Carbon Dioxide (CO2) Home Toxicity

Carbon dioxide (CO2) home toxicity is far more common than you would think. Modern homes are sealed up boxes filled with people, animals and plants that are constantly producing carbon dioxide. The outdoor air circulation is almost non-existent in a modern home which allows the carbon dioxide to build up to levels that may affect human health. The addition of open flame products such as gas fires, gas stoves, candles, and so on, can increase the carbon dioxide levels even more! So how does this affect human health?

The outdoor carbon dioxide levels are at approximately 410ppm (parts per million) by volume, having risen from pre-industrial levels of 280ppm. This industrial revolution rise in carbon dioxide is part of what is driving climate change and global warming. Obviously, the pre-industrial revolution level of 280ppm is unobtainable, so you should be aiming to have an indoor level of carbon dioxide similar to the current outdoor level of 410ppm. So what happens when the indoor levels of carbon dioxide rise much higher than the outdoor levels?

The Wikipedia article “Carbon Dioxide” states:
“Below 1%: There are few studies of the health effects of long-term continuous CO2 exposure on humans and animals at levels below 1%. Occupational CO2 exposure limits have been set in the United States at 0.5% (5000 ppm) for an eight-hour period.[122] At this CO2 concentration, International Space Station crew experienced headaches, lethargy, mental slowness, emotional irritation, and sleep disruption.[123] Studies in animals at 0.5% CO2 have demonstrated kidney calcification and bone loss after eight weeks of exposure.[124] A study of humans exposed in 2.5 hour sessions demonstrated significant effects on cognitive abilities at concentrations as low as 0.1% (1000ppm) CO2 likely due to CO2 induced increases in cerebral blood flow.[120] Another study observed a decline in basic activity level and information usage at 1000 ppm, when compared to 500 ppm.”

The “Carbon Dioxide Detection and Indoor Air Quality Control” article states:
• 250-350 ppm: background (normal) outdoor air level
• 350-1,000 ppm: typical level found in occupied spaces with good air exchange
• 1,000-2,000 ppm: level associated with complaints of drowsiness and poor air
• 2,000-5,000 ppm: level associated with headaches, sleepiness, and stagnant, stale, stuffy air; poor concentration, loss of attention, increased heart rate and slight nausea may also be present.
• >5,000 ppm: This indicates unusual air conditions where high levels of other gases also could be present. Toxicity or oxygen deprivation could occur. This is the permissible exposure limit for daily workplace exposures.
• >40,000 ppm: This level is immediately harmful due to oxygen deprivation.

Environmental carbon dioxide monitors start alarming at 1000ppm in the human environment. So we should be aiming for the indoor environment to be a similar to the outdoor environment carbon dioxide level of 410ppm with a maximum peak of below 1000ppm within the home.
My Home

Carbon dioxide readings were taken in November and December 2018 using an Autopilot Digital CO2 Monitor APCEM2. All windows and exterior doors in the home were initially kept closed. Heating and cooling were turned off. The home is a 3 bedroom modern single story home of approximately 1,683 square feet that was constructed in 1991. All interior bedroom doors are kept open. This was the reading obtained overnight:

- Master Bedroom (Has 24 Dieffenbachia Plants)
  - CO2 Maximum: 2270ppm
  - CO2 Minimum: 1890ppm

I was surprised that the home was reading far more than the alarm setting of 1000ppm and the carbon dioxide meter was continually displaying an alarm condition.

It was found that opening two rear doors of the home to allow fresh outdoor air to come in would gradually reduce carbon dioxide levels within the home to 896ppm after several hours. The carbon dioxide rapidly shot up in the evening to 1685ppm after using the gas cooker. I was able to get the carbon dioxide levels to reduce down to 1495ppm by running the two bathroom extractor fans for an hour. After performing these tests, the gas fire flu (the gas fire is not used) was opened to allow greater fresh air circulation in the home while we were sleeping.

In the morning the home was reading 1570ppm, a significant improvement on the previous night. This was reduced to 1325ppm by running the home heating system for half an hour. All doors of the home were opened for several hours to create a cross flow of fresh outdoor air and the carbon dioxide level dropped to 456ppm. After using the gas cooker in the evening with the cooker extractor fan on, the levels increased to 1305ppm. I was able to get the carbon dioxide levels to reduce down to 1275ppm by running the heating system for an hour.

At the end of this testing I had concluded that the primary source of carbon dioxide in the home was the gas cooker and that it should always be used with the cooker extractor fan running. I had already developed the good habit of venting the home daily on warm days by opening the doors for a few hours and will extend this to all days of the year regardless of outdoor temperatures. After cooking with the gas stove, I now run the bathroom extractor fans for an hour to freshen up the air of the home.

I found through experimentation that obtaining 1000ppm prior to sleeping could only be done if the home had been cross flow ventilated to the outside for a few hours during the daytime to get the carbon dioxide levels down to below 500ppm and the gas cooker had not been used. Typically, carbon dioxide below 500ppm could be achieved with all three outside doors wide open for at least three hours. Slight ventilation to the outdoors by opening a door a few inches to let a small amount of fresh air into the home had little effect on the carbon dioxide levels.
A fitness sleep tracker was reporting interrupted sleep patterns that alternated between deep sleep and light sleep all night long when carbon dioxide levels were high in the home. Deep sleep would be much longer on the nights that home had been well ventilated to the outdoors.

The largest sources of carbon dioxide were:

1. Gas stove. Cooking typically raises the carbon dioxide levels by 200ppm-900ppm, depending on if the oven is used, the number of burners used on the stove top, and the time taken to cook the meal.
2. Humans. The home carbon dioxide levels would rise by 200ppm-300ppm when inhabited.

The largest source of carbon dioxide in the home is coming from the gas stove and the solution is to cook more often with cleaner electric appliances, such as the Instant Pot. Long term, it is my intention to replace all home gas appliances as they wear out with cleaner electric ones. The broken gas clothes dryer was replaced for an electric one recently and I do wonder if it was producing higher levels of carbon dioxide inside the home than I documented in this article.

Known Health Problems of Gas Exposures

- “Indoor Air Can Cause Health Problems...Are you worried about the air you breathe? Don't think you're safe just because you're inside. The Environmental Protection Agency (EPA) says that the air in homes and other buildings can be more seriously polluted than the outdoor air. Indoor air pollution can cause big health problems. People who may be exposed to indoor air pollutants for the longest periods are often those most at risk to the effects of indoor air pollution. This includes children, older adults, and people with chronic illnesses.” [https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentTypeID=1&ContentID=2163](https://www.urmc.rochester.edu/encyclopedia/content.aspx?ContentTypeID=1&ContentID=2163)
- “What Symptoms Can a Gas Leak Cause?...Health effects. While exposure to low levels of natural gas is not harmful, long-term exposure can affect your health. Burning natural gas produces nitrogen oxide, carbon monoxide, and methane. These chemicals can trigger respiratory problems, depression, and decrease the quality of your health. Talk to your doctor if you believe the gas leak is affecting your health.” [https://www.healthline.com/health/gas-leak-symptoms#outlook](https://www.healthline.com/health/gas-leak-symptoms#outlook)
- “Gas Stove Dangers Revealed and How to Combat Them...These odorless and colorless emissions can cause inflammation of the lungs. The breathing passages are narrowed which complicates existing lung conditions. The pollutants can exacerbate allergies. Also, regular exposure can lead to asthma and wheezing. Chronic cough along with bronchitis and respiratory infections may also result. In 1996, The Lancet reported that the use of gas stoves was linked to impaired lung function. The study found this to be most common in young women. Moreover, women who used gas stoves experienced twice the amount of respiratory problems of women who used electric stoves.” [http://www.liveinthenow.com/article/gas-stoves-found-to-be-more-dangerous-than-we-thought](http://www.liveinthenow.com/article/gas-stoves-found-to-be-more-dangerous-than-we-thought)
- “Why Natural Gas and Propane are MAJOR HEALTH RISKS...Think about a woman cooking; (women have been found to be more susceptible to the harms of natural gas). As she leans over to pull food from the oven, or hovers over something on the stove top, she is breathing in the
following cocktail of chemicals: methane, radon and other radioactive materials, BTEX (benzene, toluene, ethylbenzene and xylene), organometallic compounds such as methylmercury organoarsenic and organolead, mercaptan odorants, nitrogen dioxide, carbon monoxide, organic compounds (including formaldehyde), fine particulates, and polycyclic aromatic hydrocarbons, among others. And what’s worse? Natural gas and propane actually cling to your food. So we eat it, when our food is cooked by gas. And it clings to our clothing, when we use gas dryers; so it touches our skin.” [https://eatbeautiful.net/2015/12/13/natural-gas-propane-major-health-risks-best-cook-food-dry-clothes-heat-house/]

- “Effects on health of prolonged exposure to low concentrations of carbon monoxide...Anecdotal evidence suggests that chronic exposure to CO may produce mild neurological effects. Although there are as yet no conclusive studies showing such a correlation, the evidence in its favour is accumulating...Daily exposure, leading to symptoms including headache and malaise are often reported with periods of recovery to normality occurring when exposure stops. Thus recovery during the working day with a recurrence of symptoms during the evening, or recovery during a holiday with deterioration on return, has been reported...Evidence that exposure to low concentrations of carbon monoxide can affect a number of organ systems is accumulating.” [https://oem.bmj.com/content/59/10/708]

- “The Kitchen as a Pollution Hazard... frying, grilling or toasting foods with gas and electric appliances creates particulate matter, nitrogen dioxide, carbon monoxide and carbon dioxide, and volatile organic compounds...Emissions of nitrogen dioxide in homes with gas stoves exceed the Environmental Protection Agency’s definition of clean air in an estimated 55 percent to 70 percent of those homes, according to one model; a quarter of them have air quality worse than the worst recorded smog (nitrogen dioxide) event in London...When you live in a small building, you cook a lot and don’t use your range hood, which may not be very effective anyway, then you’re probably going to have a problem with pollutants from cooking.” [https://well.blogs.nytimes.com/2013/07/22/the-kitchen-as-a-pollution-hazard/]

- “Gas Stoves, IQ, and ADHD...According to a groundbreaking new study, preschoolers with gas appliances in their homes scored lower on cognitive tests and were more likely to have ADHD than their peers...Nevertheless, there is a growing body of evidence linking outdoor air pollution with brain development. And there is strong evidence that for most homes indoor air pollution is worse than outdoor air pollution. And we do know that nitrogen dioxide causes cell damage and provokes an inflammatory response. Keeping indoor air clean seems wise, whether or not we have gas appliances.” [https://blogs.webmd.com/health-ehome/2009/07/gas-stoves-iq-and-adhd.html]

- “Teen health risk of gas cookers... Dr John Harvey, chairman of the external relations committee of the British Thoracic Society, said: "There is a growing link between exposure to gas cookers and lung problems and more research is urgently needed. All susceptible groups, such as adolescents prone to allergies and the elderly with respiratory problems, might take sensible precautions to reduce their exposure to gas fumes - such as using extractor fans and having adequate ventilation. It is also sensible to refrain from using gas cooker rings for heating the kitchen." He warned that the dangers of indoor pollution had often been overlooked because of concerns over "outdoor" pollution, and called for more attention to be paid to them.” [http://news.bbc.co.uk/2/hi/health/1391076.stm]

- “Lower levels of carbon dioxide predict improved sleep and mental performance...CO2 levels were successfully manipulated with substantially lower CO2 levels in window ventilated rooms
and mechanic ventilated rooms. Objective sleep, and the perceived freshness of bedroom air improved in ventilated rooms, as did self reported sleepiness and mental performance the day after. This small study suggests a benefit of ventilated bedrooms with lower circulating CO2 levels”


- “The Link Between Carbon Dioxide Retention and Sleep…Carbon dioxide intoxication or carbon dioxide poisoning, known, respectively, as hypercapnia or hypercarbia, occurs when a person has too much of the gas in the body. This usually happens when someone is exposed to elevated levels of carbon dioxide for a long period of time…Many people have no symptoms of hypercapnia, but if they do, they're likely to feel drowsy or find it hard to think straight. Severe hypercapnia, on the other hand, can cause noticeable symptoms, such as increased heart rate, blood pressure or muscle twitches. It can lead to respiratory failure if untreated.”
  https://www.verywellhealth.com/carbon-dioxide-retention-and-sleep-3015339

- “Sleeping in a Closed Room – Indoor CO2 Analyze…Time-Graph of CO2 PPM Level while sleeping in a closed room. What you can clearly see on the chart is how each change in the rooms occupation affects the CO2 Level quite quickly. Also what is astonishing is that we passed 2000 ppm at ~1 am. This is just 2 hours after we went to sleep in a relatively fresh air. At 4.30am i woke up (i usually wake up then) and the air felt quite stuffy (maybe also because i Knew the PPM). But then i decided to open the door wide and give my wife and baby some fresh air. If i had left the door shut, the level would have easily reached 4500 ppm until 7am.”

- “Carbon Dioxide, Hypoxia, Epinephrine Cardiac "Sensitization" Tests…With high and prolonged exposures to carbon dioxide, or prolonged strenuous exercise while breathing carbon dioxide, the frequency of cardiac arrhythmias increases.”
  http://archive.rubicon-foundation.org/xmlui/handle/123456789/10579

- “Carbon Dioxide “Alarm System” Might Help Explain Anxiety Disorders…For most people, a little stale air isn’t much of a problem—a lot of carbon dioxide has to build up before they start to panic. But for some, inhaling even a whiff or two of CO2 can provoke an immediate sense of dread. In fact, a prominent psychiatric theory holds that an overly sensitive detection mechanism for the gas, or “suffocation false alarm,” makes these folks particularly susceptible to panic disorders and other anxiety problems.”

- “Carbon dioxide hypersensitivity, hyperventilation, and panic disorder…RESULTS: Some panic patients have a chronic, subtle respiratory disturbance. Acute hyperventilation is neither necessary nor sufficient for panic to occur. Respiratory abnormalities in panic patients may adaptively aim at coping with a hypersensitive CO2 chemoreceptor system. Pharmacologic panicogens also stimulate the respiratory system, causing hyperventilation. Triggering this hypersensitive respiratory control mechanism may incite panic. Antipanic medications may reset the receptor threshold. Misattribution and catastrophic interpretation of somatic symptoms or the sense of loss of control may contribute to panic symptoms. Behavioral interventions such as desensitization or breathing retraining may block the full-blown attack. Cognitive strategies through cognitive control of respiration may supplement and accentuate these interventions.”

- “Panic Attacks as a Problem of pH. Study casts new light on the brain mechanisms behind recurrent bouts of intense anxiety…Carbon dioxide acts like an acid in the body and the brain.
Several of the experiments described in the Iowa paper showed that inhaling elevated concentrations of carbon dioxide triggered strong fear reactions in normal mice, and that some of these fear reactions required the presence of the acid-sensing protein in the amygdala. These experiments are especially relevant to understanding panic disorder. One of the most consistent findings in patients with panic disorder is that they are unusually sensitive to carbon dioxide inhalation and other laboratory procedures that increase brain acidity. Most patients with panic disorder will experience a panic attack when they inhale air containing 35% carbon dioxide, while most healthy volunteers will not.” [https://www.scientificamerican.com/article/panic-attacks-as-ph-problem/]

• “The Relationship between Central Carbon Dioxide Sensitivity and Clinical Features in Patients with Chronic Airways Obstruction...A technique has been developed which enables respiratory motor output to be measured independently of lung mechanics. The maximum rate of change of pressure at the mouth during initial transient occlusion of the airway, (dP/dt) max., represents the rate of isometric force development by the inspiratory muscles. This technique was used to study central CO2 sensitivity in 40 patients with chronic airways obstruction. Subnormal CO2 sensitivity was associated with chronic cough and sputum production, relatively mild dyspnoea, raised arterial CO2 tension, hypoxaemia, poly-cythaemia and cor pulmonale. Normal CO2 sensitivity was associated with severe dyspnoea, normal blood gas tensions, and allergic features.” [https://academic.oup.com/qjmed/article-abstract/46/2/179/1517310?redirectedFrom=PDF]

• “Genetic differences may alter carbon dioxide sensitivity, contribute to changes in astronauts’ eyes...Genetic variation may increase susceptibility of some astronauts to develop higher-than-normal carbon dioxide levels in the blood, which may contribute to eye abnormalities, including grooved bands on the retina in the eye and swelling of the optic nerve, new research indicates.” [https://www.sciencedaily.com/releases/2017/06/170630090354.htm]

• “Decreased Carbon Dioxide Sensitivity in Infants of Substance-Abusing Mothers...Results. The gestational ages by obstetrical dating and examination of the infants were not different, although birth weights and birth lengths were lower in the group of ISAMs. Other demographic data were not different, and there were no differences in the infants’ median ages at the time of study or in maternal use of tobacco and alcohol. The two groups had comparable baseline (room air) ET-CO2 levels, respiratory rates, tidal volumes, and minute ventilation. When compared with the group of ISAMs, the drug-free group had markedly increased tidal volume and minute ventilation on exposure to 4% carbon dioxide. These increases accounted for the difference in sensitivity to carbon dioxide, calculated as the change in minute ventilation per unit change in ET-CO2 (milliliters per kg/min per mm Hg). The sensitivity to carbon dioxide of control infants was 48.66 ± 7.14 (mean ± SE), whereas that of ISAMs was 16.28 ± 3.14.” [http://pediatrics.aappublications.org/content/95/6/864]

• “Carbon dioxide sensitivity and personality...Abstract. 33 U.S. Army enlisted men underwent 3 or 4 trials of a rebreathing test for CO2 sensitivity. During each trial the increase in the S's ventilation was related to increase in alveolar CO2. Ss were also administered the MMPI. Elevations were noted on nearly all standard MMPI scales for low responders to CO2, with differences between high and low responders reaching statistical significance on several scales. Differences in personality traits between high and low responders to CO2 suggest that this test may be useful for psychosomatic investigations. The interpretation of CO2 sensitivity as an
index of the excitatory level of the respiratory center in the medulla is discussed.”

http://psycnet.apa.org/record/1974-10587-001

• “Scientists differ on climate’s carbon dioxide sensitivity...Scientists have yet to settle one of the biggest questions of warming: the climate’s carbon dioxide sensitivity. How much more carbon dioxide can the atmosphere absorb – and how will life on Earth respond – before the global temperature ticks past the political milestones of 1.5 °C and 2 °C above the average levels for most of human history?” https://physicsworld.com/a/scientists-differ-on-climates-carbon-dioxide-sensitivity/

I could not find any articles that detailed the effects of raised carbon dioxide on the human fetus during pregnancy. However, I did find these articles that detail the effects of carbon monoxide:

• “Effect of moderate carbon-monoxide exposure on fetal development...The effect of moderate carbon-monoxide exposure (180 p.p.m. and 90 p.p.m. carbon monoxide in atmospheric air) on fetal development was studied in rabbits. Exposure to 180 p.p.m. carbon monoxide (16-18% carboxyhaemoglobin) during pregnancy resulted in a 20% decrease of birth-weight, and a neonatal mortality of 35% as against 1% in the control group. Exposure to 90 p.p.m. carbon monoxide (8-9% carboxyhaemoglobin) had a less pronounced effect. In women there was a negative correlation between birth-weight and carboxyhaemoglobin concentration (p<0·05). The results indicate that carbon monoxide in tobacco smoke might be responsible for the reduced birth-weight of babies whose mothers smoked during pregnancy.”

• “Effects of chronic carbon monoxide exposure on fetal growth and development in mice...Maternal and fetal CO blood concentrations ranged from 1.12- 15.6 percent carboxyhemoglobin (%COHb) and 1.0-28.6%COHb, respectively. No significant difference was observed in placental histological morphology or in placental mass with any CO exposure. At 400 ppm CO vs. control, decreased litter size and fetal mass (p < 0.05), increased fetal early/late gestational deaths (p < 0.05), and increased CO content in the placenta and the maternal spleen, heart, liver, kidney and lung (p < 0.05) were observed.”
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3297534/

It is known that the weight of plants, commonly called the yield, increases by raising the carbon dioxide levels and one can only wonder if the same effect occurs in the fetus:

• “Managing Carbon Dioxide in Your Grow Space. If you are green to gardening you might not know that carbon dioxide, the gas we all exhale, is critical to plant growth and development. Photosynthesis, the process through which plants use light to create food, requires carbon dioxide. CO2 concentration in ambient air ranges from 300-500 parts per million (ppm), with a global atmospheric average of about 400 ppm. If you are growing in a greenhouse or indoors, the CO2 levels will be reduced as the plants use it up during photosynthesis. Increasing the CO2 levels in these environments is essential for good results. Additionally, there are benefits to raising the CO2 level higher than the global average, up to 1500 ppm. With CO2 maintained at this level, yields can be increased by as much as 30%! ”
https://fifthseasongardening.com/regulating-carbon-dioxide
“Growing with CO2: Improve Your Yield Part II...Plant cells only make use of CO2 during light exposure. When increasing the CO2 levels, it is necessary to also increase water, nutrients and light proximity to plants. The presence of CO2 enables the plant to grow at a faster rate than it would in an unaltered environment. The stomata (the porous openings of the plant) take in the CO2 that is available and release water vapor when open. When increasing CO2 levels, the stomata do not open as widely due to high availability thus producing less water vapor. This creates a stronger and more resistant plant structure.”

“Will rising carbon dioxide levels really boost plant growth?...Plants have become an unlikely subject of political debate. Many projections suggest that burning fossil fuels and the resulting climate change will make it harder to grow enough food for everyone in the coming decades. But some groups opposed to limiting our emissions claim that higher levels of carbon dioxide (CO₂) will boost plants' photosynthesis and so increase food production.”

Amazon Reviews

These are some of the Autopilot Digital CO2 monitor APCEM2 comments posted by amazon reviewers:

- In my own room I tried an experiment where I closed the window with the space heater on. When the PPM got to 5000, I was not feeling like such a happy camper.
- I tested this, it was displaying a PPM around 2,000 in my house. Opened all the windows and let fresh air in. Afterwards, this device read a PPM of about 450, which is ambient levels.
- Seems to take somewhat reliable CO2 readings (400 outside, 700 in a normal room, 1000-1500 in a bedroom after sleeping with closed door and windows)
- Measurements seem reasonable to me -- around 350-400 ppm outdoors, 700-1000 in the office (not crowded).
- CO2 was not something I would have thought about. Maybe psychological but family does seem to generally feel better. Great device.
- The end result is that we aerate our room 10 times more now and feel much better overall. When you feel weak or can't concentrate high CO2 level is to blame!
- We no longer wake-up with occasional mild headaches and drowsiness. Nice product!
- Measurements seem reasonable to me -- around 350-400 ppm outdoors, 700-1000 in the office (not crowded).
- One day the unit beeped. Our house air seemed a bit stale, but I would have ignored it if it wasn’t for the alarm. Turns out the HVAC exhaust pipe had a fault and was circulating exhaust back into the house! This alerted far before our CO meter. Not an exaggeration to say it might have saved a life.
- Carbon Dioxide is an easy way to get more yield out of your plants.
Summary

The indoor home environment should be kept as close as possible to the outdoor carbon dioxide level of 420ppm. This can be achieved by:

- Installing an Energy-Recovery Ventilator (ERV).
- Opening all fire flu’s.
- Opening windows.
- Opening outside doors.
- Opening inside doors.
- Installation of fresh air vents on all sides of the home.
- Replacing gas appliances with electric appliances.
- Always running the kitchen extractor fan while cooking.
- Running the fan on the home heating and cooling system for a few hours after using cooking or gas appliances.
- Running the bathroom extractor fans for a few hours after cooking.

The more people, animal and plants that are inside of the home, the worse the carbon dioxide levels will be. If the carbon dioxide levels are high within the home, then you may observe the following problems in the occupants of the home:

- Headaches.
- Lethargy.
- Mental slowness.
- Emotional irritation.
- Sleep disruption.

Increasing the outdoor fresh air ventilation of the home may reduce these symptoms. Workplaces can be worse than the home and if you own a carbon dioxide monitor, you should measure your workplace environment also. Known causes of poor workplace air quality:

- Use of gas appliances.
- Use of solvents.
- Releasing industrial gas into the indoor environment.
- Use of cleaning products.
- Smokers.
- Open flames.
- Welding.
- Hospitals typically have poor air quality due to their use of medical gas, disinfectants, cleaning products and dense groupings of people.
All homes and workplaces should have the following installed for health and safety:

- Photoelectric smoke detector (commonly called kitchen smoke detectors).
- Carbon monoxide detector.
- Carbon dioxide meter.

The most useful of these devices on a daily basis is the carbon dioxide meter. Unless you are unlucky, you should never hear your carbon monoxide or photocell smoke detector set off its alarm. They typically require the home to become poisonous to the human occupants before they alarm.

Pursuing good air quality should be a priority for your family and should improve the quality of life within the home and workplace. I hope that you enjoyed this discussion about home carbon dioxide levels and I wish you the best of health.

Qoutes & Internet Links

- “Autopilot Desktop CO2 Monitor” http://a.co/d/1685kWt
- “Hydrofarm is the nation's oldest and largest independent wholesaler and manufacturer of hydroponics equipment and grow lights.” https://hydrofarm.com/
- “Effects on health of prolonged exposure to low concentrations of carbon monoxide.” https://oem.bmj.com/content/59/10/708
- “The Link Between Carbon Dioxide Retention and Sleep.” https://www.verywellhealth.com/carbon-dioxide-retention-and-sleep-3015339


“Effects of chronic carbon monoxide exposure on fetal growth and development in mice.” [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3297534/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3297534/)

“Instant Pot® CSG Multi-Use Programmable Pressure Cooker.” [https://instantpot.com/](https://instantpot.com/)

“The rising environmental carbon dioxide levels will significantly increase mental and physical health problems in the global population.”

**Steven Magee**

**Author of Solar Radiation, Global Warming, and Human Disease.**