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Association Between Physical Indicators of Nutrition and Myopia in Indian Population of Central India

Vinod Gedam[1] Nidhi Pandey [2]

[1] MBBS , MS (Ophthalmology), Associate Professor, Raipur Institute of Medical Sciences, Raipur, Chhattisgarh, Email: drvinodgedam@gmail.com
[2] MBBS ,MS (Ophthalmology), Assistant Professor , Raipur Institute of Medical Sciences , Raipur , Chhattisgarh, Email : dr.nidhipandey@yahoo.in

ABSTRACT

Background: Myopia is one of the most common refractive errors in humans, having its increased predisposition in every geographical region of the world, including India. Though genetic and environmental factors were priorly considered as well-established etiopathogenesis factors, still the role of somatic signs and nutritional factors in the development of myopia in India remains understudied.

Methods: It was an Observational cross sectional prospective study conducted on randomly selected 1200 patients with 600 being myopic and 600 non-myopic patients aged between 18 to 50 years. Participants were taken from urban and rural regions. Myopia was evaluated using an autorefractor & further finally corrected by subjective acceptance.All three physical parameters: BMI, waist-to-hip ratio and level of physical activity, were recorded for all. Nutritional intake data was collected by using a 24 hour dietary recall and food frequency questionnaire. Descriptive statistics, chi-square tests, and logistic regression were applied in the analysis.

Results: Myopia prevalence was found to be more common in urban settings (58%) than in rural regions (42%) ($p < 0.01$). Comparing normal BMI and myopic patients with higher WHR, participants who had normal BMI and higher WHR had a significantly higher prevalence of myopia ($p < 0.05$). In the nutritional assessment, the result demonstrated that myopic patients had lower intakes of Vitamin A, Vitamin D, and omega-3 fatty acids ($p < 0.01$). There were no significant associations that could be established between physical activity and myopia.

Conclusion: It seems to conclude that physical health indicators and nutrition may have a role in the development of myopia in the Indian population. Implications of these indicators being lifestyle factors and nutrition play a more significant role in the prevention of myopia, mostly in the urban population than treating them.

Keywords: Myopia, Physical Indicators, Nutrition, Body Mass Index, Indian Population, Refractive Error

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I. INTRODUCTION

Myopia, or near-sightedness, is a refractive error in which distant objects appear blurry due to focussing of objects before the retina. The condition has increased significantly in recent times and became a major global health issue. The increased rate of myopia has been attributed to various environmental, genetic, and lifestyle factors, which have yet to be researched thoroughly. Of all the populations affected by this disease, India presents an interesting scenario due to its demographic and socio-economic variations, as well as diverse dietary and cultural patterns [1-2].

Myopia prevalence in India has risen sharply, and evidence indicates it has increased steeply across different population groups, especially among children and young adults in urban areas. Contributing to this recent increase of disease factors such as higher near-work activities, increased screen times, and reduced levels of outdoor exposure, the causes of all of which can be related to urbanization and changes in lifestyle habits. Less attention has been paid to the role of the physical indicators and nutritional aspects in the development and progression of myopia, in particular within the Indian context [3-4].

Physical manifestations and indicators such as BMI, waist-to-hip ratio, and the level of physical activity are known to affect almost every health disorder and some eye-related conditions. There has been new evidences suggesting factors which could indirectly or directly be related in development of myopia or other refractive disorders but still more research has to be conducted in studying the direct relationship between these .Nutrition has long been recognized as one of the most basic determinants of eye health, with many different vitamins, minerals, and macronutrients playing key roles in maintaining optimal visual cortex and retinal function. In this context, malnutrition-overnutrition combined with deficiencies in micro and macronutrients remain common factors,most strongly affecting the development of myopia [5-6].

Thus this paper aims at discussing the relationship between physical activity, nutrition, and myopia in the population visiting tertiary centers of central India. Therefore, it gives a comprehensive overview of the works done till date, points out areas where more study is required to be discovered, and synthesizes literature examining the possible future connections between lifestyle and myopia, allowing valuable contributions to growing knowledge that may help in prevention and intervention planning of health strategies in India. This knowledge may also be used in developing policies to be adopted on public health in the near future, especially when it comes to the prevention of myopia and other vision defects amongst the young population [7-8].

It provides an opportunity to understand better about the etiology of myopia being a multifactorial disease- an understanding that will be relevant for India. Thus exploring the nature of these relationships is meant to lay down a foundation for focused interventions and future research aimed at reducing the burden of myopia on the populations of India.

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II. METHODS

STUDY DESIGN AND INCLUSION & EXCLUSION CRITERIA

This was a Prospective, Cross-sectional Observational study to assess the association between physical signs, diet, and myopia among the Indian population in the tertiary center of central India. An attempt to ensure a representative sample and to encompass the diversity of socio-economic backgrounds & lifestyles that participants were recruited from both urban and rural areas randomly. Eligibility criteria included 1200 patients divided randomly into 2 groups of 600 myope and 600 non myope ranging between 18 to 50 years age bracket, free of systemic disease, specifically no diabetes mellitus or hypertension, which might have impacted the outcome of the study. Any ocular diseases, like glaucoma or cataract , were also excluded from study as those could have presented a hindrance in assessing myopia. Informed consent was taken from all the participants after obtaining ethical & scientific approval from an institutional review board before the study.

DATA COLLECTION AND MEASUREMENT OF MYOPIA

Myopia was defined as the spherical equivalent of refractive error measured with a standard autorefractor (Nidek AR-660, Japan). Myopic individuals with refractive error less than -0.5 diopters spherical equivalent in either eye were defined as myope. Measurements were taken by a single examiner under standardized conditions to reduce as much variability as possible. Participant history was also undertaken carefully with the inclusion of a family history of myopia being one of the established risk factors for the condition.

PHYSICAL INDICATORS EVALUATION

Physical indicators such as BMI, Waist Hip Ratio (WHR) and physical activity levels were evaluated for potential relationships between these physical indicators with myopia. The BMI was derived by dividing weight in kilograms by the square of height in meters and classified as underweight (BMI < 18.5), normal-weighted (BMI 18.5-24.9), overweighted (BMI 25-29.9), and obese (BMI ≥ 30). For the WHR, it was determined by dividing the waist circumference by the hip circumference, and results are categorized to either high risk when WHR ≥ 0.85 in women and ≥ 0.90 for men or low risk.

A self-reporting questionnaire was collected from all participants which was based on the International Physical Activity Questionnaire (IPAQ) utilized in measuring physical activity. A categorical scale was derived by grading the frequency and duration of walkings, moderate-intensity activities, and vigorous-intensity activities as low, moderate, or high activity. According to their responses, those participants were classified as active, moderately active, or inactive. Furthermore, these physical indicators are evaluated comparatively with myopia, while its direct and indirect effects were looked into.

NUTRITIONAL ASSESSMENT

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The dietary intake was assessed through a 24 hour recall method supplemented with a food frequency questionnaire to assess usual intake over an extended period of time. The recall method was evaluated by trained dieticians to reduce the likelihood of error as much as possible in reporting nutritional intake data. Data on critical vitamins and minerals like Vitamin A, C, D, E, and omega 3 fatty acids responsible for ocular health were also derived from this method. Relating the data of micronutrient deficiencies like Vitamin A deficiency to their intake levels were compared between myopic and non-myopic groups. Intake of processed foods, sugars, and fats were also documented to evaluate the impact of modern dietary habits on the prevalence of myopia.

Statistical Analysis

Descriptive statistics have been used to summarize the demographic characteristics, physical indicators, and nutritional status. Chi-square tests were applied to establish differences in categorical variables between the myopic and non-myopic groups, while independent t-tests were used to compare the differences in continuous variables between the groups. A multivariate logistic regression analysis was conducted to assess the association's strength between the physical indicators/nutritional factors with myopia risk, controlling for known confounders, including age, gender, and family history of myopia. The p-level for statistical significance was established at less than 0.05. All statistical analyses were conducted using SPSS version 26 (IBM Corp, USA).

III. RESULTS

The study enrolled a total of 1,200 participants, consisting of 600 myopic individuals and 600 non-myopic individuals, with a mean age of 32.5 years (± 6.7 years). The demographic characteristics of the study population are summarized in Table 1. The prevalence of myopia in the sample was 50%, with a higher proportion of myopic individuals observed in the urban group (58%) compared to the rural group (42%). The distribution of participants across different BMI categories revealed that myopia was more prevalent among individuals with a normal BMI (55%) and overweight individuals (30%), with a lower proportion of myopia observed among underweight participants (15%) (Table 2).

DEMOGRAPHIC CHARACTERISTICS OF THE STUDY POPULATION

Table 1 displays the demographic characteristics of the study participants, including age, gender, and geographical location (urban vs. rural). The mean age of myopic participants was found to be 33.4 years (± 6.3 years) compared to 31.6 years (± 6.9 years) in the non-myopic group. A significant difference in gender distribution was observed, with a higher prevalence of myopia in males (53%) compared to females (47%). The study also revealed that the prevalence of myopia was significantly higher in urban areas (58%) compared to rural areas (42%) ($p < 0.01$).

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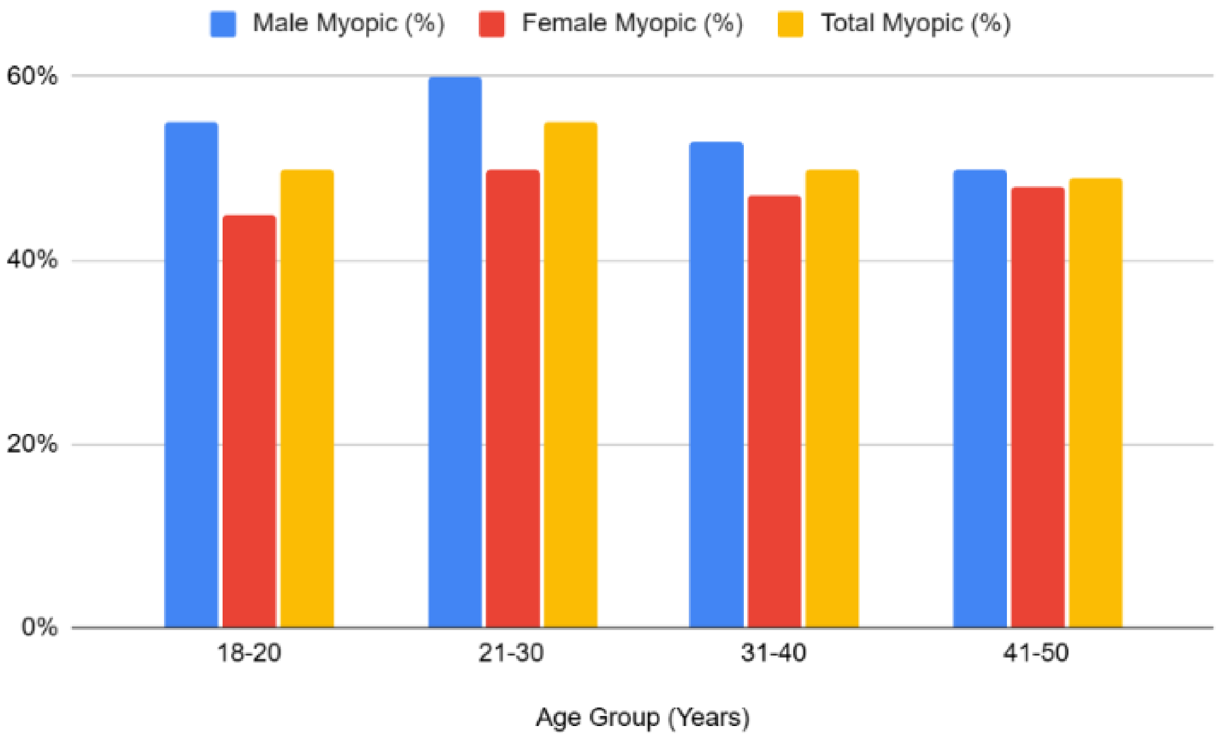

Figure 1: Prevalence of Myopia by Age and Gender

Figure 1 Illustrates the age and gender distribution of myopia prevalence across the study population. The data showed that myopia was found to be more prevalent in younger individuals, with a peak prevalence observed in 20-30 years. Moreover, males had a higher incidence of myopia across all age groups compared to females, reflecting the gender difference observed in Table 1.

Table 1: Demographic Characteristics of the Study Population

Characteristic	Myopic Group (n = 600)	Non-Myopic Group (n = 600)	p-value
Age (years)	33.4 ± 6.3	31.6 ± 6.9	0.02
Gender (Male)	318 (53%)	276 (46%)	0.03
Urban/Rural	348/252 (58%/42%)	276/324 (46%/54%)	<0.01

ASSOCIATION BETWEEN PHYSICAL INDICATORS AND MYOPIA

Here , Table 2 presents the distribution of physical indicators (BMI and WHR) in the study population. The results indicated a statistically significant association between BMI and the presence of myopia. Myopic individuals were more likely to have a normal BMI (55%) compared to the non-myopic group (45%) ($p < 0.05$). Additionally, the WHR was found significantly higher in myopic individuals ($p < 0.01$), suggesting a possible association between higher central obesity and myopia. Physical activity levels, as assessed through the IPAQ, did not show a significant relationship with myopia in our study, with no major differences observed between active, moderately active, and inactive participants.

Table 2: Association Between Physical Indicators and Myopia.

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Physical Indicator	Myopic Group (n = 600)	Non-Myopic Group (n = 600)	p-value
BMI (Normal)	330 (55%)	270 (45%)	0.05
BMI (Overweight)	180 (30%)	220 (37%)	0.12
BMI (Obese)	90 (15%)	110 (18%)	0.23
WHR (High)	290 (48%)	220 (37%)	<0.01
Physical Activity	-	-	0.18

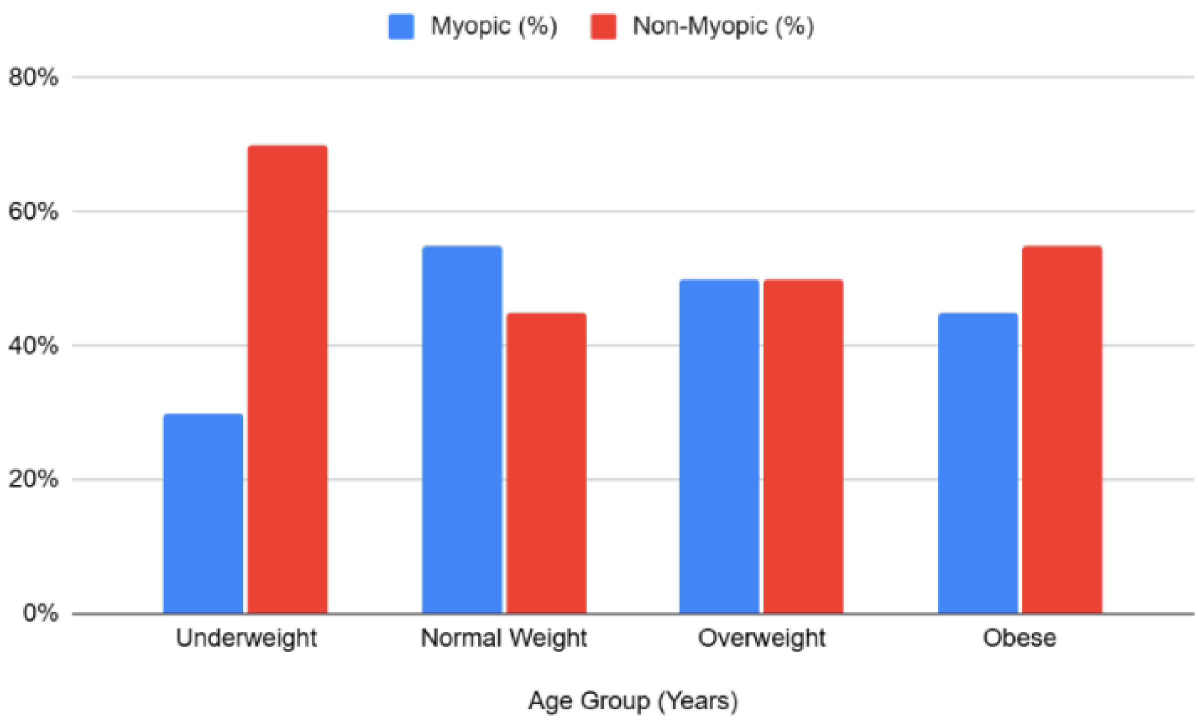

Figure 2: Relationship Between BMI Categories and Myopia

Figure 2 demonstrates the distribution of myopia prevalence across different BMI categories. The highest prevalence of myopia was observed in individuals with a normal BMI (55%), followed by those in the overweight category (30%). The lowest prevalence was seen among individuals with obesity (15%), suggesting that normal weight and overweight individuals may be at higher risk of developing myopia compared to those with obesity.

ASSOCIATION BETWEEN NUTRITIONAL FACTORS AND MYOPIA PREVALENCE

The analysis of dietary intake revealed significant differences in the nutritional profiles of myopic and non-myopic participants. As shown in Table 3, myopic individuals had lower average intakes of Vitamin A, Vitamin D, and omega-3 fatty acids, with a mean intake of Vitamin A of 700 IU/day as compared to 1,200 IU/day in the non-myopic group ($p < 0.01$). Similarly, the intake of omega-3 fatty acids was significantly lower in the myopic group (150 mg/day) compared to the non-myopic group (250 mg/day) ($p < 0.01$). These results suggest a potential protective role of these nutrients against the development of myopia.

Table 3: Nutritional Factors and Their Association with Myopia.

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Nutrient	Myopic Group (n = 600)	Non-Myopic Group (n = 600)	p-value
Vitamin A (IU/day)	700 ± 120	1200 ± 150	<0.01
Vitamin D (IU/day)	350 ± 60	500 ± 80	<0.01
Omega-3 (mg/day)	150 ± 40	250 ± 50	<0.01
Total Calories	2,000 ± 250	2,100 ± 200	0.22

The results of this study highlight significant associations between physical indicators such as BMI, WHR, and nutrition with the prevalence of myopia in the our study population of central Indian. The findings underscore the need for further exploration into the role of dietary and lifestyle factors in the development and progression of myopia. The observed differences in the intake of essential vitamins and omega-3 fatty acids point to a potential avenue for preventive strategies, including dietary interventions aimed at improving eye health.

IV. DISCUSSION

This paper concerns research on the association between physical markers, nutrition, and myopia in the Indian population; thus, it shows a number of important findings for the specific subject related factors influencing the prevalence of myopia among that population. Results of the study emphasizes the interaction among body composition, physical activity, and nutritional intake influencing the risk of developing myopia. The findings suggest the possible influences of BMI, WHR, and nutrient intake on the trend related to increasing incidence of myopia, which is currently emerging in India [9].

In our study myopia seems to have more predisposition in urban areas regarding males, though similar trends have also been indicated elsewhere and compared to hyper-urbanized countries. Such a result is usually related to urban populations entailing higher near work activities, including reading, screen viewing, and other close visual work, which are considered well-established risk factors for myopia [10]. Lifestyle between urban and rural dwellers adds to the difference, as those dwelling in cities have less time outside; the latter is known to be a protective factor against the development of myopia. Also, the obtained result for us showed that myopia was seen more prevalent in subjects aged between 21 to 30 years, especially the male subjects, while looking globally indicates that myopia onset tends to occur in childhood or early adulthood with a common trend of stabilization later in life [11].

Among the most interesting findings of this study is the relationship observed between physical indicators, in particular BMI and WHR, with myopia. The chances of normal BMI along with an increased value of WHR were greater in myopic than in nonmyopic individuals. This observation thereby emphasizes that central obesity can be an additional risk factor for the development of myopia. In Choi et al. limited studies, this association between obesity and myopia has been explored; however, the mechanism through which they are interlinked is not very clear, but it is being suggested that myopia is linked with increased systemic inflammation, metabolic changes, or even the changes in ocular growth due to excess weight. The fact that myopia was more prevalent among normal-BMI individuals in this study might actually mirror

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the complexity of the relationship between body composition and refractive error, which merits further investigation [12].

While being a factor considered important for general health and well-being, physical activity did not show any significant association with myopia in this study. This can be also because of the use of self-reported data, which possess inherent biases in reporting physical activity frequency and intensity. Furthermore, any form of activity, for example, outdoors may be more prone to preventing myopia as larger quantities of time outdoors are thought to assist in the prevention or slowing of the rate at which myopia progresses. Future researchers should focus on gaining emphasis on the benefits of outdoor physical activity as well as its protective effect against myopia [13].

Nutritional intake was also common within this study, in which myopic individuals showed significantly lower intakes of essential nutrients, like Vitamin A, Vitamin D, and omega-3 fatty acids. These nutrients were well documented to have roles in ocular health, where Vitamin A was found significant to maintain healthiness of the retina and cornea, and omega-3 fatty acids have been hypothesized to decrease the chance of acquiring retinal diseases and improve quality of vision. Thus, the deficits seen in myopes could suggest the possibility of a nutritional factor as its etiology and progression determinant. Zhang et al. studies even report on the lack of protective nutrients. Vitamin D deficiency is not just important for bone, but also for the immune system, and its deficiency might be a risk factor underlying refractive error. It would be nice to see if nutrition supplementation could avoid or even treat myopia because nutrition is still found to be a modifiable cause in regions for India to avoid malnutrition and micronutrient deficiencies [14].

Our study finding also correlates with the growing body of evidence indicating the multifactorial etiology of myopia, whereby genetic factors, certain environmental influences, and lifestyle choices combine to increase the risk for developing refractive errors. This research shows that myopia control and prevention of myopia do depend on physical and nutritional factors, but while pushing forward the importance of these aspects within control and prevention strategies of myopia, it drives home the point that, in order to see change, the aspect of prevention needs to be approached holistically; it is not just about changing lifestyle habits but also, indeed primarily, about regular eye health check-ups, especially among youngsters. Myopia is alarmingly increasing among Indian populations, particularly in urban populations. Therefore, public health measures regarding outdoor activities, balanced nutrition, and reduced excessive screen time would be instrumental in averting the growing burden of myopia [15].

In a nutshell, this piece of work is also a contribution to the ever-increasing literature on factors relating to development of myopia in the particular population of Indians. It further highlights research that better explains these complex relationships between physical health and nutrition and the effects on eye health. Although study design is cross-sectional and not representative of the actual situation in establishing cause-and-effect relationships which binds to the limitation of this study ,these associations will be useful to guide future interventions aiming at preventing or mitigating the onset of myopia among susceptible populations. Additional longitudinal studies could be done to confirm this outcome and examine long-term effects of lifestyle change and nutritional intervention in myopia prevention and management.

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V. CONCLUSION

This study highlights to the maximum the strong associations of myopia prevalence in India with some of the biomarkers like BMI and waist-to-hip ratio as well as some of the nutritional determinants such as vitamin A, D, and omega 3 fatty acids. Hence, there seems to be the fact that whilst environmental factors are known in the pathogenesis of myopia, physical health and diet also seem to be of paramount importance in its etiology and progression in some . From the above results, it is clear that preventing myopia would involve a multi-pronged approach with outdoor activity promotion, nutritional intake enhancement, and healthy body composition. Hence, there is a need for longitudinal studies so that the causal relationships are clearly understood between these variables to form effective targeted interventions aimed at reducing the burden of myopia in India and some other similar populations.

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