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The Underappreciated Role of Carbon Dioxide in Health

Analysis by Dr. Joseph Mercola | November 8, 2026

STORY AT-A-GLANCE

- CO_2 is typically thought of as nothing more than a harmful waste product of respiration, but it's actually a driver of mitochondrial energy production, and it improves the delivery of oxygen into your cells
- One of the simplest ways to optimize your CO_2 is by breathing properly. Many people tend to over-breathe, which causes them to expel too much CO_2. Proper breathing involves breathing less and breathing slower. Both of these allow CO_2 to build up, and that appears to be part of why breathwork has such wide-ranging benefits
- To have sufficient CO_2 production, you need healthy mitochondria because that's where most of your CO_2 is produced, mainly through the Krebs cycle. If you have mitochondrial dysfunction, if you're hypothyroid, or have high levels of inflammation, then you may not be producing enough CO_2
- According to Georgi Dinkov, when your CO_2 is too low, your body may revert to an "emergency" vasodilator, nitric oxide (NO). Drawbacks of elevated NO include peroxynitrite species formation and pseudohypoxia. NO also damages the polyunsaturated fats (PUFs) in your cells and inhibits energy production
- Dinkov proposes that CO_2 lowers the pH of the cell, allowing extra water to be excreted — the opposite of what he says linoleic acid and estrogen do by drawing water in and causing the cell to swell. Cellular swelling is a feature of cancer cells

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In this interview, repeat guest Georgi Dinkov reviews the role of carbon dioxide (CO_2) in health. CO_2 is typically thought of as nothing more than a harmful waste product of respiration, but it's actually a driver of mitochondrial energy production, and it improves the delivery of oxygen into your cells.

While this may come as a shock to most people, of all the strategies I know of to increase life extension, I believe optimizing CO_2 is one of the most promising, alongside a low linoleic acid (LA) diet and reducing estrogen dominance.

Unfortunately, few doctors are aware of this. The now-deceased Ray Peat, a biologist and physiologist who developed the bioenergetic theory of health,[1] was one of the few who understood it inside and out, and actually recommended its clinical use.

I wrote an **article** about this that featured his lecture on CO_2, which I watched six times as it catalyzed my interest in the topic. At the time I found his video, there were fewer than 2,000 views on YouTube. You can find it by going to YouTube and typing in Ray Peat CO_2.

Proper Breathing Is Important for Optimal CO_2 Levels

One of the simplest ways to optimize your CO_2 is by breathing properly. Unfortunately, bad advice is rampant in the breathing arena as well. The problem is that many people tend to over-breathe, which causes them to expel (breathe out) too much CO_2, resulting in respiratory alkalosis. Chronic CO_2 deficiency may also contribute to premature death.

In a nutshell, "proper" or life-extending breathing involves breathing less and breathing slower. Both of these allow CO_2 to build up, and that appears to be part of why breathwork has such wide-ranging benefits.

> *"As it turns out, carbon dioxide, even though medically it's mostly viewed as a waste product of respiration, is actually the thing that protects us from oxygen's well-known toxicity,"* Dinkov explains.

> *"In fact, if you speak to people who work in trauma or in the intensive care unit, when they have to revive people that are in shock or have suffered some kind of ischemic attack, they will tell you that the premature delivery of oxygen, or delivering too much oxygen ... is actually what kills most patients after they come out of the initial shock stage.*
>
> *The introduction of too much oxygen too quickly creates this massive cytokine storm and inflammatory reaction, and one of the reasons [for that] is that the cells are hypermetabolic — they're not producing sufficient carbon dioxide, so they're not able to utilize the oxygen properly."*

Research does show that too much oxygen can be harmful in acutely ill patients, though the increase in risk is modest. In a 2018 analysis of 25 trials in acutely ill adults, liberal oxygen therapy raised the risk of dying in the hospital by about 21% compared with a more conservative approach.[2]

Forgotten Truths

It's rather surprising that the benefits of CO_2 have become forgotten considering its historical use. Asian cultures, for example, have a long history of using carbonated water for its health benefits.

The Romans recommended taking baths in naturally carbonated water for all kinds of ailments but especially arthritis, infertility, and psychiatric ailments, and this practice extended well into the Middle Ages when monks prescribed it. To this day, many visit natural hot springs, and the likely benefit in many of these springs is the CO_2 content of the water.

In the 20th century, Russian scientists did loads of research on CO_2, and to this day, many Russian clinics offer CO_2 baths and other CO_2 treatments. There's even a suit that can be filled up with CO_2, which then diffuses into your tissues.

You'll start feeling hot very rapidly, and this is a sign of vasodilation, which is one of the cardiovascular effects of CO_2. Some have proposed that CO_2 may, over the long term, help counter arterial calcification and other signs of aging, though the evidence for this is limited.[3]

Mitochondrial Dysfunction Inhibits CO_2 Production

The key, though, is that in order to have sufficient CO_2 production, you need healthy mitochondria, because that's where most of your CO_2 is produced, mainly through the Krebs cycle. If you have mitochondrial dysfunction, if you're hypothyroid, or have high levels of inflammation, then you may not be producing enough CO_2.

According to Dinkov, when your CO_2 is too low, your body reverts to an "emergency" vasodilator, nitric oxide (NO). There are three types of nitric oxide synthases, the enzymes that make NO:[4] neuronal nitric oxide synthases (nNOS), endothelial NOS (eNOS), and inducible NOS (iNOS). He believes low CO_2 triggers iNOS. The problem with that is that now you're overproducing NO, which is not ideal. Dinkov explains:

> *"Most of the eNOS ... stays in the actual blood vessel. iNOS also spills into the blood. That's kind of the purpose of iNOS because the primary purpose of nitric oxide in the body is to fight pathogens. It's a reactive nitrogen species.*
>
> *It's produced for only two reasons, either as an emergency vasodilator, or if the immune system senses an invasion from pathogens, specifically bacteria and viruses, in which case iNOS is activated.*
>
> *The reason iNOS is bad is because the nitric oxide does not stay localized. It's made available systemically because you want to affect all blood vessels, and that's what happens when you don't have sufficient amounts of carbon dioxide production. So, if you don't have [enough] CO_2, you will have elevated NO.*

But with NO, nitric oxide, you have a lot of other bad things happening. It's a highly reactive molecule. It can form peroxynitrite species. It can damage the polyunsaturated fats (PUFAs) in the cells, no matter where they are.

Nitric oxide itself can form a covalent bond with something called cytochrome c oxidase [Complex 4 in the electron transport chain], which is the rate limiting step of the oxidative phosphorylation ...

You want to break that bond because otherwise your oxidative phosphorylation is inhibited. Methylene blue can do it, magnesium can do it, carbon dioxide can do it, near-infrared light and some quinols."

Another significant problem associated with elevated NO is pseudohypoxia, because you have oxygen in the cells but it cannot be utilized because NO impairs Complex IV in the electron transport chain.

According to Dinkov, CO_2 helps prevent this by breaking the bond between NO and Complex IV. Hence, oxygenation may be optimized when sufficient CO_2 is present. So, to summarize, CO_2 keeps your blood vessels supple without the drawback of blocking Complex IV.

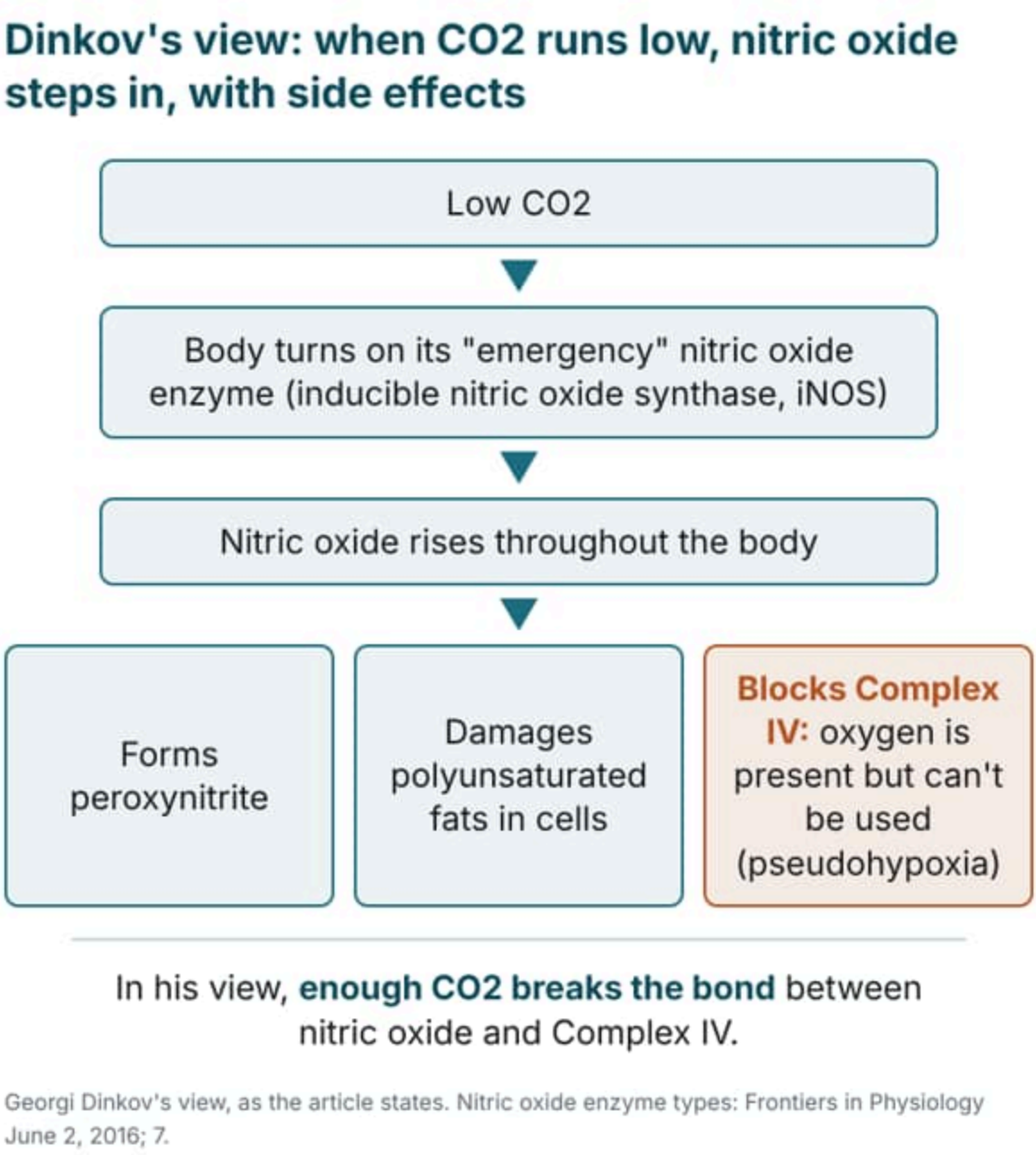


Figure 1. In Georgi Dinkov's view, low CO_2 raises nitric oxide, which can form peroxynitrite, damage fats in cells and block oxygen use.

The Bohr Effect

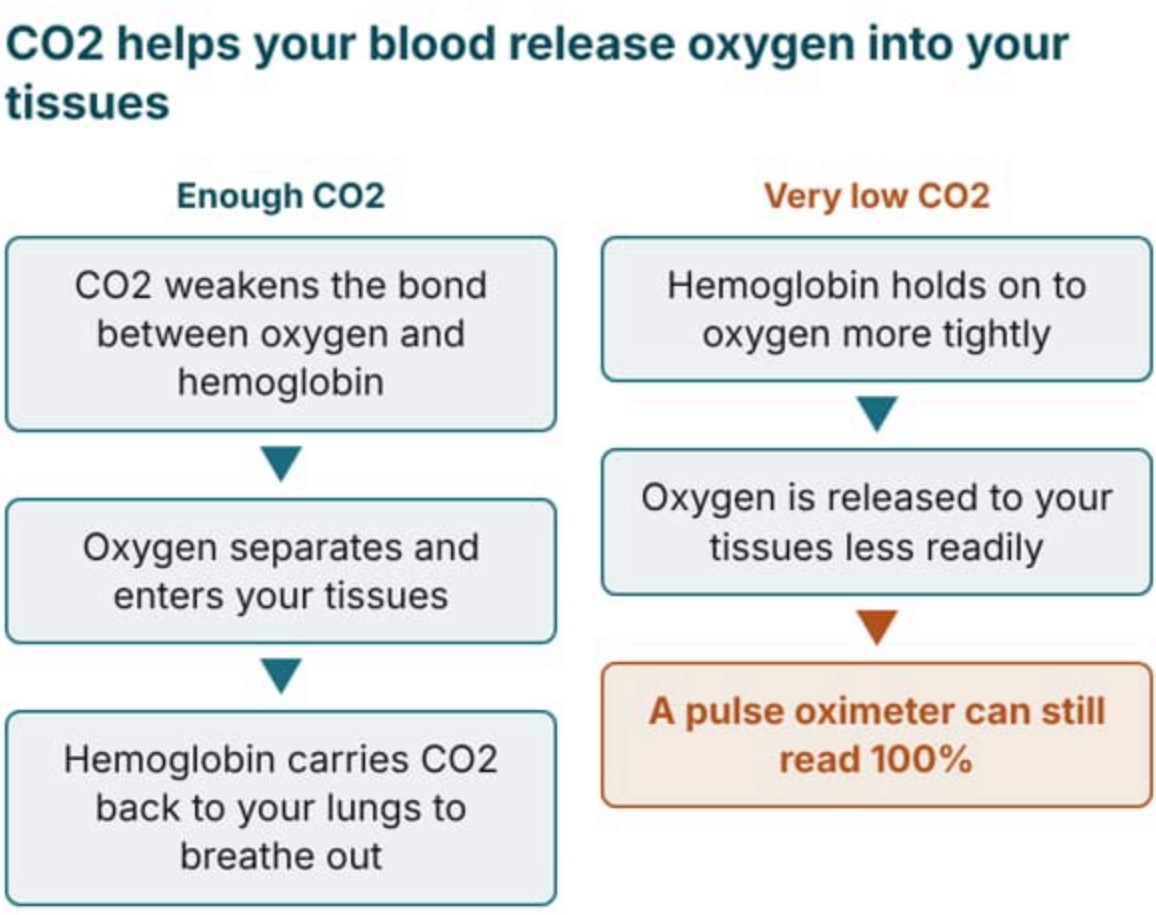
Needless to say, optimal delivery of oxygen is crucial for good health. Oxygen from the air binds to hemoglobin when you inhale and enter your blood circulation. This bond is relatively strong. To break that bond and deliver the oxygen where it's needed, CO_2 helps.

This is known as the Bohr Effect.

Basically, the Bohr Effect describes the process in which CO_2 weakens the bond between oxygen and hemoglobin so that the oxygen can separate and enter into the tissues. As the hemoglobin releases the oxygen, it can pick up some CO_2 to carry back to your lungs. The CO_2 is then expelled through your outbreath. Without enough CO_2, your hemoglobin releases oxygen less readily.

A Note on Oxygen Saturation

On a side note, a pulse oximeter measures the amount of oxygen in your blood. However, if your CO_2 is extremely low, it could still read 100% saturation because your hemoglobin is holding on to oxygen more tightly. The oxygen is circulating in your bloodstream but is released to your tissues less readily.



The Bohr effect. From the article text.

Figure 2. Enough CO_2 helps hemoglobin release oxygen into your tissues; with very low CO_2, oxygen is released less readily, though a pulse oximeter can still read 100%.

A major factor in your tissue oxygenation is how much CO_2 you're producing. If you're hypermetabolic, if your mitochondria are not working, then you're oxidizing mostly fats, which produces less CO_2 for each unit of oxygen used, so you're likely to be deficient in CO_2.

In the past (about 100 years ago), the test for seizure susceptibility was hyperventilating. The doctor would instruct the patient to breathe very quickly through the mouth for 30 seconds, and if seizure symptoms emerged, it suggested that a drop in CO_2 could trigger seizure activity in that person. A longer version of this test is still used during electroencephalogram (EEG) testing today.

CO_2, Cell pH, and Cancer: Dinkov's Theory

Dinkov believes another important aspect of CO_2 is that it lowers the pH of your cells, allowing extra water to be excreted. In his view, LA and estrogen do the opposite, drawing water into your cells and causing them to swell. Cellular swelling, aside from being a cause of edema, is also a feature of cancer cells. "In fact, I think the word tumor is a Latin word which meant swelling," Dinkov says. So, you don't want your cells to retain excess fluids. Dinkov explains his theory:

> *"Because carbon dioxide is a Lewis acid, it's an electron withdrawing agent, even though it doesn't directly bind them like a quinol. If you look at the structure, it's very similar to a quinol. It's a carbon atom with two carbonyl groups, and the quinol is very similar. They usually have a ring and two or more carbonyl groups.*
>
> *Lewis acids drop the pH of the cell, which automatically decreases the cell's affinity for water. Which means you're going to be excreting some of that extra water of the cell.*

It's not a coincidence that linoleic acid has multiple double bonds. It's much more hydrophilic than the saturated fats, which lack the double bonds. Any time you have an increase of intracellular pH, you have increased affinity for water.

The moment water streams in, that's a signal for de-differentiation and mitosis (division). If this process continues uncontrollably, we basically get cancer.

Conversely, when you excrete water, the cell becomes acidified and a little bit dehydrated, so to speak. Then you're getting high amounts of differentiation. You're also increasing the affinity of the intracellular proteins for potassium and magnesium, while decreasing their affinity for sodium and calcium. In fact, when carbon dioxide is produced and streams out of the cell, it draws calcium and sodium with it.

If you're not producing sufficient amounts of carbon dioxide, you're also probably not producing sufficient amounts of ATP, because carbon dioxide and ATP go hand in hand; they're signs of good mitochondrial function. ATP has affinity for magnesium, but if you don't have sufficient amounts of ATP, you'll have more ADP, which is the degraded version.

ADP has an affinity for calcium. So low metabolic rate, by definition, means cellular excitotoxicity, cellular alkalinity and cellular division, because of the lack of carbon dioxide and the lack of the ATP. ATP always exists in the body in a complex with magnesium. So, if you're taking magnesium but not producing sufficient amounts of ATP, it will not become bioavailable. But the production of ATP is tied to the production of carbon dioxide.

Carbon dioxide also increases the uptake of serotonin into the platelets, so producing sufficient amounts of carbon dioxide will lower your extracellular levels of serotonin.

It also increases the uptake of histamine, a very highly inflammatory mediator. Its transport also depends on carbon dioxide and on sodium as well, just like the serotonin ... So, almost everything that you do metabolically, in terms of

health, depends on the production of CO_2. It's not a waste product."

Dinkov's theory offers an interesting way to think about cell pH and cancer, but it still needs to be tested in human studies. Until then, CO_2 methods shouldn't be considered a treatment for cancer.

Respiratory Alkalosis and Cell Swelling

Cells can only produce a certain amount of CO_2 per unit of time, so when you breathe too fast, you overwhelm your cells' ability to maintain an appropriate level of CO_2. As a result, you'll have excess oxygen circulating in your bloodstream, but because the CO_2 production cannot keep up with the amount of CO_2 you exhale, you end up with respiratory alkalosis.

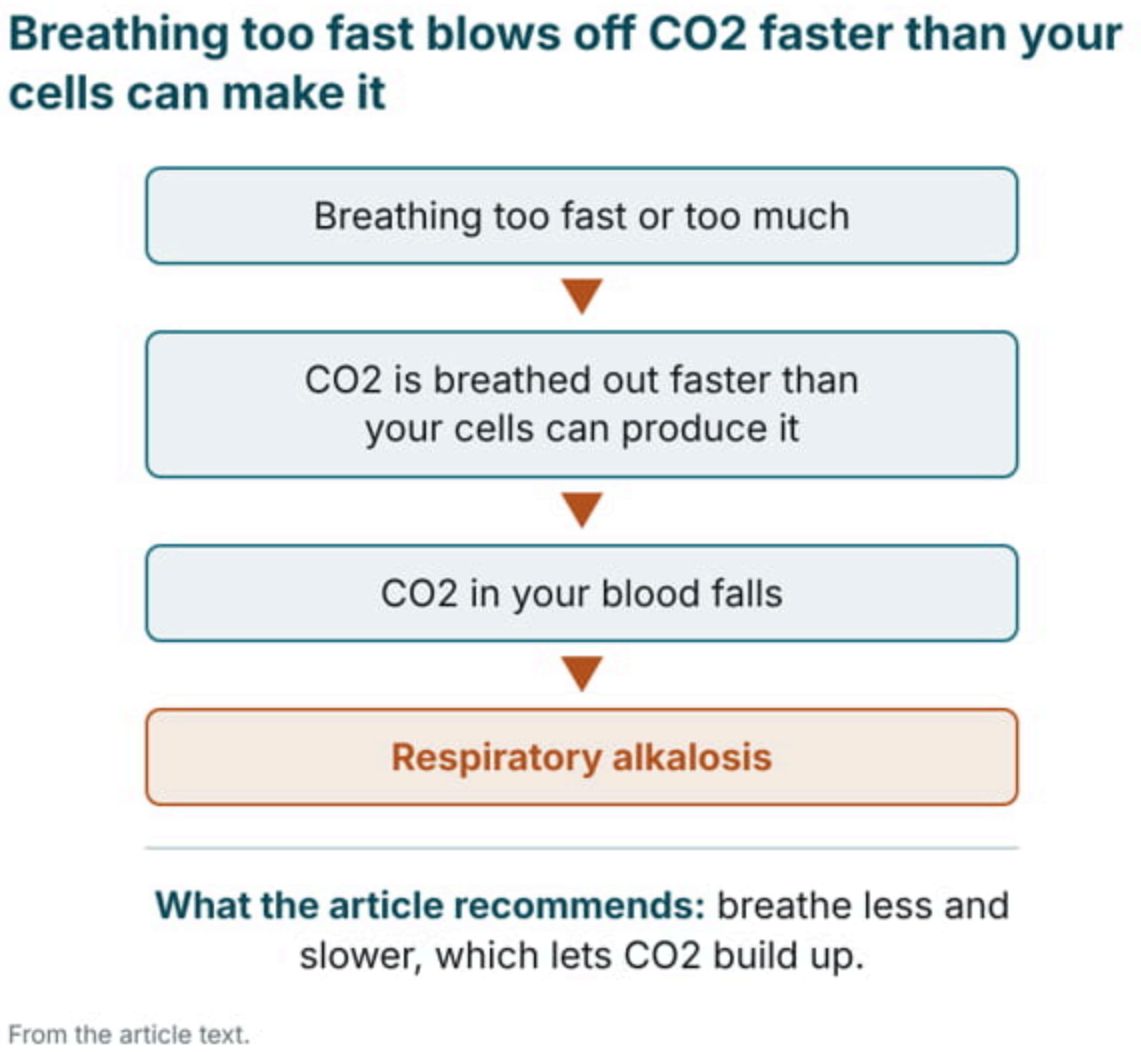


Figure 3. Breathing too fast removes CO_2 faster than your cells can make it, which leads to respiratory alkalosis.

Respiratory alkalosis may also increase intracellular water uptake, as just described, and as the pH of the cell increases, it can increase production of several inflammatory mediators, including lactate, which is another hallmark of cancer cells.

Historical Uses of CO_2

A nearly 150-year-old medical book describes the many uses of CO_2 that were believed to help at the time. It basically included the entire body and an extensive list of ailments of the day, including:

- Dementia
- Psychiatric disorders like mania
- Dysentery
- Fistulas

- Fibrotic conditions
- Whooping cough
- Tuberculosis
- Rhinitis

These were historical uses, not treatments supported by modern clinical trials. CO_2 has also been discussed in relation to migraines. Some migraines may be linked to overbreathing, which lowers CO_2 and constricts the blood vessels in your brain.[5]

Exogenous CO_2 Delivery Methods

While it's obviously important to optimize your endogenous (internal) production of CO_2, exogenous delivery or supplementation may produce greater effects, as you can deliver larger amounts than your body makes on its own. Such strategies include:

- Breathing into a paper bag
- Drinking carbonated water and other carbonated beverages
- CO_2 baths
- A special suit into which CO_2 is pumped
- Taking small amounts of baking soda in your drinking water

Talk with your doctor before trying bag breathing, CO_2 baths, or baking soda, especially if you have heart, lung, or kidney disease, or high blood pressure. Bag breathing can lower your oxygen level if overdone, so stop if you feel dizzy or short of breath, and don't use it for sudden shortness of breath or chest pain, which need emergency care.[6] Also keep in mind that baking soda is high in sodium.

A book written in 1905 by Achilles Rose, M.D., also discusses various methods of delivery, including inhalation, irrigation, and rectal insufflation. It contains case reports of it being used for asthma, whooping cough, dysentery, colitis, rectal fistulas, rhinitis, and ear infections. It is a fascinating read.

This article is for informational purposes only and does not constitute medical advice. Consult a qualified healthcare provider before making changes to your health regimen.

Sources and References

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