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Clinical Endocrinology and Metabolism

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Review Article

COVID_19 Infection, Implications, Complications, and Challenges

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Received date: January 20, 2024; Accepted date: January 31, 2024; Published date: February 05, 2024

Citation: Reza Bozorgipour, (2024), COVID_19 infection, Implications, Complications, and Challenges, *Clinical Endocrinology and Metabolism*, 3(2)
DOI:10.31579/2834-8761/044

Abstract

The COVID-19 infection caused by SARS-CoV2 virus started in late 2019 in China and was declared a pandemic by WHO in March 2020. COVID_19 infection has not been under control yet. New strains are emerging and posing challenges. On the other hand, implications and complications of earlier infections so called Long Covid have not been resolved yet. The COVID infection may affect each and every tissue and organ including vital organs inflicting sustaine damage. Vaccination significantly reduced hospitalization and mortality rates. Nonetheless, no vaccine offers complete immunity or zero transmission. There is no terminative treatment or definitive cure for this infection. Beside vaccinatio supplementary measures are desired for multilayered protection. COVID_19 infection, initial impacts, mechanisms, implications, and potential countermeasures are discussed.

Keywords: infection; decontamination; long covid; herbal; remedies; inflammation

Introduction

The COVID-19 infection caused by SARS-CoV2 virus started in late 2019 in China and was declared a pandemic by WHO in March 2020. Most countries have experienced a few surges of the pandemic by now. Alpha, Beta, Gama, Delta, and Omicron variants have been circulating around the globe. Omicron with over 50 confirmed mutations is currently the dominant variant disseminating globally. As of 18 December 2023 (WHO report), EG.5 (Omicron sub-variant) remains to be the most reported Variant of Interest (VOI) globally. While JN.1 sub-variant of BA.2.86 has been designated as a separate VOI apart from its parent lineage BA.2.86 due to its rapid increase in prevalence in recent weeks. Presumably JN.1 is approaching worldwide dominance. During the period from 13 November to 10 December 2023, overall increase of 23% in hospitalization and 51% in ICU admissions of new COVID_19 infection was recorded amongst the countries reporting consistently within the current and past reporting periods. EG.5 sub-variant tends to infect the upper respiratory tract, causing a runny nose, sore throat, and other cold-like symptoms, as opposed to lower respiratory tract symptoms. JN.1 symptoms are fever or chills, cough. sore throat, congestion or runny nose, headache, muscle aches, difficulty breathing, and fatigue. It is important to note that the symptoms can vary from person to person, and some individuals infected with the JN.1 variant may exhibit mild or even no symptoms (asymptomatic cases). Primary reports suggest JN.1 is resistant to XBB.1.5 vaccine sera, if so, it is a variant evading immunity to date. It is also possible for symptoms to overlap with common respiratory illnesses. The key point is that COVID-19 is airborne and highly contagious. Principal transmission and penetration routes are through the respiratory system.

COVID_19 infection has not been kept under control yet. New strains are emerging and posing challenges. On the other hand, implications and complications of earlier infections so called LongCovid have not been resolved yet. COVID_19 infection initial impacts, proposed mechanisms, implications, and potential countermeasures are discussed briefly.

Infiltration of SARS-CoV2 into human body

SARS-CoV-2, the virus that causes COVID-19 infection, primarily infiltrates the human body through respiratory droplets, aerosols and indirect transmission as discussed in the earlier articles (1, 2). A general overview of how it enters and spreads within the body:

*Inhalation: The virus enters the body when individuals inhale respiratory droplets and aerosols expelled by an infected person through coughing, sneezing, talking, or even breathing. These contain viral particles.

*Nasal and oral entry: Once inhaled, the virus primarily targets the respiratory system. It can bind to specific receptors ACE2 (angiotensin-converting enzyme 2) The ACE2 receptors, which are found in the nose, mouth, and lungs. The ACE2 receptor is widely expressed throughout body including in the respiratory tract, heart, kidneys, and gastrointestinal tract.

*Attachment and invasion: The spike protein on the surface of the virus binds to the ACE2 receptors on the cells' surfaces, allowing the virus to enter human cells. This process enables the virus to infiltrate and infect the respiratory tract's epithelial cells.

*Replication: After entering the cells, the virus releases its genetic material (RNA) into the host cell. The viral RNA is then used as a blueprint to synthesize new viral components and replicate itself within the host cell.

*Transmission and spread: Infected cells release newly formed virus particles, which can infect nearby cells in the respiratory tract. The virus can further spread to other areas, including the lungs, throat, and bronchial tubes.

*Systemic spread: In some cases, the virus can spread beyond the respiratory system and enter the bloodstream. From there, it can reach various organs and tissues in the body, potentially causing systemic complications.

When the virus enters the body, it can invade the cells of the airways and lungs, causing inflammation and damage. The main reason for the decrease

in blood oxygen levels in COVID-19 is due to the impact on lung function. COVID-19 can lead to a condition called acute respiratory distress syndrome (ARDS), which is characterized by severe inflammation of the lungs. This inflammation can cause fluid accumulation in the air sacs alveoli, which are responsible for exchanging oxygen and carbon dioxide with the blood. The presence of fluid and inflammation within the lungs can impede the transfer of oxygen from the air into the bloodstream, resulting in decreased oxygen levels. In severe cases, this can lead to a condition called hypoxia, which is defined as low blood oxygen levels. Hypoxia can manifest as shortness of breath, rapid breathing, or even respiratory failure. Furthermore, COVID-19 can also cause blood clotting abnormalities that can impede blood flow to the lungs. This can further exacerbate the oxygenation problem and contribute to lower blood oxygen levels. It is important to note that individuals with pre-existing respiratory conditions or other underlying health issues may be more susceptible to severe lung complications and lower blood oxygen levels when infected with COVID-19. Monitoring oxygen levels and seeking medical attention if there are concerns about decreased oxygenation is crucial for managing the infection effectively. (3)

Dysregulation of immunity system

SAR-CoV2 virus primarily affects the respiratory system, but it can also have a negative impact on the body's immune system.

* Inflammation: The virus triggers an immune response, resulting in inflammation in the lungs and other organs. While inflammation is a natural response to infection, excessive or prolonged inflammation can damage tissues and weaken the immune system.

*Cytokine storm: In severe cases, the body may overreact to the virus, leading to an excessive release of immune signaling molecules, cytokines. This "cytokine storm" can cause widespread inflammation, leading to organ damage and interfering with the immune system's ability to fight off the infection.

*Immune cell depletion: During the infection, the virus can directly infect and kill certain immune cells, such as lymphocytes. These cells play a crucial role in orchestrating the immune response, so their depletion can weaken immune defenses against the virus and other pathogens.

*Immune system exhaustion: In prolonged Covid-19 cases, the immune system can become exhausted from continuously fighting the infection. This exhaustion can impair the body's ability to mount an effective immune response, leaving it susceptible to other infections.

Furthermore, COVID-19 can also cause direct damage to immune cells, particularly those in the respiratory tract, which are critical for defending against viral infections. The virus may impair the function of these immune cells, compromising the immune response even after the infection is cleared. Studies have found that certain components of the immune system, such as T cells and B cells, can exhibit long-lasting changes or dysfunction after COVID-19 infection. There may be alterations in the levels and functioning of these immune cells, which might contribute to the prolonged symptoms and immune deregulation seen in Long COVID. Additionally, COVID-19 can have impacts on the innate immune system, affecting the body's initial response to infections. This may result in continued inflammation and immune activation, even after the viral infection has resolved. However, people with underlying health conditions or compromised immune systems may be more susceptible to these effects (4, 5).

SAR-Cov2 persistence in body system and LongCovid

The persistence of SARS-CoV-2 in the body and the development of Long COVID are areas of ongoing research, and our understanding is still evolving.

*Viral persistence: In some individuals, SARS-CoV-2 can persist in the body beyond the acute phase of infection. This can occur due to several factors, including viral reservoirs in specific tissues, immune system dynamics, or viral mutation. It has been suggested that the virus may persist in certain tissues, such as the respiratory tract, gastrointestinal tract, or even the central nervous system. While some studies have reported evidence of SARS-CoV-2 persistence in specific cases, it is important to note that the presence of the virus alone does not necessarily explain all the symptoms associated with Long COVID (6). The specific mechanisms underlying Long COVID are not yet fully understood. Other factors, such as immune dysregulation, systemic inflammation, and organ damage, may also contribute to the persistent symptoms experienced by some individuals.

*Immune system response: The body's immune response plays a crucial role in controlling and eliminating viral infections. In some cases, the immune response against SARS-CoV-2 may persist even after the virus is no longer detectable. This ongoing immune activation and inflammation might contribute to the persistence of symptoms in Long COVID.

*Tissue damage and dysfunction: SARS-CoV-2 can cause significant tissue damage and disruption in various organs and systems, including the respiratory, cardiovascular, neurological, and immune systems. This damage, combined with the virus's ability to persist in specific tissues, could potentially contribute to the development of Long COVID symptoms.

*Dysregulation of immune system and inflammation: It is speculated that Long COVID may involve a dysregulation of the immune system and sustained inflammation. This chronic inflammation may result from the persistence of viral components, ongoing immune response, or immune dysfunction. The combination of tissue damage and immune dysregulation might contribute to the persistence of symptoms. (7, 8).

Common symptoms of Long COVID

Long COVID refers to the collection of persistent symptoms and health issues that can last beyond the acute phase of a COVID-19 infection. Long COVID affects a substantial portion of individuals who have had COVID-19, with studies suggesting that around 10-30% of patients experience prolonged symptoms. This means that a large number of people worldwide may be experiencing long-lasting health issues, impacting their quality of life and overall well-being. The magnitude of Long COVID at a global scale is challenging to determine precisely due to various factors such as inconsistent definitions and reporting methods, variations in healthcare systems, and limited longitudinal data.

While vaccination has been shown to greatly reduce the risk and severity of COVID-19 infection, including the development of severe symptoms and complications, there have been cases where vaccinated individuals, including those who had mild or asymptomatic infections, have reported Long COVID symptoms. Long COVID is a complex condition with a wide range of symptoms and manifestations, but some common symptoms associated with Long C OVID are:

*Fatigue: Ongoing, persistent exhaustion and lack of energy.

*Shortness of breath: Difficulty breathing or feeling breathless.

*Brain fog: Difficulty concentrating, memory problems, or difficulty with cognitive functions.

*Muscle and joint pain: Persistent pain in muscles and joints.

*Chest pain: Discomfort or pain in the chest.

*Headaches: Frequent or recurring headaches.

*Loss of taste or smell: An altered or complete loss of the sense of taste or smell.

*Sleep disturbances: Insomnia, trouble sleeping, or disturbed sleep patterns.

*Anxiety and depression: Mental health issues, including increased anxiety or depression symptoms.

It's important to note that PTSD (Post-Traumatic Stress Disorder) is a separate condition that can develop as a result of experiencing a traumatic event, including severe illness or the emotional impact of the COVID-19 pandemic. While PTSD can occur in some individuals with a COVID-19 infection, it is not directly associated with Long COVID itself. The symptoms of Long COVID and the experiences of individuals may vary greatly.

Relationship between inflammation during COVID_19 infection and LongCovid

In general, there are two major types of inflammation, acute (short lived) and chronic inflammation. Primary symptoms of chronic inflammation are body pain, fatigue, insomnia, gastrointestinal complications but chronic inflammation can have serious implications and complications including tissue damage, frequent infections, autoimmune diseases, increased risk of cardiovascular diseases, metabolic disorders, impaired healing, increased cancer risk, mental health concerns. Chronic inflammation typically refers to long-lasting inflammation in a specific tissue or organ. If left unresolved, chronic inflammation can release inflammatory molecules into the bloodstream, leading to systemic effects and contributing to systemic inflammation.

As far as COVID_19 is concerned, there seems to be a potential relationship between inflammation during COVID-19 infection and Long COVID. Both acute COVID-19 infection and Long COVID can involve a dysregulated immune response, leading to inflammation throughout the body. In the acute phase of COVID-19, the virus can cause a severe immune response in some individuals, triggering an excessive production of pro-inflammatory molecules. This exaggerated immune response can result in widespread inflammation and damage to different organs, including the lungs, heart, kidneys, and blood vessels. In severe cases, this inflammation can even lead to acute respiratory distress syndrome (ARDS) and multi-organ failure.

Long COVID, also known as Post-Acute Sequelae of SARS-CoV-2 infection (PASC), refers to a constellation of prolonged symptoms experienced by some individuals after they have recovered from the acute phase of COVID-19. Notably, these symptoms can persist for weeks or months and include fatigue, brain fog, breathlessness, joint pain, and inflammation in various body systems.

Mounting evidences and reports suggest that the persisting symptoms in Long COVID might be partly related to ongoing inflammation. The initial acute inflammation triggered by COVID-19 infection can sometimes persist even after the virus has been cleared from the body. This persistent inflammation may contribute to the persistent symptoms experienced by individuals with Long COVID.

Cardiovascular complications after COVID_19 infection or during Long COVID

Cardiovascular complications can occur as a result of COVID-19 infection, both during the acute phase and potentially during Long COVID. Some individuals may experience direct involvement of the heart and blood vessels during the active infection, while others may develop cardiovascular complications as a long-term consequence.

Here are some cardiovascular complications associated with COVID-19:

*Myocarditis: Inflammation of the heart muscle, which can weaken the heart and affect its ability to pump blood efficiently.

*Pericarditis: Inflammation of the lining around the heart, known as the pericardium, which may cause chest pain and other symptoms.

*Blood clotting disorders: COVID-19 can lead to an increased risk of blood clot formation, which can affect blood vessels and potentially lead to cardiovascular events such as heart attacks or strokes.

*Arrhythmias: Irregular heart rhythms or disturbances in heart rate that may occur during or after COVID-19 infection.

*Cardiomyopathy: Damage to the heart muscle, which can result in heart failure or other cardiac complications.

*Vascular inflammation: COVID-19 can cause inflammation of the blood vessels, increasing the risk of conditions such as deep vein thrombosis (DVT) or pulmonary embolism (PE) (9)

However, it is important to note that these complications can occur in severe COVID-19 cases or in individuals with pre-existing cardiovascular conditions. Nevertheless, even individuals with milder or asymptomatic COVID-19 infections may experience cardiovascular symptoms or complications during or after the infection. For instance, even mild COVID_19 infection can cause vascular degeneration and arterial stiffness.

Kidneys dysfunctioning

COVID-19 infection can potentially impair kidney function. The kidneys play a crucial role in filtering waste products and excess fluids from the blood, maintaining electrolyte balance, and regulating blood pressure. COVID-19 can affect the kidneys directly or indirectly, leading to various kidney-related complications.

Some of the kidney-related issues seen in COVID-19 patients include:

*Acute kidney injury (AKI): It is a sudden loss of kidney function that can occur as a complication of severe COVID-19. AKI can manifest as a significant decrease in urine output and an increase in creatinine and blood urea nitrogen levels (10).

*Renal inflammation: COVID-19 can cause inflammation in the kidney tissues, leading to kidney damage and impairment in their filtration function (10).

*Blood clotting disorders: COVID-19 can increase the risk of blood clot formation, which can affect blood flow to the kidneys and potentially result in kidney damage.

*Pre-existing kidney conditions: Individuals with pre-existing kidney diseases, such as chronic kidney disease (CKD) or kidney transplant recipients, may be at a higher risk of COVID-19-related kidney complications.

However, certain factors, such as pre-existing kidney conditions, older age, and severe illness, can increase the risk of kidney-related issues in COVID-19 patients.

Mitochondrial dysfunctioning

COVID-19 is primarily a respiratory illness affecting the lungs. However, there is growing evidence that the virus can affect other organs and systems in the body, including mitochondria in severe cases.

Mitochondria are the energy-producing organelles within cells responsible for generating adenosine triphosphate (ATP), which is the main source of cellular energy. SARS-CoV-2 can directly enter human cells through the ACE2 receptor, widely expressed throughout body. Once inside the cell, the virus can cause various disruptions to cellular processes, including mitochondrial dysfunction. Several studies have reported that SARS-CoV-2 infection can lead to damage to mitochondrial membranes, decreased ATP production, and altered mitochondrial morphology (11). Mitochondrial dysfunction can have profound effects on cell function and overall health. Insufficient ATP production can impair the normal functioning of various organs, including the immune system, which is crucial in fighting off infections. Additionally, mitochondrial dysfunction can lead to increased production of reactive oxygen species (ROS), which are known to cause oxidative stress and damage to cellular components. Furthermore, mitochondrial dysfunction and increased ROS production can trigger an exaggerated immune response, leading to excessive inflammation, often referred to as a cytokine storm, can further damage organs and disrupt normal physiological processes.

Pancreatic beta cells dysfunctioning

There is limited evidence to suggest that COVID-19 infection can potentially affect the beta cells of the pancreas and subsequently impact insulin production. Although COVID-19 primarily affects the respiratory system, it can also lead to systemic inflammation and affect various organs throughout the body, including the pancreas. Some studies have reported cases of new-onset diabetes or worsening of glycemic control in individuals with COVID-19 infection. The exact mechanism by which COVID-19 might affect the beta cells is not fully understood. It is hypothesized that the immune response triggered by the virus, along with the resulting inflammation, may play a role

in damaging the beta cells. Nonetheless, there is also evidence suggesting the virus may directly invade the pancreas (12).

Damage to neurological system and cognitive function

COVID-19 infection can affect the neurological system and cognitive function in some individuals (13). This is known as neuro-COVID. The exact mechanisms are still being studied, but it is thought that the virus can directly invade the central nervous system, leading to inflammation and damage to brain cells.

The exact mechanisms by which the COVID-19 virus reaches the brain or affects the neurological system are still being studied. However, there are a few proposed pathways through which the virus may potentially access the central nervous system (CNS). One possible route is through the bloodstream. The virus enters the body through respiratory droplets and primarily infects the respiratory tract, but it can also enter the bloodstream and circulate throughout the body. This can allow the virus to potentially cross the blood-brain barrier and reach the brain or other parts of the CNS. Another proposed mechanism is through direct invasion. It has been suggested that the virus may enter the central nervous system directly through nerve pathways. The olfactory nerve, which is responsible for the sense of smell, has been identified as a potential route for the virus to reach t he brain. It is believed that the virus can infect the cells in the nasal cavity, including the olfactory receptors, and then travel along the olfactory nerve to the brain. Moreover, there is evidence that SARS-CoV-2 can cause inflammation and immune responses in the body, including the release of inflammatory molecules called cytokines. These cytokines can potentially cross the blood-brain barrier and enter the brain, leading to neuroinflammation and neurological symptoms.

It is important to note that while the virus can potentially affect the neurological system, the majority of COVID-19 cases primarily involve respiratory symptoms. Neurological symptoms are less common but have been reported in some individuals with increasing rate. Some common neurological symptoms experienced by COVID-19 patients include headaches, dizziness, loss of taste and smell, confusion, and difficulty concentrating. Additionally, there have been reports of more severe neurological complications such as strokes, seizures, and encephalitis in some patients (13). It is important to note that not everyone with COVID-19 will experience these neurological symptoms, and they are generally more common in individuals with severe illness. However, even mild cases can have long-term effects on cognitive function and mental health.

Long Covid treatment!

Unfortunately, there is currently no specific drug or treatment that can cure Long-Covid. The management of long-Covid typically focuses on addressing the specific symptoms and supporting the overall health and recovery of the individual. Treatment approaches may involve a combination of medications and therapies tailored to the individual's symptoms and needs. Some commonly prescribed medications for specific symptoms of long-Covid include: Pain relievers, Corticosteroids, anticoagulants, and respiratory medications like bronchodilators or corticosteroid inhalers.

Two years after initial COVID_19 infection, 30% of survivors face persistent LongCovid symptoms. Some reports show half of COVID survivors still have lingering symptoms. Indeed, 50% is a more realistic estimate as the confirmed/reported cases are usually less than the actual cases. Long Covid includes a wide range of symptoms from mild to severe. That is well over 100 million cases of LongCovid worldwide. For people with underlying health conditions or immune-compromised, the implications are acute and dreadful. COVID_19 infection may result in sequela of infections. The reports indicate significant surges of mysterious pulmonary infections, pneumonia, tuberculosis and other obscure infections along with high hospitalization and mortality rates. Such indirect unprecedented deaths are not often attributed to initial infection of COVID_19. Some of these infections show resistance to all known antibiotics. Herd immunity and immunity debt are misconceptions as COVID_19 infection suppresses/impairs the immune system making the body system more susceptible to subsequent infections. In fact, not only every COVID_19 infection is harmful and risky but also increases the risk of LongCovid.

As mentioned earlier, COVID_19 infection is ongoing global threat. Vaccination may not be sufficient to stop the disease and its consequences. A multilateral approach or multilayered protection is desired. Besides, decontamination of the respiratory system and oral antiviral of natural origin as proposed before (1), turmeric solution, widely available and affordable worldwide, may be partially helpful as explained below. Turmeric solution proposed here may be considered as a supplementary remedy partially effective in treating LongCovid patients depending on individual condition.

Health benefits of turmeric (Curcuma longa)

Turmeric contains a compound called curcumin, which is believed to have numerous potential health benefits. When consumed as a turmeric solution particularly, curcumin can provide the following expected health benefits (14, 15, 16):

*Anti-inflammatory properties: Curcumin is known to have strong anti-inflammatory effects. It may help reduce chronic inflammation in the body, which is associated with various diseases such as heart disease, diabetes, and certain types of cancer.

*Antioxidant activity: Curcumin acts as a potent antioxidant, helping to protect cells against damage caused by harmful free radicals. This antioxidant activity may play a role in maintaining overall health and preventing chronic diseases.

*Potential anti-cancer effects: Some studies suggest that curcumin may have anti-cancer properties. It could help prevent the growth and spread of cancer cells and may also enhance the effectiveness of certain cancer treatments.

* Improved brain health: Curcumin has been researched for its potential benefits to brain health. It may help promote cognitive functions, protect against neurodegenerative diseases such as Alzheimer's, and improve mood and overall mental well-being.

*Enhanced heart health: Curcumin may have cardiovascular benefits by improving blood vessel function, reducing inflammation in the arteries, and potentially lowering the risk of heart disease.

*Potential pain relief: Curcumin's anti-inflammatory properties may contribute to its potential role in reducing pain, particularly in conditions such as arthritis or muscle soreness.

* Digestive health support: Curcumin may aid in maintaining a healthy digestive system by reducing inflammation, promoting gut health, and potentially alleviating symptoms of digestive disorders such as irritable bowel syndrome (IBS).

*Antiviral properties: Turmeric has been found to have antiviral properties. The active compound in turmeric, curcumin, has been shown to exhibit antiviral activity against various viruses, including the influenza virus, herpes simplex virus, and HIV. Curcumin's antiviral properties are thought to be attributed to its ability to interfere with viral replication and inhibit viral attachment to host cells. However, it is important to note that more research is needed to fully understand the extent and mechanisms of turmeric's antiviral effects. (14, 15, 16).

Preparation of turmeric solution

The best combination is about 1/2 to 1 teaspoon of turmeric, 1 teaspoon of olive oil, a pinch of black pepper, and 1 teaspoon of lemon juice in 1 glass of warm water. The optimum amount of turmeric and olive oil for one glass of diluted turmeric solution can vary. To enhance the absorption of curcumin, it is commonly recommended to consume it with both black pepper (containing piperine) and healthy fats like olive oil. Both black pepper and olive oil have been found to increase the bioavailability of curcumin in the body. Lemon juice is rich in vitamin C, which can help boost the immune system and improve digestion. However, the exact amount can depend on personal preferences, desired flavor intensity, and the intended use of the turmeric solution. Some people may prefer a stronger or milder taste, and the

amount can be adjusted accordingly. Drinking a diluted solution of turmeric before breakfast, about 30 minutes to an hour before your meal, may be a good practice. This timing allows your body to absorb the curcumin more effectively.

Precautions and prohibition of turmeric drink

While turmeric is generally considered safe for consumption and has been used in traditional medicine for centuries, there are a few considerations to keep in mind:

*Allergies: Some individuals may have allergies or sensitivities to turmeric. If you have known allergies to other members of the ginger family, such as ginger itself must stop using it. The allergic symptoms are nausea, diarrhea, low blood pressure and uterine contractions in pregnant women.

*Stomach issues: Turmeric has been associated with causing gastrointestinal issues like stomach upset, gas, and bloating in some individuals, particularly when consumed in large amounts or for a prolonged period. Most reports have shown that 500 to 2000 mg, the median of 1000 mg, per day is an effective and safe dose of turmeric. Optimum amount of turmeric consumption can be different according to the medical conditions of each person and the type of consumption.

*Interactions with medications: Turmeric may interact with certain medications, including blood thinners, antiplatelet drugs, nonsteroidal (NSAIDs) anti-inflammatory drugs and medications for diabetes.

*Liver issues: Turmeric contains active substances, curcumin, may have an effect on the activity of liver enzymes. For people with liver problem or disease, it is better to cautious before using turmeric.

*Gallbladder and kidney issues: Turmeric may worsen symptoms in individuals with gallbladder issues or those prone to gallstones, and kidney stones. If you have such conditions, it's recommended to consult with a healthcare professional before using turmeric.

*Pregnancy and breastfeeding: While turmeric used as a spice in food is generally considered safe during pregnancy and breastfeeding, consuming large amounts of turmeric supplements is not recommended.

As with any supplement or herbal remedy, it's always wise to consult with a healthcare professional or a registered dietitian before adding turmeric to your routine, especially if any underlying health conditions or medications are involved.

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