoxicity. Before cell death would occur, the overactive cell might be releasing extra dopamine that might be interpreted as excessive anger or anxiety or other mood symptoms.

## Hangry or hanxious after a meal, instead of because you're overly hungry and due for a meal? Too much glutamate or aspartate may having been present in your last snack or beverage choice and it may have led to overactivity of the NMDA receptors.

Too much glutamate or aspartate would not typically be a problem except they became a common ingredient in many processed foods, beverages, and restaurant meals. Monosodium glutamate and other glutamate seasonings are common in savory meals and spicy snack foods, and aspartic acid, or aspartate, is in Aspartame and Neotame artificial sweeteners. Both glutamates and aspartates are considered excitotoxins because they can overactivate NMDA receptors and allow too much calcium to enter cells. Both glutamate and aspartate are amino acids that have excitatory effects for brain cells, (27), glycine and D-serine are both amino acids that have inhibitory effects. (30)

Part of the excitatory effects of the calcium in brain cells is an increase in dopamine, (31), an excitatory neurotransmitter associated with reward and positive creative moods - and also with addictions and addictive behavior. (32) The dopamine increase may lead to increased appetite - hunger, and hanxious or hangry feelings or jittery impulsiveness (31, 32) after having a large amount of foods or beverages with glutamate flavorings or aspartate sweeteners. They can be in many foods and may be hard to identify on food labels or may not even be required to be listed or may be allowed to be listed as something vague like "*natural flavorings*."

Who should care? People who tend to get migraines and anyone who would like to protect themselves against hanxious or hangry feelings and impulsive overeating. (44, 46 ) People may find it difficult to stop eating or drinking their favorite glutamate or aspartate food or beverage. Not starting can be the easiest way to not overeat or overuse addictive substances.

Having adequate stored magnesium also helps. Our cells can only keep a small amount in the electrically active form. The rest of our reserve supply of magnesium is

carried on protein or ATP molecules - which means we also need enough protein and ATP molecules, in order to have a good supply of magnesium. (48)

Magnesium ions, and also lithium, can help block the NMDA receptor activity and prevent entry of calcium into the cell, where it might cause release of dopamine which leads to the excited feelings and overeating. The amino acids glycine and D-serine are also natural inhibitors of NMDA receptors but they need the magnesium to be present.

Supplementing with D-serine up to a certain dose can be helpful for appetite suppression and weight control, but too much led to starvation in an animal based study. NMDA receptors are involved in appetite control, and depending on the balance of nutrients in the bloodstream, their activity may suppress appetite or increase it. Adequate amounts of the free amino acids glycine and D-serine are needed for the appetite suppressing effects to occur, otherwise NMDA activity tends to increase appetite. (20) D- serine supplementation has also been found somewhat beneficial for patients with Alzheimer's dementia, (30) where it might be helping inhibit NMDA receptor activity.

## To put it all together, many physical factors may be involved in hungry/angry/anxious feelings.

Hangry and Hanxious, or hyperexcited in some way, maybe even fearful feelings, (47), might be due to a problem of excess dopamine, which may include as potential underlying factors: low magnesium, low blood sugar, excess calcium, excess free glutamate or aspartate, and dehydration.

It might also be a factor if there was a lack of inhibitory amino acids, glycine or lack of the enzyme that normally makes D-serine for us out of the L-serine form.

Lack of protein and ATP could be limiting factors that lead to low reserve supplies of magnesium. Poor absorption of magnesium in the digestive tract may be a factor in which case topical Magnesium chloride creams or magnesium sulfate salt in the bath or footsoak would bypass the digestive system and be absorbed through hair follicles. (48)

Excessive stress (45) or infection may also add to the risk of mood symptoms and both can deplete magnesium reserves.

So what to do?

- Avoiding processed foods would help to avoid glutamate flavorings and aspartate sweeteners and the risk of excess causing hangry or hanxious mood changes. A few whole foods or nonfermented foods also are naturally sources of free glutamates including tomato sauce preparations, catsup, white potatoes, some

types of mushrooms, and broccoli. Refer to a list for more specific ingredients or foods that are likely sources. An ‘organic’ food label would not be helpful as a guide as many natural food products can be sources of free glutamates. (44, 46) Avoiding all free glutamate or aspartate in the diet is unlikely, reducing use can be possible though.

- Switching to more magnesium rich foods is often also reducing processed foods at the same time - eat more beans, nuts, seeds, sweet potato, whole grains and dried fruit and prepare them yourself with nutritious and flavorful whole herbs and spices which would be less likely to have added glutamates compared to seasoned salt or spice mixes.
- Magnesium rich foods are also usually fiber rich foods which helps slow down how fast blood sugar levels increase after eating carbohydrates, and help prevent a blood sugar peak and then drop, with hangry or hanxious feelings.
- Fiber is beneficial in other ways too. It may speed transit time in the intestinal tract overall, protecting against colon cancer, and helps support healthy bacterial growth within the intestinal tract. Beneficial intestinal bacteria can help with mood and appetite and the immune system too, but that is a different topic.

The benefits of intermittent fasting for health and cautions for who may be more likely to have hangry or hanxious feelings with fasting or carbohydrate restricted meal plans will be discussed in the Bonus section following this.

Thanks for listening. I’m looking forward to hearing how you are feeling! Email jen@peace-is-happy.org

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# 5. Bonus - Intermittent Fasting, benefits & cautions.

How are you feeling? Do people really want to know? And do you even know?

I know that I have trouble stopping eating sweet foods and some types of spicy snacks or meals. Not getting started is easier for me than stopping after a reasonable portion of some types of foods. Sugar or artificial sweeteners may encourage appetite signals and the amino acid glutamate may also increase appetite as well as possibly causing an excited mood, whether giddy and positive, or anxious and fearful, or angry and easily irritated. How could food do so much to the mood? By overactivating NMDA receptors in the brain which cause increased levels of the brain neurotransmitter dopamine, and can cause an increase in appetite along with other mood changes. The overactivity may also lead to damage or death to brain cells or mitochondria within cells, which may ultimately increase the risk of Alzheimer's dementia or other neurological conditions.

## Intermittent Fasting may have health benefits.

Intermittent fasting may help with weight control (4, 5) and may help protect against the risk of Alzheimer's dementia. Too much food, too many calories overall, means the body has to focus energy on storing the excess calories in fat cells. When there are limited calories and nutrients available, the white blood cells will spend more time finding and dismantling excess protein or damaged cells for reuse of the nutrients. The process is called autophagy or apoptosis, and may reduce Alzheimer's risk by removing the protein tangles before fibrotic scarring or cell death occurs.

An intermittent fasting plan might involve limiting the hours of the day when caloric beverages and foods are eaten, every day of the week - like not snacking in the evening and/or having a delayed breakfast in the morning. Another approach might be to reduce caloric intake for a couple days a week, which may be a weight loss oriented strategy. (4)

Calorie restriction and low carbohydrate plans also may promote autophagy and removal of excess protein or damaged cells, which may help prevent Alzheimer's dementia. It may also help with cancer prevention or treatment. (43)

Cancer cells have damaged mitochondria to the point that their normal use of glucose for energy is nonfunctional and energy is produced by fermentation instead, which means it is metabolized without oxygen. Glutamine can also be used as an energy source for cancer cells, with a fermentation process that enzymatically changes the glutamine form into the glutamate form of the amino acid. (41, 42) After it is released from the cancer cell the extra glutamate may lead to increased pain levels in the surrounding tissue, by overactivating NMDA receptors on other cells. (43, 49) A low carbohydrate diet and avoiding glutamates may help starve the cancer cells because the body can use ketones for energy, which are made from proteins.

Backing up a couple steps - help prevent cancer by protecting mitochondria, the energy producing organelles of the cells, by avoiding excess dietary glutamate and aspartate, and maintaining a good magnesium and blood sugar level.

## Who may be at risk from an intermittent fasting or low carbohydrate meal plan?

Switching to an intermittent fasting style of eating or a low carbohydrate type of diet plan, may provide mood benefits for some people, but others may be more at risk for hangry or hanxious drops in blood sugar, or magnesium deficient overactivity of NMDA receptors. Not eating can cause low blood sugar for anyone, and may cause low magnesium levels. Modifying an intermittent fasting plan might also help. Some people may be more comfortable with a shorter fasting time period. Or combining a low carbohydrate approach with the intermittent fasting schedule might also be a way to modify the fast - avoid carbohydrates in the evening or early morning, and have low carbohydrate nuts or seeds as a snack during those hours.

Low carbohydrate or keto or paleo diets, have become somewhat popular, and may also promote autophagy and be protective against Alzheimer's dementia. Low and moderate carbohydrate diets and/or intermittent fasting may help some people with weight control, mood or other health benefits. However others may need caution with the carbohydrate restrictions which would increase low blood sugar risks while fasting. Some essential nutrients may be difficult to obtain with more food restrictions. A nutrition book written for pregnancy provides a useful how to guide for eating a moderately low carbohydrate diet and which nutrients might need to be supplemented for vegetarian or vegan diets. It could be a useful guide for anyone and just skip the prenatal specific parts. See the book *Real Food for Real Pregnancy,* by Lily Nichols, RDN. (33)

Intermittent fasting or low carbohydrate plans would not be recommended for pregnancy and may not be equally safe for all people. It may need to be avoided or stopped by people who develop odd eating habits, or under or over eating problems. Others who should avoid intermittent or longer fasting, in addition to pregnant people, are people with a diagnosis of reactive hypoglycemia (discussed in part 1, Hangry and Hanxious). Both groups might benefit more from frequent small meals and snacks that contain a mixture of protein, fat and complex carbohydrates. (33)

People with mood swings or anxiety may need to use caution with intermittent fasting plans. (6, 7) Hangry or hanxious may be more of a risk with longer fasts. Low magnesium levels may already be present and further drops in magnesium due to the fasting might worsen psychiatric conditions. (8, 13) Excess calcium (9, 10) and

increased stress levels may also increase the risk of mood symptoms from low magnesium levels or low blood sugar levels. Having adequate magnesium within cells in advance of a glutamate or calcium excess, can help inhibit NMDA receptors on the cell surface from being activated and prevent excessive hunger, anger, or anxiety - the hangry and hanxious feelings.

People taking lithium for mood or other medication reasons may want to use caution with fasting as levels of the lithium may become more concentrated during fasting. (7) Overdose symptoms of lithium can include digestive symptoms and confusion and delirium. (11, 23)

## Low blood sugar may be a risk for anyone, whatever their psychiatric condition, who had been fasting for more than a day.

Anyone can be at risk of a high blood sugar surge and then crash to low levels if a large simple carbohydrate meal is eaten as the first meal after fasting. Starting with a glass of water with a spoonful of apple cider vinegar and/or lime or lemon juice is mentioned in a list of food recommendations for breaking a fast of 24 hours or longer. The acidity of the apple cider vinegar or lime or lemon juice helps digestion. Small amounts of fiber rich foods, probiobotic fermented foods and a mixture of protein moderate fat and a small amount of simple carbohydrate or whole fruit to restore blood sugar gradually are included in the tips. (34)

Anyone with digestive issues or who are older may find a small amount of apple cider vinegar or lime or lemon juice added to a meal, or mixed in a small amount of water along with the meal, to be helpful with digestion. The type of acidity is similar to stomach acid and we make less of it when we are older.

## Why care about NMDA receptors? Because we all have them and we all like to eat.

Avoiding excess glutamates in foods or aspartate sweeteners may help prevent hangry and hanxious feelings, and may also help with weight control and long term brain health.

We all have easy access in modern life to processed foods or beverages with artificial sweeteners, and foods that are seasoned with glutamates. Snack chips that are spicy flavors likely have glutamates, plain flavors might not. Soy sauce and other fermented flavorings would have some free glutamate. It is a free amino acid that is found within longer proteins normally. Fermenting causes proteins to be broken down into free amino acids. Hydrolyzing is a food industry term for breaking down proteins

before use as ingredients. For more details see a list of ingredient terms that might indicate a substance that contains free glutamate or aspartate. (44, 46) Within the brain the free amino acid form of glutamate can cause excitatory responses in brain cells if it activates NMDA receptors. Adequate magnesium can help prevent activation of the NMDA receptor and prevent calcium from entering the cell through the receptor channel, which would prevent elevated dopamine and increased appetite.

We all can benefit from good magnesium intake as it is the natural way our bodies inhibit overactivity of NMDA receptors. Magnesium functions best as a preventative for mood symptoms, or for pain or nerve problems. (21, 22)

Avoiding excess calcium in ratio to magnesium also may also help prevent hangry and hanxious feelings. The modern diet tends to include many sources of calcium in comparison to magnesium in typical meals and snacks. Calcium also tends to be recommended more often as a supplement - to protect bone health from osteoporosis - but magnesium is also needed to prevent osteoporosis. The two electrically active minerals work in balance with each other during normal health.

Putting it together - glutamates are used as flavoring agents in snack foods, and glutamates can activate NMDA receptors, which can stimulate the appetite, equaling a flavorful snack food that can 1) overstimulate the appetite and 2) overstimulate the mood with angry or anxious or other feelings, even fear, (47), and pain, (49) and 3) the overactivity may lead to brain cell damage or mitochondria damage which may lead to cancer (43) or Parkinson's disease or other mitochondrial conditions in addition to Alzheimer's dementia risk.

Avoiding glutamates and aspartate sweeteners may help prevent hangry or hanxious feelings, and bonus - help protect the brain, and help with weight control, and possibly prevent pain and cancer and other neurological conditions.

Magnesium and protein rich pumpkin seeds or sunflower seeds would be a healthy choice to help prevent a hangry drop in blood sugar or magnesium levels. Fennel seeds as a snack food are less protein rich but may also help with digestion, appetite control, and have anti-inflammatory effects.

Fiber rich meals and snacks with a mixture of protein, fats and complex carbohydrates can help slow digestion and stabilize blood sugar levels. Beans, nuts, seeds, and whole grains cooked with herbs and spices for natural seasonings, can provide many essential nutrients and other beneficial antioxidants and anti-inflammatory phytonutrients, and help to avoid processed foods that contain glutamate and aspartate. Many popular menu items also often contain combinations of foods that would be

natural sources of glutamates - pizza and pasta have cheese and tomato products. Asian stir-fry has soy sauce and may have broccoli, mushrooms and tofu.

To review from part 1: If you already have hangry or hanxious feelings, from a low blood sugar/no food recently type of situation, then starting with a carbohydrate serving and then having a mixed protein/fat/whole carb snack might help restore mood and stabilize blood sugar levels.

Crankiness can have many causes including dehydration. We'll talk more about some of these other topics in future episodes. Thanks for listening! I'm looking forward to hearing how you are feeling, email jen@peace-is-happy.org.

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## Link to the end of the reference list

Other references to incorporate possibly

- Does PTSD Impair Cognition Beyond the Effect of Trauma?, https://neuro.psychiatryonline.org/doi/full/10.1176/jnp.23.1.jnp16
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  Left the pdf on the phone (1005_phan_CME) - it is on Researchgate too
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