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Original Article

Effect of Vitamin D Supplement on Axial Length of Myopes

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ABSTRACT

Myopia is triggered on by excessive axial elongation. Vitamin D deficiency somehow relevant to myopia genic visual cues. **Objectives:** To compare the level of vitamin D 25(OH)D in myopes and emmetropes and to access the effect of vitamin D 25(OH)D supplements in different degrees of myopia and compare the axial length. **Methods:** A Randomize Controlled Trail Study was conducted in Madina Teaching Hospital, Faisalabad on 60 subjects from September 2022 to April 2023 with age ranges 15-25 years. All were subjected to following examinations; BCVA, slit-lamp examination, A-scan and vitamin D level. The sample was randomly divided into two groups through Non-probability Purposive Sampling Technique. Group 1 was emmetropic, whereas group 2 exhibits various degrees of myopia. Group 2 takes up supplemental vitamin D followed by 1 month. **Results:** Mean age was 20.82 years ± 2.32. Out of the total 60 subjects, 24 (40%) were male while 36 (60%) were female.47 subjects (78.3%) reported having less than 4 hours of outdoor exposure while 13 subjects (21%) reported having more than 4 hours. Mean axial length 21.97 ± .80 and 22.66 ± 1.29 of emmetropes (p=0.008) while myopes 24.30 ± .91 and 24.13 ± 1.04 at baseline and after one month respectively (p=0.023). Mean vitamin D level was 18.36 ± 1.37and 17.13 ± 1.35 of emmetropes (p=0.00) while 15.63 ± 1.54and 16.90 ± 2.75 at baseline and after one month respectively (p=0.00). **Conclusions:** There was a significant association between low levels of vitamin D and the development of myopia in emmetropes and vitamin D supplementation can help to prevent the axial length elongation of myopes.

INTRODUCTION

Emmetropia is a type of refraction when a point at an indefinite distance from the eye is conjugated to the retina. An inaccurate focus on distant objects or a lack of proper focus is one of the signs of ametropia. When it comes to ametropic eyes, there are three different forms of astigmatism, hyperopia, and myopia. Myopia, on either hand, causes this growth to continue beyond the normal length, focusing light rays in front of the retina [1]. Both in Asia and the West, the frequency of myopia has substantially grown during the past few decades. Although a myopic refractive imperfection can be corrected visually with glasses, contacts, or refractive surgery [2], the greater axial length [26 mm] increases the permanent risk of severe vision impairment and blindness due to retinal problems [3]. Myopia is brought on by a developmental mismatch between the optical parts of the eye [4]. the most prominent of which is early childhood-onset excessive axial length (AL) lengthening [5]. Public health experts urgently need to identify the cause of myopia and devise prevention strategies [6]. Associations with environmental variables such time spent outside [7] and education [8] as well as genetic risk variation have been widely documented. The development of myopia and iris color have a relationship as well [9, 10]. High myopia (6 D) has been associated to a number of ocular diseases, including cataracts and retinal detachment [11, 12]. According to the findings of past studies high myopia may be a risk factor or a predictor for the early start and development of glaucomatous optic nerve damage [13, 14]. Epidemiological researchers have identified several possible risk factors for myopia development throughout the years. Compared to people who spent more time indoors, individuals who spent more time outside had a lower incidence of myopia, according to studies [15]. This gave rise to the hypothesis that vitamin D may potentially moderate this connection [16]. Vitamin D insufficiency and inadequacy have been documented worldwide among individuals of all ages, including children, from all socioeconomic backgrounds [17, 18]. Myopia was linked to the concentration of serum 25-hydroxy vitamin D (25OHD), according to recent international investigations [19]. There remains controversy about whether this reflects the association between myopia and outdoor activity or to what extent vitamin D contributes to the pathogenesis. Serum 25(OH)D is produced from a variety of sources. Cholecalciferol, or vitamin D3, is generated in the skin during exposure to sunlight [20]. Following the nutritious absorption of meals like fatty fish, it is also absorbed by the digestive tract [21]. Consumption of foods containing yeasts and fungi leads to the production of ergocalciferol (vitamin D2) [22]. In the liver, both precursors undergo hydroxylation to produce 25(OH)D. After transformation in the kidney [23], its active metabolite 125(OH)2D is created and then transported to other parts of the body. In non-supplemented individuals, exposure to sunlight is thought to be the main predictor of 25(OH)D [24]. In addition to its major involvement in controlling the metabolism of calcium and phosphate in bone tissue and plasma, 125(OH)2D also plays metabolic roles in insulin metabolism [25]. It can play a role in immunological responses, DNA transcription, and methylation, as well as neurological diseases such Parkinson's disease and cognitive decline [26]. Whether 1,25(OH)2D directly affects eye growth is still unknown. The purpose of the study was to compare the level of vitamin D 25(OH)D in myopes and emmetropes and to access the effect of vitamin D 25(OH)D supplements in different degrees of myopia and to compare the axial length of myopes after intake of supplements vitamin D.

METHODS

At the Madina Teaching Hospital in Faisalabad, Pakistan, a Randomize Controlled Trail Study was conducted from September 2022 to April 2023. With the support of the Raosoft sample size calculator, the sample for this study has been estimated. The research had 60 participants (N=60), who were split into two groups. Group 1 as control group which included emmetropes which has no refractive error, whereas group 2 as interventional group which included people with different degrees of myopia. Myopia is the type of error in which distant vison blur. There were 30 participants in each group. The participants were chosen using the non-probability purposive selection approach. Participants in the research were 15 to 25-year-olds of both genders with a best corrected visual acuity (BCVA) of 6/6, mild to severe myopia (Mild Myopia: up to 3D, Moderate Myopia: 3D to 6.0 D, Severe Myopia: Above 6 D), and a healthy body mass index (BMI). The research was not included anyone who have ever used atropine, bifocals, or had their corneas reshaped, as well as those with a history of pathological myopia, corneal illness, drug use, strabismus, refractive surgery, or myopia treatments like those. Furthermore, people who previously took supplemental vitamins as well as those who had systemic diseases including diabetes, Marfan's syndrome, or Down syndrome that are related to myopia were eliminated from the analysis. The study which involved 60 patients, received approval from the ethics committee of the University of Faisalabad. All procedures were explained to patients in advance of the trial, and their informed consent was obtained. The components of the individual profile include age, gender, myopia degree, time spent outside, parental history, ocular history, and systemic history. At the outset, visual acuity was assessed using LogMAR (ETDRS). Both objective and subjective refraction were performed using Canon's autorefractometer and Essilor's trail box, respectively. Axial length is measured using A-Scan (Alcon). Serum 25-hydroxyvitamin D [25(OH)D] levels were assessed in blood using liquid chromatography/tandem mass spectrometry. Cobas e 411, a fully automated electrochemiluminescence immunoassay (ECLIA)-based analyzer, was used to measure the blood serum vitamin D levels. If the total vitamin D level is less than 30 nH/ml, hypovitaminosis D was considered. Patients were then randomly split into two groups. Patients in group 1 were all emmetropes, but those in group 2 had varying degrees of myopia. The emmetropes control group's axial length, vitamin D levels, and spherical error were measured at baseline and one month later. As a control group, the emmetropes group received no treatment. Just observe the parameters at baseline and at one month. The interventional group of myopes had their baseline vitamin D levels, axial length, and spherical error evaluated. For a month, they additionally got vitamin D supplement one tablet daily (Qalsan D Tablet); the parameters were then assessed. The study's data analysis was conducted using SPSS software, version 22.0. The distribution of participants' ages was examined using descriptive statistics. Applying frequency distribution, the gender,

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degree of myopia, and quantity of time spent outside were presented. To compare the variations in axial length, vitamin D level, and spherical correction before and after one-month, paired t-tests were used. This statistical test was used to compare the means of these variables within each participant before and after the one-month period. Independent t-tests were also run to compare the vitamin D levels, axial length, and spherical correction between two different groups. Group 2 was made up of myopes, whereas Group 1 was made up of emmetropes. The means of these variables between the two groups after one month could possibly be compared using this statistical test. The study's conclusions were regarded as significant at a 5% level of confidence.

RESULTS

This study focused on patients aged 15-25 years who were included as the study's subjects. The minimum age was 16 years, while the maximum age was noted 24 years. The mean age of the participants was calculated to be 20.82 ± 2.32. To understand the age-wise distribution of the study population, descriptive statistics were applied (Table 1).

Table 1: Age Distribution

Age	N	Minimum	Maximum	Mean ± SD	
	60	16	24	20.82	2.32

The figure presented in the study displays the frequency distribution according to gender of the participants. Out of the total 60 subjects, 24 (40%) were male while 36 (60%) were female. Frequency analysis was used to demonstrate the gender distribution in both groups (Figure 1).

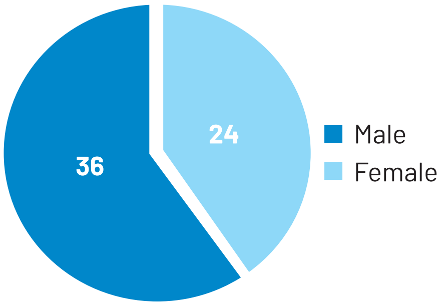

Figure 1: Gender Distribution

In this study, outdoor exposure was one of the factors assessed. A total of 60 subjects participated in the study, and among them, 47 subjects (78.3%) reported having less than 4 hours of outdoor exposure. The remaining 13 subjects (21%) reported having more than 4 hours of outdoor exposure. The frequency distribution was used to present the data on outdoor exposure time in the study population. The information on outdoor exposure time is important because it may have an impact on the vitamin D level and development & progression of myopia (Figure 2).

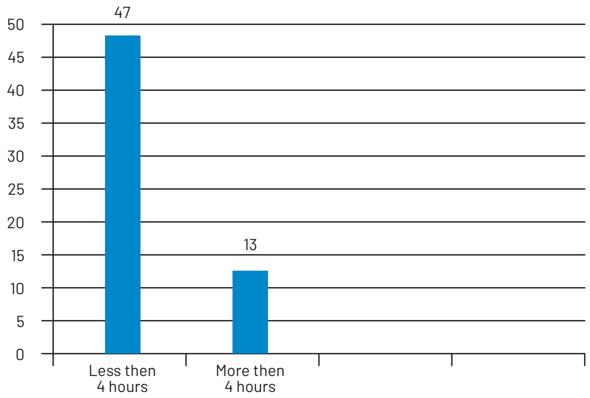

Figure 2: Frequncy of Outdoor Exposure

In the current study, the degree of myopia was divided into three subclasses: mild (up to 3 diopters), moderate (up to 6 diopters), and high myopia (above 6 diopters). A frequency distribution was conducted which showed that 6 subjects in the mild category, 16 subjects in the moderate category, and 8 subjects in the high myopia category (Figure 3).

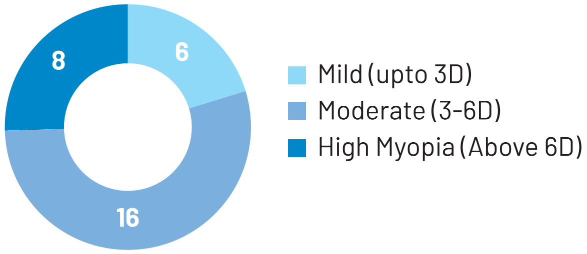

Figure 3: Degree of Myopia

A paired sample t test was conducted to evaluate the axial length of myopes and emmetropes at baseline and after one month. The result showed significant increase in axial length of emmetropes before mean=21.97 ± 0.80mm to after 22.66 ± 1.29mm (p=0.008). While in myopes the result showed significant difference in before 24.30 ± .91mm to after 24.13± 1.04mm (p 0.023). As myopes intake vitamin D supplements for the duration of one month which corelate with the hypothesis, effect of vitamin D supplement on axial length of myopes (Table 2).

Table 2: Comparison of axial length of myopes and emmetropes at baseline and 1 Month Follow-up

Parameter	Axial Length	Mean ± SD	p-value
Emmetropes	Baseline	21.97 ± 0.80	0.008
	After 1 Month	22.66 ± 1.29	
Myopes	Baseline	24.30 ± 0.91	0.023
	After 1 Month	24.13 ± 1.04	

A paired sample t test was conducted to evaluate the vitamin D level of myopes and emmetropes at baseline and at one month follow up. The result showed significant reduction in vitamin D level of emmetropes before mean 18.36 ± 1.37 ng/ml to after 17.13 ± 1.35 ng/ml (p 0.00). The result showed significant increase in vitamin D level of

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myopes before mean 15.63 ± 1.54 ng/ml to after 16.90 ± 2.75 ng/ml (p=0.00). As myopes are the part of interventional group, it received vitamin D supplements which show raised level as compare to control group (Table 3).

Table 3: Comparison of Vitamin D level of myopes and emmetropes at baseline and 1 Month Follow-up

Parameter	Vitamin D Level	Mean ± SD	p-value
Emmetropes	Baseline	18.36 ± 1.37	0.00
	After 1 Month	17.13 ± 1.35	
Myopes	Baseline	15.63 ± 1.54	0.00
	After 1 Month	16.90 ± 2.75	

A paired sample t test was conducted to evaluate the spherical correction of myopes and emmetropes at baseline and at one month follow up. The result showed onset of spherical correction in emmetropes as initially emmetropes have no refractive error. Mean 0.50 ± 0.125 SD (p 0.07) after 1 month in those emmetropes who have less level of vitamin D. The result showed significant reduction in spherical correction of myopes before mean 4.0 ± 1.90 D to after 3.01 ± 1.81D (p=0.00). As myopes are the part of interventional group, it received vitamin D supplements which show raised level of vitamin D which proposed to considered as halt of axial length progression (Table 4).

Table 4: Comparison of spherical correction of myopes and emmetropes at baseline and 1 Month Follow-up

Parameter	Spherical Correction	Mean ± SD	p-value
Emmetropes	Baseline	0.0 ± 0.00	0.07
	After 1 Month	0.50 ± 0.125	
Myopes	Baseline	4.0 ± 1.90	0.00
	After 1 Month	3.01 ± 1.81	

An independent t test was conducted to compare the axial length and vitamin D level for group 1 emmetropes and group 2 myopes at 1 month (Table 5).

Table 5: Comparison of axial length and vitamin D level of myopes and emmetropes at 1 Month Follow-up

Axial Length		
Parameter	**Spherical Correction**	**p-value**
Emmetropes	22.66 ± 1.29	0.00
Myopes	24.13 ± 1.04	
Vitamin D Level		
Emmetropes	17.13 ± 1.54	0.04
Myopes	16.90 ± 2.75	

DISCUSSION

The average blood 25(OH)D level in the participants in Veleva *et al.*, study ranged from 61,48 nmol/L (16-140 nmol/L; SD 20,15); 59,67 nmol/L (16-140 nmol/L; SD 19,30); and 71,91 nmol/L (33-111 nmol/L; SD 21, 79) in those who did not have myopia. The difference in serum levels between the two groups was statistically significant (p = 0,001) [27]. As 25(OH)D levels dropped, the likelihood of myopia increased (OR = 1.028). The results of the current investigation showed that the baseline mean serum values for myopes and emmetropes were 18.36 ± 1.37 and 15.63 ± 1.54, respectively, while the follow-up values were 17.13 ± 1.35 and 16.90 ± 2.75. Intake of vitamin D and a higher incidence of myopia are directly correlated, according to both studies' findings. In the myopia group, there was a significant positive correlation between the blood 25(OH)D tertile concentration and SE (p= 0.020), but not in the non-myopia group (p=0.599). Multiple linear regression studies nevertheless revealed a significant association between SE and low blood 25(OH)D concentration (p= 0.047) even after controlling for factors like domicile, parental income, total calorie intake, dietary Ca intake, milk consumption, and smoking history. The lowest tertile of serum 25(OH)D levels and the frequency of high myopia were significantly correlated after controlling for confounding variables (p 0.017). Low serum 25(OH)D levels have been associated with the frequency of myopia in Korean youths [28]. Present study concluded that spherical correction of emmetropes (p=0.07) there was onset of spherical refraction after one month in control group that is actually associated with low serum vitamin D level at baseline and one-month follow-up. While there is reduction of spherical correction of myopes (0.00) from baseline to one month as interventional group intake supplements. As compare to baseline there is increase in vitamin D level so there is reduction in spherical correction of myopes. In contrast to the 725 people who were not myopic, 221 (23.4%) of the 946 participants in Yazar *et al.*, study had myopia. In comparison to persons who were not myopic, myopic people reported decreased serum 25(OH)D3 concentrations (median 67.6 vs. 72.5 nmol, p 0.003) [29]. A lower serum 25(OH)D3 concentration was linked to a higher incidence of myopia in a univariable study (odds ratio [OR] for 0.001). Even after accounting for potential confounders such age, sex, ethnicity, parental myopia, education level, and ocular sun-exposure biomarker score, this connection maintained (p = 0.002). The current investigation found that, at baseline, myopes and emmetropes' mean serum measurements were 18.36 ± 1.37 and 15.63 ± 1.54, respectively, and at the one-month follow-up, they were 17.13 ± 1.35 and 16.90 ± 2.75. Myopia-related participants exhibited noticeably decreased levels of 25(OH)D3. People with low vitamin D levels were more likely to experience myopia than those with normal levels. Long-term studies are necessary to determine if raised serum levels of 25(OH)D3 are helpful at preventing myopia and whether they are simply a proxy for other biologically significant effects of sun exposure. In the Tideman study, questionnaires were utilized for measuring outdoor exposure, and an SNP array was used to identify SNPs linked to vitamin D. Using linear and logistic regression

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analysis, the associations between 25(OH)D and AL or myopia were examined. The average levels of 25(OH)D were 68.8 nmol/L, 27.5 average AL, 22.35 mm, and 0.7, and 2.3% of participants (n = 62) had myopia. The concentration of 25(OH)D (per 25 nmol/L) was negatively connected with AL after controlling for confounders (P0.01) and even more negatively correlated with AL after controlling for outdoor time (p 0.01). Myopia risk was OR 0.65 (per 25 nmol/L). The current investigation found that the baseline means serum values for myopes and emmetropes were 18.36 1.37 and 15.63 1.54, respectively, while the follow-up values were 17.13 1.35 and 16.90 2.75 [30]. At baseline and after a month of follow-up, the mean axial length of emmetropes in the current study was 21.97± 0.80 and 22.66 ± 1.29, while that of myopes was 24.30 ± 0.91 and 24.13 ± 1.04. Both research studies support the hypothesis that shorter AL and a higher prevalence of myopia were related with lower serum levels of 25(OH)D in these young infants. This would imply that 25(OH)D is more directly related to the aetiology of myopia.

CONCLUSIONS

Current study concluded a strong connection between low vitamin D levels and the development of myopia in those with emmetropia. Taking frequent supplements can stop myopia from progressing in myopes with low vitamin D levels.

Authors Contribution

Conceptualization: MJ
Methodology: NF, AK
Formal analysis: FQ, AMB
Writing-review and editing: FQ, AMB, SP

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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