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A Comparison of Vitamin D Levels in Chidren with Language and Speech Disorders and Healthy Children in the Turkish Population

Sağlıklı Çocuklarla, Dil ve Konuşma Bozukluğu Olan Çocuklar Arasında Vitamin D Düzeyinin Karşılaştırılması

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ABSTRACT

Objective: This study aimed to investigate the relationship between vitamin D [25(OH)] values with the language and speech disorders in children.

Material and Methods: A total of 200 children were included in the study, comprising 124 children, with stuttering (n=62), functional language disorder (n=40) and articulation disorder (n=22) as the patient group and a control group of 76 healthy children. Vitamin D levels were examined in blood samples taken from both the patient group and the control group.

Results: Serum vitamin D levels were determined as 23.68 ± 10.95 in patients with articulation disorder, 17.82 ± 8.28 in patients with functional language disorder, 23.36 ± 10.01 in patients with stuttering, and 26.01 ± 7.4 in the control group. Serum vitamin D values were found to be statistically significantly ($p<0.001$) lower in children with functional language disorder than in the healthy control group. It was observed that vitamin D decreased as the severity of the stutter increased.

Conclusion: According to the results of this study, there can be considered to be an important connection between vitamin D level and functional language disorder. Nevertheless, further studies are needed to confirm these findings in children with language and speech disorders.

Key Words: Articulation disorder, Functional language disorder, Stuttering,Vitamin D deficiency

ÖZ

Amaç: Bu çalışmada, dil ve konuşma bozukluğu olan çocuklar ile vitamin D (25(OH)D3) düzeyi arasındaki ilişki araştırıldı.

Gereç ve Yöntemler: Toplam 200 çocuk çalışmaya alındı. Hasta olarak alınan 124 çocukta; kekemelik (n=62), fonksiyonel dil gelişim bozukluğu (n=40) ve artikülasyon bozukluğu (n=22) vardı. Kontrol grubuna 76 sağlıklı çocuk alındı. Hastalarda ve sağlıklı çocuklarda plazmada vitamin D seviyesine bakıldı.

Bulgular: Vitamin D seviyesi; kekemeliği olanlarda 23.36±10.01, fonksiyonel dil gelişim bozukluğu olanlarda 17.82±8.28, artikülasyon bozukluğu olanlarda 23.68±10.95, kontrol grubunda 26.01±7.4 olarak saptandı. Artikülasyon ve kekemelik ile kontrol grubu arasında vitamin D açısından anlamlı fark bulunmadı. Fonksiyonel dil gelişim bozukluğu olan çocuklarda, sağlıklı gruba göre vitamin D değeri daha düşüktü ve istatistiksel olarak anlamlı bir fark saptandı ($p<0.001$). Ayrıca, kekemelik şiddeti artıkça vitamin D seviyesinin düşük olduğu saptandı.

Sonuç: Bu çalışmanın sonuçlarına göre, vitamin D düzeyi ile fonksiyonel dil gelişim bozukluğu arasında önemli bir bağlantı olduğu düşünülebilir. Ancak, yine de, dil ve konuşma bozukluğu olan çocuklarda bu bulguları doğrulamak için daha fazla çalışmaya ihtiyaç olduğu kanaatindeyiz.

Anahtar Sözcükler: Artikülasyon bozukluğu, Fonksiyonel dil bozukluğu, Kekemelik, Vitamin D eksikliği

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INTRODUCTION

Speech and language have an important place in daily life and are the means by which interpersonal communication takes effect. Language has two basic components, which are receptive language, defined as the intake and understanding of verbal stimuli through the sensory-neural network and hearing-perception processes, and expressive language, which is mediated through sensory-neural and motor-neural functions (breathing, speaking, resonance, articulation mechanisms) (1). An important consensus has been reached that there is complex interaction between biological, epigenetic, environmental and psychosocial factors in both the perceptive and expressive directions of language development (2,3). The prevalence of developmental language disorders in pre-school and school-age children has been estimated to vary between 1% and 12% (4).

In recent studies, vitamin D deficiency has been found to be related to many chronic diseases including widespread cancers, cardiovascular diseases, metabolic syndrome, infectious and automimmune diseases (5-8). In addition, vitamin D, which is a prohormone with neuroactive content, has been determined to be extremely active in cell differentiation and proliferation and peroxidisation regulation in various structures, including the brain (9). Vitamin D receptor has been identified in animal studies and in the human brain (10). It has also been shown in animal studies that developmental vitamin D deficiency leads to permanent learning and memory disorders in the long term (11). It has been reported that vitamin D deficiency could have an effect on the etiopathogenesis of diseases such as schizophrenia, autism, depression and multiple sclerosis (12,13).

To the best of our knowledge, there are no studies in literature that have shown a relationship between vitamin D levels and language and speech disorders. The aim of this study was to investigate the relationship between vitamin D level and speech disorders in patients with language and speech disorders.

METHOD

The study was conducted between January 2017 and February 2018. Approval for the study was granted by the Research Ethics Committee (Protocol: 19/2017). Written informed consent for study participation was obtained from the parents or legal guardians of the children. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Functional language disorder consists of three subgroups: expressive language disorder, language learning difficulty and specific language disorder. The three groups were included in this study. These patients had complaints of speech delay, inadequacy of speech or inability to form sentences. Spontaneous utterances (produced themselves or mimicked) of the children, as sounds, words or example sentences were recorded. The native 21 consonant phonemes and vowel phonemes were spoken by the patients. Letters and words that could not be said correctly were identified. When a consonant was said incorrectly, it was repeated at least 3 times and used within a word. The same procedures were applied to patients with articulation disorder and letters with a pronunciation problem were determined.

The rate of stuttering was determined during both speaking and reading. The Stuttering Severity Instrument-3 (SSI-3) form was completed to assess the severity of the stutter. The scoring was given equivalent to the point of stutterings during the speech function as 1, 3, 4-5, 6-7, 8-11, 13-21, 22+. The duration of the stutter was measured as <0.5 s, 0.5 s, 1s, 2s, 3s, 5 s,10 s, 30 s and 1 minute. Points were given according to this time. Head movements, extremity movements, distracting sounds and facial signs were scored between 0 and 5. Total scores were assessed and the SSI-3 score was calculated.

During the evaluation process of the children, a pediatric psychiatrist from the Department of Child and Adolescent Psychiatry was consulted. Children who were evaluated as normal by a child and adolescent psychiatrist according to the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV-TR) were included to this study (14).

The plasma level of vitamin D was measured. The total vitamin D measurements were analysed with automatic Advia Centaur XP immunoassay systems (Siemens, USA). The results were calculated automatically with standard deviations. A vitamin D level of < 20 ng/mL was considered as a deficiency, and >20 ng/mL as sufficiency.

In the power analysis applied, it was recommended that at least 22 patients were included in each group for the planned parameters of a 4-unit difference of vitamin D at significance level of a:0.05, and effect size of 0.5 values for power of the test at 0.80.

Participants were excluded from both the patient and control groups if they were taking drugs that affect serum vitamin D level (antitubercular, anti-epileptics, anti-retroviral drugs, vitamin A, vitamin D supplements) during the 3 months prior to the study. Children were also excluded if they were determined with organic language disorders, cerebral palsy, congenital hearing loss, effusion otitis media, lingual frenulum, genetic diseases, metabolic, vascular or autoimmune diseases, psychiatric or endocrine diseases or any other language disorder originating from disease or neurological injury.

Statistical Analysis

Data obtained in the study were analysed statistically using IBM SPSS vn 22 software. Conformity of the data to normal distribution was assessed using the Shapiro-Wilk test. Descriptive statistics were stated as mean, standard deviation

(SD), number (n) and percentage (%). For comparisons of the differences between categorical variables, the Pearson Chi-square test was applied, and in the comparison of mean values, the Student's t-test. A value of p<0.05 was accepted as statistically significant.

RESULTS

A total of 124 children, aged 4-15 years, with stuttering, functional language disorder and articulation disorder were included in the study. The patients comprised 22 with articulation disorder, 40 with functional language disorder and 62 with stuttering.The control group included 76 of healthy children.

The cases including to this study comprised 153 (76.0%) males and 47 (24%) females. The patient group had 100 (80.6%) males and 24 (19.4%) females with a mean age of 7.95±2.94 years. The control group consisted of 53 (69.7%) males and 23 (30.3%) females with a mean age of 7.40±3.19 years. There w as no significant difference between the groups in terms of age and gender (p>0.05) (Table I).

When the age group distribution was examined, there was seen to be a higher proportion of subjects having primary school period, followed by pre-school age children (Table I). Male patients were determined at the rate of 80.6% in the stuttering group, at 82.5% in the functional language disorder group and at 77.3% in the articulation disorder group. The functional language disorder patients had 4 with expressive language disorder, 10 with language learning difficulty and 26 with specific language disorder.

The mean vitamin D levels were 23.68±10.95 ng/ml in the articulation disorder group, 17.82±8.28 ng/ml in the language development disorder group, 23.36±10.01 ng/ml in the stuttering group, and 26.01±7.4 ng/ml in the control group. No difference was found between the articulation and stuttering groups and the control group in terms of vitamin D. There was, however,a significant difference was found between the language disorder group and the control group in respect of vitamin D values (p<0.001) (see Figure 1).

The mean vitamin D levels of the patient and control groups according to age and gender are shown in the Table II. The mean vitamin D values of the patients with articulation disorder, functional language disorder and stuttering and of the control

Table I: The demographic characteristics of the patient and control groups.

	Patient group		Control group		p
	n	%	n	%	
Age groups					
3-6 years	42	33.9	33	43.4	
7-10 years	55	44.4	30	39.5	**0.05**
11-15 years	27	21.8	13	17.1	
Gender					
Female	24	19.4	23	30.3	**0.05**
Male	100	80.6	53	69.7	
Total	124	100.0	76	100.0	

Table II: The mean Vitamin D levels of the patient and control groups according to age and gender Vitamin D values (ng/ml).

	Patient group	Control group	p
	Mean ± SD*	Mean ± SD*	
Age groups			
3-6 years	19.75±8.27	27.21±8.66	<0.001
7-10 years	24.15±11.09	25.46±5.96	=0.552
11-15 years	19.43±8.94	24.24±6.96	=0.97
Gender			
Female	20.91±11.69	26.57±8.57	=0.066
Male	21.81±9.53	25.77±6.91	=0.008

*SD: *Standard Deviation*

Tablo III. The mean Vitamin D levels (ng/ml) of the children with articulation disorder, functional language disorder and stuttering and the control group according to age and gender .

	Articulation disorder Mean ± SD*	Functional language disorder Mean ± SD*	Stuttering Mean ± SD*	Control group Mean ± SD*
Age groups				
3-6 years	19.17±5.88	18.46±7.97	23.91±10.03	27.21±8.66
7-10 years	28.09±13.31	16.63±9.00	26.22±9.71	25.46±5.96
11-15 years	19.47±6.02	-	19.43±9.46	24.24±6.96
Gender				
Female	17.88±7.46	16.59±10.17	24.69±13.33	26.57±8.57
Male	25.39±11.39	18.08±7.96	23.05±9.18	25.77±6.91

***SD:** Standard Deviation*

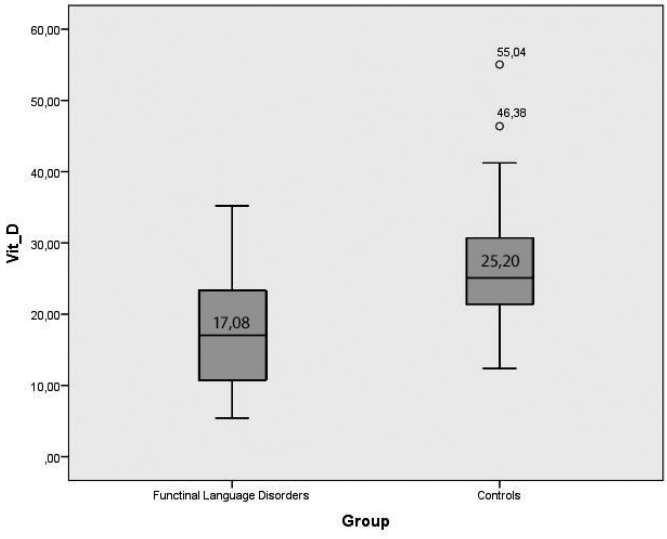

Figure 1 Evaluation of vit D in the patient and control groups with a box plot curve.

group children according to age and gender are shown in Table III. No statistically significant difference was determined between the articulation disorder and stuttering groups and the control group in the 3-6 years age group. One the other hand, there was a statistically important difference was determined between the functional language disorder group and the control group in this age range (p<0.001). In the 7-10 years age group, no significant difference was determined between the articulation disorder and stuttering groups and the control group, and a statistically significant difference was determined between the functional language disorder group and the control group (p<0.001). In the 11-15 years age group, no signficant difference was observed between the articulation disorder group and the control group, nonetheless, a significant difference was detected between the stuttering group and the control group (p=0.0004). As there were no children with functional language disorder in the 11-15 years age group, analysis could not be applied.

When the distribution of the disease subgroups was examined according to gender, a statistically significant difference was determined between females with articulation disorder and functional language disorder and the control group (p<0.05). No significant difference was determined between females with stuttering and the control group. For male patients, a statistically significant difference was determined between males with functional language disorder and the control group (p<0.001), and there was no significant difference was determined between males with articulation disorder and stuttering and the control group.The mean points of the SSI-3, applied to determine the severity of stuttering in patients was 25.2±11.2. In the SSI-3 evaluation of stuttering, the severity was determined as very mild in 13 cases (21%), mild in 17 (27.4%), moderate in 11 (17.7%), severe in 13 (21%), and very severe in 8 (12.9%). When the stuttering patients were examined according to severity, it was determined that as the severity of stuttering increased, so the vitamin D level decreased.

DISCUSSION

The results of the current study demonstrated that serum vitamin D values were statistically significantly lower in the functional language disorder group compared with the healthy control group. It was also determined that as the severity of stuttering increased, the level of vitamin D decreased. These results suggest that vitamin D deficiency could have a negative effect on cognitive functions and language development.

Language and speech require healthy brain function and are one of the most difficult human behaviors to measure. Language development shows a strong correlation with early cognitive development (15). Although the effect of cognitive ability on

language learning is not fully known, language development occurs with cognitive development and these two functions interact in the language learning process (16,17). Ouma et al. (18), reported that vitamin D supplementation has been determined to be useful in patients with mild cognitive disorder and Alzheimer's disease.

Experimental studies have shown that active vitamin D has neuroprotective potential and an anti-oxidant effect, which could affect the brain and neuron development (19,20). In human studies, vitamin D deficiency has been demonstrated to be associated with mood disorders, schizophrenia, multiple sclerosis and brain tumors (6,21,22). In those with Autism Spectrum Disorder, lower vitamin D levels have been reported (23). Vitamin D deficiency has been shown to be related to a series of events such as the acceleration of the progression of dementia, osteoporosis, vascular disease, and reduced smell function (6). It has also been associated with cochlear hearing loss, otosclerosis and Meniere's disease (24).

Previous studies have shown that nuclear receptors for Vitamin-D3 are localized in neurons and glial cells (25). The presence of vitamin D receptors in the brain shows that vitamin D has a function in this organ. Following the application of vitamin D, gamma glutamyl transpeptidase (gamma-GT) increased in the brain and this action was observed in parenchymal astrocytes and pericytes. Gamma-GT is thought to have a role in the elimination of reactive oxygen species and it has been hypothesised that vitamin D could be an effector controlling detoxification processes in the brain (26). According to this hypothesis, vitamin D strengthens intracellular glutathione pools and significantly reduces oxygen and nitrite production. These findings have revealed that gamma-GT, glutathione and vitamin D have a fundamental role in the astrocyte system, which at least partially explains the neuroprotective effects (27). In several experimental models, it has been reported that vitamin D has potential value for the treatment of neurodegenerative and neuroimmune diseases (26). When taking the speech centre as the target in the patients of the current study, it was considered that the effect at a neuronal level was a natural process.

Although many studies have been conducted on the subject of stuttering, the cause has still not been fully clarified (28,29). Stuttering is seen 4-fold more in males than females (30). In the pre-school period, physiological stuttering is often seen (31). In previous studies, magnesium, calcium and copper levels have been examined in the blood samples of stuttering patients (32-34). However, no previous study could be found that has shown a relationship between vitamin D and stuttering. The results of the current study showed no significant difference between the stuttering group and the control group but as the severity of stuttering increased, the vitamin D level was determined to decrease.

Mental diseases seen in childhood are known to be seen more often in male children (35). Harrison et al. (36) showed higher rates of speech and language disorder, hearing loss, and reactive mood in male children. Yasin et al. (37) reported stuttering in 77.2% of male patients presenting with the complaint of delayed speech. In the current study, males comprised 80.6% of the stuttering group, 82.5% of the functional language development disorder group and 77.3% of the articulation disorder group. In accordance with previous findings in literature, the rate of male children with speech problems was determined to be high.

Limitation: That there were few patients with articulation disorder was attributed to parents not seeing this as a disease and therefore not presenting at the polyclinic rather than there being few such individuals in society. As the majority of patients did not attend treatment and follow-up appointments regularly, evaluation of patients with low vitamin D after treatment could not be applied. This can be considered a limitation of the study. Furthermore, the fact that vitamin D levels are not separated according to seasons is another limitation of the study.

CONCLUSION

Language and speech disorders are health problems that are frequently seen in society. The vitamin D value was found to be low in patients with functional language disorder. It can be recommended that when treatment is planned, vitamin D deficiency should be evaluated in these patients. Nevertheless, there is a need for further clinical studies on this subject to reach stronger evidence-based conclusions.

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Informed Consent: Written informed consent was obtained from the parents or legal guardians of the patients who participated in this study.

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