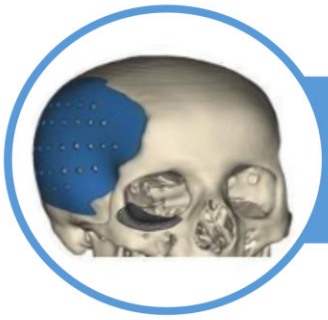

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FLUORIDE VS. IODINE: THE CORRELATION WITH HASHIMOTO'S SYNDROME

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LITERATURE REVIEW

ABSTRACT

Objective: To address the correlation between fluoride and iodine, showing how the interaction between them can cause thyroid problems such as Hashimoto's Syndrome. Methodology: In order to provide only relevant, current and scientifically based information, searches were carried out in the following databases to obtain undergraduate theses, master's dissertations, doctorates, post-doctorates and other articles published in magazines, newspapers and other reliable and renowned information bases such as: Web of Science, The Cochrane Library, Scielo, PUBMED Central, BVS/BIREME, PROSPERO, Science Direct, Nature in conjunction with Google Academy. Results: Studies show that there is a correlation between high exposure to fluoride and thyroid problems, through evidence that leads to the understanding that fluoride disrupts iodine metabolism, affecting the functioning of the thyroid gland. Conclusion: Iodine is a mineral that is essential for the human body, and it is a major contributor to the thyroid's hormone production. Fluoride is an element used in most toothpastes (fluoridated) and in drinking water in most regions, as it helps prevent tooth decay. Thus, it is seen that both fluoride and iodine have their importance in human life and functioning, however, a lack or excess of them can trigger serious problems, especially in the thyroid gland. Thus, it is seen as a conclusion that fluoride and iodine may be related to Hashimoto's syndrome because both influence the function of the thyroid gland.

Keywords: Fluoride, Iodine, Hashimoto's Disease.

FLÚOR VS. IODO: A CORRELAÇÃO COM A SÍNDROME DE HASHIMOTO

RESUMO

Objetivo: Abordar a correlação entre flúor e iodo, mostrando como a interação entre eles pode causar problemas de tireoide como a Síndrome de Hashimoto. Metodologia: Com o objetivo de fornecer apenas informações relevantes, atuais e com base científica, foram realizadas buscas nas seguintes bases de dados para obter teses de graduação, dissertações de mestrado, doutorados, pós-doutores e outros artigos publicados em revistas, jornais e outras bases de informações confiáveis e renomadas como: Web of Science, The Cochrane Library, Scielo, PUBMED Central, BVS/BIREME, PROSPERO, Science Direct, Nature em conjunto com o Google Academy. Resultados: Estudos mostram que há correlação entre alta exposição ao flúor e problemas de tireoide, por meio de evidências que levam ao entendimento de que o flúor desregula o metabolismo do iodo, afetando o funcionamento da glândula tireoide. Conclusão: O iodo é um mineral essencial para o corpo humano, sendo um dos principais contribuintes para a produção de hormônios da tireoide. O flúor é um elemento utilizado na maioria dos cremes dentais (fluoretados) e na água potável na maioria das regiões, pois auxilia na prevenção da cárie dentária. Dessa forma, vê-se que tanto o flúor quanto o iodo têm sua importância na vida e no funcionamento humano, porém, a falta ou excesso deles pode desencadear sérios problemas, principalmente na glândula tireoide. Dessa forma, vê-se como conclusão que o flúor e o iodo podem estar relacionados à síndrome de Hashimoto, pois ambos influenciam na função da glândula tireoide.

Palavras-chave: Flúor, Iodo, Doença de Hashimoto.

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INTRODUCTION

Hashimoto's syndrome, also known as Hashimoto's thyroiditis, is an autoimmune disease in which the immune system attacks the thyroid gland, leading to chronic inflammation and thyroid dysfunction, often resulting in hypothyroidism (Chaker et al., 2017). Genetic and environmental factors play a key role in the development of this condition, with iodine and fluoride often cited as modulators of the risk and progression of this disease (Leung et al., 2012; Peckham & Awofeso, 2014).

Iodine, essential for the synthesis of thyroid hormones, has a two-dimensional relationship with Hashimoto's syndrome. While iodine deficiency can compromise hormone production and cause goiter, excess iodine has been associated with increased thyroid autoantibodies, aggravating or triggering autoimmune thyroid conditions (Zimmermann & Boelaert, 2015). On the other hand, fluoride, known for its application in preventing dental caries, also has relevant interactions with the thyroid. Studies suggest that fluoride may compete with iodine in thyroid uptake, contributing to changes in glandular function, especially in populations with high exposure to the element (National Research Council, 2006; Peckham & Awofeso, 2014).

Thus, fluoride and iodine are of great importance to the human body, but in certain quantities they can harm the organism, especially in individuals with Hashimoto's thyroid. Therefore, the objective of this review article is to address the correlation between fluoride and iodine, showing how the interaction between them can cause thyroid problems such as Hashimoto's Syndrome.

METHODOLOGY

In order to provide only relevant, current and scientifically-based information, searches were conducted in the following databases to obtain undergraduate theses, master's theses, doctorates, post-doctorates and other articles published in magazines, newspapers and other reliable and renowned information bases such as: Web of Science, The Cochrane Library, Scielo, PUBMED Central, BVS/BIREME, PROSPERO,

Science Direct, Nature in conjunction with Google Academy. In addition, Rother's (2007) work was used during the creation and development of this narrative literature review article, as it is a study that addresses how a narrative review should be structured, its composition, approach, what is necessary and what should not be included in this type of article. Aiming to bring a more judicious way to the search for information to compose this article, the following descriptors were used so that only works related to this narrative review were searched: Fluoride, Iodine, Hashimoto's Disease. Grey literature was also used to enrich this work, bringing valuable, important and proven content, contributing more information to the article.

RESULTS

FLUORIDE AND THYROID

According to the author Waldbott (1965), fluoride was prescribed by a large number of European doctors with the aim of reducing thyroid activity in people suffering from hyperthyroidism. Thus, with fluoridated water, the population that consumes it would be medicated with a thyroid-depressant medication, which could trigger high levels of hypothyroidism within the population, which could cause even more problems such as fatigue, cardiovascular problems, weight gain and joint pain (Jameson & Weetman, 2020). According to the work of Galletti & Joyet (1958), fluoride exposure in fluoridated communities is approximately 1.58 to 6.6 mg/day, which is an index that exceeds a dose of 2.3 - 4.5 mg/day, which demonstrates a safety risk for people who are being exposed to high levels of fluoride, which justifies a decrease in human thyroid function. According to the double-blind study carried out by Waldbott et al. (1978), certain people within society are sensitive to fluoride and this information is a result of this same study. Thus, the introduction of fluoridated water may be the cause of hormonal and thyroid problems in a group of people who are susceptible and sensitive to fluoride.

According to Singh et al., (2014) and Susheela et al., (2012), fluoride is a universal activator/inhibitor of G protein, stimulation of the release of certain G proteins occurs from the toxic effects of fluoride, which has deactivating effects on the uptake of thyroid hormone in the cell. The thyroid mechanism is compromised, with the release of TSH

from the pituitary gland inhibited by fluoride, which will cause a reduction in thyroid production. Fluoride competes for the receptor sites in the gland that respond to TSH, causing this hormone to reach the thyroid, triggering a lower production of hormone by the gland.

According to the study by Popławska-Kita et al., (2014), there is a correlation between high fluoride exposure and thyroid problems, such as Hashimoto's thyroiditis or hypothyroidism, especially in people with low iodine levels. This same study also found that high levels of fluoride exposure trigger problems with iodine absorption, a claim that has already been scientifically proven, which leads many health professionals to recommend fluoride-free toothpastes to patients who are experiencing thyroid problems.

Peckham et al., (2015) carried out a study in which he analyzed populations that are exposed to high concentrations of fluoride in drinking water, causing a large amount of fluoride to come into contact with them. In this study, the presence of hypothyroidism was observed in several people, even in regions where there was iodine intake within the necessary and ideal amount, but which was unable to prevent the triggering of this problem in the thyroid of a large part of the population.

National Research Council (2006) was a study that analyzed the relationship between fluoride and iodine, where it can be seen that both can compete in the sodium/iodide symporter (NIS), which can reduce the absorption of iodine by the thyroid, compromising the hormonal production of people who already have iodine deficiency, which can trigger thyroid problems.

Zoe et al., (2013) was a study carried out with rats in which it was analyzed that the gland of these rats after prolonged exposure to fluoride, obtained histological changes and other problems such as: hyperplasia and hypertrophy of the thyroid follicles, in addition, functional changes were observed that indicate impairment in the synthesis of hormones produced by the thyroid gland.

Chen et al., (2007) conducted a study with rats in which he analyzed the impact after chronic exposure to subclinical doses of fluoride, with the aim of visualizing possible hormonal, oxidative and inflammatory changes in the thyroid. This study found that even moderate doses of fluoride can lead to an increase in TSH together with

inflammatory responses that in the long term can compromise thyroid function, potentially causing thyroid problems.

Kheradpisheh et al., (2018) was a study that evaluated the levels of T3, T4 and TSH in people who are within regions of low and high exposure to fluoride in drinking water, where it was seen that in regions of high exposure, a large part of the individuals had high levels of TSH which indicates possible hypothyroidism.

Basha et al., (2011) conducted a study in which the neurotoxic and metabolic effects of fluoride in rats were analyzed, focusing on analyzing thyroid function. In this study, it was seen that rats exposed to fluoride presented a drop in T3 and T4 together with behavioral changes, which suggests the relationship between fluoride exposure and the impairment of neurological areas.

Waugh (2019) carried out a study that analyzed epidemiological data and human studies, work that, after analyzing these ranges of information, was able to highlight how the chronic ingestion of fluoride through water can be associated with the presence of increased TSH, in addition to causing the origin of clinical symptoms of hypothyroidism in populations that are in vulnerable situations.

IODINE AND THYROID

Iodine is the most common element found in higher animals and is essential for human nutrition. In 1895, iodine was discovered as an essential element in the thyroid gland, and is widely used by this gland. An adult human body has about 20 to 30 mg of iodine in its composition, concentrated in the thyroid gland. Iodine is essential and used in the thyroid gland in the production of thyroid hormones: triiodothyronine (T3) and thyroxine or tetraiodothyronine (T4), which are responsible for human cellular metabolism, and their production and secretion are controlled by the hormone TSH released by the pituitary gland. One of the main problems affecting the thyroid is goiter, which is linked to low iodine intake in the diet or low absorption of the element by the gland. Due to this problem, ANVISA regulated that salt must contain between 20 and 60 mg of iodine per kg of product, added in the form of potassium iodate and not iodide, which is oxidized by atmospheric oxygen over time, being an option that avoids thyroid

problems (Medeiros-Neto, 2009).

According to the author Leung et al., (2012), excess iodine in the human body can be harmful, especially in individuals who are predisposed to autoimmune thyroid diseases such as Hasimoto's syndrome, at a time when high levels of iodine can stimulate the expression of thyroid antigens and lead to increased production of autoantibodies.

Zimmermann & Boelaert (2015) state that iodine deficiency is the main cause of goiter and hypothyroidism in regions where the population ingests insufficient iodine, which can cause individuals to have cognitive and metabolic problems. In addition, low iodine intake causes the thyroid gland to increase its activity, which can trigger its abnormal growth.

FLUORIDE VS. IODINE

One of the major issues addressed today is the relationship between iodine and fluorine, chemical elements that are halogens with similar physical and chemical properties, in addition to both being able to form compounds and their reactivity, with fluorine being more reactive than iodine. Thus, these similarities between these compounds can cause fluorine to interfere with iodine metabolism, affecting thyroid function.

Fluorine and iodine are essential components for the human body as a whole. Iodine is chemically much less active, being a halogen with less oxidative power than fluorine (Greenwood & Earnshaw, 1984). Fluorine has a higher electronegativity when compared to iodine, which makes it easier for fluorine to move around the body, affecting the functioning of the thyroid, acting more quickly, before iodine, damaging this gland. Thus, fluorine has been shown to be responsible for a large number of macroscopic and biochemical changes in the human body, especially when it comes to altered thyroid hormone levels (Singh et al., 2014).

IODINE AND FLUORIDE: CORRELATION WITH HASHIMOTO'S SYNDROME

Hashimoto's syndrome or Hashimoto's thyroiditis is an autoimmune condition in which the thyroid gland is attacked by the immune system, triggering inflammation of the thyroid and subsequently hyperthyroidism, a problem that may in fact be linked to the chemical elements iodine and fluoride. Iodine is essential for the production of T3 and T4 by the thyroid, and can lead to a person developing goiter or hypothyroidism if they are deficient in this element. However, excess of this mineral can trigger or aggravate autoimmune thyroid diseases, such as Hashimoto's thyroiditis, due to the fact that high levels of iodine can increase the production of antibodies against the thyroid, exacerbating inflammation. Fluoride is similar to iodine when it comes to its structure, and it can also compete with iodine for the same receptors in the thyroid gland. This competition can prevent iodine from being absorbed, disrupting thyroid hormone production, which can lead to hypothyroidism. Therefore, it is clear that a person with Hashimoto's Syndrome needs to have a balanced and personalized diet, avoiding excess iodine and monitoring their exposure to fluoride, avoiding or minimizing its intake, in addition to the need for monitoring by an endocrinologist to assess the body's T3, T4 and autoantibody levels (Zimmermann & Boelaert, 2015; Leung et al., 2012; Kahapola-Arachchige et al., 2017; National Research Council, 2006; Peckham & Awofeso, 2014; Chaudhri & Hooper, 2009).

DISCUSSION

The relationship between iodine, fluoride and Hashimoto's syndrome highlights the complexity of the interactions between environmental and genetic factors in thyroid health. Studies highlight that a balanced iodine intake is essential to prevent autoimmune disorders. While iodine deficiency can compromise hormone synthesis and lead to conditions such as goiter, excess iodine, even at levels considered moderate, can trigger or aggravate autoimmune thyroid diseases, such as Hashimoto's thyroiditis. This occurs due to the increased expression of thyroid antigens and the production of pro-inflammatory cytokines, which stimulate an autoimmune response.

In addition, the presence of fluoride in the environment has been associated with potential adverse effects on thyroid function. Fluoride, by competing with iodine in the sodium-iodide symporter (NIS) transporter, can reduce iodine uptake by the thyroid,

exacerbating iodine deficiency conditions in already vulnerable populations. Although fluoride exposure is widely considered safe at levels appropriate for preventing dental caries, recent studies suggest that high levels of exposure may interfere with thyroid function, especially in individuals with marginal iodine intake.

The interaction between fluoride and iodine in Hashimoto's syndrome highlights the importance of public health policies that consider the combined impact of these elements. For example, in regions where iodine supplementation is recommended, fluoride exposure should be carefully monitored to avoid adverse interactions. In addition, susceptible populations, such as women of childbearing age and individuals with a family history of autoimmune diseases, may benefit from regular assessments of thyroid function and specific guidance on iodine intake and fluoride exposure.

Finally, it is important to highlight that most of the available studies are observational and lack robust clinical trials that directly investigate the interaction between iodine, fluoride, and Hashimoto's syndrome. A deeper understanding of these mechanisms could guide more effective policies for the prevention and management of this autoimmune condition.

CONCLUSION

Iodine is a mineral that is essential for the human body, and it is a major contributor to the thyroid's hormone production. Fluoride is an element used in most toothpastes (fluoridated) and in drinking water in most regions, as it helps prevent tooth decay. Thus, it is seen that both fluoride and iodine have their importance in human life and functioning, however, a lack or excess of them can trigger serious problems, especially in the thyroid gland. Thus, it is seen as a conclusion that fluoride and iodine may be related to Hshimoto's syndrome because both influence the function of the thyroid gland.

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