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Photoprotection and Vitamin D: A Concise Systematic Review

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Abstract: One of the main factors for the increase in the incidence of skin cancer in Brazil today is exposure to solar radiation. The main means of prevention is through photoprotection, together with factors such as solar incidence in the region, the habits of the population, and the skin phototype. The relationship between photoprotection and vitamin D is fundamental for patient orientation since photoprotection is a practice widely used today for all people, both those who have already suffered some type of skin cancer and others who are at greater risk or not. to develop it. On the other hand, some studies suggest that the photoprotection of the skin would jeopardize the development of Vitamin D, which may cause its deficiency, and may subject patients to future changes in bone mineralization, increasing the risk of bone deformities and fractures since the vitamin D is essential for bone tissue and its production is stimulated by skin exposure to ultraviolet B radiation (UVB), with natural sources limited through the diet. The discussion about the relationship between photoprotection and vitamin D is essential to establish the right conditions for each patient.

Keywords: Photoprotection, Vitamin D, Prevention

1. Introduction

Annually about 540,000 new cases of cancer are detected in Brazil, of which 0.06% of the Brazilian population is affected by non-melanoma skin cancer, with overexposure to solar radiation is responsible for more than 120,000 new cases each year [1, 2].

Human skin is affected by Ultra Violet (UV) radiation, and its intensity and quantity vary according to the geographical position, time of year, and time of day. Unprotected skin is more susceptible to a set of processes that involve chemical and morphological changes that can lead to damage of varying measurements to the skin [1-3].

Due to the risks of excessive exposure to solar radiation, the need to alert the population about these risks and the importance of photoprotection as a therapeutic and prophylactic measure becomes increasingly urgent, since the main objective of photoprotection is to establish a physical barrier between the skin and solar radiation, to reduce the effects of UV radiation [2-4].

An important factor is a fact that exposure to the sun, in adequate doses, is essential for the synthesis of vitamin D. To reach the recommended value of 1,000 International Units (IU) of vitamin D per day, it takes a few minutes of exposure of at least 25% of the body. However, international recommendations were drawn from data from countries with low intensity of solar radiation, which tends to have high cases of vitamin D deficiency [1, 5, 6].

The controversy between exposure and non-exposure to the sun has led international entities, such as the American Academy of Dermatology, to position themselves, where based on scientific literature, careful exposure to the sun is recommended, as well as the use of all photoprotection measures regularly concomitant with vitamin D or dietary supplementation of vitamin D if necessary [4, 5-7].

In Brazil, it is essential to inform patients about the risks of inadvertent exposure to the sun as it is a country with a tropical climate and high levels of heatstroke, to reduce the number of new cases of skin cancer that are currently emerging today [1, 3, 4].

Therefore, the present study carried out a concise systematic review to seek and review data from the literature on the relationship between photoprotection and vitamin D to contribute to the up-to-date training of students and health professionals.

2. Methods

2.1 Study Design

The present study followed a concise systematic review model, following the rules of systematic review - PRISMA (Transparent reporting of systematic reviews and meta-analyzes-HTTP: //www.prisma-statement.org/) [8].

2.2. Search Strategy and Information Sources

The search strategy was carried out in the PubMed, Cochrane Library and Scopus databases, as well as Google Scholar in the search for doctoral and master's theses, using scientific articles from 2009 to 2017, using the MeSH Terms (keywords) **Fotoprotection; Vitamin D and Prevention**, and use of the Booleans "and" between MeSH Terms and "or" among historical findings.

2.3. Study Quality and Bias Risk

The quality of the studies was based on the GRADE instrument [9] and the risk of bias was analyzed according to the Cochrane instrument [10].

3. Results

After literary search criteria with the use of MeSH terms, a total of 68 studies were compared that were submitted to the eligibility analysis and, after that, 16 studies of high to medium quality were selected, with risks of biases that do not compromise the scientific basis of the studies (**Figure 1**)

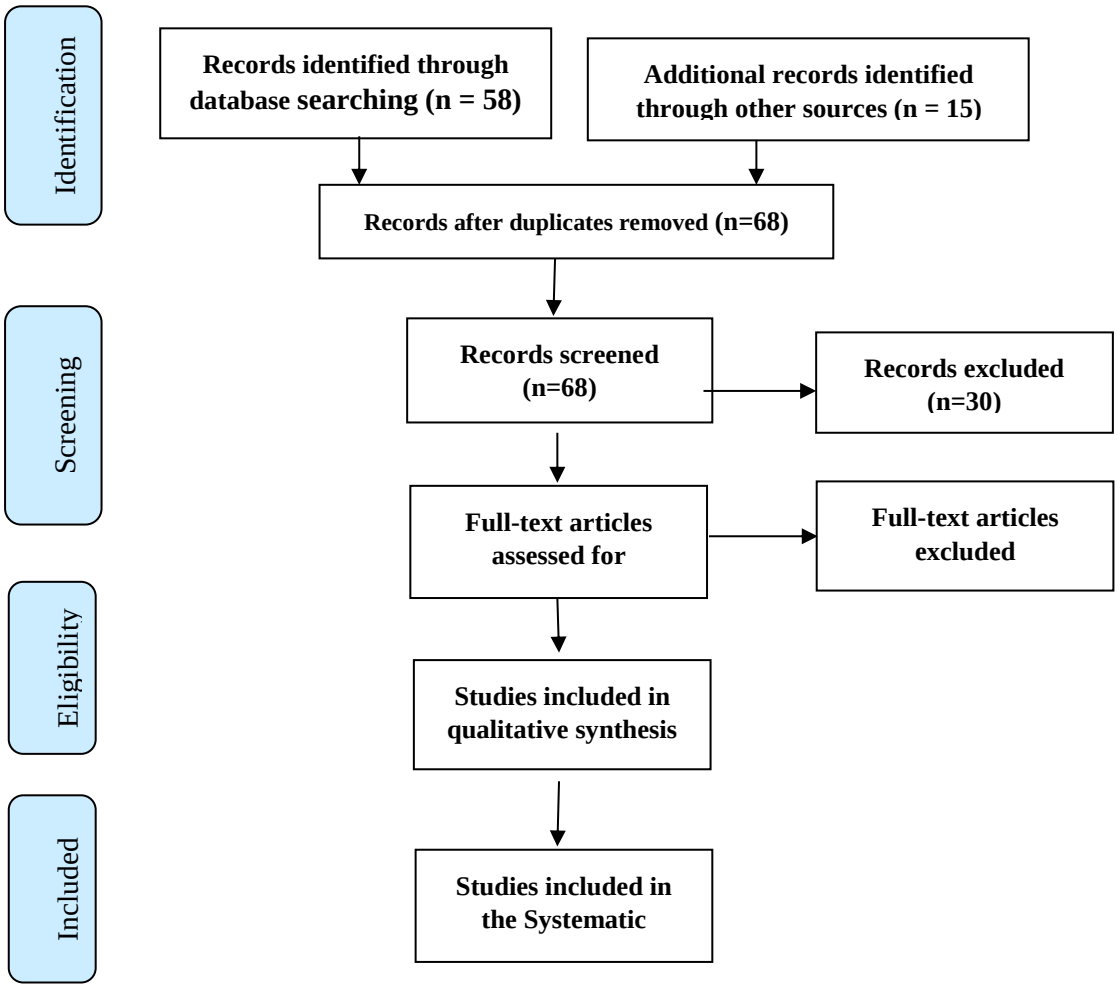

Figure 1. Flow Chart of Study Eligibility.

4. Major Photoprotection Approaches

Sun protection measures, or photoprotection, are currently widely used to prevent skin lesions, prevent the onset of cancer and delay premature aging. It is a set of measures to reduce or mitigate exposure to solar radiation of extreme importance since there is unequivocal evidence that intermittent sun exposure is associated with a greater risk [1, 4, 11].

According to Melo and Ribeiro (2015), photoprotection is the set of measures aimed at reducing exposure to the sun and preventing the development of diseases such as erythema, non-melanoma skin cancer, cutaneous melanoma, photoaging, and photo dermatoses [1]. This prevention must get along with prophylactic and therapeutic measures that cover photo education, protection through covers and glass, protection through the use of clothes and accessories, topical and oral photo protectors, combining natural and physical photoprotective measures and sunscreens [1, 2, 4].

The natural photo protectors are the factors that interfere in the UV radiation that reaches the Earth's surface, providing some type of block even if minimal in the exposure to solar radiation such as the ozone layer, clouds, fog, pollutants, time of day, season, climate, reflective surface, shade, and even the skin [3, 4, 7].

The physical factors are those called mechanical photoprotection measures, which include the use of clothes, hats, sunglasses, natural or artificial covers, and glass. Natural shadows (tree coverings) and artificial ones (umbrellas and covers) are efficient and practical, as well as clothes, however, these barriers are not fully effective making the use of sunscreen indispensable [2, 4, 7].

Sunscreens, or Ultra Violet (UV) filters, are active substances that act by mechanisms of reflection, dispersion, or absorption of the radiation that affects the skin. According to Melo and Ribeiro (2015), sunscreens can be divided into inorganic (or physical), which reflect radiation; and organic (or chemical), whose action is the absorption of radiation [1, 3, 4, 12].

Most of the existing sunscreens combine organic and inorganic filters in their formulations, to reach the level of expected efficiency and the most uniform coverage in the Ultraviolet (UVA) bands, radiation that penetrates deeply into the skin, the major responsibility for the aging of the cells of the skin. the epidermis, and UVB, radiation partially absorbed by the atmospheric layer of the earth, responsible for sunburn [1,2,4,7].

The commercialized sunscreens are made from the Sun Protection Factor (SPF), which has a greater relationship with UVB radiation, to measure how much a certain product is capable of effectively extending protection against sunburn than if the individual without the product [2,4,7]. There are recommendations to be followed for the correct application of the sunscreen, such as that it be applied in two layers, or increase the protection factor when using a single layer as a way to compensate for the inappropriate use. Periodic reapplication ensures better photoprotection, and the reapplication time depends on the sunscreen used, the type and intensity of exposure, contact with water and sweat, and the exposed area [7,12-14].

Also, according to Melo and Ribeiro (2015), in Brazil, all sunscreen must be registered by the National Health Surveillance Agency (ANVISA) as cosmetic, according to specific legislation, needing to be tested in vitro and in vivo methods [1]. However, Sun filters currently sold may not have all the necessary protection or may not have all the information on their labels. Thus, it is important not to consider the SPF as the only criterion of choice, one must pay attention to the photoprotective efficacy of the UVA, UVB, and visible light spectra [1,7,12,13].

Recent research shows advances in the development of oral photo protectors, which act at the cellular or molecular level after the incidence of solar radiation on the skin and reduce damage, combined with antioxidants that have a great influence on photoprotection [7,13,14].

5. Vitamin D – Major Considerations

Vitamin D or 25 hydroxyvitamin D (25 (OH) D) is an essential factor for the development and maintenance of bone tissue, and one of its most important benefits is to favor the absorption of calcium and mineral salts, being an important regulator of osteomineral physiology [6,15,16].

According to Marques, Dantas, Fragoso, and Duarte (2010), vitamin D, or cholecalciferol, is a steroid hormone, whose main function is the regulation

of calcium homeostasis, formation, and bone resorption, through its interaction with the parathyroid, kidneys, and the intestines [17]. Vitamin D production depends on exposure to sunlight (ultraviolet radiation in the range 290-315 nm), with 90% of cutaneous synthesis, which is quite variable and depends on several factors such as weather conditions, season, clothing, age, skin pigmentation, and use of sunscreen [5,18].

Vitamin D can also be found in foods of animal origin (fish, egg yolk, liver, and dairy products) and vegetables, and vitamin D levels may also vary according to hormonal, genetic, and nutritional factors [5,6,17,18]. The main chemical forms of vitamin D in nature and the human body are highlighted in **Table 1.**

Table 1. Main chemical forms of vitamin D in nature and the human body.

Colecalciferol or vitamin D3 - Present in foods of animal origin and vitamin supplementation;
Ergocalciferol or vitamin D2 - Present in cod liver oil and other fish (salmon, mackerel, and herring), in addition to vegetable and mushroom sources;
Calcifediol or calcidiol or 25-hydroxyvitamin-D3 or 25 (OH) D3 - Form usually dosed in the human body; has a half-life of 2 to 3 weeks;
Calcitriol or 1,25-dihydroxyvitamin-D3 or 1,25 (2OH) D3 - Active form in the human body; has a half-life of 4 hours and can be dosed under specific clinical conditions.

Currently, there is a wide discussion among scientific societies as to the serum levels of vitamin D - 25 (OH) D that would be associated with the risk of health complications. International guidelines agree that serum 25 (OH) D levels below 10 ng/mL should be avoided at any age, as well as an indication that children and adults with limited sun exposure should receive vitamin D supplementation. a large variation persists between the desired minimum concentrations and recommended doses of 25 hydroxyvitamin D (25 (OH) D) [15-18].

An increasing number of studies associate vitamin D insufficiency with an increased risk of developing several pathologies such as cardiovascular diseases, hypertension, neoplasms, diabetes, multiple sclerosis, dementia, rheumatoid arthritis, infectious diseases, preventing osteopenia, osteoporosis, osteomalacia, rickets, and fractures [17-19].

Alves et al (2013) affirm that "recent evidence correlates insufficient levels of vitamin D with an increased risk of developing other non-bone pathologies", also affirm that "sufficient plasma values of vitamin D are, therefore, fundamental to maintain good health in general" [18]. Vitamin D deficiency, when it reaches a rate of less than 20 ng/mL, is currently included among the main epidemics that afflict the general population, however, the threshold value and even the nomenclature used to describe vitamin D deficiency is still controversial, and names such as insufficiency, deficiency, hypovitaminosis can be used. The variability of laboratory methods and the absence of globally accepted reference values are factors that also hinder this classification [5,17-19].

For Castro (2011), the exposure time and the proportion of body exposed necessary for the adequate synthesis of vitamin D in the skin are difficult to define, so they cannot be defined in a general rule, because the concomitant factors for the synthesis of an adequate level of vitamin D are quite differentiated, and depend, since the season of the year, skin color, eating habits and clothing on genetic determination [15].

Final Considerations

The controversial relationship between photoprotection and vitamin D has been widely discussed to reach a consensus between adequate sun exposure for the synthesis of vitamin D and protection against the risks of this exposure. Higher SPFs due to factors such as greater sensitivity, less skin pigmentation, or other factors that require them to use concentrated filters for greater sun exposure, the occurrence of vitamin D concentration will be less than in those who did not protect themselves in the same way, but not enough to cause vitamin D deficiency.

It is an expected difference, however, without repercussion, because the photo protected people, despite lower average values, remain within the normal range and, therefore, do not tend to be deficient in vitamin D. Studies have shown that light-skinned people have demonstrated the ability to produce vitamin D with small daily exposures. Conversely, individuals who do not use any type of photo protectants, despite having higher levels of vitamin D synthesis, are among the risk group for the development of skin cancer.

This equilibrium relationship must be observed by the doctor, so that, with the analysis of all the factors presented, it can indicate more safely the adequate photoprotection in individuals at higher risk for skin cancer, without fearing the damage of the bones. The greatest concern must be related to sun exposure because, in practice, studies have shown that the regular use of photo protectors does not lead to Vitamin D deficiency.

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No additional data are available

Ethics Approval

Approval was sought and granted by the Departmental Ethics Committee.

Informed consent

Informed written consent obtained from the participant

Conflict of interest

The authors declare no conflict of interest.