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Vitamin D - is there a correlation between vitamin D level in serum and caries? - review of the literature with analysis of survey among Polish adults about supplementation of vitamin D

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ABSTRACT

Introduction: Caries is a common disease with a complex etiology, classified as a civilization disease. In Poland, it affects up to 90% of children. According to research, 99.9% of Poles between 34 and 44 years old have or have been suffering from caries - moreover, only 5.4% of those in the group have full dentition. An important role in the resistance to caries is adequate mineralization of hard tissues. The relationship between the level of vitamin D, which participates in proper bone mineralization and the presence of caries in the oral cavity, has been studied for years. In Poland, it is recommended to supplement vitamin D in children and adults from September to May and the whole year if skin production is insufficient.
Material and methods: The analysis of the correlation between the occurrence of caries and the level of vitamin D in the blood serum was made on the basis of articles published in the last 7 years, available in the database PubMed.
Results: Available researches from last seven years suggest strong correlation between level of vitamin D in serum and occupancy of caries among children.

Keywords: vitamin D, caries, severe early childhood caries

INTRODUCTION

Caries is classified as a civilization disease, it is one of the most popular infectious diseases in the world. In Poland, the frequency of caries among 6-year-olds is estimated at around 87%, up to 90% of children of all ages are affected by caries. Adult statistics are even worse - as much as 99.9% of adult Poles between 35 and 44 years old have caries and only 5.4% (!) of people in this group have full dentition. This is definitely more than in neighboring countries located on a similar latitude. [1,2,3]

Caries has a complex etiology, its essence is the destruction of dental hard tissues as a result of the action of acidic bacterial metabolites, resulting from the fermentation of sugars. Acidogenic bacteria that have a special role in the formation of caries include species: *Streptococcus mutans, Streptococcus salivarius* or *Lactobacillus acidophilus.* [4,5]

Prohormone - vitamin D is essential for proper mineralization of hard tissues, due to the fact that it regulates phosphorus and calcium level. In oral health the insufficient level of vitamin D in serum may lead to incomplete dentin mineralization in primary and permanent teeth, therefore, the teeth may be more susceptible to bacterial acids. Also, vitamin D is connected with the activity of the immunological system. This vitamin level in serum depends on social-economical status, age, latitude, season or diet. According to the literature - deficiency of vitamin D in serum is diagnosed when its concentration in serum decreases below 20 nmol/L. [6,7,8,9] At Poland's latitude in the autumn and winter season, Poles are not able to produce enough of this vitamin necessary for proper functioning in the sun. Recommendations for vitamin D supplementation in Poland are clear - this vitamin should be supplemented in children and adults in age-appropriate doses, from September to May or throughout the year if skin synthesis is insufficient. [10,11]

CORRELATION BETWEEN VITAMIN D IN SERUM AND PREVALENCY OF CARIES

Singleton et al., studied the relationship between the occurrence of severe early child caring (S-ECC) among Alaska Native children and the level of vitamin D concentration in core blood among Alaskan women. Studies have shown that children with vitamin D levels <30nmol/L in serum showed twice the value of dmft (decay-missed primary teeth) compared to children with> 30nmol/L levels of vitamin D in core blood. [12]

Seminario et al.,, also analyzed the relationship between the level of 25-hydroxyvitamin D in serum and early childhood caries among children with neurological and genetic disorders (ECC), considering the optimal level >75 nmol/L. Among children with lower than the optimal concentration of vitamin D in serum, ECC morbidity was significantly higher than in children with levels of vitamin D in blood above 75 nmol/L (13). Also, *Chhonkar et al.,* while investigating the level of vitamin D among children diagnosed with S-ECC, find out that as much as 97% of them (n = 30) were deficient with vitamin D (level in serum <20nmol/L) [9].

Also, a study conducted by *Kim et al.,* on a sample of 1699 children aged between 10 and 12, revealed a connection between the level of vitamin D and the intensity and presence of caries. The level of 50 nmol/L in the serum was considered to be the optimal level of 25(OH)D. In children with a suboptimal concentration of 25(OH)D in serum, the first moral caries occurs 1.3x times more often than in children with 25(OH)D level in serum above the optimum. [6]

A study conducted by *Benera et al.,* on children aged between 7 and 16 years, revealed that carries more often (59% of subjects) concerns people with vitamin D deficiency compared to people with its normal level (41%). Also, the time spent outdoors was correlating with the presence of caries - with the decrease in time spent in the sun, the prevalence of caries increased. [15]

Kühnisch et al., studied the teeth health of children (n=406), who supplemented vitamin D/fluoride was supplemented during the first year of life. Researchers were focusing on the occurrence of hypomineralization or caries of the first molars in the next ten years of children life. Research reveals that supplementation of the supplements during the first 12 months of life clearly reduces the probability of caries occurrence in the primary dentition, in comparison to children who maintained supplements for 6 months. However, at the same time, the quality and frequency of brushing teeth have not been studied. [16,17]

Research performed by *Akinkugbe et al.,* suggest correlation between deficiency of vitamin D and frequency of caries among adults - but emphasizes that this relationship is inconclusive. [18]

In the opposite to researches described above, *Herzog et al.,* did not find a statistically significant association between 25 and 12 years old and 25 (OH) D. [19]

According to available studies, many European countries lying at a similar or higher latitude than Poland, caries is less intense and less frequent children are affected. An example for Poland may be Denmark or France who can boast of more important ones. In Denmark, at a higher latitude than Poland, supplementation of vitamin D is not recommended. Studies conducted by *Hansen et al.* To check the level of vitamin D in plasma showed that only 10% of women and 15% of men show a deficiency of vitamin D in serum in the spring period. There are also studies on the Danish population

suggesting that some subgroups of the population are more likely to suffer from vitamin D deficiencies than others. [2,20]

MATERIAL AND METHODS

To analyze the correlation between the occurrence of caries and the level of vitamin D in the serum, researches from the years 2019-2012 were analyzed using information collected in the database PubMed.

The survey was created using Google Forms and published on various groups created on Facebook. The main target group was women of procreative age with children.

ANALYSIS OF PERFORMED SURVEY

In the first table, the majority of respondents, up to 93.6%, are female. Men constitute a fraction. That disproportion may be caused by the fact that the survey was mainly published on groups on Facebook associating young mothers. Most of the respondents declare their age between 21 and 40. Among respondents, 62% of both sexes indicated that it supplements vitamin D. More than half of the respondents - 52.4% of respondents- supplement vitamin D throughout the year, while 46.7% during the autumn and winter. Among men, the majority of vitamin D supplements during the autumn and winter period, while the majority of women throughout all year. The men's research group was relatively small in relation to the female group, so these data are not quantifiable.

Suvery results	All (n=234)	Female (n=219)	Male (n=15)
		93,6%	6,4%
Age range (n=234)			
15-20	1,3%	0,9%	6,7%
21-30	49,1%	46,5%	86,6%
31-40	47,9%	50,7%	6,7%
41-50	1,3%	1,4%	0%
51-60	0,4%	0,5%	0%
Do you suplement vitamin D?			
Yes	62%	57,7%	33,3%
No	38%	42,3%	66,7%
What time of year do you supplement vitamin D? (among people which supplement vitamin D) (n=140)			
	All (n=145)	Female (n=140)	Male (n=5)
In autumn and winter	46,9%	46,4%	60%
In summery time	0,7%	0%	20%
All year	52,4%	53,6%	20%

Table 1. Results of survey among adults.

Among the surveyed parents, as many as 95.9% declare that they supplement their vitamin D with their child/children. The majority of them, as many as 76%, declare that they supplement vitamin D throughout the year, and only 24% only in the autumn and winter period. good" condition of their child's teeth. Among children supplementing vitamin D in autumn and winter, 17.5% of children are rated as "good" by their parents. Among children supplementing vitamin D in the whole year, 11.7% of children have teeth assessed by parents as "good", and 1.9% of parents in this group determine the teeth of their child as in the "medium" condition.

Do you supplement vitamin D with your children?	
Yes	95,9%
No	4,1%
Do you know the pediatric's recommendation for vitamin D supplementation among children?	
Yes	92,9%
No	7,1%
What time of year do you supplement vitamin D? (among people which supplement vitamin D) (n=140)	
In autumn and winter	24%
All year	76%
The condition of the child's teeth, in the parents' opinion, among children supplementing vitamin D in the autumn and winter:	
Very good (the child does not have / did not have any carious cavities, no tooth was removed due to caries)	82,5%
Good - a few cured cavities, no teeth removed due to caries	17,5%
Medium - a lot of cavities, removed more than 2 teeth due to caries	0%
The condition of the child's teeth, in the parents' opinion, among children supplementing vitamin D throughout the all year:	
Very good (the child does not have / did not have any carious cavities, no tooth was removed due to caries)	86,4%
Good - a few cured cavities, no teeth removed due to caries	11,7%
Medium - a lot of cavities, removed more than 2 teeth due to caries	1,9%

Table 2. Results of survey's questions dedicated to people which take care of child.

Among the surveyed parents, as many as 95.9% declare that they supplement their vitamin D with their child/children. The majority of them, as many as 76%, declare that they supplement vitamin D throughout the year, and only 24% only in the autumn and winter period.

Survey results may be distorted by the fact that the questionnaire was carried out in the online form - the parent could easily check what are the pediatric recommendations for vitamin D supplementation and respond as they think they should, even though they do not supplement the vitamin D to their child. The questionnaire was also available on the organized mother's group with medical education - a sample of the population may not reflect the actual knowledge of the society.

SUMMARY OF LITERATURE REVIEW

Most of the authors (75%) from the analyzed literature, which examines the relationship of the vitamin D level between disorders of dental structures, suggest that there exist a correlation with the majority of research conducted on persons during bone mineralization (most of the studies were performed on children). According to studies, the effect of vitamin D on tooth mineralization begins already during fetal life - a deficiency of vitamin D in pregnant women was associated with a higher incidence of S-ECC in their children. A study conducted on adults is not conclusive as to the existence of such a connection. More accurate research is required, especially in the study of the association of vitamin D with the occurrence of dental caries among adults. This type of research is demanding and difficult to carry out due to the complexity of the etiology of caries.

CONCLUSIONS

Caries is a common disease with complex etiology. Correct bone mineralization, with which the level of vitamin D in the blood is associated, is an important defensive element against caries. Ensuring a proper level of vitamin D in the serum is only part of the fight against this disease. We can not consider this element, as a cause of caries alone neglecting education in the area of proper oral hygiene, among children and adults, or fluoride prophylaxis.

Performed survey suggest that the association of vitamin D with the prevalence of caries is not entirely clear, but available studies suggest a significantly strong correlation between the level of vitamin D in serum and the occurrence of caries among children.

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