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RESEARCH ARTICLE

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Autism and Dissolved Oxygen Levels in Drinking Water

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ABSTRACT

Autism spectrum disorders are a group of neurological and developmental disorders that affect how people interact with others, communicate, learn, and behave. Although autism can be diagnosed at any age, it is known as a "developmental disorder" because symptoms usually appear during the first two years of life.

The term "spectrum" is used to describe autism because there is wide variation in the type and severity of symptoms that people with these disorders have. Autism spectrum disorders affect people of all genders, ethnicities, and economic groups. While they can last a lifetime, treatments and services can improve symptoms and the ability to function for people with these disorders.

The incidence and prevalence of autism spectrum is growing rapidly, so it is important to develop effective strategies that allow us, rather than treating the signs and symptoms, to take effective actions to prevent the onset of the disease.
The levels of dissolved oxygen in drinking water have a surprising inverse correlation: the lower the levels of dissolved oxygen in the water with which there is regular contact, the higher the incidence and prevalence of the autism spectrum and vice versa.

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Background

Autism spectrum disorder is a construct used to describe individuals with a specific combination of impairments in social communication and repetitive behaviors, highly restricted interests and/or sensory behaviors beginning early in life. The worldwide prevalence of autism is just under 1%, but estimates are higher in high-income countries. Although gross brain pathology is not characteristic of autism, subtle anatomical and functional differences have been observed in post-mortem, neuroimaging and electrophysiological studies [1]. Autism spectrum disorder (ASD), also known as autism, is a common, highly heritable and heterogeneous neurodevelopmental disorder that has underlying cognitive features and commonly co-occurs with other conditions. The behaviors, strengths and challenges of people with autism have attracted the attention of scientists and clinicians for at least 500 years [2].

Manifestations of autism include impairments in social communication and interaction, sensory anomalies, repetitive behaviors and varying levels of intellectual disability. Together with these core symptoms, co-occurring psychiatric or neurological disorders are common in people with autism, of which hyperactivity and attention disorders (such as attention-deficit/hyperactivity disorder (ADHD), anxiety, depression and epilepsy are prevalent [3]. Epidemiological administrative and community-based studies have suggested that autism is more common in males than in females, with reported ratios ranging from 2:1 to 5:1, with an estimate of 4:1 in the 2010 Global Burden of Disease study [4]. Estimates of the prevalence of autism in various populations and settings differ according to the method of ascertainment used in the study, including definition, sampling and the extent of independent population case assessment in contrast to administratively based sources.

In the 2010 Global Burden of Disease study, an estimated 52 million people had autism globally, equating to a prevalence of 1 in 132 individuals [5]. Worldwide, little interpretable variation in the prevalence of autism between regions, ethnicities or services and resource provision has been reported. Indeed, one systematic review did not find a strong effect of ethnic, cultural or socioeconomic factors on the prevalence of autism [6].

Autism is not rare in older people; therefore, autism is increasing in prevalence over time [7]. Diagnoses of autism in children are increasing year by year [8]. This finding highlights the importance of obtaining information on autism rates in settings where professionals may be able to improve their recognition. The prevalence of autism in mental health inpatient settings is estimated to be far higher than in the general population, ranging from 4% to 9.9% [9]. Some studies identified environmental risk factors for autism as advanced parental age [10] and birth trauma, particularly if due to proxies of hypoxia

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[11]. Furthermore, maternal obesity, a short interval between pregnancies, gestational diabetes mellitus and valproate use during pregnancy have all been associated with increased risk of autism. However, these factors cannot be considered causal, but could be reactive, independent or contributory for autism. Other negative associations include prolonged labor, delivery by caesarean section or assisted vaginal delivery, premature rupture of membranes and the use of assisted reproductive technologies, among other factors. Environmental risk factors could trigger the risk of autism through several complex underlying mechanisms such as genetic and epigenetic effects, inflammation and oxidative stress, or hypoxic and ischemic damage. Among the difficulties in interpreting statistical data, already biased, are the numerous cognitive theories that have been suggested to underline the behavioral and developmental manifestations of autism, although the prominence and the consensus on the potential explanatory value of these theories have declined in the past decade [12].

Genetic Factors?

Twin and family studies consistently demonstrate that autism has a particularly large genetic contribution, with estimated heritability ranging from ~40% to 90% [13], which is surprisingly elevated. In addition, one analysis demonstrated that autism is among the most heritable common medical conditions [14] and therefore difficult to explain. More than 100 genes and genomic regions have now been confidently associated with autism [15], which, together with our lack of understanding about the behavior and function of genes, complicates things further. But the fact that so many genes involved have been identified that seem to fail simultaneously, tells us that in Autism, as in other diseases, there is a generalized failure. And in any system, when things point to it, the first thing we need to think about is energy.

Where Does the Energy for the Central Nervous System Come from?

Considering the different sources of information, the answer is unanimous: glucose. And since neurons supposedly combine glucose with oxygen to obtain energy, then we must think that both glucose and oxygen are basic elements for the supposed combustion process of said hexose to occur properly. Well, if either of the two is not available inside the cells or neurons in adequate quantity and form, then such combustion cannot be carried out or at least does not happen in an adequate way, that is: in time, place, and form. Then a question arises:

Where Does the Oxygen Inside Cells Come from?

The oxygen we have inside all our cells does not come from the atmosphere, but from inside it, as in plants. Specifically, from intracellular water, as in plants. And it is also through the dissociation of water molecules, as in plants. In other words, eukaryotic cells possess the ability to oxygenate themselves. But generating oxygen and hydrogen from the dissociation of the water molecules that eukaryotic or prokaryotic cells contain inside them is not a learned skill but is a fundamental piece for the origin and subsequent emergence of life. Furthermore, the process of water dissociation is exact, amazingly accurate, in both plants and animals, and it has not changed since the beginning of time since it is a fundamental part of the origin of life. We could say that first there was the generation of oxygen (and hydrogen), and from there began the sequence of the chemical logic of life. Which to date is preserved and cannot change. Any metabolic process inside our cells begins with the simultaneous generation of oxygen and hydrogen. So, the sequence is repeated over and over again, then the generation of oxygen inside the cell is incessant, because the requirements of cell metabolism are strict, so it cannot be otherwise. The dissociation of the water that the cell contains inside is constant and within very narrow ranges, and it cannot be otherwise. As soon as the turnover rate of the water dissociation process is altered, in less than 40 seconds, the cells undergo functional, then anatomical, and finally cell death (necrosis).

Brief Description of the Process of Water Dissociation

Protoporphyrin IX (PTP IX) is a molecule present in all forms of life, and the molecules possessed by living beings or specifically eukaryotic and prokaryotic cells, come from it. Examples include chlorophyll, hemoglobin, bilirubin, cytochrome P 450, myoglobin, etc. They characteristically dissociate irreversibly those water molecules present inside the cell, since they tolerate very little oxygen toxicity.

The irreversible reaction of protoporphyrin IX derivatives can be described as follows:

$$2H_2O_{(liq)} \rightarrow 2H_{2(gas)} + O_{2(gas)}$$

So far, the only molecule capable of tolerating the toxicity of oxygen and in turn transforming the power of light into chemical energy, through the dissociation and reforming of water, is melanin.

Therefore, the description of this reversible process is as follows:

$$2H_2O_{(liq)} \rightarrow 2H_{2(gas)} + O_{2(gas)} \rightarrow 2H_2O_{(liq)} + 4e^-$$

That is: for every two water molecules that reform, 4 high-energy electrons are generated. High-energy electrons are elementary particles that are easily exchanged and can come from any nearby atom or molecule, so it is usually almost impossible to know where they come from.

The Importance of Water Quality in Cell Metabolism

Water is known as the universal solvent, although theoretically other compounds may work even better for this purpose. But now that we know that water not only works as a solvent but is the perfect substrate for life since it is the source of oxygen (and hydrogen) par excellence for living beings, we better understand Nature's insistence on placing water as an indispensable requirement for the emergence of life.

To date, it is not known whether melanin or derivatives of protoporphyrin IX can use any other substrate that can be dissociated by these molecules, but from what has been

seen so far, water seems to be the perfect substrate for such dissociation to occur properly in time, form, and space. Any change in the physical or chemical properties of water affects the rate of turnover of the dissociation of the water molecule into the cell, to a greater or lesser degree; also depending on the pressure, temperature, degree of lighting, time of day, time of year, age, weight, height, sex, etc. And when it comes to pollutants, almost anything that falls into water changes its viscosity, dissolved oxygen levels, chemical and biochemical oxygen demand, transparency, charge, etc.

Therefore, our cells, organs and systems are sensitive or very sensitive to the physicochemical changes that water may undergo during its biological cycle, both inside and outside the cell; it is affected by a myriad of factors that ultimately result in the turnover rate that occurs inside both eukaryotic and prokaryotic cells. Let's not forget that the demands and requirements of cells are numerous and incessant, so the need for oxygen (and hydrogen) is all the time, both day and night; and when these needs or requirements are not adequately covered, functional alterations occur, then anatomical, and finally cell death (necrosis). And the cycle is similar in nature, since Oxygen is a fundamental requirement for all aerobic life, from the intertidal to the greatest depths of the ocean (and inside the cell). Oxygen is critical to the health of the planet and life, playing a direct role in the biogeochemical cycling of carbon, nitrogen, and many other key elements, both outside and inside the cell.

The increasing decline in dissolved oxygen (DOL) levels in fresh and salt water, and thus within living things, has not been adequately recognized by clinicians, academics, politicians or the public. Much less the broad consequences of such deoxygenation, that has worsened worldwide primarily because of climate change, agricultural runoff and inputs of human and industrial waste. (Figure 1).

Figure 1: World hypoxic areas (red dots) [16].

And since water with low levels of dissolved oxygen can cause any disease, given the variety of contaminants it can contain, then we have a parameter that is relatively easy to evaluate and compare with the incidence and prevalence of epidemiologically important diseases, such as autism (Figure 2).

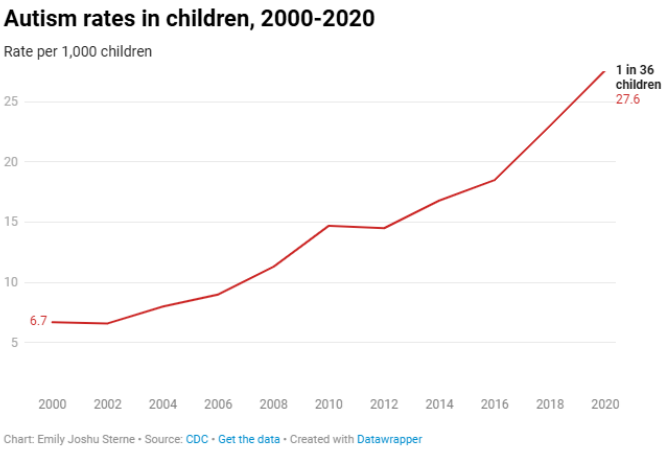

Figure 2: Autism rates in children in USA. 2000-2020.

A threshold value for hypoxia often used for estuaries and shallow coastal waters is 60 µmol kg−1 (approximately 1.5 ml l-1 or 2 mg l-1) [17], and areas with oxygen concentrations below this level are commonly referred to as dead zones.
The effects of deoxygenation in water are reflected in multiple ways in living beings, especially in marine life, which tends to decrease and finally disappear almost completely. And autism meets the requirements in this regard, that is, the diffuse effects of deoxygenation, in these cases at the CNS (Figure 3).

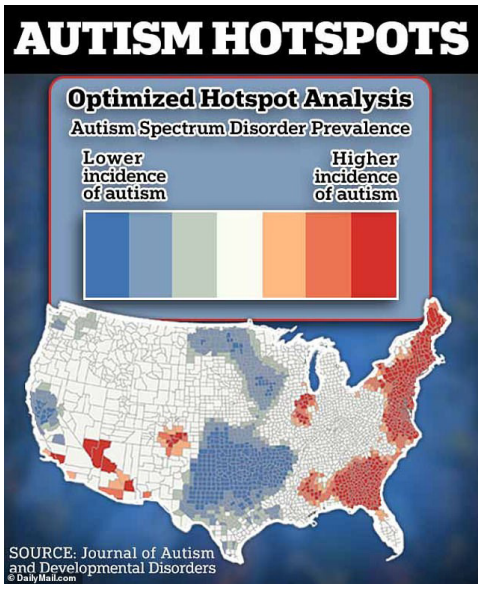

Figure 3: The incidence and prevalence of autism is graphically shown in this image. Source: Daily mail.

When comparing figures 1 and 3, a certain correlation is observed between the geographical areas most affected by water deoxygenation and the higher incidence and prevalence of autism spectrum syndrome.

The Relationship between Autism and Water Quality

Autism does not seem to have a specific anatomical substrate, nor does it have a single or specific symptomatology. In the central nervous system no characteristic alteration has been

found, much less punctual; rather, something like a diffuse dysfunction of the CNS is observed. Which is congruent with the diversity of symptoms; and its frequency is such that we are already talking about neurodiversity, that is: the mind, like the body, within certain limits, can have various forms and should not be considered as a disease but as an expression of biological diversity. In the case of the human body, there are varied phenotypic expressions (tall, medium, or short statures), in terms of body weight, also the manifestations are varied even in the same individual, and even in the same individual, weight varies significantly throughout the day, which was published by first time, by Sartorious in Italy, in the early 1600s. That is: the mind, like the body itself, can have various forms, in the case of the mind, they would be called thought mechanisms. These would be conditioned by the experiences that people experience throughout life, and from birth itself. These emotional and physical experiences shape patterns of behavior in the individual, which in the end condition some type of reaction when the individual faces situations like those he or she experienced in the past. And this physical and mental conditioning will happen in a different or abnormally biased way, when the person is exposed, in one way or another, to poor quality water (Figure 3).

Conclusion

Due to the non-linearity of marine processes and those inherent to the CNS, they are difficult to assess and may vary across systems. All regions of the ocean and the CNS are impacted by multiple stressors. The biological response to these is assumed to exhibit a strong variation and complexity. But finally, we have a specific piece of information to address and that is the levels of dissolved oxygen in both drinking water and salt water. And the response to the attention of these levels can be predicted if we compare the areas with the best levels of dissolved oxygen and the geographical areas with the lowest incidence and prevalence of Autism (Fig. 1 and 3), which coincide. So, immediately we have the answer to two important questions.

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