

## URINE AND STOOL HEALTH.

We will start with the stool health

FAECAL Bristol stool chart The Bristol Stool Chart, Bristol Poo Chart or Bristol Stool Scale is a medical aid designed to classify stools (known as 'faeces' or 'poo') into seven groups. ON THIS PAGE What is the Bristol Stool Chart? Who uses the Bristol Stool Chart? Why is the Bristol Stool Chart important? Bristol Stool Chart PDF Bristol Stool Chart Recording Sheet What should my stools look like? What does an unhealthy stool look like? BRISTOL STOOL CHART PDF Bristol Stool Chart PDF BRISTOL STOOL CHART RECORDING SHEET If you are looking for a Bristol Stool chart recording sheet, we recommend using our bowel diary in conjunction with the Bristol Stool Chart. WHAT IS THE BRISTOL STOOL CHART The Bristol Stool Chart was developed in 1997 as a clinical assessment tool. There are seven types of stools (faeces) according to the Bristol Stool Chart.

WHO USES THE BRISTOL STOOL CHART? The Bristol Stool Chart, Bristol Poo Chart or Bristol Stool Form Scale is a medical aid designed to classify faeces into seven groups. This chart is used by medical professionals, however it is a great tool for anyone wanting to monitor and improve their bowel movements. Refer to Bristol Stool Chart Recording Sheet. WHY IS THE BRISTOL STOOL CHART IMPORTANT? The Bristol Stool Chart is widely used as a research tool to evaluate the effectiveness of treatments for various diseases of the bowel. The chart is used to describe the shapes and types of stools. It is also used as a tool to diagnose constipation, diarrhoea and irritable bowel syndrome. BRISTOL STOOL CHART TYPES WHAT SHOULD MY STOOLS LOOK LIKE? The type of stool or faeces depends on the time it spends in the colon. After you pass faeces, what you see in the toilet bowl is basically the result of your diet, fluids, medications and lifestyle. You can use the Bristol Stool Chart to check what your stools are telling you. The Bristol Stool Chart shows seven categories of stool. Every person will have different bowel habits, but the important thing is that your stools are soft and easy to pass – like types 3 and 4 below. WHAT IS NORMAL ON BRISTOL STOOL CHART? Type 1-2 indicate constipation, Type 3-4 are ideal stools as they are easier to pass, and Type 5-7 may indicate diarrhoea and urgency. The Bristol Stool Form Scale is also referred to as The Bristol Stool Chart. Some users may also search for The Bristol Poo Chart. WHAT DOES AN UNHEALTHY STOOL LOOK LIKE? Please refer to the Bristol Stool Chart below. Type 1, 2, 5, 6 and 7.

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Reference: Heaton, K W & Lewis, S J 1997, 'Stool form scale as a useful guide to intestinal transit time'. Scandinavian Journal of Gastroenterology, vol.32, no.9, pp.920 - 924. Retrieved on 2/3/2007.

**WHAT ARE THE SIGNS OF A HEALTHY BOWEL?** Being 'regular' is a way of describing good bowel habits or normal bowel function. We often talk about our bowels being regular but this is often misunderstood as meaning that you go to the toilet to pass faeces every day. It's common for people to empty their bowel once a day, although it's still normal to be more or less often. Being regular really means that soft yet well formed bowel motions are easily passed and that this happens anywhere from 1–3 times a day to 3 times a week. The bowel usually wants to empty about 30 minutes after a meal (commonly breakfast), but bowel movements can vary from person to person.

**GOOD BOWEL FUNCTION FOR ADULTS** There's more to good bowel function than just being regular. For example, you should be able to: hold on for a short time after you feel the first urge to go to the toilet pass a bowel motion within about a minute of sitting down on the toilet pass a bowel motion easily and without pain – you shouldn't be straining on the toilet or struggling to pass a bowel motion that is hard and dry completely empty your bowel when you pass a motion – you don't have to return to the toilet soon after to pass more.

**BOWEL CONTROL PROBLEMS** People who pass bowel motions at the wrong time or in the wrong place may be experiencing poor bowel control, or faecal incontinence. They may also pass wind when they don't want to. Poor bowel control is more common than you think. About 1 in 20 people experience poor bowel control and it affects both men and women. It's more common as you get older, but young people can also have poor bowel control. In some cases, people with poor bowel control also have poor bladder control and may leak urine (urinary incontinence).

**GOOD BOWEL FUNCTION FOR CHILDREN** Children usually develop the ability to be toilet trained by about three years of age. Soiling is when the bowels are emptied in places other than the toilet. Even after a child is toilet trained, there may be occasional accidents with soiling (poo) in your child's underwear. If a child is unable to be toilet trained or has regular poo accidents after the age of three to four years, then they should be medically assessed. If a child has been toilet trained and at a later stage starts to soil, this also needs medical assessment. How many children get soiling? About 1-3% of children can have this problem and some of them may have wetting as well. It is more common in boys. Soiling may vary from a 'skid mark' to larger amounts that need to be removed from underwear before it can be washed. Why do children soil? In almost all cases soiling happens because the large bowel is not emptying properly and the child is constipated. Constipation is very common and occurs at some time in up to 25% of children. If it is not recognised and treated, bowel actions may become harder and less frequent. Over time, stretching of the bowel makes it less sensitive, so the child may not feel when poo needs to come out and therefore has an accident. It is quite possible that there is hard poo inside the bowel, but the soiling is soft runny poo leaking around the hard mass, and so you don't realise that constipation is the underlying problem.

**SEEK HELP FOR BOWEL PROBLEMS** In many cases incontinence can be prevented, better managed and even cured. Talk to your family doctor or contact the National Continence Helpline on 1800 33 00 66. The National Continence Helpline is staffed by continence nurse specialists who offer free and confidential information, advice and support. They also provide a wide range of continence-related resources and referrals to local services.

Last Updated: Fri 09, Feb 2024

**Bristol Stool Chart for Healthy Poop** The chart can help you assess whether your stool is healthy or a cause for concern.

Everybody passes stool (poop), but what is considered "healthy" can look different from person to person. Knowing what type of stool you have is an important way to understand your bowel health. You can do so using the Bristol Stool Chart, which sorts stools into seven categories based on appearance and texture. [1] The Bristol Stool Chart indicates that easy-to-pass stool is considered healthy. However, stool that is too hard or too soft can mean you have constipation or diarrhea, respectively. Here's what else you need to know.

**How Is the Bristol Stool Chart Used?** Researchers use the Bristol Stool Chart to understand how quickly food travels through the digestive system and if different treatments work for bowel-related conditions. A healthcare provider uses the chart to understand your bowel movements better. [1] The Bristol Stool Chart numbers stools from 1 to 7, from hardest to loosest. Types in the middle of the chart are considered normal stools. Types 1 and 2 are signs of constipation, while types 6 and 7 are signs of diarrhea.[1] If you notice a change in your stool, a provider may ask you to point to the number on the chart that best matches your stool. This can help them give you an accurate diagnosis for constipation, diarrhea, irritable bowel syndrome, or other underlying conditions. They may also ask you about the color or smell of your stool and take additional tests. Signs of a Healthy Bowe

poop is stool that is easy to pass. Types 3 and 4 stools are considered to be ideal and healthy. [1] Other characteristics to consider include: Appearance: Normal poop should be medium-brown, smooth, and not too soft or firm. Frequency: The frequency of bowel movement differs from person to person. Some people may pass stool multiple times a day. Others may only pass stool three times a week. Both of these are considered normal.[3] Smell: Smelly poop is also normal. Stool naturally has an unpleasant odor, but the smell should be familiar. [4] However, if your stool smells different than usual, you may want to check in with a healthcare provider.

**What Can Affect Your Bowel Habits?** A few factors can affect your gut health and, in turn, your bowel habits. Those factors include:[5] Body structure Diet (e.g., not eating enough fiber) Family and genetic history Stress Bowel Function in Kids

However, you want to pay attention to how soft a child's bowel movements are using the Pediatric Bristol Stool Form for Children. The scale numbers stools from types 1 to 5, with types 3 and 4 having the optimal appearance for a child's stool. Type 3 is smooth, soft, and sausage-shaped, while type 4 is slightly mushy and has ragged edges. [6] Signs of Unhealthy Bowel Function Constipation and diarrhea are signs of bowel dysfunction and are both relatively common. In a 2018 study that included data from over 71,000 people, 20.2% reported having diarrhea, and 19.7% reported having constipation within a week.[7] Additionally, you may notice you have different colored stools. Though they may result from your diet, stool color changes can sometimes indicate an issue with your bowels.

**Constipation** Types 1 and 2 are stools that are hard to pass. If your stools are like Types 1 and 2, you are likely to be experiencing constipation. Constipation can occur when food passes through your digestive tract too slowly. [8] Other factors that can cause constipation are a lack of fiber intake, water intake, and exercise. Certain medications, vitamins, and not going to the bathroom when you have to go can also lead to constipation. and less fiber in your stools. [10] Type 7 is stool that is completely liquid with no hard pieces. This can be a sign that your digestive system is inflamed.[10] Factors that can result in diarrhea include bacteria from contaminated water or foods, viruses, or

parasites. You might also experience diarrhea due to taking certain medications or food intolerances. [11] Stool Color Changes A serious condition can sometimes cause a change in the color of your stool. In other situations, the color may change based on what you eat.[12] For example, having black stools may be caused by internal bleeding in the stomach. However, black licorice, Pepto-Bismol, and iron supplements can also turn stool black temporarily. [13] Additionally, you might experience red, grey or white, and green stools due to health conditions or from something you've eaten. If you're unsure why you have a change in stool color, speak to a healthcare provider to determine the underlying cause. How To Improve Bowel Health A healthy bowel is an important aspect of your overall health. To maintain a healthy bowel or improve bowel function, you can:[14][15][5] Consider using probiotics Eat high-fiber foods Enjoy smaller meals at a slow pace

Use a squatting position if possible—by sitting on the toilet and putting your feet up on a footstool—when you need to have a bowel movement When To Contact a Healthcare Provider Usually, bowel issues like constipation and diarrhea should clear up within a few days. Reach out to a healthcare provider if you experience either condition for longer than three to five days. You should also seek immediate medical care if you experience:[9][11] Blood in your stool Fever Rectal bleeding Severe back or stomach pain Unexpected weight loss Vomiting

A Quick Review The Bristol Stool Chart is a helpful tool you and a healthcare provider can use to understand your bowel health. The seven categories on the chart illustrate what types of stools are healthy and which stools can indicate problems like constipation or diarrhea.

Types of Poop, Color Chart, and More Medically reviewed by Avi Varma, MD, MPH, AAHIVS, FAAFP — By Emily Rekstis — Updated on February 1, 2024 Stool comprises digested food, proteins, bacteria, salts, and other substances produced and released by your intestines. What your poop looks like can be important. Unexpected changes could be a sign of an underlying condition. Characteristics Bristol stool chart Color guide Floating Constipation Medical attention FAQ Poop Color and Texture: What it Means [View video transcript](#) We all do it. For some, it's a necessary inconvenience. For others, it's a pleasant and satisfying part of the digestive process. It has fascinated toddlers since time immemorial, and there's a reason for that. Going number two might not be the prettiest topic for a dinner party, but there's much to learn from this mundane yet mysterious process. In the end (no pun intended), it's simply a part of our functioning body. So, what exactly is poop? Although everyone is unique in the size, shape, and smell of their poop, there are a few things that indicate a healthy (or unhealthy) poop. ADVERTISEMENT What does healthy poop look like?

Healthy poop can be as varied and as unique as the individuals who make it. But there are a few general rules to follow if you want to assess your poo artistry for optimum health. Color The poop emoji has one thing right: the brown coloring. The combination of stomach bile and bilirubin, which is a pigment compound formed from the breakdown of red blood cells in the body, gets the credit for this oh-so-lovely shade of brown. Shape A somewhat log-like shape is how most poop should come out due to its formation within the intestines. However, as we'll get to later, there are a variety of shapes that poop can have. When they differentiate from the log shape, that's when your poop is trying to tell you something's up. Size Poops shouldn't come out in small pellets — something else we'll get to later — but instead should be a couple of inches in length and comfortable and easy to pass. Consistency Anywhere between a firm and soft consistency is pretty much normal. If it sways too much one way or another, it could suggest some digestion or fiber issues. Length of time A commonly heard joke is that when someone takes too long in the bathroom,

it must mean they're pooping. A healthy poop, however, should be easy to pass and take only a minute or so to push out. That said, some people do spend a bit more time on the toilet, so as a general rule, a poop should take no more than 10 to 15 minutes. Frequency of 24 Fun fact: Did you know most people poop around the same time every day? On average, a person with healthy digestion will poop anywhere between every other day to three times a day. Any less could suggest possible constipation. This means you need some more water to move the "boat." Bristol stool chart of 24 The Bristol stool chart is an overarching indicator of how and why different types of poops look or feel a certain way. It's broken up into seven categories based on a 2,000-person study published back in 1992, and it makes poop knowledge basic and easy to understand. Type 1: Marbles Appearance: Hard and separate little lumps that look like nuts and are hard to pass. Indicates: These little pellets typically mean you're constipated. It shouldn't happen frequently. Type 2: Caterpillar Appearance: Log-shaped but lumpy. Indicates: Here we have another sign of constipation that, again, shouldn't happen frequently. Type 3: Hot dog Appearance: Log-shaped with some cracks on the surface. Indicates: This is the gold standard of poop, especially if it's somewhat soft and easy to pass. Type 4: Snake Appearance: Smooth and snake-like. Indicates: Doctors also consider this a normal poop that should happen every 1–3 days. Type 5: Amoebas Appearance: Small, like the first ones, but soft and easy to pass; the blobs also have clear-cut edges. Indicates: This type of poop means you're lacking fiber and should find ways to add some to your diet through cereal or vegetables. Type 6: Soft serve Appearance: Fluffy and mushy with ragged edges. Indicates: This too-soft consistency could be a sign of mild diarrhea. Try drinking more water and electrolyte-infused beverages to help improve this. Type 7: Jackson Pollock Appearance: Completely watery with no solid pieces. Indicates: In other words, you've got the runs or diarrhea. This means your stool moved through your bowels very quickly and didn't form into a healthy poop. As with size and consistency, poop's color can be a helpful signal about what's going on within your body. As we previously mentioned, varying shades of brown are considered the norm. Even a hint of green is considered healthy. But if your poop is veering toward other ends of the rainbow, you might want to assess. Black What does a person's poop color mean? If you've had licorice, iron supplements, or bismuth medications (such as Pepto-Bismol), that could be the explanation behind black stool. If you haven't had any of that, black poop could be a sign of bleeding in the upper gastrointestinal tract. It may seem like red would be a more likely color for this sort of concern, but since it's taken a while to travel down, it's older and darker. Green While hints of green are quite normal, if your poop has gone from brown to full green, it may mean one of two things. You've added lots of green foods like spinach to your diet, or your stools are passing through you too fast. When it doesn't pick up as much brown tinting bilirubin, it has more bile salts that turn it this color. Pale, white, or clay If your poop is a chalky light shade, it might mean you're lacking bile. Bile is a digestive fluid that comes from your liver and gallbladder, so if you're producing white stool, it probably means your duct is blocked. Pale poop could also be a side effect of certain medications like anti-diarrhea medicine. Either way, if it continues, consult with a healthcare professional. Red You're probably not surprised to hear that red poop can mean bleeding, either due to hemorrhoids or bleeding in the lower intestinal tract. If your stool is a little red, however, there may be no need to fret immediately. There are other, less serious reasons for this change in color. Foods like beets, cranberries, red gelatin, or tomato juice can turn poop red as well. Yellow Greasy, stinky, yellow stool is typically a sign of too much fat. This could also be a direct relation to a malabsorption disorder like celiac disease, where your body isn't absorbing enough nutrients. If your poop looks bright yellow, it could signify a condition called giardiasis, which is caused by an intestinal parasite in North America and the world.

Typically, you can develop giardiasis from contaminated water or exposure to someone with the condition

What does it mean when your poop floats

Now and again, when you take a look in the toilet bowl, you'll see poop bobbing like a toy sailboat in the bathtub. As alarming as this seems, it means that the stool is less dense than the others that sink. One potential reason for this lack of density can come from an increased amount of gas or water or even a high fiber diet.

It's also possible that malabsorption is, once again, the reason for a floating stool. If this is the case, the other abnormalities previously mentioned, like slight constipation, might also be present.

Constipation is defined as having fewer than 3 bowel movements per week. There could be many reasons you experience this lack of pooping. Nerve issues in and around the colon or rectum may slow down pooping, as can problems with pelvic muscles. Conditions that affect hormones, like pregnancy or diabetes, could also be the culprit. If you're experiencing this clogged-up feeling, add more high fiber foods to your diet, like beans, vegetables, fruits, and whole grains. Drinking fluids, staying active, and managing stress can also help alleviate constipation. If a diet change doesn't seem to get things moving, constipation could be caused by certain medications or even a blockage in the bowel. Talking with a doctor is the best What does constipation mean? ADVERTISEMENT course of action to find relief in this instance When should you consult with a doctor or other healthcare professional? A green poop here or hard poop there happens to the best of us. When this type of irregularity carries on for more than a day or two, you should take action and talk with a doctor. The same goes for changes in color or consistency or constipation. Chronic constipation can obstruct the bowels, while chronic diarrhea can make it difficult for a person to absorb necessary nutrients from food. Both chronic constipation and chronic diarrhea could even be a sign of more serious conditions. Again, the first sign of either of these should not be immediate cause for concern, but keep an eye on it and see if it lasts more than a few days. That said, pay attention to any signs of blood. If you haven't eaten any of the foods mentioned above that could turn your poop into this color, consult with a healthcare professional as soon as possible. As quick as we are to write it off, our poop can provide a wealth of knowledge about our health and ourselves. So, next time you pop a squat, take note of what's going on. The toilet bowl is a window into your health and you. What do unhealthy bowel movements look like? Unhealthy bowel movements can vary but may include diarrhea (loose, watery stools), constipation (hard, difficult-to-pass stools), or changes in frequency or texture that persist. What does your stool type mean? Stool type can indicate digestive health. Type 1 indicates severe constipation, while type 7 suggests diarrhea. Types 3 and 4 are considered typical, with 4 being the ideal "sausage" shape and smooth texture. What is type 4–6 stool? Type 4–6 stool refers to the Bristol Stool Scale, a tool for classifying stool types. Type 4 is smooth and soft, like a sausage or snake. Type 6 is fluffy with ragged edges, indicating mild diarrhea. What is type 5 stool consistency? Type 5 stool is soft blobs with clear-cut edges, considered a borderline typical stool consistency on the Bristol Stool Scale. What to know about the Bristol Stool Form Scale Medically reviewed by Kelsey Trull, PA-C — By Louise Morales-Brown — Updated on February 20, 2024 The Bristol Stool Form Scale (BSFS), or Bristol stool scale, is a chart that can help classify stools into seven groups. Characterizing the stool based on its consistency can help identify if it is a healthy bowel movement. The bowel is the part of the digestive system that allows people to absorb nutrients from food and expel the waste that the body cannot use. If feces pass too quickly or too slowly, it may indicate a problem with the bowels. This article explains the BSFS and suggests tips to improve bowel health and function

In 1997, Dr. Kenneth Heaton developed the BSFS, a diagnostic tool to help classify stools into seven categories. Healthcare professionals can use the chart as a practical guide in assessing how long a stool has spent in the bowels. The scale uses stool consistency to describe and categorize feces. Dr. Heaton devised the BSFS as a quick, inexpensive, and reliable way to classify stools visually without the need for laboratory testing. Healthcare professionals can use the BSFS to help assess the condition of the bowel and measure the effectiveness of certain treatments. For example, they may use the BSFS to help diagnose irritable bowel syndrome (IBS). The BSFS is a scale that classifies stools, ranging from the hardest to the softest. Experts consider types 1 and 2 to be uncharacteristically hard and indicative of constipation, while types 6 and 7 are unusually loose and may indicate diarrhea. Healthcare professionals generally consider types 3, 4, and 5 to be the most typical..

### Types of stools

The BSFS categorizes stool into seven types. Types 1 and 2 Type 1 has the appearance of separate hard lumps, while type 2 is sausage-shaped but lumpy. Both types could indicate constipation, as these stools are hard, dry, and difficult to pass. They may also be darker in color. This occurs when food passes too slowly through the digestive system and the colon absorbs too much water. To help treat constipation, people can consume more fiber, drink more

Individuals may also consider trying over-the-counter (OTC) laxatives for a short time. In more severe cases, a healthcare professional may prescribe medications to soften the stool and encourage the colon to pass feces. Learn more about laxatives for constipation. Types 3, 4, and 5 Type 3 has a shape similar to a sausage but with cracks on the surface, while type 4 has a comparable appearance to type 3 but with a smooth and soft surface. Experts generally consider these types to be the most healthy and typical stool forms. Type 5 stools are soft blobs with clear-cut edges that a person can pass easily. Some may also consider this type to be typical in those without bowel issues, while others may suggest it is too loose and may imply diarrhea. Types 6 and 7 Type 6 is a mushy stool that appears to consist of fluffy pieces with ragged edges, while type 7 is entirely liquid with no solid pieces. These types of stools may suggest a person is experiencing diarrhea, as the stools are loose. They may also be lighter in color. This is due to passing the stool through the digestive system too quickly and the bowel is unable to absorb water. To help treat diarrhea, individuals need to drink plenty of fluids to maintain hydration and consider taking OTC antidiarrheal medication. For chronic or persistent cases of diarrhea, people can speak with a healthcare professional, who can identify the cause and prescribe appropriate medications. Learn more about treating diarrhea at home Signs of a healthy bowel

The bowel consists of the small and large intestines, which both play an important role in keeping people healthy. They allow the body to absorb

Signs of a healthy bowel can include : regular bowel movements of well-formed (types 3 and 4) stools being able to hold on for a short amount of time after first feeling the urge to pass a stool defecating within roughly a minute of sitting on the toilet passing a stool without any pain or need to strain completely emptying the bowel when having a movement

### How to improve bowel health and function

In addition to having a healthy diet, drinking plenty of fluids, and getting regular exercise, people can try other strategies to improve their bowel health and function. These may include : Bowel training:

Individuals can attempt to train themselves to have a bowel movement at consistent times each day. For example, people can try to pass a stool shortly after eating breakfast. It is also advisable for a person to allow plenty of time and use the bathroom as soon as they feel the need to go.

**Positioning:** Maintaining appropriate toilet posture may make it easier for individuals to have a bowel movement and avoid straining. This typically involves relaxing, placing the feet on a footstool to ensure the knees are higher than the hips, leaning forward, bulging out the abdomen, and straightening the spine. **Changing medications:** If a person suspects that a medication or supplement may be affecting their bowel movements, they should discuss this with their healthcare professional. They may be able to change the dose or suggest a different medication. **Dietary changes:** As well as eating more fiber, it may be beneficial for people to consider avoiding foods and drinks that may irritate their stomachs. This may include alcohol, caffeine, and fatty foods. However, before making any drastic dietary changes, it is advisable to speak with a medical professional.

#### When to speak with a doctor

If a person is persistently passing stools at either end of the BSFS or switching from one end of the scale to the other, it is advisable that they consult with a healthcare professional. A healthcare professional can help identify the potential cause of abnormal bowel movements and recommend suitable treatments to allow an individual to pass regular and healthy stools. The BSFS is a diagnostic tool that people can use to classify their stools based on their appearance. The chart ranges from type 1 (hard) to type 7 (loose) and may identify problems with bowel movements through the shape and consistency of the stool.

Everything you need to know about pebble poop Medically reviewed by Kelsey Trull, PA-C — By Zawn Villines — Updated on September 10, 2023 Pebble poop is when poop appears as small, hard, separate lumps. It can also appear as a solid piece that looks as though it consists of pebbles. Both types are a sign of constipation.

Constipation is a common problem that most people experience from time to time. Chronic constipation can be painful and may indicate an underlying health problem. In this article, learn about the causes of pebble poop, as well as the possible treatments and home remedies. Symptoms

Pebble poop, or pellet-like stool, may occur when very hard stool breaks apart into smaller pieces. This breakage can happen during digestion, or it may take place in the anus immediately before a person has a bowel movement. It can be more difficult to pass these small pellets than a normal stool, and a person may strain to pass stool. Most people have a regular bowel movement pattern, passing stool from three times a day to once every 3 days. People with longer digestion periods and less frequent pooping may develop hard stools. When food passes through the digestive system, the colon absorbs some of the water that the food contains. Food that passes more slowly than usual spends too much time in the colon. As a result, the colon absorbs too much water, and the stool may become hard. Some other symptoms that a person might experience in addition to pebble-like stool include: straining to poop abdominal bloating stools that feel too large to pass the feeling that some stool remains left behind, even after a bowel movement The Bristol stool form scale is a tool that helps people classify stool appearance.

#### Causes

Hard, pebble-like stool is a sign of constipation , which can happen for many reasons. Certain lifestyle and dietary factors can make constipation worse. For example, constipation is more prevalent in seniors due to the changes in muscle tone and nervous system function that typically

occur with age. An older adult who does not eat enough fiber or takes medications that may cause constipation has an even higher risk of hard

Anxiety: Children and toddlers may not poop when they feel anxious or when there is a major change in their home or bathroom routine. Toilet training children may refuse to poop if their parents or caregivers are punitive or too aggressive with toilet training. Medications: Certain medications and dietary supplements may make constipation worse. These include antacids containing aluminum and calcium, anticholinergics, antispasmodics, anticonvulsants, calcium channel blockers, diuretics, iron supplements, narcotics, some antidepressants, and certain medications for Parkinson's disease. Gastrointestinal problems: Irritable bowel syndrome (IBS) and other conditions that affect the stomach and intestines may cause constipation. Some people with food sensitivities also experience this symptom. Physical injuries: Spinal cord injuries, damage to the bowels, and muscle injuries to the pelvic floor — such as those resulting from childbirth — may make it difficult for a person to have a bowel movement. This delay can slow digestion and cause pebble poop. Chronic illnesses: Many chronic illnesses can cause constipation by affecting nerve or muscle function. Diabetes, hypothyroidism, and colon cancer are conditions that may cause this symptom. Lifestyle: A sedentary lifestyle may increase the risk of constipation, especially for people with other risk factors. Other lifestyle changes like becoming pregnant, traveling, and changes in diet may cause constipation. Diet: Low-fiber diets may cause pebble poop and constipation. Some people develop pebble stools when they do not drink enough water.

### Home remedies

If the symptoms are mild or the constipation is not chronic, a few lifestyle changes may help a person treat pebble poop at home. Medication can also help them manage occasional hard stools. These strategies may help .

Eating more fiber: High-fiber foods may help soften the stool. Adult women require 22-28 grams (g) of fiber daily, while men need about 28-34 g each day. Fruits and vegetables are rich in fiber. Drinking more water: For some people, pebbly stools are a sign of dehydration. Trying a stool softener: Stool softeners reduce the amount of water the colon absorbs, making stools easier to pass. Using an over-the-counter constipation medication: These drugs can speed up digestion. Constipation medications may also make hard stools easier to pass. Exercising: Exercise can improve the strength of pelvic floor muscles and support muscle tone in the abdomen and throughout the body, making it easier for a person to have a bowel movement.

### Medical treatments

When a person has chronic constipation or a serious underlying medical condition, symptoms may only improve with medical treatment. A doctor may prescribe prescription medications such as lubiprostone, linaclotide, or prucalopride. However, the right treatment will depend on the reason why a person has constipation. For example, a person with pelvic floor dysfunction may not have sufficient strength to pass stool, slowing digestion and causing pebble poop. A doctor may recommend pelvic floor physical therapy. For people with IBS, a doctor may advise eliminating possible trigger foods from the diet one by one to see if this helps resolve the symptoms. If a person identifies a particular food that seems to cause issues, they can avoid or limit their intake. Biofeedback therapy may also be recommended if a person is having problems with the muscles that control bowel movements. This therapy involves a person learning to control their muscles through the use of electronic devices and a coach.

## Pebble poop in children and babies

Pebble poop can be distressing for babies and young children. They may fear that passing the stool will hurt, and they might refuse to have a bowel movement. Parents and caregivers should seek treatment for children with chronic constipation or persistently hard stools. People can try these home remedies to help an infant or child pass hard stool: Giving the child plenty of water and reassuring them that drinking more water may help. Ensuring the child eats plenty of high fiber foods like fruit and vegetables. Encouraging the child to get enough physical activity through walking, playing catch, or biking, for example. Getting the child into a routine of regularly sitting on the toilet or potty around the same time every day, ideally after a meal. Asking the child if they feel worried about using the potty or toilet, or if there are certain environments they feel uncomfortable doing this (such as school or playschool) Staying calm and reassuring, as displaying anger or stress can intensify a child's anxiety about having a bowel movement. Using a reward system when the child uses the bathroom regularly. It is essential not to give constipation medication to a baby or child without first talking with a doctor. The following strategies may help babies: Moving the baby's legs in a circle as though pedaling a bicycle while the baby lies on their back. This movement can stimulate the muscles and bowels and may help the baby's bowel movement. Giving the baby a gentle tummy massage while they're lying down.

If the baby is on solids, make sure they're getting enough fiber – apples, pears, and prunes are particularly good for constipation.

## Summary

Hard, pebble-shaped poop is a common frustration. The occasional pebble poop usually means that a person did not get enough fiber or water that day. Minor stomach problems and infections can also temporarily slow digestion, causing constipation. When pebble poop lasts for days or weeks, however, it may be a sign of a serious problem. Chronic hard stools can also be very painful, triggering anxiety about having a bowel movement. In many cases, a quick consultation with a doctor can help resolve the problem. Even when the cause of pebble poop is more serious, prompt medical care can stop the problem from getting worse.

## The Scoop on Poop: What Does Your Poop Say About Your Health?

Everybody poops. We've been taught this since childhood, but sometimes, people aren't comfortable talking about it. Poop may not be a topic fit for dinner table conversation, but it's a completely normal — and essential — bodily function. Plus, it can tell you a lot about your health. A bowel movement is the last stop your food makes as it goes through your digestive tract. Sometimes called stool or feces, your poop is what's left of your food and drink after your body absorbs important nutrients. What and how you eat affects your digestive system, and sometimes, your bowel movements can change simply because of changes in your diet. Other times, changes in bowel movements signify something more serious. What's "normal" depends on each individual person — but there are some signs you can look for that mean something may be off. Here are some other ways your poop may be able to tell you about your health.

## What Does It Mean When Your Poop Changes Color?

vegetables can turn your poop green. Also, food coloring can change the color of your poop. In these cases, it's OK if your poop isn't quite so brown," explained Nitin Ahuja, MD, MS, physician at Penn

Gastroenterology Perelman. Other times, there may be something else going on that's causing your poop to change color. Light-Colored Poop If your poop is light-colored, yellow, clay-colored, or very light brown, this may be a sign of: Black Poop "Your poop can become black if you eat foods such as black licorice and blueberries or if you're taking iron supplements. However, it can also be an indicator of bleeding or tumors in your digestive tract," warned Dr. Ahuja. Red Poop Blood in your stool can cause your poop to appear red. A tiny bit of bleeding can be a result of constipation, or if you're a woman having her period, but it can also be a sign of: • An infection or inflammation (swelling) in your gallbladder, liver, or pancreas • Alcoholic hepatitis, which is inflammation in your liver caused by alcohol consumption A blockage in the bile ducts, the part of your digestive system responsible for moving a fluid called bile from your liver and gallbladder to your small intestine. Such blockages may be caused by gallstones or narrowing of the ducts themselves. • • Bleeding in the rectum or anus • Abnormal blood vessels • Blood supply being cut off to parts of your digestive system • Swelling in the lining of your stomach • Food or a foreign object being stuck in your digestive system Cancer of parts of your digestive system 4/6/24, 2:34 PM Page 3 of 7 Your primary care provider can determine if there are any problems with your digestive system by performing a physical exam and lab or imaging tests

What Does it Mean if You're Pooping Too Often or Not Enough? Dr. Ahuja explained, "There isn't a set amount of times you should poop — it's different for everyone, and some people may poop every day, while others may poop every other day. The important thing is staying regular. If your pooping habits seem to suddenly become more or less frequent, that can be a cause for concern." Diarrhea If your poop is loose and watery and you have to go more than three times in one day, that's diarrhea. Not only can it be inconvenient, it can mean that your body is trying to get rid of something in your digestive system

Some causes of diarrhea are: • Bacteria or parasites (tiny organisms) from contaminated food or water • Viruses such as the flu, norovirus, or rotavirus • Medications with magnesium, such as antibiotics or antacids Food intolerances, which are when your body has a hard time digesting certain ingredients. One common food intolerance is lactose intolerance — when your body has difficulty processing a carbohydrate found in dairy products. • • Diseases of your stomach, small intestine, or colon, such as Crohn's disease • Problems with your colon, such as irritable bowel syndrome (IBS)

"Diarrhea is a common problem, and it usually goes away on its own. If it lasts more than a few days, though, it can be a sign of a more serious problem, and you should see your primary care provider," said Dr. Ahuja. Diarrhea in children — especially infants — can be particularly dangerous because they can get dehydrated quickly and become very sick. Every once in a while, diarrhea can be normal, but it's important to monitor it. You should not hesitate to see your child's primary care provider right away if you're concerned.

Constipation Poop that's hard, dry, and/or painful to pass is called constipation. If you only have three or fewer bowel movements per week, constipation could point to issues with your diet., Some causes of constipation are

- A diet low in fiber, which is a nutrient found in foods such as fruits, vegetables, and whole grains • Dehydration • A lack of exercise or physical activity • Medications such as antidepressants or opioids

"You don't need to poop every day — but if your bowel habits change or are causing you pain, talk to your primary care provider. Also, use laxatives only if your physician tells you to, as they can further disrupt your digestive system if not used properly," said Dr. Ahuja. What About Other Changes in Your Poop?

**Floating Poop** If your poop never seems to sink in the toilet bowl, that can be a reflection of your diet and certain health conditions. Floating poop can be caused by:

Poor absorption of nutrients — called malabsorption • Too much gas, which can occur with a change in your diet • A gastrointestinal infection • Pancreatitis

Usually, floating poop isn't a cause for concern on its own. However, if you have other symptoms, such as significant weight loss, talk to your primary care provider to see what's going on. **Foul-smelling Poop** Your poop may not smell like flowers, but the odor of your poop should be familiar. If it's suddenly extremely bad smelling and has you running for the air freshener each time you go to the bathroom, this can be a sign of a problem. Foul-smelling poop can be caused by:

- Celiac disease • Crohn's disease • Chronic pancreatitis, which is inflammation of your pancreas • Cystic fibrosis, a genetic disease that can affect your lungs, pancreas, liver, kidneys, and intestines • An intestinal infection, which can be caused by a virus, bacteria, or parasites in your intestine • Malabsorption

If you didn't make any major changes to your diet and your poop suddenly has a strong odor, talk to your primary care provider.

**Monitor Your Pooping Habits** Dr. Ahuja concluded by saying that, "The most important thing to remember is to be on the lookout for any changes in your bowel movements. If your poop is suddenly more or less frequent, or looks significantly different, don't ignore these changes." Regularity is a good thing when it comes to poop, and you should make sure to get to your physician's office if anything seems a bit ... stinky.

#### Anal Fissures

These are small tears in the skin around the anus, usually caused by constipation and hard stools. Along with bright red blood, you might notice pain during bowel movements and afterward. You can add more fiber to your diet or take a stool softener to ease the problem. A warm bath might help, too. If it doesn't get better, your doctor can give you a cream to soothe the area.

#### Polyps

Benign growths in your colon don't usually cause bleeding during bowel movements, but it's possible and can happen slowly over time. Other symptoms include changes in the color of your stool and changes in your bowel habits that last longer than a week or two. Polyps can turn into cancer, so it's key to find and remove them before they do. Make sure you know when it's time to get a colonoscopy and other cancer screening tests.

#### Colorectal Cancer

Blood can be a sign of a tumor in your colon or rectum. You might see bloody streaks in your poop, or notice that it is dark-colored, a sign of bleeding higher up in your digestive system. Often, though, you can't see blood on your own, but your doctor may find traces of it with a screening test. Other colorectal cancer symptoms include diarrhea or constipation, belly pain or cramps, bowel

movements that are narrow, and fatigue. You'll need surgery, and possibly chemotherapy or radiation, to treat this condition.

#### Inflammatory Bowel Disease

This condition includes Crohn's disease (inflammation in any part of your digestive tract) and ulcerative colitis (inflammation in your colon and rectum). Both can cause blood during bowel movements, pain, weight loss, and diarrhea. Your treatment will focus on lowering inflammation, pain relief, and controlling diarrhea. Usually, medicines and changes to your diet and other

**Diverticulosis/Diverticulitis** Diverticulosis means that small pouches form in the walls of your intestines. When one of them gets infected, you have diverticulitis. Other than blood on toilet paper or in the bowl, symptoms can include cramps, fever, nausea, changes in your bathroom habits, diarrhea, or constipation. Antibiotics and a change in diet might solve your problem. But if your case is severe, you might need surgery.

**Peptic Ulcers** .These open sores in the lining of your stomach and intestines can cause dark 4/6/24, 2:31 PM Page 26 of 30 blood to show up in your poop. But it doesn't happen to most people with ulcers. The most common symptom is pain. You also might have heartburn, burp a lot, or feel nauseated. Treatment can include antibiotics and medicine to block acid. You may need to limit your use of nonsteroidal anti inflammatory drugs (NSAIDs), since they can be hard on your stomach.

Important: If your stool looks black and tarry and you feel lightheaded, get emergency help

Occasionally, stool may be flat, squarish, or stringy. These changes are often the result of diet. However, irritable bowel syndrome, chronic constipation, and other conditions may cause long-term changes in stool shape.

Poop should generally resemble the place from which it comes: the intestines. It is usually slightly rounded, like a sausage, and smooth, with some cracks on the surface.

It can be concerning if stools are suddenly not "normal." Most of the time, however, a change in appearance is short-lived and nothing to worry about.

#### **Is flat poop a problem?**

Share on Pinterestwenzdai figueroaTemporary changes to the shape or color of stool are common and not necessarily a sign of illness.Sometimes, they stem from the person's diet. For example, foods containing colorings can change the color of poop. An excess of fatty

foods can lead to oily or greasy poop, and eating too little [fiber](#) can likewise give stool an unusual appearance.

If the changes only last for one or two bowel movements, or even a couple of days, they are likely no cause for concern.

However, if changes in stool shape or color last longer or accompany other symptoms, the cause may be an underlying condition that requires medical attention.

## Causes

While changes in the color or appearance of stool often stem from the diet and are temporary, some underlying health issues can cause more lasting changes.

Below, we describe some conditions that may cause flat poop:

### Irritable bowel syndrome

[Irritable bowel syndrome \(IBS\)](#) refers to a group of gastrointestinal symptoms that occur without any visible signs of damage or disease in the digestive system.

Symptoms [include](#)[Trusted Source](#):

- [stomach pain](#)
- [bloating](#)
- [gastroesophageal reflux](#)
- [gas](#)
- needing the toilet urgently
- whitish [mucus in stool](#) Treatment may include:
  - eating more fiber
  - avoiding [gluten](#)
  - switching to the [low FODMAP diet](#)

[Learn more about the signs of IBS here.](#)

## Constipation

[Constipation](#) involves having fewer bowel movements than usual or having hard stool that is difficult to pass.

Symptoms [include](#)Trusted Source:

- small, hard, pellet- or [pebble-like](#) stool
- stomachache
- cramping
- gas
- [frequent belching](#)
- bloating
- no bowel movements for several days

Treatment may [include](#):

- avoiding triggering foods
- drinking more fluids
- taking [laxatives](#)
- taking [stool softeners](#)
- taking [fiber supplements](#)

[Find home remedies for constipation here.](#)

## Diarrhea

[Diarrhea](#) is the passage of loose or watery stools [several times a day](#)Trusted Source. It may also involve pain or discomfort.

Symptoms [include](#)<sup>Trusted Source</sup>:

- an urgent need to use the bathroom
- cramping
- a [loss of control](#) of bowel movements
- [nausea](#)
- pain in the abdomen

Treatment may involve:

- taking over-the-counter diarrhea medication
- treating the underlying cause
- replacing lost fluids and [electrolytes](#)

[Learn how to stop diarrhea fast here.](#)

## Colorectal cancer

Changes in the shape of stool can be one sign of [colon](#) or rectal cancer. If a [tumor](#) grows in either area, it can change the shape of the bowel and cause stool to be flat or thin and pencil-like.

Symptoms [include](#)<sup>Trusted Source</sup>:

- [blood in the stool](#)
- [darker stool](#), indicating bleeding further up the gastrointestinal tract
- feeling the need to have a bowel movement and no relief afterward
- diarrhea, constipation, or other changes in bowel habits that last more than a few days
- [weakness](#) and [fatigue](#)
- [unintended weight loss](#)
- [vomiting](#)

Treatment may include:

- surgery to remove the cancerous cells
- [radiofrequency ablation](#)Trusted Source, which involves killing these cells with a probe containing tiny electrodes
- cryosurgery, which freezes and destroys the abnormal tissue
- [chemotherapy](#), which involves stopping cancer's growth with drugs
- [radiation therapy](#)Trusted Source, which involves using high energy X-rays, for example, to kill cancerous cells or keep them from growing
- targeted therapy, which involves attacking cancerous cells, without harming regular cells, using drugs or other substances
- immunotherapy, which involves using the immune system to fight the cancer

It is important to remember that the earlier a doctor diagnoses cancer, the better the likelihood of successful treatment.

[Learn more about colorectal cancer here.](#)

## Other potential causes

Anything that may cause the colon or rectum to narrow may also cause flat poop. These issues include:

- [fecal impaction](#) — a partial blockage or impaction of waste in the intestines or rectum
- [hemorrhoids](#) — swollen veins in the lower rectum or anus
- trapped abdominal hernias
- [colon polyps](#)
- a distended, or stretched, colon
- [food poisoning](#)

## What to try at home

The best approach depends on the cause of the issue. Some home care techniques involve:

### Fiber

If constipation causes flat stool, eating more fiber-rich foods can help.

Foods with high fiber content include whole grains and many fruits and vegetables. Leave the skins on, when possible.

[Learn about high fiber foods here.](#)

### Water

Drinking lots of water can ease the passage of stool, making it less likely to be flat.

[Learn about the symptoms of dehydration here.](#)

### Exercise

Some types of physical activity may have a positive impact on gastrointestinal problems.

Activities such as walking, yoga, aerobic exercise, and tai chi may help improve physical and mental health-related symptoms of IBS, according to [research from 2019](#)Trusted Source.

### Low FODMAP diet

[FODMAP](#)Trusted Source stands for “fermentable oligosaccharides, disaccharides, monosaccharides, and polyols.” These are short-chain carbohydrates that can be poorly absorbed by the small intestine and can cause gastrointestinal symptoms.

[Evidence](#)Trusted Source supports the use of a low FODMAP diet in the treatment of IBS.

[Learn more about the low FODMAP diet here.](#)

## **When to consult a doctor**

Flat poop is rarely a cause for concern. However, a person should seek medical advice if any of the following symptoms occur:

- blood in stool
- dark stool
- pus or mucus in stool
- high fever
- abdominal pain or cramping
- sudden, prolonged constipation
- pooping more or less often than usual
- drastic changes in the consistency of stool

Overall, if thin or flat stool occurs for more than 3 days, even without any of the above symptoms, a person should consider contacting a doctor.

## **Frequently asked questions**

Here are some questions people ask about flat poop.

### **Is flat poop normal?**

Flat poop is not usually a cause for concern. However, people should speak with a doctor if they have blood in their stool or persistent changes in bowel habits for no clear reason.

### **What can flat poop mean?**

Flat poop can be a sign of constipation, diarrhea, irritable bowel syndrome, an enlarged prostate, or colorectal cancer. Stool can also change in color and consistency according to the diet.

## Summary

Bowel movements naturally vary from day to day, and these temporary changes are usually nothing to worry about.

However, prolonged changes can indicate an underlying health issue. If flat poop occurs for more than 3 days, seek medical advice. It may be wise to do so earlier if there are other symptoms.

Last medically reviewed on January 10, 2023

- [Colorectal Cancer](#)
- [Constipation](#)
- [Irritable Bowel](#)

Colon cancer is one of the most common types of cancer. It originates in the colon or rectum and is medically known as colorectal cancer, though most people shorten it to colon cancer. While it is currently one of the leading causes of cancer-related deaths, it is preventable. It's also easier to treat when found early.

The colon, also known as the large intestine, is a long, tube-like organ that plays a crucial role in digesting food. It absorbs water and nutrients from the food you eat and helps form waste into stool. The colon is divided into several sections, including:

- the ascending colon
- transverse colon
- descending colon
- sigmoid colon

The rectum is the last portion of the large intestine, connecting the colon to the anus. It serves as a storage area for stool before it is eliminated from the body. When stool enters the rectum, it triggers the urge to have a bowel movement.

Together, the colon and rectum are responsible for processing and eliminating waste from the body, helping to maintain overall digestive health.

## How Can Colon Cancer Affect Stool?

When it comes to colon cancer, subtle changes in bowel habits and stool characteristics can be important signs. Paying attention to these changes can help you spot potential problems early so that you can get proper medical help.

In healthy individuals, stool is typically brown and has a soft, well-formed consistency that is easy to pass.

Variations in consistency, including diarrhea and constipation, may indicate the presence of a bowel condition or, in some instances, colon cancer. Some variations to be aware of include:

- Pebble stool. Pebble stool refers to small, hard, and lumpy feces. While this can be a sign of constipation, persistent occurrences, particularly if accompanied by other symptoms such as abdominal pain or blood, may indicate a blockage within the colon.
- Pencil-thin stool. Pencil-thin stool is unusually long and thin, which can indicate there is a narrowing of the colon due to a cancerous tumor.
- Flat stool. Abnormally flattened or ribbon-like feces characterize flat stool. Tumors that change the shape of the colon or rectum can create this type of stool.
- Mucus in stool. Mucus is a gel-like substance secreted by the intestines that aids in stool passage through the colon. While a small amount of mucus in stool is considered normal, an excess should be examined, especially if accompanied by other symptoms.
- Blood in stool. Take it seriously if you notice blood in your stool or bright red bleeding from your rectum. This could signify pre-cancerous polyps or cancerous tumors in your digestive tract. As your stool passes through, it can mix with blood, making it appear dark brown or black.

It is important to remember that these symptoms can often be caused by other digestive issues and underlying conditions, including:

- [Inflammatory bowel disease](#)
- Constipation
- [Hemorrhoids](#)
- Enlarged prostate
- Anal fissures

For this reason, if you experience any changes in your bowel habits, seek a comprehensive medical check. Your doctor may suggest screening or diagnostic procedures such as a [colonoscopy](#).

## What Is a Colonoscopy?

Colonoscopies are an excellent tool for both detecting and preventing colorectal issues, and they are typically performed as a part of routine screening or if there are concerns about digestive health.

It is a minimally invasive medical procedure where a doctor uses a long, flexible tube with a camera on the end to examine the inside of your colon. The procedure allows your doctor to check for any abnormalities, such as polyps or signs of colorectal cancer.

Regular [colon cancer screenings](#) are essential for individuals aged 45 and above or those with a family history of the disease to potentially detect and treat colon cancer early. Understanding these [warning signs of colon cancer](#) and following routine screening practices can lessen the risks associated with colon cancer.

Early detection is key to successful treatment and improved outcomes – [Schedule your appointment](#) today.

## What causes narrow stools? Should I be concerned?

Answer From Elizabeth Rajan, M.D.

Narrow stools that happen now and then probably are harmless. But in some cases, narrow stools — especially if pencil thin — may be a sign that the colon is narrowing or has a blockage. And that could be due to colon cancer.

Irritable bowel syndrome (IBS) also may cause changes in the size of your stools. IBS can cause stools to be smaller, larger or narrower than usual. It also causes changes in the consistency of stools.

Check with a healthcare professional if you notice any changes in the appearance of your stool that last longer than 1 to 2 weeks. Get medical help right away if your bowel changes happen with rectal bleeding or severe belly pain. With

**Elizabeth Rajan, M.D.** Anyone can have narrow stools every now and again. As long as bowel movements are otherwise normal, this usually isn't cause for concern.<sup>1</sup> There are a number of possible causes of thin stools that do warrant attention, however.

Narrow stools can be caused by constipation, irritable bowel syndrome (IBS), and the use of certain medications. Less commonly, thin poop can point to something serious such as colorectal cancer.

Contact your healthcare provider if you notice these stools persist for more than a week or two or you experience them more often than not.

This article discusses narrow stool and its potential causes, as well as other signs that you should seek medical attention.



# What Are Narrow Stools?

Narrow stools are long and pencil-thin, rather than the normal rounded shape. They may be harder to pass, requiring you to strain or bear down more than usual.

Depending upon the cause, narrow stool may be accompanied by other symptoms, such as:<sup>1</sup>

- Abdominal pain
- Weight loss
- Bloating
- Blood mixed in or on the stool

[The Meaning of Poop Colors, Shapes, Sizes, and Consistency](#)

## Causes of Narrow Stools

There can be many reasons for thin or narrow stools. Sometimes they happen without any known cause. When they happen frequently, the causes may range from constipation to something more serious like cancer.

## Constipation

Thin stools can signal [constipation](#). When you are "backed up," stool passes slowly through the intestines. This allows the intestines to absorb

more water from the stool, making it even more difficult to pass.

If there is significant constipation, only thin amounts of stool may be able to pass through.<sup>1</sup>

Increasing fiber in the diet is important for [treating constipation](#). Staying well-hydrated can also help.

Medications may be necessary for those whose stools don't improve enough through dietary changes or drinking extra water. These medications can include:<sup>1</sup>

- [Laxatives](#), which help stimulate the intestine to pass stool
- [Stool softeners](#), which can make the stool easier to pass by allowing the stool to retain water and fat cells

## Hemorrhoids

[Internal hemorrhoids](#) are swollen and inflamed veins in the rectum or anus that don't extend outside the body. If they are large, they can force stool into a narrow shape as it exits. Internal hemorrhoids may also cause rectal bleeding, which may be present in or on poop.<sup>2</sup>

Hemorrhoid symptoms are often relieved with nonsurgical methods such as:

- **Increasing water intake** to rehydrate hard stool so it can pass with less straining
- **Consuming more fiber** or taking fiber supplements to soften the stool so it can pass more easily
- **Surgery:** This is considered if the hemorrhoid prolapses (extends beyond the anus) or becomes thrombosed (a clot forms in it).<sup>2</sup>

## Irritable Bowel Syndrome (IBS)

IBS can cause changes in the size and shape of your stool. It's common for people with IBS to have stool that is smaller or narrower, especially in **constipation-predominant IBS**.

IBS flare-ups can happen during periods of stress, which may cause narrow stools.

If your narrow stools are caused by IBS, you may also have other symptoms like constipation, gas and bloating, and bowel movementrelated abdominal pain.

IBS can often be treated with diet and lifestyle changes, such as avoiding trigger foods, eating foods that are high in fiber, and drinking plenty of fluids. In some cases, medication may be required. These could include:

- Fiber supplements or laxatives

- Anticholinergic medications
- Pain medication
- Certain kinds of antidepressants

## Diverticulitis

Diverticulitis is a digestive condition in which inflamed or infected pockets have formed in the large intestine (colon). People with an advanced case could have narrow stools or very small stools that are shaped like pellets.

This happens when the condition causes the lower colon to become distorted, which can change the shape of your stool.<sup>3</sup>

When you have diverticulitis, you may also have:

- Blood in your stool, which causes it to take on a bright or dark red color or become black and tarry
- Foul-smelling stool
- Bouts of diarrhea or constipation
- The need to strain during bowel movements

Mild cases of diverticulitis are usually treated with diet changes and antibiotics. Cases of diverticulitis that are likely to cause narrow

stool usually need additional treatment.

Some people with diverticulitis develop an abscess that needs to be drained. In severe cases, surgery to remove part of the intestine may be necessary.

## Fecal Impaction

Fecal impaction is similar to constipation, but more significant. With an impaction, a lump of dry stool is stuck in the rectum (the bottom portion of the colon just before the anus).

This blocks the ability of other waste to move through normally. Only narrow stool may be able to pass.<sup>4</sup>

Fecal impaction is treated by removing the stuck stool in the rectum. This can be done manually by a healthcare provider. They will use a welllubricated, gloved hand to insert a finger or two into the rectum to help break up the stool so it can be removed.

Interventions such as suppositories or enemas may also be used.<sup>5</sup>

## Medications

Medications that slow the movement of the intestines can cause narrow stools. They can lead to constipation and possible fecal impaction, causing thin stool. Some of the medications that can do this include:<sup>1</sup>

- Opioid pain medications, such as morphine or hydrocodone
- Anticholinergics, such as scopolamine or oxybutynin
- Antidiarrheal medications, if taken too often

## Colorectal Cancer

A cancerous mass in the intestine or closer to the end, near the anus, can cause thin stools. If the mass is large enough to block the stool's movement through the intestine, pencil-thin stool may be the only thing that is able to get by.

Other symptoms associated with colon cancer include:<sup>6</sup>

- Abdominal pain
- Blood in the stool
- Unintentional weight loss

Treatment for colorectal cancer can vary, depending on how advanced the cancer has become. Surgery to remove the mass is a common procedure and may be followed by chemotherapy or radiation, or both.<sup>7</sup>

## Anal Cancer

Anal cancer can have many of the same symptoms as colorectal cancer, including narrow stools. This type of cancer begins in the cells around or inside the opening of the anus.

With anal cancer, you may also have:

- Bleeding and/or pain from or around the anus
- [Anal itching](#)
- Changes in bowel habits, such as more or fewer bowel movements
- Straining during bowel movements
- A lump or mass on the anal opening
- Unusual discharge from the anus

Like other cancers, anal cancer may be treated with a combination of radiation and chemotherapy or surgery.

## Are There Tests to Diagnose the Cause of Thin Stools?

A healthcare provider may recommend tests to help determine the cause of thin stools. Tests that may be done to look for the cause of thin stools can include:

- [Digital rectal examination](#): A healthcare provider performs this manual exam to see if they can feel a mass inside the rectum.<sup>1</sup>

- [Stool tests](#): A sample of stool is sent to a lab and can be analyzed for infections or blood.<sup>8</sup>
- [Colonoscopy](#): During this procedure, a camera is inserted into the colon to look for any areas that may be abnormal or causing the symptom of thin stool. If something looks abnormal, a biopsy (sample) can be taken for testing.<sup>6</sup>

## When to See a Healthcare Provider

The occasional episode of thin stool is likely not a cause for concern. However, if thin stools occur more frequently over a period of one or two weeks, notify a healthcare provider.

You should also notify your healthcare provider if your narrow stools aren't responding to what you're doing to improve them (such as increasing fiber) or are accompanied by other symptoms, such as abdominal pain or weight loss. Blood in the stool is always a reason to talk to a healthcare provider.

Addressing the underlying condition early can help prevent complications like complete bowel obstruction or further growth and spread of cancer.

## Summary

Occasional narrow stools are not usually concerning. When narrow stools are happen often or persist longer than a week or two, they may have causes that range from constipation to cancer. See your healthcare provider.

Narrow stools accompanied by other symptoms, such as blood in the stool or abdominal pain, should also be evaluated. Tests can be done to help find the cause.

### FREQUENTLY ASKED QUESTIONS

- What is a normal stool supposed to look like?

Normal stool may be a little different for each person but should be brown in color, soft, and not difficult to pass. It generally stays together when entering the toilet and doesn't contain any blood.

#### [\*\*Learn More\*\* Blood in Stool](#)

- What does thin stool look like?

Thin stool is stool that is not large in size, but is more ropelike. It can also be described as pencil-thin and long.

#### [\*\*Learn More\*\* Stool Appearance Changes](#)

- What causes thin stool?

Thin stool can be caused by colorectal cancer. It can also have specific cause.

Yeong Yeh

subsequent development of gastrointestinal symptoms. One good example of this is celiac disease, which affects 1% of the population with the damage occurring in the gut as a result of eating gluten, a protein present in the wheat. More recently a new entity is emerging termed non-celiac gluten sensitivity which may affect more than 10% of the population.

Food intolerances are reported to be very common affecting up to 40% of individuals who have irritable bowel syndrome (IBS) type symptoms. A further exciting development is the dietary interventions studies showing benefit to patients with IBS when trying a FODMAP (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols) diet, gluten free diet, or probiotics. However one area of confusion for both clinicians and the public alike are the entities of Food Allergy and Food Intolerance. Food allergy is predominantly a childhood diagnosis and is reported to affect 4-7% of children. Making the diagnosis is based on the presence of either an IgE immunoglobulin blood or skin prick test, however crucially patients must also report allergic symptoms. It is possible to have a positive IgE test as a marker of having been sensitized to the allergen but not



# World Digestive Health Day

## WDHD – May 29, 2016

## YOUR DIET AND GUT HEALTH

actually develop an allergic response.

Nevertheless we now consider that 1-2% of adults may also have food allergy (for example peanut allergy or seafood allergy). There are at present no tests for food intolerances, so distinguishing between food allergy and food intolerance is vital.

The World Gastroenterology Organisation (WGO) wishes to raise awareness of the relationship between what we eat and gastrointestinal symptoms through its annual public advocacy and awareness campaign, World Digestive Health Day (WDHD). WDHD is celebrated each year on May 29<sup>th</sup>, with associated activities and initiatives continuing throughout and beyond the campaign year. WDHD aims to provide a broad overview on this common association by providing gastroenterologists, and hence their patients and the lay public, with an understanding of the latest basic and clinical research in the role of food in our gut. “Diet and the Gut – ‘Your Diet and Gut Health’” is the WDHD campaign theme for 2016

The World Digestive Health Day Campaign is led by the following individuals representing a global view and expertise. They have guided the course of the WDHD campaign, leading in the development of tools and activities throughout 2016 and beyond.

WGO President-Elect and Chair of the WGO Foundation  
Ankara, Turkey

Approximately one third of people in the general population complain of some gut-related symptoms, such as flatulence, bloating, heartburn, nausea, vomiting, constipation, diarrhea, food intolerance, incontinence, and

and seeks to translate research into clinical practice and facilitate communication between healthcare providers, healthcare payers, and the public. We want to ensure that patients receive appropriate dietary and lifestyle advice as well as appropriate investigations and treatment, relevant to their condition, whether this is celiac disease, non-celiac gluten sensitivity, IBS, food intolerance, or food allergy. The WGO’s task will be supported by the development of educational and training materials, around the world, in collaboration with WGO Member Societies and by the concurrent development and publication of the WGO Guidelines and Cascades on the management of different conditions where our diet may play a role.

abdominal pain. While most physicians look at these gut-related symptoms in the context of the gastrointestinal (GI) diseases, gut-health related symptoms occur more often in the absence of demonstrable functional and structural diseases in the GI tract. These digestive symptoms may not be life threatening, but they can significantly affect the general wellbeing and quality of life of the affected individuals.<sup>1,2</sup>

Furthermore, the health of the gut is deeply rooted in the psyche of society

and the presence of any of these gut symptoms may prompt an individual to consult a doctor. Ancient medicine, such as Ayurveda, the ‘science of life’ originating in

Table 1: *Indicators of gut health*

India more than 3,000 years ago, and Asian medicine, suggest that many of the human diseases arise from the gut and that strengthening of the digestive system, with the foods we eat, holds the key to good health.<sup>3</sup>

## HOW TO DEFINE GOOD GUT-HEALTH?

‘What constitutes a healthy gut’ is as yet not well defined. As the World Health Organization defines “health” as a positive state of health, rather than “the absence of diseases,” the healthy gut can be defined as a state of physical and mental well-being without gastrointestinal symptoms that require the consultation of a doctor, absence of any disease affecting the gut, and also the absence of risk factors for diseases affecting gut.<sup>1,4</sup> Therefore, to maintain good gut-health, one needs to undertake measures not only at the tertiary level of prevention to retard the disease process, but also consider both primary and secondary levels of prevention to maintain be all encompassing so that it covers all perspectives, ranging from the Asian understanding of the gut as the middle of spiritual and physical strength to the Western understanding of the GI barrier as a central body

site interacting with the environment and involved in the pathophysiology of many intestinal and extra-intestinal symptoms and diseases.<sup>3</sup>

## INDICATORS OF GUT-HEALTH

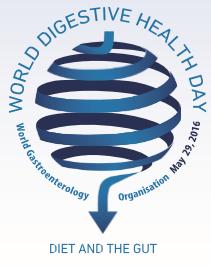
The GI system is complex and comprised of absorptive mucosa, epithelial transport, gastrointestinal motility, immune system, and gut microbiome; normality in all or most of its constituents provides a healthy gut. Any defect or abnormality in any or many of the above constituents may predispose one to diseases or may cause disease. (see Table 1)

## HOW TO MAINTAIN GUT-HEALTH?

Our knowledge about how to maintain or restore gut-health is limited in evidence-based medicine terms, but general observations suggest that there is a wide range of possible ways to support gut-health and GI well-being. Current medical

Criteria for a healthy GI system	Specific features of gut-health
Effective digestion and absorption of food	Effective absorption of food, water, and minerals Regular bowel movement, passage of normal stool No diarrhea, constipation, and bloating Normal nutritional status
Absence of GI illness	No acid peptic disease, gastroesophageal reflux disease (GERD), or other gastric inflammatory disease No enzyme deficiencies or carbohydrate intolerances No inflammatory bowel disease (IBD), celiac disease, or other inflammatory state No colorectal or other gastrointestinal cancer
Normal and stable intestinal microbiota	No bacterial overgrowth Normal composition and vitality of the gut microbiota
Effective immune status and gut barrier	Effective GI barrier function Normal levels of immunoglobulin A Normal number and activity of immune cells
Quality of life	Normal quality of life

Adapted from, Bischoff SC. ‘Gut health’: a new objective in medicine? *BMC Med.* 2011;9:24.



# World Digestive Health Day

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### UNDERSTANDING OF NORMAL GUT HEALTH, *continued*

a disease free gut as far as possible. Good gut-health should be the goal of the GI system. Here we present some guidance for which there is an evidence base. Research is much more focused on the treatment of defined GI disease rather than on the primary and secondary prevention of the diseases. For example, we know of several effective drugs to treat autoimmune liver disease or inflammatory bowel disease (IBD), but very little on how to prevent such diseases.<sup>5,6</sup>

Evidence-based approaches to maintain gut-health and to prevent GI diseases are limited. This is still an open and relevant field for clinicians, epidemiologists, and scientists to ponder on the enormous value of preventive strategies to maintain a healthy gut and prevent GI diseases. While measures such as regular physical activity, avoidance of smoking, maintaining a balanced diet schedule, and avoidance of saturated fat in the diet have proven to be effective cardioprotective strategies, we need to define similar strategy for good gut-health.<sup>7</sup>

Certain lifestyle characteristics, such as balanced diet, moderate but regular exercise, avoidance of chronic stress, ingestion of adequate amount of fibers, and use of well-defined and specific pre- and probiotics, have been shown to have a positive effect on gut health.

Since the GI system is complex, it follows that any preventive strategy should include measures to address each aspect of the GI system. The following could be proposed as individual preventive steps to maintain different aspects of the GI evidence base but in some aspects this information remains empirical. (see Table 2)

#### GENERAL HYGIENE AND GUT-HEALTH

The GI tract, unlike other systems of the body, is exposed to the environment at both its ends and it is exposed to enormous amount of junk, some of which is toxic, on a daily basis. Therefore the hygiene of an individual will impact the hygiene of their GI tract. Any disturbance of

the balance between the microbiome and the mucosal immune system will lead to impairment of the GI barrier and subsequently to an increased risk to gut health and the development of GI disease.<sup>8-9</sup> In fact many diseases, such as GI infection, antibiotic-associated diarrhea, IBD, irritable bowel syndrome (IBS), food allergy, and so on, are related to the hygiene hypothesis.<sup>8-10</sup> Therefore, any

Table 2: Preventive strategy to maintain good digestive health

• General hygiene
- Maintenance of hygiene in food and water
- Proper washing of hands
• Dietary advices
- Healthy and well-balanced diet
- Adequate amount of fibre in the diet
- Avoidance of processed food
- Low FODMAP diet
- Eating of food slowly
- Avoidance of food that leads to food allergic symptoms
- Drinking of lot of fluids (non-sugar based)
• Maintenance of healthy gut microbiota
- Probiotics and prebiotics
- Avoidance of proton pump inhibitors and nonsteroidal anti-inflammatory drugs (NSAIDs)
- Maintenance of hygiene

• Avoidance of injurious agents to gut
- Smoking: predisposes to gastroesophageal reflux
- Drugs which damages intestinal mucosa, such as NSAIDs
- Excess and unindicated use of proton pump inhibitors
- Avoidance of excess of alcohol
• Maintenance of epithelial integrity
- Maintenance of healthy microbiome
- Prevention of GI infections
• Maintenance of enterocytes

changes have been shown to help prevent major societal diseases such as allergy, obesity, and cancer.<sup>15</sup> A low FODMAP diet or gluten free diet has been reported to be beneficial in patients with IBS.<sup>16,17</sup>

There are evidences to suggest that high-fat, as well as highfructose, diets disturb the GI barrier and induce fatty

## World Digestive Health Day WDHD – May 29, 2016



### UNDERSTANDING OF NORMAL GUT HEALTH,*continued*

conditions that might disturb the intestinal microbiome and the mucosal immune system should be avoided.

#### DIET AND GUT-HEALTH

A balanced diet is one of the important ways to keep the digestive system healthy. One of the important reasons for constipation in healthy individuals is inadequate intake of fibers in their diet. Adequate fiber in the diet encourages passage of contents through the digestive system and gives the correct consistency and bulk to stools. The dietary fibers could be soluble or insoluble. While the recommended daily intake of dietary fibers varies between 25-35g/day from country to country, only a proportion of the world's population is able to meet the recommended daily amount of dietary fibers.<sup>11,12</sup> While fiber intake is generally adequate in many Asian countries, the intake however is much lower in both Europe and the USA. Other than its benefit in proper laxation, dietary fibers protect from diverticular disease and colorectal cancer.<sup>13</sup>

Furthermore, a high-fiber diet has many other benefits, including lowering of cholesterol, control of blood sugar in diabetics, and weight reduction.<sup>14</sup> Furthermore, dietary

liver disease and subclinical inflammatory conditions associated with metabolic disturbances.<sup>18,19</sup>

Therefore, measures to maintain a good gut-health include eating of a healthy and balanced diet, ingestion of adequate amount of fibers, reduction in the ingestion of saturated and processed food, slow and regular eating, and, finally, avoidance of foods that may lead to digestive symptoms. An individualized elimination diet in selected individuals with food intolerances, food allergy, or celiac disease may also contribute to good gut health.<sup>20,21</sup>



## UNDERSTANDING OF NORMAL GUT HEALTH,*continued*

25. Fajardo AM, Piazza GA. Chemoprevention in gastrointestinal physiology and disease. Anti-inflammatory approaches for colorectal cancer chemoprevention. *J Physiol*

### AVOIDANCE OF FACTORS WHICH CAN INDUCE DAMAGE TO GI TRACT

Tobacco abstinence, moderate alcohol consumption, maintenance of normal body weight, avoidance of nonsteroidal antiinflammatory drug (NSAID) ingestion, and control of stress can support gut-health.<sup>22</sup>

The psychological and cognitive factors, including stress, affect the GI motility, GI secretion, and overall function of the GI tract.<sup>23</sup> While there is a lack of high quality evidence to support that improvement in lifestyle affect GI functions, there has been increase in the popularity of meditative strategy to calm down the mind. Despite the limitations of the literature, the evidence suggests that meditation programs could help reduce anxiety, depression, and pain in some clinical populations.<sup>24</sup> Thus, clinicians should be prepared to talk with their patients about the role that a meditation program could have in addressing psychological stress.<sup>24</sup> Furthermore, such methods are now practised by many health professionals for attaining not only the general well-being but for maintenance of a good gut health too.

### USE OF DRUGS TO PREVENTION OF GI DISEASES

Chemoprevention by taking aspirin, cyclooxygenase-2 inhibitors, and calcium may reduce the recurrence of adenomas and/or the incidence of advanced adenomas in individuals with an increased risk of colorectal cancer (CRC), and taking aspirin may reduce the incidence of CRC in the general population.<sup>25,26</sup> However, both aspirin and

NSAIDs are associated with adverse effects, so it will be important to consider the risk-benefit ratio before recommending these agents for chemoprevention.

An interesting idea is whether gut health can be further supported by using modulators of the intestinal microbiome or the GI barrier, such as probiotics or prebiotics. Indeed, it has been shown that chronic bowel diseases, such as IBD, are associated with adherence of commensal bacteria to the otherwise sterile intestinal epithelium and that selected probiotics can prevent the adhesion of pathogenic bacteria to the intestinal mucosa or restore leaky gut by improving the molecular composition of tight junctions.<sup>27-30</sup> Moreover, probiotic bacteria can support the normal development of the mucosal immune system.

In summary, nearly one third of world's population suffer from some form of gut related symptoms, most of which may be unrelated to specific structural or functional disease in the GI tract. There is a need to popularize the primary preventive strategies for maintenance of good gut health.

# World Digestive Health Day

## WDHD – May 29, 2016

## DIETARY FIBER; DEFINITION, RECOMMENDATION FOR INTAKE, AND ROLE IN DISEASE PREVENTION AND MANAGEMENT

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Dietary fiber is the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption by the human intestine. Dietary fiber includes polysaccharides, oligosaccharides, lignin, and associated plant substances. The sources of fiber vary in chemical and physiological properties.<sup>1,2</sup>

“Dietary fiber” was first used in the literature in 1953 by Hipsley, who used the term to refer to celluloses, hemicelluloses, and lignin.<sup>3</sup> Since then, the definition has undergone many revisions. According to Codex Alimentarius, dietary fiber is defined as carbohydrate polymers with 10 or more monomeric units, which are not hydrolyzed by the endogenous enzymes in the small intestine of humans. The decision to include carbohydrates from three to nine monomeric units was left to national authorities.<sup>4</sup> Several authorities from Canada, Australia, New Zealand, and the European Union considered carbohydrates with three to nine monomeric units as a part of dietary fiber definition. The definition has been expanded to include oligosaccharides, such as inulin and resistant starches. A universal definition, or consistency among definitions, is necessary for food labels and for research purposes.

There are several different classification systems for dietary fiber. Classifications of components of dietary fiber are based on their gastrointestinal solubility, site of digestion, products of digestion, or physiological properties.<sup>1</sup> Most common fiber classification categories include water-insoluble/less fermented fibers (cellulose, hemicellulose, lignin) and the watersoluble/well fermented fibers (pectin, gums, and mucilages).<sup>5</sup> Physiological effects of fiber differ from one non-digestible carbohydrate to another. The same amount from different sources of fiber does not really infer the same levels of impact on health. There are many different forms of fiber in food and there is also a wide range of foods delivering fiber. Dietary fibers can be extracted from edible material (intrinsic) or modified and added back into a food (extrinsic).<sup>6</sup> Dietary fiber supplements have the potential to play an adjunctive role in offering the health benefits provided by high-fiber foods.

Current recommendations for dietary fiber intake are related to age, gender, and energy intake; and the general recommendation for adequate intake is 14 g/1000 kcal.<sup>2</sup> This average intake includes non-starch

polysaccharides, analogous carbohydrates, lignin, and associated substances.<sup>2</sup> Using the energy guideline of 2000 kcal/day for women and 2600 kcal/ day for men, the recommended daily dietary fiber intake is 28 g/day for adult women and 36 g/day for adult men. The Institute of Medicine in the USA recommended intakes of 30 g dietary fiber daily for adults based on protective effects against cardiovascular disease.<sup>7</sup> Other organizations followed suit, recommending an intake of at least 25 g dietary fiber daily for the general population. Most people, however, under consume dietary fiber, and usual intake averages only 15 g per day.<sup>8</sup>

Dietary fiber intake provides many health benefits. A generous intake of dietary fiber reduces risk for developing various diseases, including coronary heart disease, stroke, hypertension, diabetes, obesity, and certain gastrointestinal (GI) disorders. Increased consumption of dietary fiber improves serum lipid concentrations, lowers blood pressure, improves blood glucose control in diabetes, aids in weight loss, and appears to improve immune function.<sup>9</sup> High dietary fiber intake may reduce the risk of total mortality (See Table 1).

## INCREASED FECAL BULK/LAXATION

Solubility, viscosity, and water holding properties of fiber affect digestion and the absorption function of the GI tract. High insoluble fiber intake increases fecal bulk and decreases

Table 1: *Beneficial effects of dietary fiber in disease prevention and management*

- Increased laxation
- Decreased colonic transit time
- Increased colonic fermentation/short chain fatty acid production
- Positive modulation of colonic microflora
- Beneficial effect on mineral absorption
- A protective role in the prevention of colon cancer and other malignancies
- Improvement in immune function.
- Reduced total and/or LDL serum cholesterol levels
- Attenuation of postprandial glycaemia/insulinaemia
- Reduced blood pressure
- Weight loss, Increased satiety
- Decreased mortality

of constipation.<sup>10</sup> Fibers in diet are effective promoters of normal laxation, as are psyllium seed husk and methylcellulose in the form of supplements. Beside insoluble dietary fibers, soluble fructans have been shown to have a beneficial effect in the large intestine.<sup>11</sup> Diverticular disease is one of the most common GI diseases. A generous intake of dietary fiber is considered to be protective, ameliorative, and preventive of recurrences of diverticular disease.<sup>10,11</sup> Similarly, several trials have shown that supplementation of some types of dietary fiber can prolong remission during the course of the inflammatory bowel disease (IBD). These effects are primarily related with increased luminal production of immunomodulator short chain fatty acids (SCFA). There is general agreement that if there is no intestinal strictures and the patient is in remission, dietary fiber consumption should not be limited in IBD.



## DIETARY FIBER; DEFINITION, RECOMMENDATION FOR INTAKE, AND ROLE IN DISEASE PREVENTION AND MANAGEMENT, continued

transit time, thereby helping in the prevention and treatments, such as calcium, magnesium, and iron. Fermentation of **GUT MICROBIOTA AND PREBIOTIC EFFECTS**

Dysbiosis in gut microbiota is associated with the pathogenesis of many diseases, including infectious diseases, allergy, IBD, obesity, diabetes, liver disease, and colon cancer.<sup>12</sup> Gut microbiota can be affected by many factors, including medications, stress, and diet. Dietary fibers acting as a prebiotic selectively enrich beneficial gut bacteria, mainly *bifidobacteria* and/or *lactobacillus*.<sup>2</sup> Prebiotics that include fructo-oligosaccharides, oligofructose, and inulin were shown to increase the concentrations of bifidobacteria and or lactobacillus species in the gut. Bacterial fermentation of the ingested fiber in the colon produces SCFAs, primarily acetic, propionic, and butyric acid. These SCFAs provide various health benefits to the host, such as: supplying fuel to colonocytes; regulating proliferation and differentiation of epithelial cells; increasing colonic blood flow, reducing colonic pH; stimulating pancreatic secretions, other gut hormones, and the autonomic nervous system; promoting sodium and water absorption; and regulating gut motility.<sup>12</sup>

### MINERAL AND MICRONUTRIENT ABSORPTION

There are concerns that micronutrient absorption may be adversely impacted by diets high in fiber. Diet high in insoluble fiber is not associated with poorer micronutrient status in healthy population consuming their usual diet.<sup>13</sup> On the other hand, certain fiber types play a beneficial role in mineral and micronutrient absorption. Highly fermentable fibers have resulted in improved metabolic absorption of certain minerals by colonic microbiota and subsequent SCFA production leads to reduction in luminal pH. The SCFA and lower pH may, in turn, dissolve insoluble mineral salts, especially calcium, magnesium, and iron, and increase their absorption.<sup>1</sup>

### CANCER PREVENTION

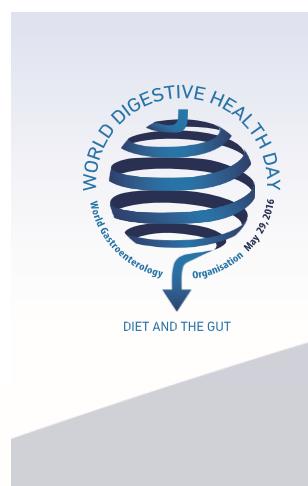
Recent studies support this inverse relationship between dietary fiber and the development of several types of cancers, including colorectal, small intestine, oral, esophageal, larynx, and breast.<sup>14</sup> Cellulose is the major type of fiber that has been shown to reduce risk of colon cancer. This effect is related to decrease in colon transit time and excretion of mutagens, as well as decrease in fecal bile acid concentration.<sup>15</sup> Pectin and pectic oligosaccharides were shown to induce apoptosis in human colonic adenocarcinoma cells *in vitro*.<sup>16</sup> Although the mechanisms responsible are still unclear, several explanations have been proposed. First, dietary fibers are fermented to produce SCFAs, which have anti-carcinogenic properties. Second, there is less contact time between potential carcinogens and mucosal cells. Third, dietary fiber increases the binding between bile acids and carcinogens. Fourth,

increased intake of dietary fiber yields increased levels of antioxidants. Fifth, fibers may decrease estrogen absorption in the intestines.<sup>14,15</sup> Dietary fiber is also preventive against esophageal carcinogenesis, most notably esophageal adenocarcinoma by modification of gastroesophageal reflux and weight control.

## CARDIAC DISEASE

Cardiac disease is attributed to lifestyle, such as diet, physical activity, and cigarette abuse. High levels of dietary fiber intake are associated with significantly lower prevalence rates for cardiac disease, stroke, and peripheral vascular disease.<sup>2</sup> A pooled analysis of 10 prospective cohort studies indicated that every 10 g/d increase of dietary fiber was associated with decreased risk of coronary events and coronary death by 14 and 27 %, respectively.<sup>17</sup> Control and treatment of cardiac risk factors by high fiber intake decreases the prevalence of cardiac disease. Soluble fibers have been shown to increase the rate of bile excretion, therefore reducing serum total and LDL cholesterol. Dietary fiber regulates energy intake and blood glucose, thus enhancing weight loss. Dietary fiber has been shown to decrease pro-inflammatory cytokines, such as interleukin-18 which may have an effect on plaque stability. By controlling all of these risk factors, enough fiber intake condition then improves blood pressure regulation. However, short term direct antihypertensive effects of dietary fiber is very controversial.

## BLOOD GLUCOSE AND INSULIN REGULATION



**World Digestive Health Day**  
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**DIETARY FIBER; DEFINITION, RECOMMENDATION,  
INTAKE, AND ROLE IN DISEASE PREVENTION AND MANAGEMENT,cc**

decreases the risk of cardiac events. Improved cardiovascular

## INCREASING THE FI

Dietary fiber has been shown to modify postprandial blood glucose and insulin responses.<sup>18</sup> Mainly, the viscosity of a fiber affects glucose absorption. When viscous soluble dietary fibers mix with water, it thickens. Intake of soluble dietary fiber increases viscosity of the stomach content, prolongs gastric emptying, increases transit time through the small intestine, and reduces the rate of starch digestion and glucose absorption. Studies have shown that arabinoxylan (AX), β-glucan, fructo-oligosaccharides, and synthetic carbohydrate analogues, such as dextrins, can reduce post-prandial glucose and insulin responses.<sup>17</sup> Daily 20 g of fructo-oligosaccharide intake decreases hepatic glucose production.<sup>19</sup> Resistant dextrins also decrease postprandial blood glucose concentrations.<sup>20</sup>

## **REDUCED TOTAL AND/OR LDL SERUM CHOLESTEROL LEVELS**

The cholesterol lowering effect of dietary fiber is well-known. Soluble fibers form a viscous layer in the small intestine. This reduces the reabsorption of bile acids and in turn increases the synthesis of bile acids from cholesterol and reduces circulating blood cholesterol.<sup>21</sup> The U.S. Food and Drug Administration has concluded that a minimum dose of 3 g/day of oat or barley β-glucan is needed for a beneficial reduction in blood cholesterol levels and subsequent decrease in the risk of coronary heart disease. Psyllium and guar gum have been shown to lower serum cholesterol and LDL in subjects with elevated serum cholesterol, in subjects with non-insulin dependent diabetes, and in subjects receiving lipid-lowering drug therapy.

## **OBESITY**

Satiation is commonly linked with dietary fiber intake; in particular, β-glucan influences appetite and enhances postprandial satiety. Indigestible dextrins increase satiety and weight reduction. Overall, ingestion of both insoluble and soluble fibers have been linked with positive effects on weight control. The decrease in obesity and metabolic syndrome parallels with the decrease in liver steatosis and steatohepatitis.

When fiber is being increased for a specific purpose, a more careful choice of fiber type is important. If it is desired to lower cholesterol or to improve glycemic control, soluble fiber (such as oat bran or psyllium) should be chosen. If bulking or correction of constipation is desired but the patient suffers from flatulence, insoluble fiber should be used.<sup>22</sup> A gradual increase in fiber intake is usually recommended to improve tolerance by minimizing problems of gas and bloating.

Large amounts of purified soluble fiber alone may be harmful. High-fiber diet may cause inadequate energy intake. Studies conducted in rats have shown injurious effects of very high fiber diets in the distal colon and enhancement, rather than suppression, of tumorigenesis. This finding may in part relate to massive fermentation of excess fiber in the proximal colon with relatively poor delivery of health-promoting fermentation products to the distal colon. Fiber-induced expansion of the bacterial populations might lead to utilization of alternative metabolic pathways by these populations and these alternative pathways may have more toxic products.<sup>22</sup> The production of excess gases from fermentation, with the bulking effects of fiber, can induce bloating. Such symptoms are poorly tolerated by patients with IBS. The colon does adapt to these dietary changes, but this requires several weeks to occur and a gradual introduction is recommended. So enough fiber intake in regular diet is recommended, while too much fiber alone might be hazardous in different aspects.<sup>22</sup>

## **SUMMARY**

Regular fiber intake is recommended for general health. Different fiber types can be useful for the treatment of several gastrointestinal diseases like constipation, diarrhea, IBS, or IBD.<sup>23</sup> Patients diagnosed with diabetes, obesity, hyperlipidemia, hypertension, and other cardio-metabolic diseases can get a clinical improvement with soluble fiber intake. Dietary fiber has been demonstrated to play a role in the prevention of colorectal cancer and other neoplastic diseases.

3 Gong J, Yang C Advances in the methods for studying gut microbiota and their relevance to the



# World Digestive Health Day

WDHD – May 29, 2016

DIET AND THE GUT

## WHAT ARE FODMAPS? EVIDENCE FOR USE OF LOW FODMAP DIETS IN GI DISORDERS



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Summary of IBS, Gluten, and Wheat studies				
Lead Author	Country	Year	Patients	Outcome
Wahnschaffe	Germany	2001	102 IBS-D without CD	Stool frequency significantly improved in patients with HLA DQ2/DQ8
Wahnschaffe	Germany	2007	145 IBS-D without CD	HLA-DQ2 predicted response to GFD
Biesierski	Australia	2010	34 self reported gluten sensitive IBS	Significant reduction in overall symptoms in GFD group
Carroccio	Italy	2011	920 patients with IBS	70 patients wheat sensitive and 206 multiple food sensitivities including wheat
Vazquez-Roque	USA	2012	45 IBS-D	Increased intestinal permeability in patients receiving gluten
Vazquez-Roque	USA	2013	45 IBS-D	Reduction in stool frequency in patients on GFD
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Aziz	UK	2015	40 IBS-D	UEGW 2015
Di Sabatino	Italy	2015	59 Self reported NCGS	DBPC 4.375 gm

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research of



## WHAT ARE FODMAPS? EVIDENCE FOR USE OF LOW FODMAP DIETS IN GI DISORDERS, *continued*

Summary of IBS and FODMAP studies				
Lead Author	Country	Year	Patients	Outcome
Shepherd	Australia	2006	N=62 Uncontrolled	74% Response Rate
Shepherd	Australia	2008	N=25	Randomised Placebo Controlled Rechallenge
Ong	Australia	2010	N=30	Randomised Cross Over Single Blind
Biesierski	Australia	2010	34 self reported gluten sensitive IBS	Significant reduction in overall symptoms in GFD group
Staudahcer	UK	2011	82 IBS randomised	76% response versus 54% standard diet advice
Staudahcer	UK	2012	41 IBS randomised	68% response versus habitual diet 23% response
Ostgaard	Norway	2012	N=79 & N= 35 Healthy Subjects (Retrospective)	Significant Improvement in Pain
Biesierski	Australia	2013	37 with IBS on GFD	FODMAPs then GFD and gluten containing arms
De Roest	New Zealand	2013	N=90 Prospective Uncontrolled	72% satisfied with symptom improvement
Mazzawi	Norway	2013	N=46 Prospective Uncontrolled	Improvement in total symptoms
Wilder-Smith	Switzerland	2013	N=312 patients with a functional GI disorder	Of the 76% who completed adequate relief in 93%
Pedersen	Denmark	2014	19 IBS patients	67 (37-120) points improvement
Halmos	Australia	2014	30 IBS	~ 50% reduction in symptoms
Bohn	Sweden	2014	82 IBS	65 completed with equal response to FODMAP diet (56%) versus Traditional Dietary Advice (52%)

Summary of IBS and FODMAP studies				
Lead Author	Country	Year	Patients	Outcome
Shepherd	Australia	2006	N=62 Uncontrolled	74% Response Rate
Shepherd	Australia	2008	N=25	Randomised Placebo Controlled Rechallenge
Ong	Australia	2010	N=30	Randomised Cross Over Single Blind
Biesierski	Australia	2010	34 self reported gluten sensitive IBS	Significant reduction in overall symptoms in GFD group
Staudahcer	UK	2011	82 IBS randomised	76% response versus 54% standard diet advice
Staudahcer	UK	2012	41 IBS randomised	68% response versus habitual diet 23% response
Ostgaard	Norway	2012	N=79 & N= 35 Healthy Subjects (Retrospective)	Significant Improvement in Pain
Biesierski	Australia	2013	37 with IBS on GFD	FODMAPs then GFD and gluten containing arms
De Roest	New Zealand	2013	N=90 Prospective Uncontrolled	72% satisfied with symptom improvement
Mazzawi	Norway	2013	N=46 Prospective Uncontrolled	Improvement in total symptoms
Wilder-Smith	Switzerland	2013	N=312 patients with a functional GI disorder	Of the 76% who completed adequate relief in 93%
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# World Digestive Health Day

## WDHD – May 29, 2016

### WHAT IS THE ROLE OF FOOD IN IBS?



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Irritable bowel syndrome (IBS) is common, with a pooled global prevalence of 11.2%.<sup>1</sup> The etiology of IBS is not entirely clear, but 40% to 84% of IBS patients believe that food-items are important triggers of their gastrointestinal symptoms. Carbohydrates are reported as a source of symptoms in 70% and gluten-based products cited as an offending culprit by roughly one-in-four.<sup>2</sup> Furthermore, IBS patients who report adverse food reactions tend to have more severe symptoms, associated subjective health complaints of musculoskeletal pains and chronic fatigue, and reduced quality of life.<sup>2,3,4</sup> Most recent work has focused on wheat, gluten, and FODMAPs (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols).

Carbohydrate malabsorption (e.g. lactose malabsorption), by virtue of its resultant distension of the intestine with increased water content and gas from bacterial fermentation, has long been documented to cause IBS-like symptoms and restriction of perceived culprits has been an adjunct to standard therapy. Restricting all slowly-absorbed and indigestible short-chain carbohydrates (a low FODMAP diet) has randomized controlled evidence from multiple centers across many countries of efficacy in patients with IBS. It benefits up to three of four patients with IBS and is proposed as a primary therapy for IBS. Most patients who benefit can de-restrict the diet and maintain the benefits.

More controversial has been the role of gluten in IBS; and the entity of non-celiac gluten sensitivity (NCGS) is now accepted by consensus. Unfortunately, the study of its



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epidemiology, pathophysiology, and characteristics has been hindered by the lack of objective diagnostic criteria and reliance upon self-report of improvement with a gluten-free diet and exacerbation by subsequent ingestion of wheat. Furthermore, what component(s) of wheat that is/are driving symptoms in any individual is difficult to define. The population prevalence of NCGS when self-reported ranges from 0.6% to 13%.<sup>5</sup> The pathophysiology of NCGS may involve an innate immune responses being driven by gluten or non-gluten wheat-associated proteins, such as alpha-amylase trypsin inhibitors, or the FODMAPs, which co-exist with gluten in cereals.<sup>5</sup> Some may have celiac disease that has yet to fulfill all diagnostic criteria. Definitive demonstration of gluten/wheat-protein sensitivity is by randomized, placebo-controlled, double blind cross-over studies using FODMAP-depleted gluten. Three prospective studies have been reported in patients with self-reported NCGS, with the consistent finding of less than 5% of such patients having specific responses to gluten. A major hurdle has been strong nocebo effects in these studies. Results of double-blind placebo-controlled challenges in 920 adults with self-reported wheat sensitivity but not celiac disease or wheat allergy found minimal nocebo response in general and were able to detect 30% with positive wheat reactions, although the majority of these also reacted to other foods, particularly milk protein.<sup>6</sup> Nearly all of the patients had evidence of immune activation in the intestine and/or colon, particularly increased density of intraepithelial lymphocytes and eosinophilic infiltration. This contrasted with patients in the randomized

## WHAT IS THE ROLE OF FOOD IN IBS, *continued*



2.

5.

*Hepatol*

*Gastroenterol*

Figure 1.

Globally, when looking at the evolving literature, a response rate of about 70% might be anticipated when IBS patients are placed on either a low FODMAP diet or gluten-free diet (GFD). Furthermore, there may be long-term benefits with patients continuing their dietary intervention of their own accord 12–18 months after the initial dietetic consultation.<sup>9</sup> However, the risks associated with restrictive diets (especially nutritional inadequacy, unfavorable effects on the gut microbiota or the encouragement of eating disorders) must be seriously considered, especially when dietary manipulations are professionally unsupervised or purely patient-initiated.

In summary there is now an emerging evidence base that nutritional therapies can be used for IBS patients with an expectation of benefit. The selection of diet could be

controlled trials (RCTs) where such patients were mostly excluded. Interestingly, when patients with apparent NCGS were re-challenged with gluten or placebo in parallel-group studies, significant differences were observed with greater symptom severity in the gluten-treated group.

Hence, gluten-containing cereal sensitivity is likely to represent one or more entity in individual patients – previously undiagnosed celiac disease, FODMAP sensitivity, gluten or other wheat protein sensitivity, multiple food protein sensitivity, or none. Defining the specificities in an individual is largely done by judicious clinical evaluation including assessment of duodenal histology, and ‘n-of-one’ dietary re-challenge studies with the ultimate aim of gaining the greatest symptomatic benefit with the least dietary restriction and of achieving sustained benefits.



based on clinical judgement, patient preference and local skill-base, or categorization according to the absence or presence of 'celiac lite' features (See Figure 1).

6. DIET AND THE GUT

## INTRODUCTION

Intolerance to carbohydrates, such as lactose intolerance, is a common type of non-allergic food intolerance.<sup>1</sup> The number of patients diagnosed with carbohydrate intolerance has increased during the last few decades mostly as a consequence of increase in carbohydrate



## World Digestive Health Day

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## CARBOHYDRATE INTOLERANCE (LACTOSE, SUCROSE, AND FRUCTOSE): IDENTIFICATION AND TREATMENT

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consumption, especially added sugar, in the diet. There has been increasing awareness among both general population and physicians about dietary intolerances and hence more and more patients with this disorder are now diagnosed. Carbohydrate intolerance can either be genetic or non-genetic in origin<sup>2</sup> (See Table 1).

### LACTOSE INTOLERANCE

The intolerance to lactose is due to either relative or absolute deficiency of lactase enzyme and the deficiency can occur because of three disorders:

- Congenital lactase deficiency
- Secondary lactase deficiency
- Adult type lactase deficiency

Table 1: Classification of carbohydrate intolerance

Genetic	Non-genetic
Early onset	Functional impairment
Congenital lactase deficiency	Fructose intolerance
Congenital sucrase-isomaltase deficiency	Sorbitol
intolerance	Trehalose intolerance
Glucose-galactose malabsorption	
Late onset	
Adult type lactose intolerance	



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# CONGENITAL LACTASE DEFICIENCY

Congenital deficiency of lactase is rare and it is most often described in reports from Finland. There is a severe deficiency of lactase, the enzyme responsible for the digestion of lactose. Premature stop codons and a truncated protein as a result of frame shifts missense mutations in the coding region of lactase enzyme, or exon duplication are the most common genotypes identified. Symptoms occur shortly after birth. Symptoms subside when diet is changed to lactose free substances. The activities of all other disaccharidases remain normal.

# SECONDARY LACTASE DEFICIENCY

Deficiency of lactase occurs secondary to diseases of the intestinal mucosa both during acute settings (such as after an episode of gastroenteritis, or due to chronic diffuse mucosal diseases such as celiac disease or Crohn's disease). With the healing of the intestinal mucosa, the level of lactase improves with resolution of the symptoms. The recovery of lactase may take a longer time even when mucosa has healed, which reflects the observation that lactase activity is the last to recover in comparison to other disaccharidases activities.

# ADULT TYPE LACTASE DEFICIENCY

This is the most common cause of lactase enzyme deficiency and up to 70% of world's population has an activity of lactase a level below a critical threshold for the digestion of dietary lactose.<sup>3</sup> It is an autosomal recessive condition in which there is a gradual reduction in the activity of lactase after two years of age. The prevalence of lactase deficiency varies widely in the different geographic locations around the world. In the USA, 20% of Caucasian people have deficiency of enzyme, while 80-100% of Asians have deficiency of lactase enzyme. The prevalence of lactase deficiency is about 70-95% in Africa and 15-70% in Europe. The persistence or non-persistence of the This consists of a substitution in a sequence of DNA

that regulates the lactase gene. While genotype CC correlates with hypolactasia, TT genotype correlates with lactase persistence.<sup>4</sup>

# PATHOPHYSIOLOGY AND CLINICAL SYMPTOMS

The lactase enzyme is located in the brush border (microvilli) of the small intestinal epithelial cells. The enzyme splits and hydrolyzes dietary lactose into glucose and galactose for transport across the cell membrane. The absence or deficiency of lactase leads to failure of hydrolysis of lactose, hence unabsorbed lactose remains in the intestinal lumen and fluid drives osmotically into the intestinal lumen.<sup>5,6</sup> In addition to increasing the volume and fluidity of the gastrointestinal contents, unabsorbed lactose enter colon. The fermentation of lactose by colonic microflora produces lactic acid and hydrogen. In the presence of methanogenic bacteria, hydrogen and carbon dioxide combine together to form methane in the colon. The excessive production of hydrogen and methane in the intestine leads to bloating, distention of the abdomen, excessive flatulence, nausea, and abdominal pain (non-specific in nature). The excessive unabsorbed lactose with osmotically driven water, in excess of colonic absorption, can lead to diarrhea in some patients.



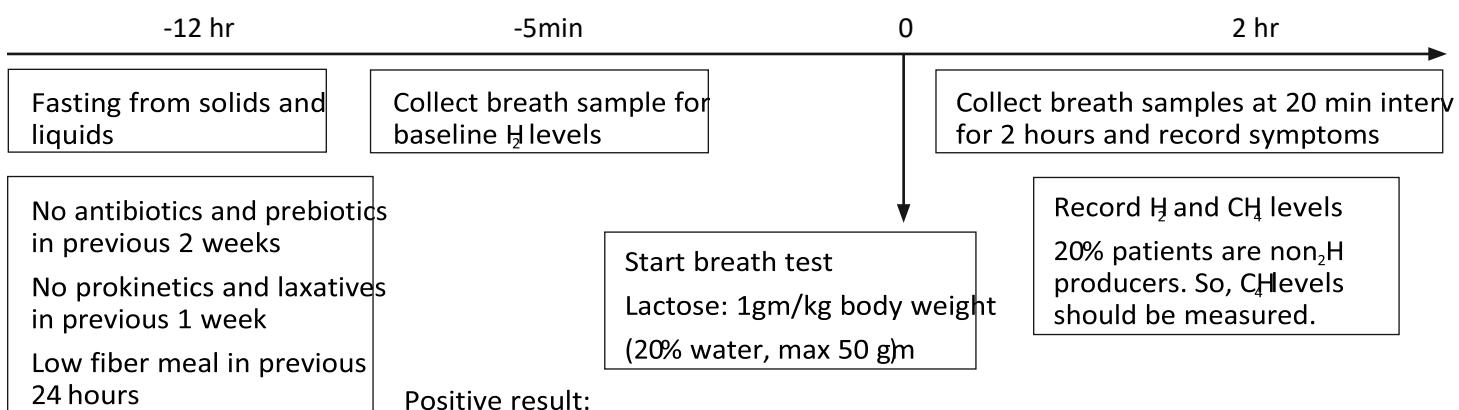
## CARBOHYDRATE INTOLERANCE (LACTOSE, SUCROSE AND FRUCTOSE): IDENTIFICATION AND TREATMENT *continued*

lactase is associated with the point polymorphism C/T 1391. In patients with common adult-type hypolactasia, the amount of ingested lactose required to produce symptoms varies from 12 to 18 g, or 8 to 12 ounces of milk. Ingestion of small cramps, and flatulence, but not diarrhea. Ingestion of larger amounts of lactose, a faster gastric emptying time, and faster intestinal transit time all contribute to more severe symptoms. Several factors determine the symptoms onset of symptoms of lactose

moderate amounts of lactose usually produces bloating, specificity of 85%. The test is performed and the results are interpreted as depicted in Figure 1.<sup>2</sup>

### LACTOSE TOLERANCE TEST

Patient consumes 50g of lactose dissolved in water. Samples of capillary blood are obtained to test the plasma glucose concentration at -5, 0, 15, 30, 45, and 60 minutes.



intolerance, such as lactose content in the diet, gut transit time, fermentation capacity of gut, and (possibly) neuropsychological factors.

## DIAGNOSIS

The diagnosis of lactose intolerance should be suspected in patients who have symptoms of bloating and chronic diarrhea. A relationship of symptoms occurring with the intake of milk and milk products and relief in symptoms with avoidance further strengthens the diagnostic possibility of lactose intolerance. The diagnosis of lactose intolerance can be confirmed by lactose hydrogen breath test, lactose tolerance test, and genetic study. Lactose hydrogen breath test is most commonly used test for the diagnosis and the test has a sensitivity of 88% and

A maximal plasma glucose increase of 1.4 mmol/L( 25.2 mg/dl) or higher indicates lactose intolerance.<sup>7</sup> The sensitivity and specificity of lactose tolerance test is high (both >90%).

The genetic test to identifies single nucleotide polymorphism associated with lactase persistence/non-persistence. Genotype CC correlates with hypolactasia, while TT genotype with lactase persistence. One should know that all those who have CC genotype will not develop symptoms of lactose intolerance.

## TREATMENT

The mainstay of treatment of lactose tolerance is avoidance of all lactose containing milk and milk containing products (Table 2). In adult type lactase



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### CARBOHYDRATE INTOLERANCE (LACTOSE, SUCROSE AND FRUCTOSE): IDENTIFICATION AND TREATMENT, *continued*

#### GENETIC TEST

deficiency, lactose-containing foods are limited for 2-4 weeks to induce remission. After 4 weeks, lactose-containing products can be reintroduced gradually as per the tolerance of the individual. In secondary lactose intolerance, lactose is restricted only for a limited duration and can be reintroduced safely after recovery from the intestinal damage.<sup>8</sup> Patients with lactose intolerance are prone to calcium deficiency, so supplementation of calcium should be given. Patients with mild lactose malabsorption may benefit from using lactase enzyme supplements. The incubation of milk with lactase enzymes may also be helpful. Lactase enzyme supplementation should be an adjunct to, not a substitute for, dietary restriction. Non-dairy synthetic drinks and soy milk are a useful substitute for milk. It is common for health providers to mistakenly tell the patient not to eat any dairy products, which deprives them of a healthy source of protein and the most bioavailable source of calcium. Instead patients should be instructed about low or no lactose dairy products (See Table 2).

It should be noted that lactose content may be included in the list of ingredients depending on the country in which the product was processed, manufactured, or sold.

#### SUCROSE INTOLERANCE (CONGENITAL SUCRASE- ISOMALTASE DEFICIENCY)

Congenital sucrase-isomaltase deficiency is a rare autosomal recessive disorder with decreased ability to digest sucrose, maltose, short 1–4 linked glucose oligomers, branched (1–6 linked) α-limit dextrans, and starch.<sup>9</sup> Over 25 mutations have been identified in genes responsible for sucrase-isomaltase synthesis on the chromosome 3. These mutations affect different parts of protein synthesis to cause enzyme deficiency (e.g.

Table 2: Food items, which are restricted and allowed in patients having lactose intolerance

transport, processing, folding, and anchoring to the enterocyte membrane). This phenotypic heterogeneity is reflect-

Food items that should be avoided	Food items that are allowed
All kinds of milk: whole, low fat, nonfat, cream, powdered, condensed and evaporated, Chocolate containing milk	Lactose-free milk and soy milk Lactose-free dairy and hard cheeses
Butter, cottage cheese, ice cream, creamy/cheesy sauces, cream cheeses, soft cheese and mozzarella	Yogurts unless unfermented milk is added back in
Whipped cream	Kiefer
Milk, bread, crackers, and creamer	All fruits
Muffin, biscuit, waffle, pancake, and cake mixes	All vegetables
Bakery products and desserts that contain the ingredients listed above	All legumes
	All cereals
	All meat, fish, and eggs
	All vegetable fats

ed in a range of enzymatic capability ranging from complete absence of sucrase activity to a low residual activity and from completely absent isomaltase activity to a normal activity.

Prevalence of congenital sucrase-isomaltase deficiency in North American and European populations range from 1 in 500 to 1 in 2000 among non-Hispanic whites, with a lower prevalence in African Americans and whites of Hispanic descent. Prevalence of this disorder is 5% to 10% in Greenland Eskimos, 3% to 7% in Canadian native peoples, and about 3% in Alaskans of native ancestry.<sup>10,11</sup>



## CARBOHYDRATE INTOLERANCE (LACTOSE, SUCROSE AND FRUCTOSE): IDENTIFICATION AND TREATMENT *continued*

### DIAGNOSIS CLINICAL SYMPTOMS

Clinical manifestations are similar to that observed in patients having lactose intolerance, and the severity of the symptoms depend upon the content of the sucrose and starch in diet. The activity of enzyme sucrase can also be induced by diet containing high sucrose and carbohydrates and its expression can be reduced by diet containing high protein and low carbohydrates. Hormones such as corticosteroids and thyroxine induce expression of sucrase-isomaltase in the mucosa of small intestine. All these factors collectively affect onset and severity of symptoms.

In clinically suspected patients, diagnosis is made on small intestinal biopsy, which was gold standard for years. Criteria applied to make the diagnosis include normal small bowel morphology in the presence of absent or markedly reduced sucrase activity, isomaltase activity varying from 0 to full activity, reduced maltase activity, and normal lactase activity, or in the setting of reduced lactase, a sucrase:lactase ratio of <1.0.

Molecular genetics helps in making early diagnosis and avoids invasive, repetitive procedures. At least 80% of patients have one of four common mutations, namely p.Val577Gly, p.Gly1073Asp, and p.Phe1745Cys in the sucrase domain and p.Arg1124X in the isomaltase domain.<sup>12</sup> It has replaced the need for small intestinal biopsy for diagnosis.

### TREATMENT

The sucrase-isomaltase intolerance is treated mainly by the dietary restriction. (See Table 3) Oral supplementation of sucrase-isomaltase (derived from *Saccharomyces cerevisiae*) can also be used, if available.

Table 3: Food items, which are restricted and allowed in patients having FRUCTOSE INTOLERANCE

Fructose is a monosaccharide, which is naturally present in fruits and vegetables.<sup>13</sup> Fructose, because of its sweet taste, is used extensively in food industry as a sweetener such as in juices, candies, and beverages. Fructose is also a constituent of disaccharides sucrose along with glucose.

### HEREDITARY FRUCTOSURIA

Heredity fructosuria is a rare clinical disease, which occurs due to a deficiency of this aldolase B enzyme. The deficiency of enzyme leads to incomplete metabolism of fructose, which leads to accumulation of fructose-1-phosphate in the liver, kidney, and intestine. Patients may have symptoms in the form of hypoglycemia, abdominal pain, vomiting, and diarrhea.<sup>14</sup>

### FRUCTOSE INTOLERANCE

Fructose is generally absorbed passively along with glucose via GLUT-2 transporter present on the basolateral membrane of enterocytes. Fructose is also absorbed by GLUT-5 is non glucose dependent transporter located in the brush border of the small intestine. Defects in these transporters can lead to fructose malabsorption. Transportation of ingested glucose

ing sucrase-isomaltose intolerance

Foods to avoid	Food items which are allowed
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Apple, apricot, banana, cantaloupe, grapefruit, melon, mango, orange, peach, pineapple, and tangerine	Wheat, rice, corn, einkorn, oats, kamut, spelt, rye, bread, pasta, flour, and cereals with no added sugar
Carrot and potato	Avocado, berries, cherries, fig, grapes, kiwi, lemon, lime, olives, papaya, pear, pomegranate, prunes, and strawberries
Beans, chickpeas, green peas, lentils, peas, and soy	All vegetables
Yogurt sweetened with sucrose, sweetened condensed milk, and sweetened cream	Milk, dairy product, butter, cream, cheeses, and yogurt sweetened with dextrose or fructose
Sugar (sucrose), ice cream, all desserts made with sugar, marmalade, candies, jellies, chocolate, and licorice	All meat, fish, and eggs
Commercial cookies and cakes with added sugar, sweetened drinks	All fats Fructose, honey, cocoa, unsweetened juice, homemade low-sucrose cookies, and cakes

through SGLT-1 activates GLUT-2 which in turn gets inserted on the apical membrane. Therefore, ingestion of glucose enhances absorption of fructose as well. Glucose also increases paracellular absorption of fructose. These mechanisms explain the possible fructose malabsorption after eating foods whose fructose component is in excess of glucose. Fructose intolerance can also occur because of diffuse mucosal diseases of intestine such as celiac disease.

Clinical features are similar to symptoms caused by other carbohydrates intolerances such as lactose intolerance, as described above.

The diagnosis of fructose malabsorption can be made by hydrogen breath test after ingestion of fructose 0.5 gm/kg (maximum 25 gm) dissolved in water. The diagnosis is confirmed by an increase of >20 ppm in hydrogen or >10 ppm in methane levels over the baseline twice in succession and abdominal discomfort after the consumption of the test dose. Fructosehydrogen test has both sensitivity and specificity of over 80%. food items, which are rich in fructose. (See Table 4) Patients should be advised to adhere to a low fructose diet (< 10 gm/

day). Emphasis should be given on balanced intake of glucose and fructose. Supplementation of xylose isomerase, which converts fructose into glucose, can also be provided which decrease symptoms of fructose intolerance <sup>15</sup>.

Table 4: Food items, which are restricted and allowed in patients having fructose intolerance

Food items, that which should be avoided	Food items, which should be allowed
All fruits	All cereals
Fructose, honey, high-fructose corn syrup, sorbitol, jams, gelatin desserts, candies, and all desserts sweetened with fructose	All meat, fish, and eggs
All dairy	All dairy
All fats	All fats
Condiments such as barbecue sauce, ketchup, sweet and sour sauce, pancake syrup, and plum sauce	Sugar (sucrose), molasses, and saccharine
Broccoli, carrots, cauliflower, green beans, green peppers, sweet potatoes, and tomatoes	Pumpkin, radish, scallions, spinach, spinach, white potatoes, shallots, cucumber, and lettuce
Beans and peas	Beans and peas

## CONCLUSIONS

Amongst the carbohydrate intolerances, lactose intolerance is the most common. Because of overlapping symptoms with other small intestinal diseases, carbohydrate intolerance should be kept in mind and suspected clinically. The mainstay of treatment is avoidance of carbohydrate causing symptoms.

## DEFINITION AND FORMS OF FOOD ALLERGY

Adverse immune responses to proteins in a food constitute a food allergy. All other forms of adverse reactions to foods (ARF) are non-immune reactions (see Figure 1), commonly referred to as food intolerances, which comprise physiological, pharmacological, psychological, and unknown mechanisms.<sup>1</sup> A clinician's ability to discern food allergies from food intolerances is absolutely essential, as prognosis and management of allergy and intolerance require vastly different approaches.<sup>2,3</sup>



## FOOD ALLERGY AND THE DIGESTIVE TRACT



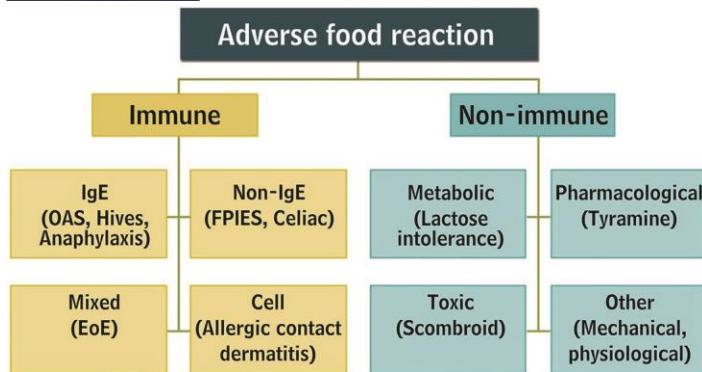
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Modified from Boyce JA, et al. JACI 2010 Dec; 126(6):1105

Figure 1.

Classical food allergy or hypersensitivity results from a humoral response involving immunoglobulin E (IgE) antibody directed to specific proteins. These antibodies bind to effector cells, basophils in the circulation, mast cells in skin, and mucosal tissues of the gastrointestinal (GI) and respiratory tracts and upon exposure to the offending food, these cells degranulate, releasing histamine and other mediators which give rise to a variety of symptoms.<sup>4</sup> Other forms of food allergy arise from an abnormal cellular response to specific foods.

Celiac disease is an example of a T cell-mediated disease.<sup>5</sup> Specific peptide sequences of proteins known as gluten can activate T lymphocytes in genetically susceptible individuals. The T cells release cytokines and other cellular events lead to the enteropathy which characterizes the disease. Celiac disease (discussed elsewhere) is unique as it is both a food allergy and an autoimmune condition.

Food allergy can be mediated by eosinophils that infiltrate the entire luminal digestive tract.<sup>6</sup> Only the mucosal layer of the esophagus is involved in eosinophilic esophagitis (EoE), but in the remaining rare forms of the disease that involve the stomach, intestine, and/or colon, eosinophils are found in the mucosa (most common), the muscular layer, and/or the serosa.

### CLINICAL PRESENTATIONS

IgE-mediated responses to food allergy present a wide range of clinical manifestations with a rapid onset, a spectrum that ranges from self-limited, localized hives to potentially fatal anaphylaxis. Hives and angioedema are the most common symptoms of food allergy. GI, cardiovascular, and/or respiratory systems may be affected. The most serious symptom of IgE-mediated food allergy is generalized anaphylaxis. The primary manifestations of a GI allergic reaction are a) GI anaphylaxis (nausea, vomiting, abdominal pain, diarrhea) which typically develops along with allergic symptoms beyond the digestive tract, such as wheezing and urticaria and b) the oral allergy syndrome.<sup>7</sup> GI allergy symptoms typically present within a span of a few minutes to a couple of hours after ingesting the culprit food.

A rare type of anaphylaxis—food-dependent exercise-induced anaphylaxis—triggers an anaphylactic response when an individual consumes an offending food within 2 to 4 hours of participating in exercise, though no allergic



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## FOOD ALLERGY AND THE DIGESTIVE TRACT, *continued*

Table 1: Cross-reactivity between pollens and fruits and vegetables in consequences occur if the individual ingests that same food and does not exercise.<sup>2</sup>

*oral allergy syndrome.*<sup>2</sup>

Birch	Almond, aniseed, apple, apricot, carrot, celery, cherry, hazelnut, parsley, peach, peanut, pear, and plum
Ragweed	Banana, cantaloupe, cucumber, honeydew, watermelon and zucchini
Mugwort	Aniseed, bell pepper, broccoli, cabbage, caraway, cauliflower, celery, fennel, garlic, mustard, onion, and parsley
Orchard	Cantaloupe, honeydew, peanut, tomato, watermelon, and white potato
Timothy	Swiss chard and orange

Symptoms of the oral allergy syndrome—also called pollen food allergy syndrome, which is a form of contact hypersensitivity almost entirely confined within the oropharynx—include the rapid onset of pruritus and swelling of the lips, tongue, palate, and throat.<sup>7</sup> These symptoms usually resolve within minutes of onset, however. Individuals who have seasonal allergic rhinitis to birch or ragweed pollens commonly show signs of oral allergy syndrome after eating raw fruits and vegetables (see Table 1).

Eosinophilic esophagitis (EoE) is a new disease, not reported until very late in the past century. It presents with dysphagia, food impaction, heartburn, and regurgitation. It occurs more often in males and is often associated with other atopic dis-

orders. Endoscopic findings include edema, concentric fixed

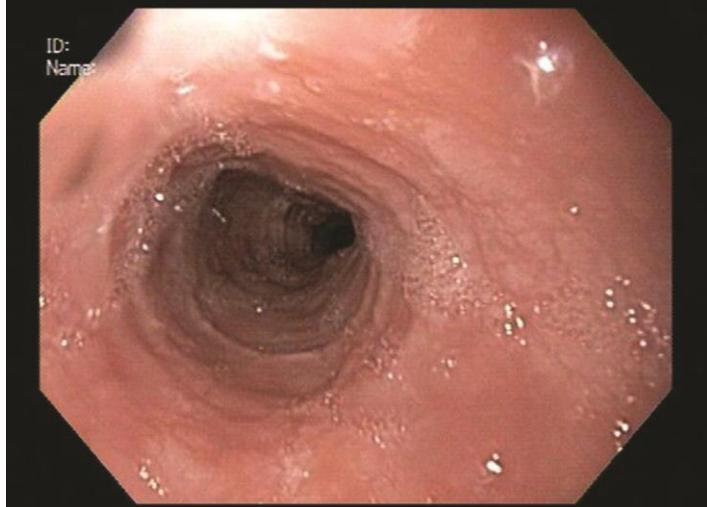


Figure 2.

rings, exudates, linear furrows (as demonstrated in Figure 2), and in advanced disease, strictures. Currently, there are no established markers that aid in determining which foods are the culprits other than eliminating common foods (6-food diet or 4-food diet) to observe if there is clinical and endoscopic improvement, as well as reduced numbers of eosinophils in mucosal samples. After a response to food elimination, one food group at a time is reintroduced to assess clinical, endoscopic, and histological endpoints. If there is no worsening of esophageal mucosal eosinophil counts another food group is introduced and so on, until there is worsening of symptoms, endoscopy, and pathology. Eventually through repeated periods of avoidance and challenges a specific exclusion diet can be established for an individual patient. In general, wheat and milk should be the last group to test as they are the most likely to produce a recrudescence of EoE. Additional therapies include proton pump inhibitors (PPIs) to treat co-existing acid reflux and/or PPI-responsive EoE, topical corticosteroids (swallowed fluticasone or oral budesonide suspension), and rarely systemic corticosteroids. Oral prednisone and



## FOOD ALLERGY AND THE DIGESTIVE TRACT, *continued*

food allergic reactions in North America: milk, eggs, peanut and budesonide capsules are usually used for treating eosinophilic gastroenteritis (EGE). EGE is less associated with food-allergy and food elimination has little benefit compared to EoE. Interestingly, while EoE prevalence is increasing, the frequency of EGE has not changed since the mid-1950s.

### FOOD ALLERGY AND THE GLOBAL PERSPECTIVE

More than 50 million Americans are estimated to have allergies and up to 15 million of them have food allergies.<sup>8</sup> One in every 13 children under the age of 18 years have food allergy. US healthcare dollars spent on food allergy approaches \$25 billion per year. Although the vast majority of ARFs, more than 85%, are not due to true food allergies. One-fifth of the US population self-imposes diet modifications because of perceived ARFs.<sup>2</sup> Most ARFs are due to food intolerances that, though often unexplained, do not involve the immune system.

Food allergies affect 4% of adults and 8% of children in the USA and the prevalence seems to be on the rise.<sup>8</sup> The U.S. Centers for Disease Control and Prevention (CDC) reported a 50% increase in food allergy between 1997 and 2011. Approximately 200,000 emergency room visits and 300,000 ambulatory-care visits annually in the United States are related to food allergy.<sup>2</sup> Eight foods account for 90% of all tree nuts, soy, wheat, fish, and shellfish.<sup>9</sup> The most common food allergens affecting adults are shellfish, fish, peanuts, and tree nuts.<sup>2</sup> By the time a child reaches school age—in approximately 80% of cases—allergies to milk, eggs, soy, and wheat have usually abated.<sup>9</sup>

A recent systematic review provides a relatively recent estimate of the prevalence of food allergy in Europe.<sup>10</sup> Studies published in Europe from January 1, 2000 to September 30, 2012 were identified from searches of four

differences within Asia were also noted. Though uncommon electronic databases. Two independent reviewers appraised the studies and extracted the estimates of interest. Data were pooled using random-effects meta-analyses. Fifty studies were included in a narrative synthesis and 42 studies in the meta-analyses. Although there were significant heterogeneity between the studies, the overall pooled estimates for all age groups of self-reported lifetime prevalence of allergy to cow's milk, egg, wheat, soy, peanut, tree nuts, fish, and shellfish were 6.0, 2.5, 3.6, 0.4, 1.3, 2.2, and 1.3, respectively. The prevalence of food-challenge-defined allergy to these same foods were on average 10-fold less compared to the self-reported food reactions. Allergy to cow's milk and egg was more common among younger children, while allergy to peanut, tree nuts, fish, and shellfish was more common among the older ones. Allergy to most foods, except soy and peanut, appeared to be more common in Northern Europe. The heterogeneity between studies was high and participation rates varied across studies, reaching as low as <20% in some studies.

Asia is a populous and diverse region and a recent review aimed to summarize the current literature on food allergy from this region, comparing it with western populations. A PubMed search using strategies “Food allergy AND Asia”,

“Food anaphylaxis AND Asia”, and “Food allergy AND each Asian country” was conducted.<sup>11</sup> Fifty-three articles, published between 2005 and 2012, were reviewed. The overall prevalence of food allergy in Asia was comparable to the West, but the types of food allergy differed in order of relevance. Shellfish was the most common food allergen in Asia, likely reflecting the abundance of seafood consumption in this region. Symptoms varied widely, from oral symptoms to anaphylaxis, within given individuals. In contrast, peanut prevalence in Asia was extremely low compared to the West for unclear reasons.

Egg and cow's milk allergy were the two most common food allergies in young children and infants, with prevalence data comparable to western populations.

In most Asian countries, wheat allergy is the most common cause of anaphylaxis in Japan and Korea, and is increasing in Thailand. This study highlights important differences between East and West, and within the Asian region.

Eosinophilic esophagitis (EoE) occurs in children and adults with a strong male preponderance. There has been a marked increase in EoE in North America, Europe, and Australia. The reasons for this increase remain unclear, but are likely to be influenced by genetic and environmental factors, as well as early-life exposures. Based on recent population-based data, the estimated EoE prevalence in the USA is 56.7 per 100,000 persons.<sup>12</sup>

The peak prevalence was observed in patients between 35 and 39 years of age. Prevalence figures in Asia and the Middle East generally appear to be lower than in Western countries, but population-based studies are not available. Although celiac disease and EoE can occur in given individuals, typically males, a causal association between celiac disease and EoE appears unlikely. Additional population-based studies are needed to define the epidemiology of EoE.

In summary, food allergy occurs worldwide with varying prevalence according to specific food consumption and geographic regions. Food allergies, including EoE and celiac disease, are increasing in prevalence over time and are more frequent in western countries. However, data for all countries and regions of the world is incomplete.

Classical CD presents with signs and symptoms of malab-

## DEFINITIONS

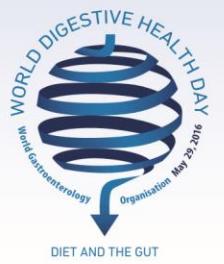
Celiac disease (CD) is a chronic enteropathy produced in genetically predisposed subjects by the ingestion of gluten.

Gluten represents the protein mass that remains when wheat dough is washed to remove starch. Gliadins and glutenins are the major protein components of gluten and are present in wheat, rye, and barley.

Non-celiac gluten sensitivity is a condition in which people in whom CD and wheat allergy has been excluded present symptoms which improve with a gluten free diet (GFD).

Wheat allergy is an adverse immunologic reaction to wheat proteins, mostly IgE- but rarely also non-IgE mediated. It may present as an allergy affecting the skin, gastrointestinal or respiratory tract, a contact urticarial, but also as the so called exercise-induced anaphylaxis, or as asthma/rhinitis (baker's asthma).

growth failure in children.



## CELIAC DISEASE



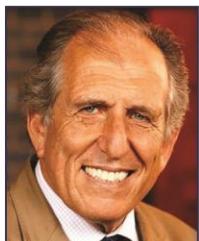
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In the so called non-classical form of CD, patients may present with mild gastrointestinal symptoms without clear signs of malabsorption or with extra-intestinal manifestations. In this case the patient will suffer from abdominal distension and pain and a myriad of extraintestinal manifestations such as: iron-deficiency anemia, chronic fatigue, chronic migraine, peripheral neuropathy unexplained chronic hypertransaminasemia, reduced bone mass and bone fractures, and vitamin deficiency (folic acid and B<sub>12</sub>), late menarche/early menopause and unexplained infertility, dental enamel defects, depression and anxiety, dermatitis herpetiformis, etc. The family screening that follows a CD diagnosis has shown that CD may run asymptomatic, in asymptomatic CD patients, however, the GFD will also improve the quality of life and health.

### EPIDEMIOLOGY

CD is common, with a world prevalence of about 1%, varying from 0.14%–5.7%. The observed increased number of new cases in the last decades is due to better diagnostic tools and thorough screening of individuals considered to be at high-risk for the disorder. However, the ratio of diagnosed to undiagnosed cases of CD varies from country to country, suggesting that most cases of CD are still undetected. Globally, there is the need to increase the knowledge of disease, especially among primary care doctors.

### ROLE OF GENETICS

The MHC-HLA locus is the most important genetic factor in the development of CD. The disorder is associated with human leukocyte antigen (HLA)-DQA1 and HLA-DQB1 genes, and the alleles HLA DQ2 (95%) and DQ8 (the rest) are present in the vast majority of CD patients. Recent data showed that also HLA class-I molecules are associated to the disorder.

### SYMPTOMS

CD may present at any time in life with an ample spectrum of symptoms and signs.

sorption, including diarrhea, steatorrhea, and weight loss or

### DIAGNOSIS

The gold standard for CD diagnosis relies on the presence in serum of CD specific serology and the intestinal biopsy shows the presence of increased number of intraepithelial lymphocytes (IELS) and various degrees of villous shortening.

The celiac disease clinical presentation may be monosymptomatic or oligosymptomatic, or with low intensity. The following signs or symptoms may be present at any age.

Gastrointestinal symptoms (diarrhea, abdominal distension and/or pain, chronic constipation in children, dyspepsia, early satiety, and loss of appetite)

Iron deficiency and anemia



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## CELIAC DISEASE, *continued*

Table 1.

Chronic fatigue and lack of energy
Chronic migraine
Dermatological manifestations (such as rash, psoriasis, and blisters)
Peripheral neuropathy - numbness and parasthesias
Unexplained chronic hypertransaminasemia
Vitamin deficiency (folic acid, vitamin D, vitamin B <sub>12</sub> )
Reduced bone density
Unexplained infertility
Delayed puberty, late menarche/early menopause
Unexplained miscarriage, premature birth, or small for gestational age infant
Incidentally recognized at endoscopy performed for GERD
Dental enamel defects
Depression and anxiety, moodiness, and irritability
Celiac crisis (cholera-like syndrome)

The CD serology encompasses serological markers targeting the auto-antigen, such as antiendomysial (EMA) and anti-tissue transglutaminase (anti-tTG), and those targeting the offending agent, against synthetic deamidated gliadin peptides (anti-DGPs). All of these antibodies are based on immunoglobulin A (IgA) or immunoglobulin G (IgG). Specifically, IgG-based tests are useful for detecting CD in selected IgA-deficient patients. It is recommended to test also the level of the serum total IgA, as IgA deficiency is present in 2% of population. In case of selective IgA deficiency in a second blood samples, IgG-based tests should be performed (antiDGP, anti-tTG or EMA) because negative IgA antibodies will not be diagnostic.

Patients having a low titer of antibodies, and having histologically normal mucosa, may be a false positive test. The recommendation is to repeat the serology after six months while on a gluten-containing diet. If serology remains to be positive, these patients may be called potential CD and they should be followed. Majority of potential CD patients later develop the disorder. The long-term follow up of such patients is not well known.

The intestinal (duodenal) biopsy has been considered as essential for diagnosing CD. CD predominantly affects the mucosa of the proximal small intestine, with damage gradually decreasing in severity towards the distal small intestine. Under light microscopy, the most characteristic histological findings in patients with CD who are taking a gluten-containing diet are:

- Increased density of intraepithelial lymphocyte (>25/100 epithelial cells)
- Crypt hyperplasia with a decreased villi/crypt ratio
- Blunted or atrophic villi
- Mononuclear cell infiltration in the lamina propria
- Epithelial changes, including structural abnormalities in epithelial cells.

A modified Marsh classification for villous abnormalities is now widely used for assessing the severity of villous atrophy in clinical practice. It is highly recommended that the pathologists include report changes in a structured format, including the abovementioned histological changes, intraepithelial lymphocytes count, and interpretation in terms of modified Marsh's classification. A negative histological diagnosis may justify a second biopsy in selected patients who have positive autoantibodies, such as high titre anti-tTG, anti-DGP, and/or endomysial antibodies. Patients with dermatitis herpetiformis having a positive serology may have normal histology.

Upper endoscopy, performed for other causes than biopsy procurement, may show scalloping and/or flattening of



## CELIAC DISEASE, *continued*

toms and signs of malabsorption, very high tTG-IgA titer (>10korn), Emmer Graham flour, rye, or barley (including malt, presence of the HLA haplotype DR3-DQ2, especially homozygotes, the minimum in presence of DR4-DQ8). Some other conditions (even if they may not be related pathogenically to CD) are considered at higher risk for CD. Therefore, there is the recommendation to test for CD the patients affected with type 1 diabetes mellitus, autoimmune thyroid disease, autoimmune liver disease, Down syndrome, Turner syndrome, Williams syndrome, and selective immunoglobulin A (IgA) deficiency.

The intestinal biopsy is always necessary if the antibodies are negative. However (and according to very new concepts for children), biopsies may be omitted in the presence of symptome upper limit of normal), and positive EMA in a second blood sample. When the country resources are low, CD diagnosis can rely on the sole presence of positive serology or even of a histology demonstrating intestinal damage, followed both by the good clinical response to GFD. Presumptive GFD followed by dramatic clinical improvement has been considered an indirect diagnostic tool for CD. However, this strategy (sometimes useful in underprivileged countries) must be strongly discouraged as the GFD will by time decrease the specific antibody levels and restore the damaged mucosa, not allowing a proper CD diagnosis.

## IMPORTANCE OF GENETICS FOR DIAGNOSIS OF CD AND POPULATION AT RISK

First-degree and (to a lesser extent) second-degree relatives have an increased risk for CD. Because of the genetic predisposition, in HLA positive people the onset of the disease or symptoms, on a gluten-containing diet, may occur at any time in life. On the converse, a negative HLA test will exclude the possibility of CD. All first-degree relatives should be screened for celiac disease.

Approximately 7% to 10% of first-degree relatives may develop CD; the risk varies considerably with their relationship with the index patient (the maximum risk in

patients with CD is 40%).

Some other conditions (even if they may not be related pathogenically to CD) are considered at higher risk for CD. Therefore, there is the recommendation to test for CD the patients affected with type 1 diabetes mellitus, autoimmune thyroid disease, autoimmune liver disease, Down syndrome, Turner syndrome, Williams syndrome, and selective immunoglobulin A (IgA) deficiency.

## TREATMENT, THE GLUTEN-FREE DIET

Patients with CD should not eat products containing wheat for the rest of their lives. Patients should consult a dietitian who is knowledgeable about gluten-free diets, especially during the first year after diagnosis. The safe limit of gluten intake varies across patients and has been considered to be 10-100 mg/day, although a subsequent study indicated that the upper limit should be closer to more like 50 mg/day.

Celiac patients cannot eat the following cereals and flours: semolina, spelt, triticale, wheat germ, wheat starch, wheat bran, bulgur, couscous, durum flour, farro, gluten flour, Kamut, malt extract, malt flavoring, and malt syrup).

Gluten-free grains, flours, and starches that are allowed in a gluten-free diet include: amaranth, arrowroot, bean flours, buckwheat, corn, garbanzo beans, seeds, millet, Montina flour (Indian rice grass), nut flour, nut meals, oats (uncontaminated), potato flour, potato starch, quinoa, rice (all forms), sorghum flour, soy flour, tapioca, and teff flour.

A small subgroup of patients with CD may also be intolerant to pure oats. Oats must be pure and uncontaminated by gluten to be suitable per most CD patients.



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which often is the consequence of persistent gluten intake. The majority of industrially produced foods may contain gluten. Any dietary deficiencies, starting from the correct fiber content, but also iron, folic acid, calcium, and (very rarely) vitamin B<sub>12</sub>, should be corrected.

### DIFFERENTIAL DIAGNOSIS

In absence of a positive serology, the histological lesions suggestive of CD may suggest the presence of conditions other than CD.

The differential diagnosis includes infective diseases (tropical sprue, giardiasis, cholera, *H. pylori*, HIV), immunodeficiency states, drug-induced enteropathy (olmesartan, mycophenolate, chemotherapy), allergy (eosinophilic gastroenteritis, in children enteropathy caused by food allergy), radiation damage, graft-versus-host disease, chronic ischemia, Crohn's disease, and autoimmune enteropathy.

### EXTRAINTESTINAL MANIFESTATIONS AND COMPLICATIONS

There are increased risks for unexplained infertility (12%), osteoporosis (30–40%), and bone fractures (35%) in classically symptomatic CD. Patients with (long-term untreated) CD have an elevated mortality risk due to an increased risk for malignancy. In particular, CD has been related to higher risk of malignant lymphomas, small-bowel adenocarcinoma, and oropharyngeal tumors. Likely, less than 1% of diagnosed patients may develop a severe complication called refractory CD, which is defined as persistence or recurrence of clinical symptoms and histopathological abnormalities despite excellent adherence to GFD for at least 12 months. Refractory CD must be considered, particularly in patients with CD diagnosed over the age of 50. This complication should

- Dietary lapses are the first cause of the lack of response to be differentiated from the very common non-responsive CD, (intentional or non-intentional) (see below).

### MANAGEMENT OF CELIAC DISEASE

The vast majority of CD patients report an improvement in symptoms within few weeks after starting the GFD. Although most patients have a rapid clinical response to a GFD, the rate of response varies.

Patients who are extremely ill may require hospital admission, nutritional support, and, occasionally, steroids. With strict dietary adherence, the titer of CD-specific antibodies falls. The complete histological resolution, however, may take years and may not be achieved in every patient. There is evidence that the lack of histological resolution could be determined by persistent consumption of gluten.

Key issues when following up CD are:

- Serological tests cannot detect minimal gluten intakes (traces), so expert physicians and nutritionists should evaluate of the clinical situation and the GFD.
- Repeated duodenal biopsy to evaluate healing and for assessing adherence to a GFD is a controversial area among experts. However, intestinal biopsy should be considered as mandatory in patients persisting with symptoms despite evidence of strict GFD.
- In case of persistence of symptoms in patients with CD consider: overlapping irritable bowel syndrome (IBS) or inadvertent gluten ingestion (most common causes), but also a wrong CD diagnosis. Consider also other diseases, such as lactose intolerance, food allergies other than wheat, pancreatic insufficiency, microscopic colitis, bacterial overgrowth, IBS, ulcerative jejunitis, enteropathy-associated T-cell lymphoma, and refractory CD.

- During the first year after diagnosis of CD it is important to check symptoms and laboratory tests (best predictors: quantitative determination of anti-DGP IgA and anti-tTG IgA) and, if possible, to visit a nutritionist.
- In women, a DEXA bone mineral density scan serves as a baseline measure of bone mass.
- Facilitate the approach to support groups for CD patients.
- If necessary and/or requested, offer a psychological consultation.

Celiac disease (CD) is a chronic enteropathy in genetically predisposed individuals in response to gluten intake.<sup>1</sup> CD as we know it is, rather than being a rare and incurable disease until the 1950's, both quite common in screening studies and readily treatable. The treatment is a gluten-

involves damage to the brain, especially the cerebellum. Celiac disease is a serious medical condition that requires a long-term follow-up plan to maintain excellent health and to prevent complications from occurring.

Maintaining a strict GFD is difficult in the East and West and has both financial and quality of life implications.<sup>6</sup> Evidencebased follow-up for out clinic management should be developed in the years to come.

#### Cascade with resource-sensitive options for the diagnosis of celiac disease.

Resource level	Cascade of diagnostic options
Gold standard	<p>Medical history and physical examination</p> <p>Celiac disease-specific antibodies assessment and intestinal biopsy • Anti-tTG IgA and anti-DGP IgG. Total IgA to exclude IgA deficiency. Intestinal (duodenal) biopsies are always recommended</p> <ul style="list-style-type: none"> <li>• In certain situations biopsies may be omitted after discussing the pros and cons with an expert physician with special knowledge in celiac disease.</li> </ul>
Medium resources	<p>Medical history and physical examination</p> <p>Antibody assessment as a single diagnostic tool – when endoscopy is not possible or trained pathologists are not available; titer levels should be considered.</p> <p>Intestinal biopsies as a single tool* – in settings in which pathology is (perhaps remotely) available but clinical laboratories cannot reach the required standards.</p>
Low resources	<p>Medical history and physical examination</p> <p>Antibody assessment as a single diagnostic tool</p> <ul style="list-style-type: none"> <li>• Start with testing anti-tTG IgA. If negative and still suspected for celiac disease, add total IgA or DGPIgG, if available.</li> </ul>

Diagnosis only based on symptoms and/or response to the gluten-free diet is strongly discouraged. free diet (GFD).<sup>2</sup> Most patients report clinical improvement within weeks. However, mucosal recovery may last years after the start of a GFD.<sup>3</sup> CD occurs only in patients who express HLA-DQ2 and/or DQ8 molecules.<sup>4</sup> The prevalence of CD in adults varies between one in 100 and one in 300 in most parts of the world.<sup>5</sup>

Three conditions are triggered by a systemic immune reaction to gluten consumption: celiac disease, the skin rash dermatitis herpetiformis, and gluten ataxia, which



## MANAGING ADULT CELIAC DISEASE IN THE OUTPATIENT CLINIC



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### INTRODUCTION GLUTEN FREE DIET

The one and only therapy for CD is a life-long gluten-free diet. Willem-Karel Dicke started this in the Netherlands in 1933; this is over 80 years ago.<sup>2</sup> No food, beverages, or medications containing any amount of gluten from wheat, rye, barley, spelt, kamut, or other gluten containing cereals can be taken; even small quantities can be harmful. Only food and beverages with a gluten content of maximum 20 ppm are accepted. Oats have been reported to be non-toxic in almost 100% of patients with CD.<sup>7</sup> GFD will result in symptomatic, serologic, and histological remission in most patients. With a strict GFD, antibody levels (tTgA and EMA) decrease very rapidly.<sup>1</sup> However, histological normalization takes 2-5 years, especially in adults.<sup>3</sup> In children, histological normalization occurs within 3-6 months, although antibody levels can take 1-1.5 years before normalization is reached. Compliance is often difficult, especially when a patient is “asymptomatic” or does not have the classical symptoms. It helps patients and their relatives to be properly informed about the chronic disease, the do’s and don’ts, and the risk of untreated CD to increase knowledge and encourage self-empowerment of the patients. Despite the importance of adequate information, leading celiac support groups and working groups did not define guidelines so far to assess the outcome and standardize adherence to the GFD.

### FOLLOW UP IN GENERAL

There is a lack of data about the best logistic outpatient clinic approach of patients during a lifelong GFD.

Amongst the many guidelines for celiac follow-up, there is a lack of clarity regarding “What, who, and when.” We do follow-up with 700 patients at our out-clinic. In the past, we saw the majority of patients on a regular annual face-to-face follow-up. Now we control (if necessary by telephone and laboratory controls in their local cities) and make appointments “at request”. We have the impression that the adherence to a gluten-free diet improves by having a regular follow up, even by telephone, within the setting of a dedicated celiac clinic.

The question is if with the adherence to a GFD, quality of life and the avoidance of complications is indeed improved. In the past, one of the key factors relating to the adherence to a GFD was supposed to be the quality of the dietician. Of course, GE-clinics do have dietetic experience, but the majority of patients nowadays also have excellent access to the internet and thereby to websites advocating and explaining GFD; this is an advantage and a risk/ pitfall at the same time, as the internet is spoiled with erroneous information, confusing the necessarily strict follow-up of the diet. The majority of patients manage their diets without any problems as gluten free products are widely available. The diet is

difficult to follow for non-native speakers, immigrants, illiterates, the elderly, and patients on a low budget.

future a useful tool to supplement the currently accepted assays.<sup>9</sup>



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This is even more outspoken and problematic in the Middle-East, North Africa, the Indian Subcontinent, and Latin America.<sup>6</sup> Only in the first years is dietetic follow-up part of the regular follow-up. However, refractory celiac and gluten ataxia patients should be controlled by a dietician every 6-12 months.

### FOLLOW UP SEROLOGY

IgA tissue Transglutaminase (tTgA) is the preferred method for monitoring the quality of GFD-compliance. Minor dietary mistakes are not detected by this. Interpreting this test is straightforward, a celiac patient on a GFD for at least 6-12 months should have a negative test. EMA can remain positive in follow-up during GFD for years. The tTgA levels should be as close to zero as possible, indicating a minimal antibody response to gluten, or at least show a significant and ongoing dropping. A negative test is what most celiac patients want to see some time after beginning the GFD. A normal tTgA value can sometimes be reached only after a year or more on the diet, especially if the initial value was very elevated. What matters is that the number declines consistently over time. One should be aware that in non-compliant patients, a mucosal and serological relapse might develop even after many years of gluten challenge.<sup>8</sup> Also, there is no reliable way to monitor compliance with a GFD. Recent studies indicate that measuring the amount of the protein I-FABP in the blood may provide in the

### MANAGING ADULT CELIAC DISEASE IN THE OUTPATIENT CLINIC, *continued*

#### HISTOLOGICAL FOLLOW UP

#### LABORATORY FOLLOW UP

A significant decrease (or normalization) of markers for malabsorption, such as fat in the stool, was the hallmark of control until the late eighties. We rarely check for this anymore as a standard procedure. For those presenting with severe malnutrition, as well as ongoing weight loss, we assess nutritional status and intestinal absorption capacity should be assessed.<sup>10</sup> Checking if the small intestine normalizes is mandatory: hemoglobin, iron, vitamin B<sub>6</sub>, folic acid, vitamin B<sub>12</sub>, calcium, alkaline phosphatase, vitamin D, and parathyroid hormone. We advise checking for the so-called common associated autoimmune conditions (Thyroid-stimulating hormone, Thyroid hormone), and finally tTgA to check the diet adherence. The sensitivity of tTgA for the quality of diet adherence control is not well studied. The key endpoints in the clinical follow-up are normalization of weight, prevention of overweight, and mucosal healing, which means normalization of histology to Marsh 0-1.

Rates of mucosal healing are highly variable. In some studies up to 40% of patients had persisting villous atrophy after two years and about 10% after five years on a GFD.<sup>3,11</sup> This raises the question whether symptoms alone constitute a reliable guide to mucosal healing. Ongoing villous atrophy can lead to persisting deficiencies and problems such as osteoporosis and mimic irritable bowel syndrome (IBS). Clinical symptoms, celiac serology,

and laboratory markers of inflammation are unfortunately not robust enough measures to confirm mucosal healing. Until better non-invasive tests of mucosal healing can be developed, a repeat intestinal biopsy after one year of GFD is recommended. The majority of patients diagnosed after the age of 40-45 years do have a slow normalizing histological recovery. As part of our research, we repeated intestinal biopsies after one year of dietary therapy in the mid-nineties. However, this is not our approach in 2015. We repeat biopsies only in patients with severe abnormalities, especially if diagnosed above the age of 50, or based on lack of improvement and persistent or recurrent complaints.

Our principal problem is whether re-biopsies indeed change the clinical outcomes in the majority of patients.

Recently Biagi *et al.* showed that the majority of celiac patients do not present a satisfactory histological response, and they suggested a duodenal biopsy to be the only tool that could identify patients with unsatisfactory histological response.<sup>12</sup>

## ADHERENCE TO GFD

So far reports never defined the frequency of monitoring for assessing compliance and outcome. Training families to adhere to GFD is important; consultation by gastroenterologists and cooperating dieticians should take place every 4-8 months in the first year. Celiac families with additional screen-detected relatives need in general fewer controls, as they are already familiar with our advice about GFD.

Dietary adherence guarantees mucosal healing and at least improvement of non-gastrointestinal symptoms. Non-invasive biomarkers for complete mucosal recovery might be useful. The majority of patients who normalize rapidly, with normal diet and a BMI 20-25, need less follow-up. In general, we advise controlling those patients in the out-clinic only once every two years. Patients with a lack of improvement we see at least twice a year. In between the two-year interval follow-up we ask the general practitioner to check serum hemoglobin, <sup>12</sup> function to be checked annually.

## SYMPTOMS DURING FOLLOW-UP

If patients present themselves with low BMI, we try to normalize the BMI between 18.5 - 25, and above 20 for elderly and refractory celiac patients, however at the moment 40% of our newly diagnosed celiac patients are overweight with a BMI over 25 kg/m<sup>2</sup>.<sup>15</sup> In a substantial part of those patients, the weight goes down in the first year after initiation of GFD, not just because the diet is "unpalatable", but also because some hungry feeling is disappearing. So far studies about the appropriate attitude for this subgroup are lacking. Normally BMI increases on the GFD. On GFD 15-20% of patients move from a normal or low BMI-class into an overweight BMI-class and 20 % of those already overweight at diagnosis gain weight.<sup>16</sup>

The disappearance of fatigue, especially in females over the age of 30, is one of the most significant problems and goals in daily clinic routine; the proportion of patients who do have a slow response to a gluten-free diet and/or histologic recovery is another topic.<sup>1</sup>

## SCREENING IN CELIAC FAMILIES

We observed a high positive screening rate of 10% in both first and second-degree relatives.<sup>17</sup> However, there probably was a selection bias; only those relatives with a low threshold for screening were screened. Maybe, this selection of patients in the family already had (albeit minor) complaints. A large multi-center study from the USA showed a rate of only 5% in both first and second-degree relatives.<sup>18,19</sup> We suggest that 4-5% reflects the true rate in daily practice appropriately. Patients with a first-degree family member with a confirmed diagnosis of CD should be offered to be tested if they show possible signs or symptoms of CD. We advise offering newly diagnosed celiac patients screening on their first and second family degree family members. Screening should include DQ2/8 typing, tTgA antibodies, hemoglobin, folic acid, vitamin B<sub>12</sub>, iron, and Thyroid function.



## MANAGING ADULT CELIAC DISEASE IN THE OUTPATIENT CLINIC, *continued*

folic acid, vitamin B<sub>1</sub> vitamin D, and tTgA and that Thyroid FOLLOW UP AND DIETICIANS

Malabsorption, weight-loss, and vitamin/mineral deficiencies characterize classical CD. We recently reported that the majority of patients in an “early diagnosis” adult untreated CD patient group, with non-classical presentation, had serum vitamin and mineral deficiencies at diagnosis.<sup>15</sup> A majority of celiac patients were zinc deficient at diagnosis. Based on our body weight at diagnosis and nutritional serum parameters: at least vitamin B<sub>6</sub>, folic acid, vitamin B<sub>12</sub>, zinc, and (25-hydroxy) vitamin D of the fat soluble vitamins. Moreover, we suggest follow-up until serum values are at satisfying levels or upon indication (bone density deviations, chronic or recurrent diarrhea, or zinc related skin lesions).

Careful dietetic review once a year was part of the deal in our out clinic. However, the majority of well-educated patients are reluctant to this approach. Therefore, inadvertent gluten intake is discussed during the out-clinic visit, especially in patients with a poor educational state or low-income families. In that case, we check if there is adequate nutrient vitamin and mineral intake. There is a lack of studies about GFD check in different countries.<sup>6</sup> We and others have already reported 30 years ago that the dietary adherence is poor in a substantial part of patients.<sup>20</sup> In our out-clinic we control around 30-40 patients who do not adhere at all. The majority of those patients normalize the diet to an adequate GFD within five years of follow-up due to an increase in symptoms.

Recently an Israeli study reported about pediatric celiac patients who were lost to follow-up.<sup>21</sup> This cohort had not only lowered adherence to GFD, but also failed periodic serological monitoring, which left them oblivious to the consequential disease activity status. This is problematic in young patients, who may not reach their growth

experience and supported by others, we suggest monitoring potential (catch-up growth, etc.) and are still too young to consider the long-term effects of their attitude with an enlarged risk for auto-immune disease in general. Continuation time of mineral and vitamin interval has yet to be determined since patients are at risk for deficiencies even after 10 years of a GFD.<sup>22</sup>

## FOLLOW UP AND DERMATITIS HERPETIFORMIS

Dermatitis herpetiformis (DH) is the cutaneous manifestation of gluten-sensitive enteropathy. It is a herpetiform clustering of extremely itchy urticated papules, especially on the extensor side of the elbows and knees, buttocks, and scalp.

Improvement of DH with GFD takes several months according to the current literature.<sup>23</sup> However, remission can take some years, but is poorly documented in current literature. Diamonodiphenyl sulfone and sulfapyridine are the primary medications to treat DH. Diamonodiphenyl sulfone is almost always indicated and initiated due to rash and the itching.



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### MANAGING ADULT CELIAC DISEASE IN THE OUTPATIENT CLINIC, *continued*

The exact mechanism of action is unknown but thought to be related to inhibition of neutrophil migration and function. Patients should be monitored for the adverse effects of diamonodiphenyl sulfone, primary hemolytic anaemia, methemoglobinæmia, agranulocytosis, and neuropathy. For patients unable to tolerate dapsone, sulfapyridine may be substituted; however dapsone does not improve GI mucosal pathology. More than 70% of patients on GFD are able to slowly wean off dapsone over a period of 2-3 years.<sup>24</sup> More than 90% of our 80-100 DH patients on a strict GFD cannot wean off dapsone in the first years. More than 50% of patients go on for at least 5-10 years. No reports are available on long term follow up of dapsone in DH.

#### FOLLOW UP AND GLUTEN ATAXIA

Of the three gluten-induced conditions, gluten ataxia is the only one without a straightforward path to diagnosis.<sup>24</sup> In fact, although awareness is growing, it has not been accepted by all mainstream neurologists.

If any antibodies to gluten are present in lab tests, then our recommendation is to consider for all ataxia patients “with no alternative cause for their ataxia” to start GFD for 12-24 months. Stabilization or even improvement after 1 – 2 years would be a strong argument that the patients suffer from gluten ataxia.<sup>25</sup> We need proper observational studies about this issue.

#### FOLLOW UP AND MEDICAL MANAGEMENT IN FOLLOW-UP

Follow-up can be arranged in primary care as long as the expertise is available. Unfortunately, the critical number of celiac patients per general physician is insufficient. In the Netherlands, only 25,000 patients are known in a population of 16 million inhabitants. We have around 10,000 GPs. This means that a general GP controls as a mean only 2.5 patients. This suggests that their expertise is insufficient. The number of gastroenterologists in the country is 500, so in general, gastroenterologists should control at least 50 celiac patients per doctor. Prompt access for our celiac patients to specialized centers around the country is recommended but not well-organized. So far only 15-20 gastroenterologists in our country are devoted to CD. However, access to those doctors is limited; the majority of them is each controlling only 150-200 celiac patients per year. Access for patients to a well-trained celiac interested gastroenterologists is limited. Secondary, especially tertiary, care is recommended if complicated CD arises. It should be noted that this care is not well organized, not only in Europe, but worldwide.

Long-term adherence to GFD leads to significant improvement in bone density. However, we see major abnormalities in bone density in our population diagnosed above 50 years of age, females as well as males. All of these high-risk patients for bone fractures should be treated with calcium and vitamin D. All osteopenia/osteoporotics in these age-groups are treated for 36 months with intravenous bisphosphonates, four times per

year 60mg APD. During our yearly follow-up we measure calcium, alkaline phosphatase, vitamin D, and Parathyroid hormone for a compensatory increase of the bone mass. Bone density should be measured in every adult newly diagnosed celiac patient.

A 24-months treatment course with risedronate 35mg once weekly, concomitant with calcium and Vitamin D supplementation, in osteopenic inflammatory bowel disease (IBD) patients improved bone density.<sup>27</sup> Similar studies are urgently needed in CD.

Appropriate criteria for follow-up bone density in daily practice for CD are lacking. We repeat bone density investigation in the case of osteopenia in general after an interval of three years. In general, gastroenterologists pay more attention to post-menopausal women with CD in supplementation of calcium than to males; however, we do have the impression that the lumbar spine quality of males is more severely hampered than in females.

## HYPOSPLENISM

Hypsplenism associated with CD may result from impaired immunity to encapsulate pathogenic microorganisms. Arbitrarily, we vaccinate all celiac patients with a spleen volume below 100cc with Pneumovac®.

## MICROSCOPIC COLITIS

Microscopic colitis (MC), including lymphocytic and collagenous colitis, are associated with autoimmune disorders, especially with CD. In case celiac patients during follow-up develop watery diarrhea, we always screen for MC.<sup>28</sup> MC is very common in our celiac center, maybe even too common based on selection bias in our referral celiac patients. We treat them with slow release budesonide (Entocort®) for three months and in the case of a relapse with thiopurines especially tioguanide (thiosix®).<sup>29</sup>

There is an increased risk for malignancies, already recognized over 50 years ago.<sup>30</sup> Small-bowel cancer, cancer of the esophagus, female celiac patients in their twenties and thirties with B-cell Non-Hodgkin lymphoma,

and seniors in their sixties for Enteropathy Associated T-cell Lymphomas (EATL) are well recognized in current literature.<sup>1</sup>

Celiac disease is a common diagnosis, but malignant outcomes are rare. EATL is such an infrequent complication that the majority of gastroenterologists may never see it amongst the population of celiac patients they diagnose and see for follow-up.<sup>31,32</sup>

Evidence suggests the risk for increased mortality and malignancies is reduced in those who adhere to the diet. However, EATLs present themselves especially in those patients diagnosed above 50 years of age.<sup>30</sup> Only 10% of patients referred to us with suspicion for (Pr)-EATL are diagnosed with those complications.<sup>32</sup> The risks of malignancy related to CD reported in literature are likely to remain overestimated owing to either bias or confounding.<sup>32,33</sup>

## REFRACTORY CELIAC DISEASE

In the situation of non-responsiveness to a GFD, dietary adherence should be meticulously evaluated. Monitoring levels of tTgA and/or EMA are suitable for this purpose. Additionally, all patients should be referred to a skilled dietician. When inadvertent gluten ingestion is reasonably excluded, the CD diagnosis should be re-evaluated. Absence of the CD-related genotypes (HLA-DQ2.5 or HLA DQ8) at diagnosis is highly suggestive of misdiagnosis. When other causes or VA have been excluded, these patients are referred to as refractory CD (RCD).

Since 2001, we have divided RCD into two types based on the absence (Type I) or presence (type II) of an, usually clonal, intraepithelial lymphocyte population with aberrant phenotype.<sup>34</sup> Our diagnostic approach and the latest insights in treatment options are readily available in literature.<sup>4</sup>

## ESOPHAGEAL CANCER

Around 90% of all esophageal cancers are related to lifestyle, such as tobacco, alcohol, diet, and overweight. Esophageal cancer is more than 10 times higher in patients with Barret's esophagus. However, esophageal



## MANAGING ADULT CELIAC DISEASE IN THE OUTPATIENT CLINIC, *continued*

### (PRE)-MALIGNANT CELIAC CONDITIONS

cancer is also higher in people with CD.<sup>35</sup> In case of Barret's esophagus, we screen our celiac patients in follow-up. Otherwise, we do not screen them for this minor risk factor.

Unfortunately, CD has strongly been suggested in the past to be related with some site specific intestinal malignancies. In contrast to this, according to the available reports the risk of colorectal cancer (CRC) has been described a similar or lower to that of the general population.<sup>36</sup> Untreated CD may be protective, probably owing to impaired absorption of fat, hydrocarbons, and putative co-carcinogens implicated in the pathogenesis of CRC, which may be poorly absorbed and rapidly excreted.<sup>37</sup> The reflex of gastroenterologists when patients present with diarrhea at their out-clinics is to recommend a colonoscopy with a very low threshold, so the majority of the elder celiac patient population already had a colonoscopy at diagnosis or follow-up.

### RISK OF CARDIOVASCULAR DISEASE

Cardiovascular diseases that have been suggested to be associated with CD include ischemic heart disease (IHD), cerebrovascular events, and cardiomyopathy. The risk of IHD may be related to the pro-inflammatory activated immune cells like in Rheumatoid arthritis<sup>38</sup> and with low folic acid state, could affect the development of arteriosclerotic lesions.

### COLON CANCER

In 2004, West *et al.* studied almost 4,000 patients with CD with respect to hypertension, hypercholesterolemia, heart disease, and stroke.<sup>39</sup> However, they showed a lower prevalence of hypertension and hypercholesterolemia in CD in comparison with controls. GFD gives a significant increase in BMI and cholesterol in celiac patients adherent to the diet.<sup>40</sup> There is a body of reports published on cardiovascular risks in celiac patients, however, conclusions of some studies are at odds with each other. The co-occurrence of T1DM in some celiac patients should be taken into consideration.<sup>41</sup>

When we find arteriosclerosis during abdominal CT in the work-up of complicated CD referred for second opinion we start aspirin 100mg daily and keep the cholesterol below 4 mmol/L. Recent studies, however, did not recognize an increased risk of IHD in celiac patients.<sup>39</sup>

### CONCLUSION

A life-long GFD improves health and the quality of life in a vast majority of patients with CD, even in those with minimal symptoms.<sup>1</sup>

GFD is in daily practice (especially in the second and third world) difficult to sustain, owing to several barriers including social, cultural, economical, and practical aspects. Adher-

**AT DIAGNOSIS (PHYSICIAN AND DIETITIAN)**

- Complete physical examination
- Education on celiac disease
- Gluten-Free dietary counselling by a skilled dietitian
- Recommend family screening (DQ2/D8 and celiac serology)
- Recommend membership in celiac support group
- Bone Densitometry (not routinely recommended for children)
- Celiac serology (if not previously obtained)
- Routine Tests (complete blood count, iron studies, folate, thyroid function tests, liver enzymes, calcium, phosphate, vitamin D, and DQ2/8)

is difficult for underprivileged patients. Pediatric data have shown that regular follow-up is associated with a significant increase in long-term compliance with GFD. Medical follow-up by gastroenterologists interested in CD is, in our opinion, essential for monitoring patients with CD to identify and prevent nutritional deficiencies, medical complications, and support adherence to GFD. However, the best way to follow up celiac patients has not yet been established.

**AT 2-4 MONTHS (PHYSICIAN AND DIETITIAN)**

- Assess symptoms and coping skills
- Dietary review

CD is, in our opinion, essential for monitoring patients with CD to identify and prevent nutritional deficiencies, medical complications, and support adherence to GFD. However, the best way to follow up celiac patients has not yet been established.

**AT 6 MONTHS (PHYSICIAN) (BY TELEPHONE)**

- Assess symptoms
- Complete physical examination (on indication)
- Dietary review
- Celiac serology (tTgA)
- Repeat Other Routine Tests (if previously abnormal)

We do see the majority of our patients face-to-face every two years and in between by telephone within our setting of a dedicated celiac clinic (see Table 1). We hope to standardize this with celiac support groups and workings groups to assess the outcome and standardize the adherence to a GFD.<sup>42</sup>

**AT 12 MONTHS (PHYSICIAN AND DIETITIAN)**

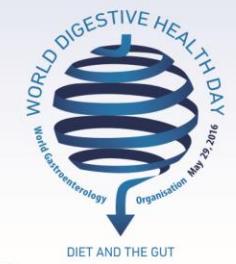
- Assess symptoms
- Abdominal physical examination (on indication)
- Dietary review
- Celiac serology (tTgA)
- Repeat Other Routine Tests
- Small intestinal biopsy (not routinely recommended for children)

**AT 24 MONTHS (PHYSICIAN) (BY TELEPHONE AS CLINICALLY INDICATED)**

- Assess symptoms
- Dietary review
- Celiac Serology
- Thyroid function tests
- Other Tests as clinically indicated
- Dietitian as clinically indicated

**AT 36 MONTHS (PHYSICIAN)**

- Bone densitometry (if previously abnormal)
- Assess symptoms
- Dietary review
- Celiac Serology
- Thyroid function tests
- Test as clinically indicated



## EATING DISORDERS AND THE GI TRACT: DEFINITION, RECOGNITION, THE ROLE OF THE PSYCHOLOGIST IN CARE



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### INTRODUCTION

Eating disorders (EDs) represent a group of psychiatric disorders which commonly have significant concurrent gastrointestinal (GI) symptoms, creating significant management challenges for gastroenterologists, psychologists, and other health professionals involved in their care. Further, diagnosis is made more challenging due to the cyclical patterns associated brain-gut interactions associated with EDs (e.g., psychopathology and behaviors associated with EDs can influence GI function and in turn GI function can influence psychopathology and behaviors). At the core of all EDs are abnormalities of eating or eating-related behaviors resulting in altered consumption and/or absorption leading to significant impairment in health and/or psychosocial functioning.<sup>1</sup> The most common EDs which

may present to an adult gastrointestinal (GI) practice are Anorexia Nervosa (AN; Restricting type or Binge-eating/purging type), Bulimia Nervosa (BN), Binge-Eating Disorder (BED), and Avoidant/Restrictive Food Intake Disorder (ARFID). It should be noted that several other EDs, such as Other Specified Feeding or Eating Disorder, Unspecified Feeding or Eating Disorder, and atypical conditions associated with mental health problems (e.g., muscle dysmorphia), may also present at an adult GI practice, but are beyond the scope of this chapter.

### DEFINITION AND PREVALENCE OF EDS

AN and BN share a common focus on an individual's self-evaluation being strongly influenced by their body shape or weight. In AN, an individual is of a significantly lower weight than would be expected. Despite this low



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### EATING DISORDERS AND THE GI TRACT: DEFINITION, RECOGNITION, THE ROLE OF THE PSYCHOLOGIST IN CARE, *continued*

and instead experience a sense of lacking control during weight, there is a strong fear of gaining weight that is accompanied by restrictions of energy intake to prevent weight gain. Individuals with AN may belong to a subtype that is restrictive and achieves weight loss through low food intake or high exercise or to a binge-eating/purging subtype that eat large quantities of food and use compensatory methods to control weight (e.g., vomiting, laxatives, or exercise). AN has a 12-month prevalence of 0.4% and is more common in young females. In contrast, individuals with BN, although also engaging in binge-eating and purging to control weight, are not significantly underweight binge-eating episodes. BN has a 12-month prevalence of 1.0–1.5% and is also more common in females.<sup>1</sup>

In contrast, BED and ARFIDs are more focused on the food or the process of eating itself. In BED, episodes of binge-eating occur with a sense of lacking control, however, there are no compensatory methods to control weight. Instead, after eating large amounts without feeling hungry, an individual may conceal symptoms, feel guilty, depressed, or disgusted with themselves. The BED group may also be under recognized in part because they do not fit the young female stereotype. BED has a 12-month prevalence of 1.6% in females and 0.8% in males. ARFIDs involve falling below energy and nutritional needs due to a lack of interest in eating, dislike for the sensation of food, or concern for possible consequences of eating (e.g., choking or vomiting).<sup>1</sup>

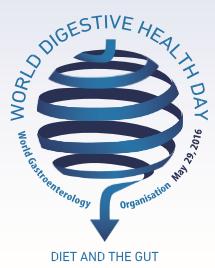
#### COMMON GI COMPLAINTS REPORTED BY INDIVIDUALS WITH EDS

It is very common for individuals with EDS to experience GI symptoms. For example, in BN compensatory methods to control weight after a binge-eating episode can include self-induced vomiting or laxative abuse. The use of these

#### RECOGNITION OF EDS IN GI PRACTICE:

methods can be problematic for GI health and lead to a variety of complications, such as dental, esophageal, motility, or impaired gastric emptying.<sup>2</sup> Conditions such as AN are often associated with abnormal GI sensations and motility, however some of these may be reversible with weight gain and others may relate to underlying psychiatric manifestations, possibly a common cause (such as previous abuse). Individuals with EDS who attend a GI clinic prior to ED treatment request more tests and have more hospital admissions than other GI patients or ED patients who first attend ED treatment.<sup>3</sup> Additionally, individuals with functional gastrointestinal disorders (FGIDs) are significantly more likely to have a history of eating disorders than a gallstone disease comparison group, indicating that coexisting GI symptoms may persist after the ED has resolved.<sup>4</sup> Both upper and lower GI symptoms are common among individuals with EDS,<sup>2</sup> and the eating disorder itself may be ‘hidden’ by the GI symptoms. Consequently, awareness of EDS in gastroenterologists is important as patients with EDS may approach them before approaching other professionals, such as a psychologist.

Individuals with EDS have been found to frequently approach practitioners regarding physical GI symptoms prior to talking about EDS.<sup>2</sup> A recent systematic review (based on four studies with total of 691 GI patients) suggests that disordered eating patterns occur in around 23% of GI patients.<sup>5</sup> Gastroenterologists can help patients with EDS by being aware of EDS and routinely screening patients for these, as some symptoms may become salient during psychological distress.<sup>4</sup> Establishing a multi-disciplinary team of healthcare professionals (such as physicians, registered dieticians, psychologists, and psychiatrists) may also be helpful.<sup>6</sup> This can help patients with EDS to receive support for their EDS and avoid unnecessary and potentially dangerous tests and/or



## EATING DISORDERS AND THE GI TRACT: DEFINITION, RECOGNITION, THE ROLE OF THE PSYCHOLOGIST IN CARE, *continued*

Table 1: *Definition and summary of the primary forms of ED-focused hospitalization, whilst having their FGID symptoms and also the physical complications of their EDs managed appropriately.*

### SIGNS TO HELP IDENTIFY GI PATIENTS WITH EDS

- Younger female demographic
- Psychological distress or comorbid mental disorder
- Concerned with size or shape of body
- Underweight or over-eating
- Excessive focus on foods and engagement with restrictive eating patterns based upon beliefs relating to foods (e.g., most healthy/pure)
- Erosion of tooth enamel
- Reflux symptoms
- Extensive investigations required to identify GI issue
- Functional motility disorders
- Score on an ED screening survey

### TREATMENT OF EDS

The latest guidelines from the American Psychiatric Association<sup>6</sup> and the UK based National Institute for Clinical Excellence<sup>7</sup> provide detailed and evidence-based recommendations in the treatment of EDs. The first steps in the treatment for AN and BN are to restore a healthy weight, reduce or eliminate binge-eating or purging, and to treat any physical complications of the disorders.<sup>6</sup> Focus should also include goal setting to restore a healthy eating pattern and the provision of nutritional information on how to achieve this. Additionally, therapy is recommended to reassess unhelpful thinking, treat comorbidity, build family support, and to prevent relapse. Patients are often treated in the outpatient setting, and may benefit

treatment of ARFD. No treatments have been recommended *psychological therapies*

Psychological treatment form and definition:
<i>Cognitive-Behavior Therapy (CBT):</i> Symptoms targeted directly to re-evaluate thinking (i.e., identifying and correcting negative core beliefs/unhelpful thoughts), promote helpful behavioral responses, and reduce individual distress. Focus on unhelpful behaviors and dysfunctional attitudes relating to eating, weight, body shape, exercise, and other psychosocial issues (e.g., bullying, and family discordance).
<i>Psychodynamic Interpersonal Therapy (IPT):</i> Interventions that have a primary focus on understanding and working with transference (the unconscious transferring of feelings from one person to another). Focus is to foster psychological insight and address underlying personality disorders.
<i>Dialectical Behavioral Therapy (DBT):</i> Disordered eating is viewed as an attempt to regulate uncomfortable emotions, and are treated with mindfulness, tolerance of distress, regulation of emotion, and interpersonal skills. Regulating emotions can address the sense of losing control and binge-eating, reducing its frequency.
<i>Family Therapy (FT; e.g., The Maudsley Approach):</i> Interventions that incorporate the whole family system and focus on fostering new skills in relationships, communication, and problem-solving. When individuals are younger and of shorter illness duration, parental support of re-nutrition is effective.

from psychotropic medications such as selective serotonin reuptake inhibitors (SSRIs).<sup>7</sup>

Cognitive-Behavior Therapy (CBT; including self-help oriented CBT) and Psychodynamic Interpersonal Therapy (IPT) have been identified as an effective treatment for

AN, BN, and BED.<sup>7,8</sup> For BN, both CBT and IPT, but not Dialectical Behavioral Therapy (DBT), are effective in reducing binge-eating and compensatory methods, and also decreased body dissatisfaction.<sup>9</sup> CBT has also been demonstrated to reduce the frequency of binge-eating episodes in adults diagnosed with BED.<sup>10</sup> Specifically regarding AN, Family Therapy (FT) shows the most potential when patients are younger and in the earlier stages of their ED.<sup>11</sup> The research is less advanced in the for ARFID, due to a lack of research trials.<sup>12</sup> Although it has been found hospitalization tends to be longer than in AN.<sup>13</sup> It should be noted that psychological therapies for EDs range in terms of their format (individual, group, or combined), frequency, and duration, for a detailed summary and recommendations for the treatment of EDs.<sup>6,7</sup> See Table 1 for definition and summary of several common forms of ED-focused psychological therapies.

## ROLE OF THE PSYCHOLOGIST FOR PATIENTS WITH EDs

- Provide psychological assessment and associated ED-specific psychological interventions
- Develop treatment formulations that identify and take into account patient predisposing factors (e.g., developmental traumas, attachment style, and cognitive development), precipitating factors (e.g., stressors), perpetuating factors (e.g., defense styles, level of insight, and ED maintaining cognitions/behaviors), protective factors (e.g., personal strengths), and ED severity
- Provide psychological interventions associated with, but not directly related to, the eating disorder, such as school/ socialization problems, and family difficulties
- Provide input to team treatment plan for patient with an ED

- Providing psychoeducation to both patients and families affected by an ED
- Providing ongoing advice and support to medical and allied health team
- Facilitate insight, self-esteem, and psychological and physical recovery
- Facilitate positive coping strategies and resilience to manage future stress and challenges
- Work with medical and allied health professionals to monitor and reduce patient self-harm
- As relapse is extremely common for AN, BN, and BED, long term monitoring and relapse prevention work is often needed

## ORTHOREXIA NERVOSA

Orthorexia Nervosa (ON) is a dysfunctional eating condition not yet recognized by the Diagnostic and Statistical Manual (DSM-5),<sup>1</sup> but may be observed in GI cohorts.

ON involves an obsession with an increasingly limited diet focused upon consuming the most healthy or ‘pure’ foods and intake. The exclusion of foods that are categorized as less healthy or pure can lead to malnutrition and have a significant impact on psychosocial wellbeing. In a recent review, Varga and colleagues<sup>14</sup> identify that the average prevalence of ON in a general population is 6.9% and up to 57.8% in highrisk groups such as healthcare professionals and artists. No research has tested the efficacy of a treatment for ON.<sup>15</sup> Koven and Abry<sup>15</sup> suggest that a combination of CBT and psychotropic medication may be efficacious due to the success in treating AN and Obsessive-Compulsive Disorder. However, recent research suggests that 30% of outpatients with AN or BN can go on to develop ON after treatment.<sup>16</sup> As such, it is also important to notice whether a previous restriction or

compensation becomes a preoccupation with food that is categorized as healthy or impure.

## CONCLUSION

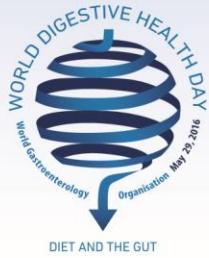
Individuals with EDs often have GI symptoms for which they may seek treatment with a gastroenterologist before seeking treatment for the symptoms of their ED. This can result in unnecessary tests, hospitalizations, and missed opportunity to address their underlying distress. It is an ongoing challenge for gastroenterologists to identify and

Probiotics, defined by the World Health Organization (WHO), are "*live microorganisms that when administered in adequate amounts, confer a health benefit on the host.*"<sup>1</sup> It is specified by genus, species, and strain (using an alphanumeric designation) for example *Bifidobacterium infantis* 35624. Common probiotic species include *Lactobacillus*, *Bifidobacterium*, *Saccharomyces* (a yeast), and some *E. coli* and *Bacillus* species. Probiotic strains must be assessed for biosafety based on the seven criteria listed by the European Union (EU).<sup>2</sup> Clinical indications of probiotics for gut health are given in Table 1.

Prebiotics are "*selectively fermented ingredients that allow specific changes, both in the composition and/or activity in the gastrointestinal microflora that confers benefits upon host well-being and health.*"<sup>3</sup> The common prebiotics include the fructooligosaccharides (FOS), galactooligosaccharides (GOS), lactulose, and inulin. Given together (synbiotics), prebiotics can enhance the gut effects of probiotics.

support patients with EDs. However, screening for EDs and establishing a team approach can help effectively treat EDs and any physical complications effectively, and work toward the best outcome for ED patients.

**Acknowledgements:** The authors would like to thank Ms. Sarina Cook for her work in reviewing the material and integration of content. We also thank Janine Lemon, Psychologist based at the Eating Disorders Unit, Royal Melbourne Hospital, and Dr. Naomi Crafti, Psychologist and Senior Research Fellow, Monash University, for their valuable feedback and advice regarding the article.



# World Digestive Health Day

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## PROBIOTICS AND PREBIOTICS FOR GUT HEALTH: THE ESSENTIALS



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Probiotic bacteria exert their effects by transiently adhering to the intestinal mucosa and eventually the strains would pass out in the feces. Fecal recovery is useful as an indirect measure of gut colonization. The half-life of a probiotic can vary from strain-to-strain, but it has been established that certain microbial strains survive and remain detectable in stools for up to four weeks after discontinuation of intake. Survival in the host for a longer period may require continuous intake, but whether prolonged colonization is beneficial remains unclear. A third of probiotics are estimated to survive in adequate numbers in order to affect gut microbial metabolism and exert its intended clinical responses.

The probiotic preparations available in the market include capsules, sachets, yogurts, and fermented milk or fruit drinks. There are also external factors that affect viability

Table 1: Clinical indications of probiotics for gut health

### PEDIATRIC

Acute infectious diarrhea  
Prevention of antibiotic-associated diarrhea  
Prevention of nosocomial diarrhea  
Adjuvant therapy for *Helicobacter pylori* eradication  
Alleviate some symptoms of functional bowel disorders  
Infantile colic  
Prevention of necrotizing enterocolitis in preterm infants  
Mildly active ulcerative colitis

### ADULTS

Acute onset infectious diarrhea  
Prevention of antibiotic-associated diarrhea  
Prevention of *Clostridium difficile*-associated diarrhea  
Adjuvant therapy for *Helicobacter pylori* eradication  
Irritable bowel syndrome  
Ulcerative colitis (maintenance of remission, treatment of mildly active colitis and pouchitis, and prevention and maintenance of remission in pouchitis)  
Constipation  
Hepatic encephalopathy

### VIABILITY OF PROBIOTICS

of probiotics, including storage (refrigeration or shelf) and transportation. Microbial strains are sensitive to external environment (in particular to oxygen, moisture, and heat). Furthermore, in order to be viable in the gut, probiotics should be able to tolerate gastric acid, bile, and pancreatin; adhere to mucus and/or potentially pathogenic bacteria; reduce pathogen surface adhesion; possess bile salt hydrolase activity; and be resistant to spermicides. Depending on the final applications and entry routes of hosts, most industries will first pre-screen putative probiotic strains for these properties prior to health and nutraceutical assessments.

### DOSING AND TIMING OF PROBIOTICS

The optimal effective dose at which probiotics produce clinical benefit remains unclear. Present clinical studies



## PROBIOTICS AND PREBIOTICS FOR GUT HEALTH: THE ESSENTIALS, *continued*

human epithelial cells; possess antimicrobial activity and have utilized a minimum daily therapeutic dose of  $10^6$  to  $10^9$  colony forming units (CFU).<sup>3</sup> The duration of probiotic therapy also varies among hosts and targeted therapeutic effects, and thus it is advisable for probiotics to be taken continuously. Although host and physiology dependent, *Saccharomyces boulardii* has been reported to be cleared from the body within three to five days after stopping as compared to *Enterococcus faecium*, which reportedly persisted for five weeks after probiotic intake in humans. A meta-analysis by Ritchie *et al.* reported that some probiotic strains showed significant clinical efficacy when taken for as little as one week up to 240 weeks.<sup>4</sup> Hunger *et al.* suggested that probiotics should be taken for at least one month in those with lower gastrointestinal (GI) symptoms<sup>5</sup> and a longer period is needed for metabolic diseases. Various factors affect such dosing variations; a) the original gut microbiota profile of hosts, as probiotics need to colonize to exert certain health benefits and should the original gut microorganisms prevent such colonization, thus the effects of probiotics are hindered; b) the diet and physiology of hosts such as fibers and polysaccharide intake which alter the unstirred layer of the intestinal epithelium will change the attachment of probiotics to gut lining; c) gut-related diseases which increase the concentration of toxic metabolites to probiotics will hinder their survival; d) metabolism of hosts often vary, leading to different dosage and time needed for a beneficial effect to be materialized; e) unlike drugs, most mechanisms and specific targeted sites of health benefits by probiotics remain unknown, thus variation will remain.

No definite recommendation on proper timing of probiotic consumption has been made so far. Certain strains, such as *Lactobacillus rhamnosus* and *Saccharomyces boulardii*, may be administered before a meal or just after a fat-containing meal to avoid

**Introduction** Tripathiet *et al.* reviewed the literatures on acid and resistance to gastric acid but many commercial strains nowadays have been tested for acid resistance before bile tolerance of several Bifidobacteria species and noted that *Bifidobacterium longum* survived best.<sup>6</sup> Some *Lactobacillus* species are able to survive in environments between pH 3.7 up to 6.0. Presently, commercial products have addressed this issue by providing more effective delivery systems via microencapsulation, enhanced coatings, and drying methods to enhance strain viability. Consumption would clearly depend on individual probiotic strain properties, as well as, product formulation.

## SAFETY OF PROBIOTICS

The US Food and Drug Administration (FDA) defined probiotics as Generally Recognized as Safe (GRAS).<sup>7</sup> However, there are many commercial probiotic preparations available with different species, strains, and efficacy. Therefore, safety assessments are strain-specific and the GRAS status does not cover all probiotic products *per se*. The European Union (EU) project on biosafety evaluation of probiotics (PROSAFE) recommends the following safety measures: proper identification of microbial strain via biochemical and molecular methods; determination of antibiotic resistance and transfer; standard antimicrobial susceptibility testing; *in vitro* assessment of virulence; and *in vivo* assessment of strain pathogenicity.<sup>8</sup>

The Agency of Healthcare Research and Quality (AHRQ) together with the National Institutes of Health (NIH) have reviewed in detail the existing literatures on safety of probiotics.<sup>7</sup> Amid rare systematic reporting of adverse events, the authors concluded that present randomized controlled trials (RCTs) did not show an increased risk of adverse events for children, adults, or elderly.<sup>7</sup> In this

regard, probiotics can be theoretically consumed in people of all ages. Common side effects include abdominal cramps, nausea, flatulence, and taste disturbances, which are usually observed only in the first three days of consumption and may not be attributed to the probiotics. Excipient materials used for production and the addition of prebiotics to probiotics can impart GI side effects due to their indigestible nature. Although rare, certain probiotic strains could produce more acids than others, leading to increased gut motility and subsequently exerting gut discomfort. This is normally not detrimental to health and may actually be useful in combating pathogenic bacteria in the gut.

The most important concern regarding probiotic use is the risk of sepsis. Probiotic bacteria, such as *Lactobacillus casei* and *Lactobacillus rhamnosus*, have been observed to cause misdirected hosts. Several cases of fungal sepsis have been documented in relation to *Saccharomyces boulardii* in patients with central venous catheters.<sup>7</sup> Although the exact mechanisms for bacterial translocation remain unknown, host factors such as intestinal mucosal injury, immunodeficiency, and abnormal intestinal flora are likely important reasons.

The following risk factors for sepsis are associated with probiotic, namely: (1) major risk factors - immunocompromised host and premature infants; (2) minor risk factors - presence of a central venous catheter, history of cardiac valvular disease, impaired intestinal

epithelial barrier, concomitant administration of broad spectrum antibiotics to which probiotic is resistant, administration by jejunostomy tube, and probiotics with properties of high mucosal adhesion. Premature infants, patients with chronic diseases, and/or debilitation are also considered as high-risk populations. Probiotics, though generally safe, should be used in caution in these specific patient groups.

plasmid associated and thus are allowed as a natural trait in certain genera of probiotics. These are allowed within certain resistance allowance limits.

Another debatable issue is the inhibitory effect that antibiotics have on probiotics. Probiotics have been used as an adjunct to prevent antibiotic-induced super-infections. For example, *Saccharomyces boulardii* has protective effect for antibiotic-associated diarrhea. Likewise, concomitant probiotics and antibiotics can reduce the incidence of *Clostridium difficile*-associated diseases in high-risk patients. Studies, however, differed in the timing of probiotic administration after antibiotics. Some patients are given probiotics within 48 hours of antibiotic initiation up to the entirety of antibiotic course and some up to seven to 10 days after. It is recommended that *Lactobacilli* probiotic strains be given at least two to four hours after antibiotic, unlike *S. boulardii*.

Figure 1 summarizes the factors affecting the probiotic life cycle and current challenges in the use of probiotics.



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## PROBIOTICS AND PREBIOTICS FOR THE HUMAN GUT MICROBIOME

infective endocarditis and liver abscess in immuno-comprSome resistance traits are in-born chromosomal and non-

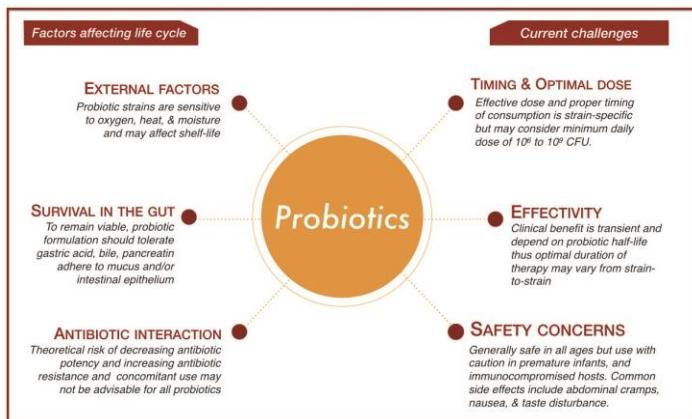


Figure 1: Factors affecting the probiotic life cycle and current challenges in the use of probiotics

## PROBIOTICS-ANTIBIOTICS INTERACTIONS

A theoretical interaction is the potential for antibiotic-resistance transfer between probiotics and pathogenic bacteria, as a result of chromosomal mutations or horizontal gene transfer. Antibiotic resistance to vancomycin, chloramphenicol, and erythromycin have been identified in *Lactobacillus* species. Again, this emphasizes the importance of appropriate regulation with proper strain identification, *in vitro* evaluation, and antimicrobial susceptibility testing of probiotic strains.<sup>8</sup>

## ROLE OF PREBIOTICS

All prebiotics are fibers but not vice versa. Some prebiotics (e.g. galacto-oligosaccharides or inulin-type

the intestinal mucosa and affecting mucosal immune system development and predisposition to cause inflammation fructans) exert similar functions as the human milk oligosaccharides (HMO) and are important for the development of metabolic, immune, and nervous systems of infants.<sup>9</sup> A specific mixture of shortchain galactooligosaccharides (scGOS) and long-chain fructooligosaccharides (lcFOS) in a 9:1 ratio has been suggested for infant use. Generally, prebiotics improves gut metabolism, stool consistency, and stool transit by increasing bacterial mass and osmotic water-binding capacity in the gut lumen, thereby reducing the risk of constipation.<sup>10</sup> Other gut modulatory benefits of prebiotic supplementation include alleviation of GI discomfort (e.g. bloating, flatulence and abdominal pain) and reduction of the risk of immune-related diseases, infection, and inflammation. Fermentation of prebiotics in the colon generates short-chain fatty acids in particular butyrate. Colonic inflammation is associated with low production of butyrate. Prebiotics can also enhance calcium absorption, mainly the fructans.

## SUMMARY

Probiotics, like any live microorganisms, are affected by *ex vivo* and *in vivo* conditions. Much clinical evidence has shown that probiotics and/or prebiotics can be used as a natural duration of therapy to cater for various indications and population groups.

, Moreno L, et al. Supplementation of infant formula with probiotics and/or prebiotics: a systematic review and comment

## STATE OF THE ART

Microbial cells in the human body outnumber human cells by about ten to one. The vast majority of these reside in the gastrointestinal tract. Non-culture based technologies have evolved over the past several years, revolutionizing the feasibility and accuracy of the human microbiome analysis. There had been longstanding belief that the fetus resides in a sterile environment, but this has been challenged in recent years with microbial discoveries in both the placenta and meconium<sup>1</sup> thanks to these advanced technologies. It is also now well established that mode of delivery, maternal diet, infant diet, antibiotic exposure, and the home environment can all have significant impact on the early development of the infant intestinal microbiome<sup>2</sup> (See Figure 1). The intestinal microbiome of the infant and young child is susceptible to dramatic shifts secondary to environmental exposures until 1-3 years of age. This implies that disruptions in normal, healthy microbiota development in infancy can have lasting effects even in adulthood.<sup>3</sup>

Increased hygiene and a lack of exposure to various microorganisms have been held responsible for the “epidemic” of chronic inflammatory diseases that over the past 30-40 years has been recorded in industrialized countries. That is the essence of the hygiene hypothesis that argues that rising incidence of asthma, inflammatory bowel disease (IBD), multiple sclerosis, type 1 diabetes, irritable bowel syndrome (IBS), celiac disease (CD), and other chronic inflammatory diseases may be, at least in

Microbiome Project Initiative. As our understanding of the human microbiome expands, the hygiene hypothesis continues to be revised and frequently challenged and was recast more recently as the “microflora hypothesis.”<sup>5</sup> This suggested that Western lifestyle alters exposure to microbes (rather than infection *per se*), causing perturbations in the colonization of part, the result of lifestyle and environmental changes that have made us too “clean” for our own good. The hygiene hypothesis, first proposed by Greenwood in 1968 and subsequently by Strachan in 1989, suggested lack of early childhood infections in the developed world might be responsible for this rise in allergic and autoimmune diseases.<sup>4</sup>

Over the past several years, knowledge of the human microbiome has been rapidly accelerating thanks to the Human through mechanisms that are still being elucidated, and thus increasing the risk for chronic diseases. Specifically, there is mounting evidence suggesting that microbiome-mediated maturation of gut epithelial barrier and of the immune system impact capacity for the host to develop responses that maintain immune tolerance and prevent aberrant pro-inflammatory or allergic responses. Indeed, it appears that there is a two-way connection between the microbiota and immune dysfunction, with both influencing and shaping each other, and a complex relationship maintained to ensure homeostasis. Additionally, by causing increased gut permeability, gut dysbiosis may lead to passage of endotoxins and/or food-

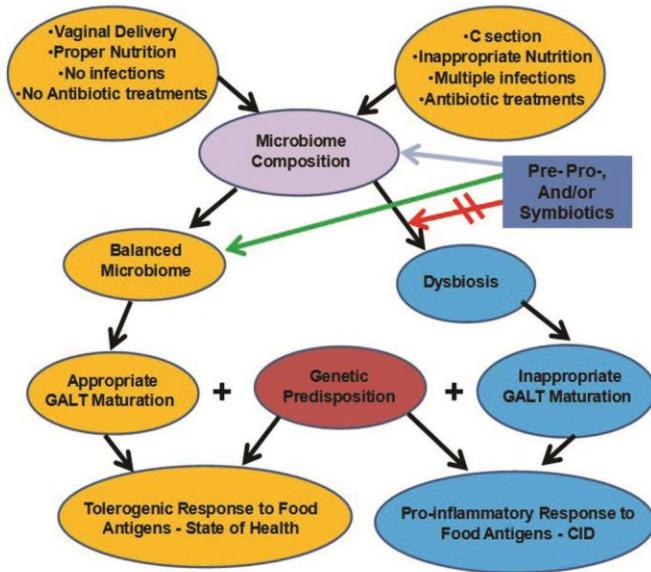


Figure 1: Factors influencing the epidemics of chronic inflammatory diseases by affecting microbiome composition. *Prenatal, perinatal, and postnatal factors play a key role in shaping gut microbiome composition and, in turn, the proper maturation of the gut associated lymphoid tissue (GALT) to exert either a tolerogenic or pro-inflammatory function that, together with genetic predisposition, may lead to a state of health or diseases, respectively.*

productions of po-inflammatoty cytokines, including IFNy and TNFa<sup>2</sup>. They in turn causes further increase in intestinal permeability causing a vicious circle<sup>3</sup> that leads to massive dietary and microbial influx from gut lumen to submucosa, break of tolerance and, ultimately, to chronic inflammation.<sup>4</sup> Adapted from P. Brandtzaeg. *Beneficial Microbes* 2010.

derived peptides into the intestinal mucosal and eventually blood stream with subsequent increased interactions with immune cells leading to break of tolerance and, ultimately, onset of chronic inflammation (See Figure 2).

Early in life, exposure to healthy and diverse commensal species promotes protection against chronic inflammation by those mechanisms, and therefore that pre-, peri-, and post-natal environmental factors (including physical, chemical, biological, behavioral, and social environmental factors) which strongly influence our gut ecosystems, thereby setting us up to be susceptible to or protected from the development of diseases throughout the entire lifespan (See Figure 1). Of all these factors, nutrition is by far the most influential one, suggesting that Western diet

GI diseases in which the microbiome is suspected to play a significant role in disease pathogenesis: IBD, CD, and IBS. Mechanistic discovery, ongoing prospective studies, interventions tried, and areas of promising future development will be highlighted.

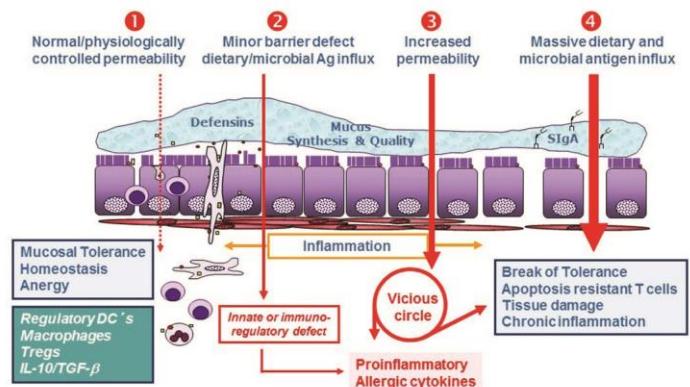
## INFLAMMATORY BOWEL DISEASE

The involvement of microorganisms in the pathogenesis of IBD has been postulated for many years. However, despite the great effort spent in search of the pathogen(s) triggering the chronic inflammatory process that characterizes IBD, the is indeed one of the key driving forces of the epidemics of these chronic diseases through changes in microbiota composition.

Figure 2: Mechanisms leading to loss of intestinal mucosal homeostasis: *Under physiological circumstances a very tightly controlled antigen trafficking assure gut mucosal homeostasis, anergy and, therefore, state of health<sup>1</sup>. Functional loss of gut barrier function leads to inappropriate passage of undigested nutrients and/or endotoxins causing innate immune response or immune regulatory defects leading to the*



## THE HUMAN GUT MICROBIOME, continued



## ONGOING DISCOVERY IN COMMON GI CHRONIC DISEASES

Research is blossoming in the area of the microbiome in nearly all human diseases. Here, we will discuss the current state of the field in three of the most common chronic elusive. Now there is good evidence that the pathogenesis of IBD is the consequence of an inappropriate immune response to commensals rather than the consequence of infection with specific pathogens. This exaggerated response seems secondary to the combination of genetic mutations and imbalance of the gut microbiome.<sup>6</sup> However, disparities in methodological approaches, including different techniques used to analyze gut microbiome, disease activity, site of inflammation, and different site of microbiota sampling (stools vs. mucosa), make comparison among the studies reported in literature very difficult. Nevertheless, a common theme emerges, suggesting that this dysbiosis is characterized by reduction in biodiversity ( $\alpha$ -diversity) and altered representation of several taxa. Gut dysbiosis is often associated with specific dysfunctions of microbial metabolism and bacterial protein signaling, including involvement of oxidative stress pathways and decreased carbohydrate metabolism and amino acid biosynthesis counterbalanced by increase in nutrient transport and uptake.<sup>6</sup> While these changes

identification of microorganism(s) causing IBD has remained suggest a possible mechanistic link between modifications in microbiota composition and IBD pathogenesis, these studies remain mainly associative.

## CELIAC DISEASE

CD is unique among autoimmune diseases in that there is a strong association with HLA DQ2 and/or DQ8(39), the environmental trigger (gluten) is known, and disease-specific autoantibodies have been identified and can be measured. Therefore, exposure to the environmental trigger can be carefully studied and frequent prospective screening against the autoantibody tissue transglutaminase (tTG) can determine precisely when the loss of tolerance to gluten occurs.<sup>7</sup> Dysbiosis has been implicated in the development of CD. *In vitro* studies suggest that microbes can influence the digestion of gliadin, the production of cytokines in response to gliadin, and gliadin.<sup>8</sup> The vast majority of research describes differences in the composition, structure, and diversity of the fecal and small intestinal microbiota in patients with CD based on age, disease status, and associated signs and symptoms. Associated metabolic activity, as measured by patterns of short chain fatty acids (SCFA) in the stool, is altered in patients with active CD and linked to the described dysbiosis. However, differences in specimen collection, analysis techniques, age of the study



## THE HUMAN GUT MICROBIOME, *continued*

The Soddu A, Basile S, Seregi A, Fader M, Stintzing C, et al. *Gut* now appears clear that to understand and study these P, et al. Proof of Concept of Microbiome-Metabolome Analysis and Delayed Gluten Exposure on Celiac Disease population, and disease status make it difficult to compare studies.

## IRRITABLE BOWEL SYNDROME

Several studies suggest that gut microbiota is altered in IBS, with different composition and decreased complexity in microbiota of IBS patients compared to healthy controls as well as within the subgroups of IBS patients.<sup>9</sup> Although these microbiota signatures are a meaningful step towards a better understanding of a link between gut dysbiosis and IBS, it must be taken into consideration that these results are obtained from relatively small sample populations. Considering that IBS is a multifactorial syndrome with many possible causes and different clinical presentations, it is possible to predict that results derived from these studies will explain the role of specific microbiota composition in subgroups of patients rather than explaining the pathogenesis of the IBS population as a whole.<sup>9</sup>

## CONCLUSIONS AND FUTURE DIRECTIONS

The major limitation of current studies linking gut microbiome with clinical outcomes is their descriptive nature. To link gut microbiome composition with disease pathogenesis, it is necessary to generate solid mechanistic evidence of disease onset and progression in relation to dynamic changes of abnormal microbiome causing host epigenetic modifications controlling gut barrier, immune functions, and, ultimately, loss of tolerance. Currently there are limited effective strategies for the treatment or prevention of these chronic diseases. The advent of genomics, proteomics, and now advanced microbiome

## THE HUMAN GUT MICROBIOME, *continued*

analysis raised the expectation of therapeutic solutions that have yet to materialize. It is now becoming clear that these diseases are final destinations, but that the paths to disease development vary from patient to patient. To date, a myriad of cross sectional studies have described alterations in the gut microbiota composition in a variety of disease states, after the disease has already presented. microbiome shifts, prospective cohort design is required to capture changes that precede or coincide with disease and symptom onset. Additionally, prospective studies integrating microbiome, metagenomic, metatranscriptomic, and metabolomic data with comprehensive clinical and environmental data are necessary to build a systems-level model of interactions between the host and the development of disease.<sup>10</sup> The creation of novel network models is essential to providing a mechanistic approach to exploring the development of disease. As the field expands exponentially in the wake of non-culture-based technologies to study the microbiome, a multi-omic research approach has the potential to revolutionize our understanding of most common diseases affecting humankind. This knowledge will provide personalized therapeutic (precision medicine) and preventive (primary prevention) targets for microbiome manipulation using prebiotics, probiotics, and/or symbiotics (See Figure 1)



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WDHD – May 29, 2016  
Montevideo, Uruguay

Obesity prevalence is an alarming health problem worldwide, but even more so for the Americas, where it reaches the highest rates. Over the last few decades, global strategies aimed to stop or slow down this pandemic phenomenon have clearly failed. Obesity and overweight related diseases have turned out to be the first causes of morbidity and mortality throughout American countries, surpassing disabilities and deaths due to malignancies, infection, and malnutrition. Fiftyfive percent of all deaths are currently caused by associated obesity and overweight diseases.

Obesity and being overweight affect 62% of adults in the Americas, with Mexico, Chile, and the USA being at the top of the list. Seven out of ten adults in these countries are obese or overweight. Concern grows further when checking prevalence rates in childhood and adolescence; obesity and being overweight have also been constantly increasing in this group, reaching prevalence rates of 25%.

Several robust investigations have already found a cause/effect relationship between diet and obesity.

Unanimously, studies show that energy excessive input is a hallmark of the modern diet. This energy excess poses a threat to physiological mechanisms of weight homeostasis.

After many years of hard scientific search, investigations managed to disclose the main issue behind the excess of energy in diet. It is not only the energy excess itself, but

also its quality, that really makes the difference for human health. Belief in the caloric hypothesis has finally weakened since components in alimentary products are now considered potent hormone and neurotransmitter triggers for nutrition science. Most of the ingredients used in the process of food production add a powered effect in terms of metabolic responses, when compared to "in natura" food effects, which have less impact on energy body regulation. Subsequently, repetition in the consumption of processed food leads to well-known underlying hyperinsulinemia, the very early stage in the development of overweight and obesity disorders.

## GREAT SIGNIFICANCE OF LATEST PAN AMERICAN HEALTH ORGANIZATION NUTRIENT PROFILE MODEL TO PREVENT GROWING OBESITY INCIDENCE

In order to facilitate the recognition of healthy or unhealthy food, four categories have been proposed:

1. "In natura" food is directly obtained from plants or animals (such as leaves, fruits, eggs, and milk) and is ready to consume without any kind of modification after leaving nature. This type of food couples physiologically with human metabolic pathways and helps to preserve weight homeostasis.
2. "Minimally processed" food is the result of "in natura" food after a minimum modification process, such as drying, polishing or grounding of grains, meat freezing, or milk pasteurization. In this group, components like oils, fats, sugar, and salt (critical nutrients) are moderately used in culinary preparation to add flavor and diversity to dishes without affecting nutritional balance. This kind of food is still harmonious with human metabolism.
3. "Processed" food is mainly produced by the addition of critical nutrients to "in natura" food or "minimally processed" food. Some examples include: canned vegetables, syrup fruits, canned meats, cheese, and packaged bread. This kind of food is created to last longer than "in natura" or "minimally processed" foods, but it loses original nutritional qualities detrimental to health balance.

4. “Ultra-processed” food is characterized by several manufactured steps. Most of it is represented by industrial exclusive components, such as refined vegetable oils, high fructose syrup, synthetic proteins, modified starch, petroleum and coal derived synthetics, colorants, flavoring, and additives. Some examples include: soft drinks, stuffed biscuits, ice cream, sweets, sweetened cereals, cakes mixtures, cereal bars, soups, pasta and sauces ready to heat, sweetened milks and yogurts, energy drinks, and frozen meal products ready to heat. These are all high energy dense and their components impact directly on metabolic pathways, impairing hormonal and sensorial balance, and accelerating weight gain.

When compared to “in natura” or “minimally processed” foods, “processed” and “ultra-processed” foods have much more sugar, unhealthy fat, and sodium.

Furthermore, “processed” and “ultra-processed” foods lack diet fiber, minerals, and vitamins, while carrying higher energy density. Even with all of these harmful characteristics, “processed” and “ultraprocessed” foods are still conveniently practical, ubiquitous, strongly publicized, extremely palatable and habit stimulating. In fact, all these features may explain why handmade meal preparations are being replaced by “processed” and “ultra-processed” food. Consequently, many traditional culinary customs are gradually extinguishing.

The Pan American Health Organization (PAHO) met recently to find new resources to tackle the concerning health consequences of this nutritional transition on the American population. The PAHO Nutrient Profile Model was formulated to cover all countries in the American region. It aims to involve all governments in making crucial decisions to create environments conducive to healthy eating.

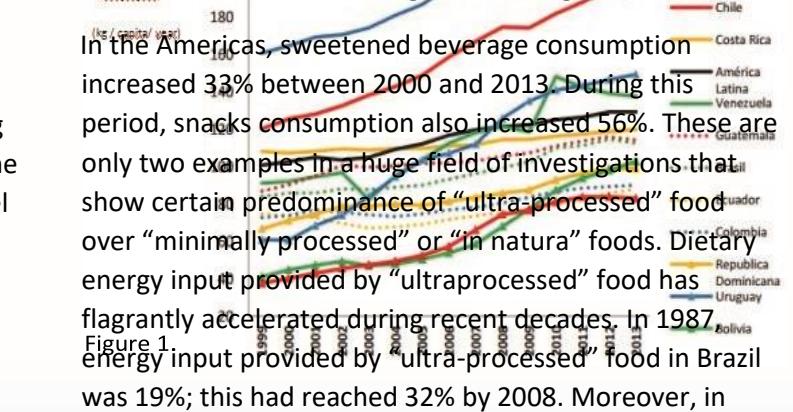
Some of its most remarkable strategies include:

- Preventing unhealthy food consumption.
- Quantifying and controlling “critical nutrients” present in processed food, including: salt, sugar, trans fats, and saturated fats.
- Warning about “critical nutrients” contained in food products by adding an information label on the front side of packaging.
- Establishing specific guidelines for food and beverage consumption in schools.
- Restricting marketing of unhealthy food and beverages among children.
- Applying tax policies to limit unhealthy food consumption.
- Avoiding sweeteners in children’s food and beverages, since repetitive sweet flavor (regardless of calories) stimulates and defines consumer habits.

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These guides claim that implementing new nutritional programs, saving food health benefits, and combating “ultraprocessed” food’s harmful effects is urgent for public health. The PAHO requires countries to inform

consumers about certain “critical nutrients” hidden in packaging and to restrict confusing messages behind food publicity. They focus as well on encouraging people to cook and prepare their own fresh dishes, in an attempt to reinforce traditional flavors and help regional customs reappear and survive among nutritional globalization.



1938, energy input provided by “ultra-processed” food in Canada was 24%; by 2001 this had increased to 55%.

Figure (1) shows the evolution of “ultra-processed” food sales from 1999 to 2013 in 12 countries from Latin America. This study was conducted by the PAHO in order to estimate “ultraprocessed” food consumption trends through over the last few years. Results showed that “ultra-processed” food sales continuously grew in all countries, with marked elevations in Uruguay (+145%), Peru (+121%), and Bolivia (+151%).

Thereafter, these consumption trends were analyzed against obesity growing rates in those countries and significant statistical association was found.

When epidemiological data is put together, the human metabolic dialogue between diet and obesity is clearly understood. Then, taking decisions to fight this problem becomes essential. Health and education workers, media outlets, and governments can join efforts to improve the public’s nutritional status. The PAHO Nutrient Profile Model attempts to serve as a roadmap in this complex context.

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# THE GUT RESPONSE TO FOOD; A PHYSIOLOGICAL PERSPECTIVE ON FOOD-INDUCED GASTROINTESTINAL SYMPTOMS

Before launching into a discussion of the potential roles of food allergy or intolerance in gastrointestinal symptomatology, or even in the pathophysiology of a common functional gastrointestinal disorder, such as irritable bowel syndrome (IBS), one must first consider the potential role of a more fundamental factor in the precipitation of GI symptoms and gut distress on, or soon after, food ingestion; namely, the physiological response to food. All physiological processes in the gut, including motility, secretion and blood flow respond to food intake, or the anticipation thereof, in order to maximize digestion and absorption. Both neural (and the vagus, in particular) and hormonal elements contribute to these responses. Signals along the gut-brain axis, a bidirectional pathway between the GI tract and the brain, may initiate, perpetuate or modulate the food response. Other factors, including mucosal immune responses and even the gut microbiota may participate in this bidirectional interaction, the latter leading to the concept of the microbiota-gut-brain axis.<sup>1-3</sup> The interplay between these factors in the genesis of gastrointestinal postprandial symptoms is nicely illustrated by IBS where these phenomena have been studied in some detail; food responses in IBS and their regulation will, therefore, be used as an illustrative example throughout this chapter.

## NEURAL REGULATION OF GUT RESPONSES

The central nervous system (CNS) communicates with the enteric nervous system via the sympathetic and parasympathetic branches of the autonomic nervous system. The anticipation and/or ingestion of food stimulate the autonomic nervous system leading to such well-described physiological responses as the cephalic phase of gastric acid secretion, receptive relaxation of musculature in the upper gastrointestinal tract and the gastro-colonic response. Given the frequent localization by sufferers of their pain to the left lower quadrant and of the prominence of post-prandial urges to defecate in IBS, the gastro-colonic response, a neurally-mediated homeostatic reflex, was an early target of investigation in this disorder.

Not only were IBS subjects shown to exhibit an exaggerated gastro-colonic response<sup>4-6</sup> but exaggerated responses to food ingestion were also demonstrated in the small intestine and, even, in the gall bladder.<sup>7-11</sup> That autonomic nervous dysfunction in response to a meal might contribute to symptom generation is nicely illustrated again by IBS; alterations in the autonomic nervous system have been reported in patients with IBS; the most consistent finding being increased sympathetic nervous system activity.<sup>12-16</sup> In other words, IBS sufferers are more susceptible to, and experience more exaggerated manifestations of the “gut distress” that we all experience on occasion when extremely stressed. Such reactions are seen in perhaps their most florid form in the individual with a severe anxiety disorder. Changes in parasympathetic nervous system activity have been less consistent in IBS and, while responses have varied, decreased parasympathetic responses have been observed most frequently.<sup>12-16</sup>

## ENDOCRINE REGULATION OF THE RESPONSE TO FOOD

A number of gut hormones play an integral part in the responses to food<sup>17</sup>. Enteric endocrine cells populating the gut secrete an array of hormones, such as motilin, gastrin, cholecystokinin (CCK) and peptide YY and respond to the anticipation and/or arrival of food or the products of digestion, and, thereafter, modulate the fate of gut contents in either a paracrine or endocrine manner. Motilin is secreted in the inter-digestive period when it released on distension of the duodenum by intense



# World Digestive Health Day

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### THE GUT RESPONSE TO FOOD; A PHYSIOLOGICAL PERSPECTIVE ON FOOD-INDUCED GASTROINTESTINAL SYMPTOMS, *continued*

delayed gastric emptying and small bowel transit in an at- could occur as a consequence of a reduction in methanogen contractile activity of phase III of the migrating motor complex and stimulates gastric motility.

Ghrelin, thought to play a major role in satiety and also released on food ingestion, also stimulates motility. Interestingly, higher circulating ghrelin levels have been described in IBS patients and could contribute to associations between food ingestion, dysmotility and IBS symptoms in some affected individuals.<sup>18,19</sup> Cholecystokinin release is stimulated by the arrival of fat and protein into the proximal gut and delays gastric emptying, increases gut motility and enhances rectal hypersensitivity.<sup>20</sup> Both fasting and post-prandial levels of CCK are elevated in IBS and an exaggerated response or hypersensitivity to CCK can cause symptoms of constipation, bloating or abdominal pain.<sup>21</sup> In disorders of maldigestion and/or malabsorption the arrival of unabsorbed nutrients in the distal ileum (and fat in particular) stimulates the release of peptide YY from ileal neuro-endocrine cells and leads to tempt to halt caloric losses: the so-called ileal brake.<sup>22</sup>

### ROLE OF NEUROMODULATORS AND NEUROTRANSMITTERS

Serotonin is a neurotransmitter and paracrine signaling molecule and is secreted primarily from enterochromaffin (EC) cells, which accounts for approximately 80% of total body serotonin secretion. Increased enterochromaffin (EC) cells, elevated postprandial serotonin levels and decreased serotonin reuptake due to decreased affinity for the reuptake transporter protein have been reported in different IBS subtypes; the former being observed in post-infectious IBS and the latter two in IBS-D.<sup>23,25</sup> Serotonin stimulates receptors responsible for peristalsis and secretion in the GI tract, and acts to promote communication along the gut and on the gut-brain axis. The post-prandial diarrhea and urgency commonly reported by sufferers with IBS-D may be due to an exaggerated serotonin response leading to increased peristalsis and secretions.<sup>23</sup>

### FOOD-MICROBIOTA INTERACTIONS

The gut microbiota plays a pivotal role in gut homeostasis in health and in the pathogenesis of a number of intestinal and extra-intestinal diseases. It includes a diverse population of approximately  $10^{14}$  bacterial cells; 10 times more than that total number of human cells. The functions of the gut microbiota include the protection of the host from enteric pathogens, the development of the host immune system, participation in host metabolism and contributing to nutrition. Our diet has a major impact on the composition of the microbiota and differences in dietary patterns are a major determinant of interindividual variations in microbiota diversity. For an excellent overview of many aspects of the gut microbiota, please refer to the 2014 World Digestive Health Day publication "WGO Handbook on Gut Microbes", which can be downloaded for free at:

[http://www.worldgastroenterology.org/UserFiles/file/\\_WDHD-2014-handbook-FINAL.pdf](http://www.worldgastroenterology.org/UserFiles/file/_WDHD-2014-handbook-FINAL.pdf).

Interactions between components of the diet and/or the products of digestion could play a role in

the genesis of food related symptoms and changes in diet or microbiota could exacerbate or

alleviate such symptoms. As a by-product of bacterial fermentation is liberation of gases (e.g. nitrogen, hydrogen, carbon dioxide and methane) an increase in the numbers of gas-producing organisms (e.g. *E. coli*, *Veillonella* species) may cause flatulence and bloating.<sup>26</sup> Flatulence bacteria, (*Methanobrevibacter smithii* and certain *Clostridium* and *Bacteroides* species) which convert hydrogen produced by other intestinal bacteria to methane and greatly reduce gas production.<sup>27,28</sup> In contrast, excess methane production has been linked to constipation.<sup>27</sup> The arrival of undigested carbohydrates into the colon will provide more substrate for fermentation, as well as acting as a prebiotic. Local changes in gas production, in conjunction with enhanced sensitivity to gas distension may contribute to bloating, a remarkably prevalent post-prandial symptom in a number of functional gastrointestinal disorders. Bacterial metabolism of carbohydrates also produce short chain fatty acids which stimulate colonic and ileo-colonic motility and secretion<sup>29,30</sup> and could cause diarrhea; stool volume and consistency will also be influenced by the extent of bacterial deconjugation of bile acids.

# Urine Health

## Now we move on to the urine health below

Abstract Frequent monitoring of hydration status may help to avoid the adverse effects of dehydration. Other than urine color assessment, hydration assessment methods are largely impractical for the general population and athletes to implement on a routine basis. Despite its widespread use, the validity of urine color as an indicator of hydration status has not been systematically evaluated. The objective of this systematic review is to determine the validity of urine color evaluation as a hydration status assessment method in the general adult population, older adults, and athletes. Using the PRISMA guidelines, electronic databases were searched to identify original research articles of all study design types for inclusion. Of the 424 articles screened, 10 met inclusion criteria. Most studies compared urine color to either urinary specific gravity or urine osmolality, and reported significant associations ( $r$ ) ranging from 0.40 to 0.93. Lower correlations were noted in studies of adults aged  $>60$  years. Studies generally reported a high sensitivity of urine color as a diagnostic tool for detecting dehydration and supported the ability of this method to distinguish across categories of hydration status. Research is needed to determine if clinicians, patients, and clients can accurately utilize this method in clinical and real-world settings. Future research is also needed to extend these findings to other populations, such as children. Key teaching points Inadequate hydration can lead to impairments in physical performance and cognitive function. Methods used to assess hydration status include plasma/serum osmolality, urinary specific gravity (USG), urine osmolality (Uosm), change in body weight, urine volume, and urine color. Urine color assessment is a practical method that is routinely used in clinical, athletic, and other settings. The validity of this method has not been systematically evaluated. Available research was limited to 10 articles. Validity of this method was generally supported; however, research has not investigated the validity of this method by clinicians, patients and clients.

Symptoms The regular color of urine varies. It depends on how much water you drink. Fluids dilute the yellow pigments in urine. So the more you drink, the clearer your urine looks. When you drink less, the yellow color becomes stronger. But urine can turn colors far beyond what's typical, including: Red. Blue. Green. Orange. Dark brown. Advertisement Policy Opportunities Mayo Clinic does not endorse companies or products. Advertising revenue supports our not-for-profit mission. Advertising & Sponsorship Ad Choices Products & Services A Book: Mayo Clinic Family Health Book, 5th Edition Show more products from Mayo Clinic Cloudy white. When to see a doctor See your health care provider if you have: Blood in your urine. This is common in urinary tract infections and kidney stones. Those problems often cause pain. Painless bleeding might be a sign of a more serious problem, such as cancer. Dark or orange urine. This can be a sign that the liver isn't working correctly, especially if you also have pale stools and yellow skin and eyes.

## Causes

A change in urine color is often caused by certain medicines, foods or food dyes. Sometimes it's caused by a health problem. Here are some unusual urine colors along with things that can cause them. Keep in mind that colors can look slightly different to different people. For instance, what looks red to you might look orange to someone else. Red or pink urine Red urine isn't always a sign

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of a serious health problem. Red or pink urine can be caused by: Blood. Health problems that can

cause blood in the urine include an enlarged prostate, tumors that aren't cancer, and kidney stones and cysts. Some cancers can cause blood in urine too. Hard exercise, such as long-distance running, also can cause this bleeding. Foods. Beets, blackberries and rhubarb can turn urine red or pink. Medicines. A tuberculosis medicine called rifampin (Rifadin, Rimactane) can turn urine reddishorange. So can a medicine for urinary tract pain called phenazopyridine (Pyridium). Constipation drugs that contain the medicine senna also can bring on this color change

Orange urine Orange urine can be caused by: Medicines. Phenazopyridine and some constipation medicines can turn urine orange. So can sulfasalazine (Azulfidine), a medicine that lessens swelling and irritation. Some chemotherapy medicines for cancer also can make urine look orange. Vitamins. Some vitamins, such as A and B-12, can turn urine orange or yellow-orange. Health problems. Orange urine can be a sign of a problem with the liver or bile duct, mainly if you also have lightcolored stools. Dehydration also can make your urine look orange. Blue or green urine Blue or green urine can be caused by: Dyes. Some brightly colored food dyes can cause green urine. Dyes used for some kidney and bladder tests can turn urine blue. Medicines. A medicine for depression called amitriptyline can make urine look greenish-blue. So can a treatment for ulcers and acid reflux called cimetidine (Tagamet HB). A water pill called triamterene (Dyrenium) also can turn urine greenishblue. Urine can turn green due to a medicine for pain and arthritis symptoms called indomethacin (Indocin, Tivorbex). Green urine also can be caused by propofol (Diprivan), a strong medicine that helps people sleep or relax before surgery

Health problems. A rare disease called familial benign hypercalcemia can cause children to have blue urine. Urinary tract infections caused by a certain type of bacteria can cause green urine. Dark brown or cola-colored urine Brown urine can be caused by: Food. Eating lots of fava beans, rhubarb or aloe can cause dark brown urine. Medicines. Some medicine that can darken urine are: Chloroquine and primaquine, which treat and prevent malaria. The antibiotics metronidazole (Flagyl, Metrocream, others) and nitrofurantoin (Furadantin, Macrobid, others). Constipation medicines that contain senna (Senokot, Ex-Lax, others). Methocarbamol (Robaxin), a muscle relaxer. The seizure medicine phenytoin (Dilantin, Phenytek). Medicines called statins that lower cholesterol. Health problems. Some liver and kidney disorders and some urinary tract infections can turn urine dark brown. So can bleeding inside the body called a hemorrhage. A group of illnesses that mainly affect the skin or the nervous system, called porphyria, also can cause brown urine. Extreme exercise. A muscle injury from extreme exercise can cause tea- or cola-colored urine. The injury can lead to kidney damage

Cloudy or murky urine Urinary tract infections and kidney stones can cause urine to look cloudy or murky. Risk factors A change in urine color that isn't due to foods or medicine could be caused by a health problem. Some things that put you at risk of health problems that can affect urine color are: Age. Tumors of the bladder and kidney, which can cause blood in the urine, are more common in older people. Men older than 50 sometimes have blood in the urine due to an enlarged prostate gland. Family history. If any of your blood relatives, such as a parent, sibling or grandparent, have kidney disease or kidney stones, you're more likely to get them too. Both kidney disease and kidney stones can cause blood in the urine. Hard exercise. Distance runners are most at risk. But anyone who exercises hard can have blood in the urine

The color of your urine changes with your hydration level but may also change due to pigments in your food or from taking certain medications. Some color changes may signal a health condition that needs medical attention. Doctors refer to the standard color of your urine as "urochrome." Urine

naturally carries a yellow pigment. When you stay hydrated, your urine will be a light yellow, closeto clear. If you're getting dehydrated, you'll notice that your urine is becoming a deep amber or even light brown. Sometimes your urine color can indicate a health condition you must address.

### Urine colors

Urine colors can vary depending on what you eat, any medications you're taking, and how much water you drink. Many of these colors fall on the spectrum of what "normal" urine can look like, but there are cases where unusual urine colors may be a cause for concern

#### Clear urine

Clear urine indicates that you're drinking more than the daily recommended amount of water. While being hydrated is a good thing, drinking too much water can rob your body of electrolytes. Urine that occasionally looks clear is no reason to panic, but urine that's always clear could indicate that you need to cut back on how much water you're drinking. Clear urine can also indicate liver problems like cirrhosis and viral hepatitis. If you're not consuming large amounts of water and have ongoing clear urine, you should see your doctor. Yellowish to amber urine The color of "typical" urine falls from light yellow to a deeper amber color. The urochrome pigment naturally in your urine becomes more diluted as you drink water. Urochrome breaks down hemoglobin, the protein that carries oxygen in your red blood cells. In most situations, the color of your urine will depend on how diluted this pigment is. Having a lot of B vitamins in your bloodstream can also cause urine to appear neon yellow

Red or pink urine Foods: Urine may look red or pink if you eat fruits with naturally deep pink or magenta pigments, like beets, rhubarb, or blueberries. Medical conditions: While red or pink urine might be from something you ate recently, there are sometimes other causes. Some health conditions can cause blood to appear in your urine, a symptom known as hematuria, including enlarged prostate, kidney stones, and tumors in the bladder and kidney. Medications: Medications that may turn your urine a reddish or pink hue include senna or senna-containing laxatives, phenazopyridine (Pyridium), and the antibiotic rifampin (Rifadin). Speak with a doctor if you're ever concerned about blood in your urine. Orange urine The following things can cause your urine to look orange: Dehydration: If your urine appears orange, it could be a symptom of dehydration

Medical conditions: If you have orange urine and light-colored stools, bile may get into your bloodstream because of issues with your bile ducts or liver. Adult-onset jaundice can also cause orange urine. Medications: Medications that can cause your urine to look orange may include phenazopyridine (Pyridium), the anti-inflammatory drug sulfasalazine (Azulfidine), and chemotherapy drugs. Blue or green urine In general, blue urine is rare and most likely connected to something in your diet. Food: Blue or green urine can be caused by food coloring, especially a dye called methylene blue. This dye is in many types of candy and some medications. Medications: Medications that can cause blue or green urine include cimetidine (Tagamet), amitriptyline, indomethacin (Indocin), promethazine (Phenergan), and vitamin B supplements. Medical procedures: It can also result from dyes in medical tests performed on your kidneys or bladder

Medical conditions: The Pseudomonas aeruginosa bacterial infection can also cause your urine to turn blue, green, or indigo purple. A condition called familial benign hypercalcemia can also cause blue or green urine. Low to moderate calcium levels may appear in your urine and change color

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when you have this condition. Many people with this genetic condition don't have symptoms that

they notice. Dark brown urine In most cases, urine that's dark brown indicates dehydration. Medications: Dark brown urine can also be a side effect of certain medications, including metronidazole (Flagyl) and nitrofurantoin (Furadantin), chloroquine (Aralen), cascara or senna based laxatives, and methocarbamol. Foods: Eating large amounts of rhubarb, aloe, or fava beans can cause dark brown urine. Medical conditions: Brown, tea-colored urine could be a symptom of rhabdomyolysis, a breakdown of muscle tissue that is a serious medical condition. A condition called porphyria

can cause a buildup of the natural chemicals in your bloodstream and cause rusty or brown urine. Dark brown urine can also indicate liver disease, as it can be caused by bile getting into your urine. Exercise: Intense physical activity, especially running, can cause dark brown urine, known as exertional hematuria. This isn't considered unusual. When your urine is dark because of exercise, it'll typically resolve with some rest within a few hours. If you frequently see dark brown urine after exercise, or if your urine doesn't return to normal after 48 hours, you should speak with a doctor about possible underlying causes.

The following are things that can cause your urine to appear cloudy: Medical conditions: Cloudy urine can indicate a urinary tract infection. It can also be a symptom of some chronic diseases and kidney conditions. In some cases, cloudy urine is another sign of being dehydrated. Pregnancy: If you have cloudy urine and are pregnant, it could be a sign of

a dangerous condition called preeclampsia. You should contact your healthcare professional immediately and let them know if you develop cloudy or bubbly urine during pregnancy. Cloudy urine: Urine with foam or bubbles is called pneumaturia. This can be a symptom of serious health conditions, including Crohn's disease or diverticulitis. There are some cases where urine is foamy, and doctors can't determine the cause. What does kidney failure pee look like? If you're in kidney failure, your urine may be varying shades of these colors: dark amber red brown Note that dark yellow urine may also mean that you're dehydrated, and your urine may also turn red after eating beets or foods with dyes. Some medications may change your urine color as well.

What are the three early warning signs of kidney disease? Many people have no signs or symptoms of kidney disease until it has progressed. However, there are a few signs and symptoms of kidney disease. They are often subtle and may include: changes in your urine, such as: making less urine needing to pee more often seeing blood in your urine foamy urine insomnia feeling tired having trouble concentrating swelling in your arms and/or legs swelling in your face – especially around your eyes muscle cramps What color is urine in stage 2 kidney disease? There are generally no symptoms or only mild symptoms in stage 2 kidney disease, so your urine may be its typical yellow color. You may have more protein in your urine (proteinuria or albuminuria) if you have

kidney disease, even in stage 2, and that can make your urine foamy. You may have to flush more than once. For some people, there may be small amounts of blood in their urine (hematuria), making it more of an amber or darker yellow color. What color is urine with stage 3 kidney disease? In stage 3 kidney disease, there may be protein or blood in your urine, and it may be foamy, dark amber, pink, or reddish in color. In most cases, abnormal urine colors are simply a result of dehydration, something you ate, or a side effect of medications you're taking. Urine should resume its typical.

coloring within 2 to 3 days after you notice an unusual color. If your urine is cloudy, brown, blue, or green and doesn't return to a pale straw color, schedule an appointment to speak with a doctor

What The Color of Your Pee Says About You Urine has been a useful tool of diagnosis since the earliest days of medicine. It can tell a lot about what's going on in your body, from how hydrated you are to whether you might have a urinary tract infection.

Here's a look at some of the things it can tell you from urologist Petar Bajic, MD. What color should urine be? Your urine is a mix of water, electrolytes and waste that your kidneys filter out from your blood. When you're healthy and hydrated, your urine should fall somewhere between colorless and the color of light straw and honey. When you don't consume enough fluids, your urine becomes more concentrated and turns a darker yellow or amber color. "It's completely normal for the color of your urine to vary a little day by day," says Dr. Bajic. "But it should stay within a certain range of yellow." But what about when the color changes and moves to other sections of the crayon box? First, relax: There may be a simple explanation. Certain foods, antibiotics, laxatives and dyes can temporarily turn your urine a different hue. Of course, that attention-grabbing color may be a sign of a bigger issue, too: "If you see something really unusual, don't just ignore it," says Dr. Bajic. So let's explore what is normal and what deserves some extra attention.

No color (transparent) Clear urine sends a clear message: You may be drinking too much water. Now it's true your body needs water to stay hydrated and function properly. The basic rule of thumb is to aim for drinking 64 ounces of liquid a day to keep your system operating at peak efficiency. Surging over that total can make your urine start to look like the water you're guzzling down. (Plus, you're going to be making a lot of trips to the restroom as your body works to drain out all that extra fluid.) An occasional clear pee isn't a big deal. But if it's an ongoing issue you may be lowering salt and electrolyte levels below what your body needs.

What if your urine is clear and you're not knocking back glass after glass of water? That may signal an underlying kidney problem or diabetes. In this situation, it's best to see a doctor to get answers.

Pale straw- to a dark yellow-colored Good news! You're in the preferred section of the urine color chart. Urine that falls in the pale yellow category signals that you're healthy and hydrated, says Dr. Basic. That yellowish color, by the way, is caused by a pigment called urochrome produced by your body. Amber- or honey-colored Darker urine is your body talking to you. What's it saying? Basically, drink some water, says Dr. Bajic. The darker hue is a sign of mild dehydration. Basically, your urine is a more concentrated mix due to a lower-than-needed level of fluid in your system. This can happen if you've been outside sweating on a hot day or just finished a workout. Refill your tank and the color should go back to normal.

Syrup- or brown ale-colored Your dehydration level just crossed a line into a more worrisome status. Get fluids in ASAP. A flow that's dark brown also could be caused by bile getting into your urine, a sign of liver disease. Rusty or brown-colored pee also is a symptom of porphyria, a rare disorder affecting the skin and nervous system. If rehydrating doesn't lighten up your urine, see your doctor.

Pink- to reddish-colored The explanation for this unexpected turn on the color wheel could be as simple as what you ate, notes Dr. Bajic. If beets, blueberries or rhubarb passed through your lips within the last day or so, you may be seeing the results. If you haven't eaten anything like that, though... well, there may be a reason for concern. Pink or reddish urine could be a sign of: Blood in your urine. Kidney disease. Cancers of the kidney or bladder. Kidney stones. A urinary tract infection. Prostate problems. Lead or mercury poisoning. Contact your doctor as soon as possible if the color doesn't return to yellow.

Orange-colored You may not be drinking enough water if your pee looks orange. Or you could have a liver or bile duct condition. Or it could be food dye or medications.

Rehydrate first and contact your doctor if the orange color doesn't disappear

Blue- or green-colored OK ... this is definitely different

Most likely, it's the result of something you ate (think heavily dyed foods) or a medication, says Dr. Bajic. However, a rare genetic disease involving hypercalcemia can turn your urine blue or green. Ditto for certain bacteria that can infect the urinary tract. See your doctor if you continue to urinate this color.

Cloudy urine Urinary tract infections and kidney stones can cause urine to become cloudy. Once again, too, dehydration also could be the culprit. Drink plenty of water and call your doctor if the symptoms persist

Foaming or fizzing urine The explanation here could just be basic hydraulics, says Dr. Bajic. Basically, you're emptying a lot out of your bladder and stirring up toilet water a bit more than usual with a heavy and intense stream. However, foaming or fizzing also could indicate excess protein in your diet or a kidney problem. See a doctor if this happens consistent.

Final word You can tell a lot just from looking at your urine. But medical professionals can tell a lot more from doing the kind of sophisticated analysis that comes with a urine test during a regular physical examination. You're not just putting urine in that cup when you visit the doctor's appointment. You're providing information — and that can be one of the best things you can do for your health

There's so much talk about what we put into our bodies, but we should also talk about what comes out. Understanding your toilet habits is more beneficial than you may think. It's an indicator of your gut health and can signal that something might not be right with your body. Before you flush your number 2s, have a look at them to gain valuable insight into your health. Not sure what to look for? Here's a guide to help. So, what can my poo tell me? Amazingly, your poo (stool) can provide clues about what's going on with your diet, fluid intake, medication use and lifestyle. Your poo can reveal if:

you're drinking enough water you're experiencing a food intolerance or allergy you're under a lot of stress you're not eating enough fibre you have worms or a parasite you have damage to your gastrointestinal tract you're experiencing digestive and absorption issues the health of your organs has changed, such as your kidneys or gallbladder you need to get checked for certain cancers such as bowel cancer you're taking certain medication or supplements

What does a healthy poo look like? You want the colour of your poo to range from light brown to dark brown. The shape and texture should be like a snake or sausage. This consistency reflects a healthy gut microbiome and digestive system. Your digestive system includes the digestive tract and other organs that help the body break down and absorb food. Your gut microbiome lives in the digestive tract and is made up of good and bad bacteria. A healthy gut microbiome means there are more good than bad bacteria. This can help to support your immune system, regulate your weight and play a role in the production of happy hormones that influence your mental health. A healthy number of toilet breaks vary. It can be from a minimum of 3 times a week to a maximum of 3 times

a day, and you shouldn't have to strain to pass stool (do a poo). To work out if your poo is healthy, you can examine the colour, shape and texture

**Colour** The colour of your poo can depend on what you eat and drink, medications and the time food has spent in your digestive system.

Black may indicate certain medication use, like iron supplements, or undigested food. Light to dark brown may indicate an ideal and healthy stool. Pale or clay may indicate coeliac disease or pancreas issues. Orange may indicate blocked bile ducts or antacid usage. Yellow or green may indicate a fatty diet, parasite or stress. White spots or mucus may indicate medication use or problems absorbing food. Dark to light red may indicate blood in the stool, or that you've recently eaten beetroot.

When should I see my doctor? A change to your stool won't always mean that you should be worried, but you should monitor it. If you have diarrhoea or constipation for more than 2 – 3 days, your stools are black, tarry, very light pale or grey in colour, or you see blood in your stool,

Your urine can tell you a lot about your health and your habits. Urine is produced when blood passes through the kidneys, which filter out excess waste and water. This waste travels through tubes known as ureters and is stored in the bladder until you urinate. Urine is roughly 95 percent water, and the rest is composed of thousands of compounds — both inorganic and organic — exiting the body. Certain changes in your urine or urine habits, either during or after urination, may indicate that you have a medical condition. These signs often include:

Dark or discolored urine Cloudy urine Blood in urine.

**What Do the Smell and Color of My Urine Tell Me?** Changes in the smell and color of your urine are typically harmless, but sometimes, they can indicate a medical problem. Normal, healthy urine is usually mildly yellow with a slight odor.

Urine can range in odor for various reasons

Forty percent of people can smell a change in urine after they eat asparagus, sometimes called "asparagus pee."<sup>[2]</sup> Dehydration can produce an ammonia-like odor.<sup>[3]</sup> Fruity-smelling urine can be a sign of type 2 diabetes.<sup>[4]</sup> Foul-smelling urine can indicate bacteria from an infection.<sup>[4]</sup>

Urine can also vary in color for a variety of reasons:

Clear urine is a sign of good hydration and potential overhydration. Pale yellow urine is an indicator of good hydration. Dark yellow urine is a sign to drink more fluids. Amber-colored urine can indicate dehydration. Orange urine can be caused by various foods or medications or be a sign of potential liver problems. Pink or red urine can be caused by foods or medications, or it can also be a sign of blood in the urine. Blue or green urine can be caused by medications or food dyes, but it can be a sign of bacteria or the rare condition known as blue diaper syndrome, too. Dark-brown urine can be a sign of liver or kidney problems

White urine can occur when your body contains excess calcium or phosphate, or it may indicate a urinary tract infection

You should always consult with your doctor if you notice a sudden change in the color or odor of your urine.

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What Causes Urine to Be Cloudy?

Cloudy urine can be an indication of a variety of medical conditions:

Dehydration Cloudy pee can indicate that you are not getting enough water and other fluids

Urinary Tract Infection Blood, pus, or excess white blood cells can cause cloudy or milky urine and can indicate that you have a urinary tract infection.

Sexually Transmitted Infections STIs can produce an excess of white blood cells, which can cause cloudy urine.

Kidney Stones High levels of minerals in urine can cause cloudiness and be a sign of kidney stones

Diabetes Cloudy urine can indicate that uncontrolled diabetes.

Prostate Issues An inflamed or infected prostate can lead to an increase in the amount of white blood cells or other discharge, which can cloud urine

Vaginitis A vaginal infection can increase the number of white blood cells released in urine and cause cloudiness.

Why Is There Blood in My Urine (Hematuria)? Blood in urine, also known as hematuria, occurs when red blood cells leak from your urinary tract. Blood in urine can indicate that you have an undiagnosed or untreated medical condition.

Sometimes blood in urine is visible, appearing clotlike or turning the urine pink, red, or brown. Other times it can be viewed only with a microscope (called microscopic hematuria).

Conditions that cause blood in urine can include:

Bladder or kidney stones Kidney disease or injury Enlarged prostate Urinary tract infections

If you notice or suspect blood in your urine, contact your healthcare provider as soon as possible. Your doctor will conduct a urinalysis and various other tests to determine the cause of the bleeding and any appropriate treatment.

What Does Painful or Burning Urination Mean? Painful or burning urination can often be the first sign of an undiagnosed medical condition. The most common cause of painful urination is a urinary tract infection, which occurs when bacteria infect the bladder, urethra, or kidneys. Additional causes of painful urination can include: [15] [16] Inflammation of the vulvar region Inflammation of the urethra

What Are the Possible Reasons for Frequent Urination? Frequent urination can be disruptive to sleep, work, hobbies, and your mood. Frequent urination is not always a sign of a medical problem. As you age, the bladder loses some of its holding capacity, and you may have to urinate more frequently. Frequent urination is also common during the first and third trimesters of pregnancy

Diseases affecting the urinary tract, such as a urinary tract infection, can also cause frequent urination. Infection affects the bladder's capacity to hold urine, and it can also affect the functioning of the urethra or kidneys. Poorly managed or uncontrolled type 1 (<https://www.everydayhealth.com/type-1-diabetes/guide/>) or type 2 diabetes (<https://www.everydayhealth.com/type-2-diabetes/guide/>) can also cause frequent urination, when increased blood sugar causes more fluid to escape the kidneys into the urine. Prostate problems are

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the most common reasons that men age 50 and older struggle with frequent urination. If you suffer

from frequent urination, your doctor may conduct a urinalysis and other tests to determine the cause. Antibiotics are used to treat urinary infections, and there are special prescription medications used to treat an overactive bladder. Your doctor may also recommend that you reduce fluid intake before you go to bed.

**How Does Your Urine Change When You're Pregnant?** Urine changes throughout pregnancy, and monitoring your urine can help your doctor ensure both you and your baby are healthy. A urine test can detect pregnancy around two weeks after conception by measuring increased levels of the hormone human chorionic gonadotropin (hCG) (<https://www.everydayhealth.com/drugs/hcg>). Urinating more frequently can also be an early sign of pregnancy and will occur throughout the first trimester. Frequent urination returns during the third trimester when the growing fetus and uterus put increased pressure on the bladder.

Pregnant women also need to drink more water, so dark and more concentrated urine can be a sign of dehydration. Pregnant women are also at increased risk of developing urinary tract infections, which can cause cloudy pee and blood in the urine. UTIs carry increased risks to the mother and fetus during pregnancy, so it's important to get the infection treated as soon as possible. A urinary infection can also be a sign of group B streptococcus, a bacterium that can spread to a baby during delivery and cause complications. Women are typically tested for GBS during their third trimester.

**Proteinuria: What Does Protein in the Urine Mean, and How Is It Tested?** Proteins serve many functions in the body, but when proteins escape into urine, it can be a sign of potential kidney problems. It's normal to have a small amount of protein in your urine, and temporarily higher levels can be caused by exercise, dehydration, stress, fever, or cold temperatures. If high levels of protein are detected multiple times, you may have kidney disease. People with diabetes and hypertension have a higher risk of developing kidney disease, so their urine may be analyzed regularly via urinalysis. Protein in urine (<https://www.everydayhealth.com/urine/protein-urine-proteinuriacauses-symptoms/>) can also be a sign of preeclampsia in pregnant women. If kidney disease is caused by hypertension or diabetes, treatment will involve getting these medical conditions controlled and monitored. Treatment may also include lifestyle changes and prescription medication, including angiotensin-converting enzyme inhibitors (ACE inhibitors)

**Urine Therapy: Is Drinking Your Own Pee Good for You?** Urine therapy, or urotherapy, is a type of alternative medicine in which people use or ingest their own urine for medicinal purposes. But there is no scientific evidence that urine therapy provides medicinal value. When you drink urine, you ingest all the waste that your kidneys have filtered out of your body. Therefore, drinking urine can make your urine more concentrated with waste, causing dehydration and kidney damage. So drinking your urine is generally not recommended as a survival technique. **What Is Maple Syrup Urine Disease?** Maple syrup urine disease is a rare genetic disorder in which an infant's body cannot properly process amino acids (<https://www.everydayhealth.com/amino-acids/guide/>) found in proteins. This causes urine to have a sweet-smelling odor, much like maple syrup. It affects roughly 1 in 185,000 infants.

The more serious form of the disease can be detected in newborns, and other times the onset of symptoms is delayed until late infancy or childhood. Additional symptoms of maple syrup urine disease can include

Trouble feeding  
Lethargy  
Seizures  
Vomiting

If untreated, the condition can lead to neurological damage, coma, and even death. Treatment typically involves a diet low in certain amino acids and sometimes requires dialysis. If your family has a history of maple syrup urine disease, talk to your doctor about genetic counseling. Trouble feeding Lethargy Seizures Vomiting [36]

Most people take note of the color of their urine and notice that it can change from day to day. This is a good habit, because your pee can provide some clues about your health and what's going on inside of your body. And the color of your urine can tell you more than just your hydration status.

Brown pee, in particular, is common and can mean several different things — ranging from harmless to more serious. So let's review some of the different causes of brown urine and what to do when it happens. What can my pee say about my health? The color of your urine can change depending on several factors, from hydration status and medications to underlying medical conditions. What color should urine be?

Urine gets its yellow color from urobilin or urochrome, a chemical that is produced when your body breaks down red blood cells. Your kidneys then remove this chemical from the blood, combine it with water, and excrete it as urine. Generally, the more water that you drink, the paler your urine will be. Drinking too much water may cause your urine to appear clear. Darker yellow means that you may not be drinking enough fluids. Although urine generally varies between lighter to darker yellow, it can also take on many different hues for different reasons. Here, we'll discuss common reasons why your pee may turn brown. What causes brown pee? Brown pee isn't always a cause for concern. If the color is between light brown and dark yellow, it may mean that you are just a little dehydrated. Even certain foods can give a brown tint to your urine, like rhubarb, asparagus, or fava beans. Someone who is menstruating may also have urine that appears brown when blood mixes in. This is most common at the start or end of menstruation, when the blood can appear more brown than red. There are also certain medications that can turn your pee brown. These include: Senna, a common over-the-counter laxative Phenytoin (Dilantin), an anti-seizure medication Levodopa, a medication for people with Parkinson's disease Antibiotics, such as nitrofurantoin (Macrobid) and metronidazole (Flagyl) Antimalarial medications, like chloroquine and primaquine

Iron supplements These cases are often the cause of brown urine, which aren't a reason for concern. But sometimes brown urine can be a sign of something more serious going on

Are there any serious causes of brown pee? There are several health conditions that can lead to brown urine. Some are temporary and treatable, but there are also long-term and potentially serious causes. We'll review a handful of these conditions. Urinary tract infection

Urinary tract infection (UTI) may lead to darker colored urine for different reasons. In most cases, the color change is due to blood in the urine. This can occur when bacteria cause bleeding as they invade and inflame the lining of your urinary tract. Liver disease Liver disease, such as cirrhosis or hepatitis, can lead to dark urine. This occurs when there are abnormally high levels of bilirubin in the urine, which is a waste product that the liver typically breaks down. If you have brown urine due to liver disease, you'll likely have other symptoms from your condition. Some examples are: Extreme fatigue Jaundice Nausea or vomiting Abdominal pain or distention Weight loss Swelling of the legs Kidney disease There are several kidney conditions that can result in brown urine. These include: End-stage kidney disease or kidney failure: Brown urine can result from the buildup of waste products that occurs when the kidneys aren't functioning normally. Post-streptococcal

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glomerulonephritis: This is a very rare

complication of strep throat that's more common in children. Kidney stones: As stones move down the urinary tract, they tend to irritate the lining and lead to bleeding. Rhabdomyolysis Rhabdomyolysis is a condition that occurs when there's a significant amount of muscle breakdown, like after intense exercise. As muscles break down they release myoglobin, a dark-colored substance that you excrete in your urine. During rhabdomyolysis, you'll likely experience significant body and muscle pain, as well as swelling in the arms and legs. Cancer The most common cancer that can lead to brown urine is renal cell carcinoma, which can cause blood to leak into the urine. Melanoma can also cause melanin, a dark pigment, to leak into the urine. But this is extremely rare. What should I do if I notice my pee is brown? If you notice a dark hue to your urine, but you otherwise feel well, a good step is to start hydrating. If the dark color clears and you don't have any other symptoms, it's safe to say you'll be OK. But if your pee is still dark after you drink a good amount of water, you should watch for signs that something more serious is going on. It's a good idea to see your provider if you experience any of the following: Fever, which can be a sign of infection

Muscle aches or pain Persistent vomiting or diarrhea Abdominal or flank pain Fatigue or disorientation Even if you don't have any of these symptoms, and your urine color doesn't improve within hours when you're better hydrated, you should reach out to your provider for further evaluation. The bottom line It's completely normal to check out the color of your urine. In fact, it's one of the many ways to keep daily tabs on your health. A variation in the color and shade of urine is normal. If your pee turns brown, don't be shy to talk to your provider about it. And if you have other new symptoms with your brown urine, it's best not to delay evaluation. The Unmentionables is a series that focuses on common curiosities about our bodies that, at some point, have been labeled as taboo, shameful, or embarrassing. But these are important questions we all have about our health, and we should be able to ask them. This series aims to dispel the stigma, normalize the discussion, and openly address these important health topics.