ANAEMIA AND REFRACTIVE ERRORS: THE OVERLOOKED ASSOCIATION

Physiology

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ABSTRACT

Refractive errors have been a handicap since ages. It can be corrected with the help of aid but can't be completely cured medically (in some cases surgical option may be viable). This study attempts to look at whether there's an association of refractive errors with anemia which can help in its management. Adults having refractive errors may also have anaemia-this observation was made infrequently in other parts of the country but not in the eastern part. It has been found that anaemia and refractive errors are widely prevalent among young adults in India, particularly medical students. So this study was conducted among young adults (hence confounding factors like diabetes, hypertension causing diabetic retinopathy, hypertensive oculopathy- usually present in middle aged to older adults which affect ocular health and cause secondary refractive errors can be avoided). In this study, medical students enrolled as study subjects were screened for refractive errors and anaemia. Certain inclusion and exclusion criteria were followed. It was found that the odds ratio of refractive errors being present in anaemic as compared to non-anaemic was 7.607. This points out to a significant association between anemia and refractive errors.

KEYWORDS

Refractive Errors, Anaemia, Association

INTRODUCTION

Symptoms of anaemia range from fatigue, weakness, shortness of breath, pale skin, dizziness, headaches to cardiovascular issues[1]. Uncorrected refractive errors like myopia (far vision worse than 6/6 of Snellen's Chart), hypermetropia (near vision worse than N6 of Jaeger's Chart), and astigmatism (corneal curvature irregularity) affect vision and cause headaches, impaired concentration affecting attention span hence studying which hampers peak academic performance. [2]Refractive errors aren't curable yet but can be managed with the help of aid/surgery.[2] Medical students who have just entered from school and shifted to an entirely new environment of a medical college cum hospital are at risk due to long hours of course work leading to stress and irregular sleep, imbalanced dietary habits which can worsen anemia leading to decreased interest in activities causing absenteeism thus declining academic performance.[1,3] Studies show a possible association between anemia and refractive errors. This type of study is uncommon in the eastern region of the country[4-11].

This novel research aims to study the prevalence of refractive errors and anaemia among first year undergraduate medical students of Medical College Kolkata.

MATERIALS AND METHODS

1) Study- This Observational, Institution based, Cross-Sectional Study was conducted in 220 first year MBBS students of Medical College Kolkata. Participants were enrolled in the study after receiving clearance from the Institutional Ethics Committee and informed consent; further selected based on Inclusion and Exclusion Criteria and thereafter tested for anaemia and refractive errors.

Inclusion Criteria
All first year undergraduate medical students of Medical College Kolkata who gave consent for participation.

Exclusion Criteria
Ophthalmological Exclusion Criteria:- Those who had history of diabetes/hypertension/glaucoma, any corneal ulcer/pterygium/conjunctivitis, eye injury/ surgery.
Hematological Exclusion Criteria:- Those who had received blood transfusion/donated blood in the last 3 months/ received treatment with haematinics in the last 3 months / history of any major blood loss in last 3 months / history of any visit exceeding ten days (in the last 3 months) to an area of high altitude.

Study Tools:- Snellen's chart, Jaeger's chart, Auto Refractometer, Trial lens, Trial frame, Automated Haemoglobin analyser- uses the principle of Spectrophotometry to analyse the haemoglobin level (thus eliminating human error).

Outcome Definition and Parameters- Anaemia is defined as hemoglobin <13g/dL in males and <12g/dL in females (WHO).[13]

Person is said to be myopic when the far vision is worse than 6/6 of Snellen's chart, hypermetropic when near vision is worse than N6 (Jaeger's Chart). Astigmatism, based on the degree of corneal curvature irregularity, leads to noticeable blurring and difficulty with both near and distant vision resulting in significant vision distortion and requiring stronger corrective lenses or surgery for effective correction.[2]

2) Anaemia Diagnosis- Blood samples were collected by the same investigator from study subjects following sterile procedure. Samples were then tested using the same Automated Haematology Analyser – Sysmex XT-2000i (model & make). It detects haemoglobin levels based on cyanide-free SLS (Sodium Lauryl Sulphate) method-in this, SLS reagent lyses red blood cells and then forms a stable coloured complex with haemoglobin which is measured photometrically (the toxic compound- cyanide is not used).

Anaemia was diagnosed as <13g/dL in males and <12g/dL in females as per WHO criteria.[13]

3) Diagnosis of Refractive Errors- The study subjects were screened for refractive errors :- myopia, hypermetropia and astigmatism at the Regional Institute of Ophthalmology, Medical College Kolkata.

Myopia- was tested in all subjects by using Illuminated Snellen's chart to an accurate degree using pin hole. If the distant vision of any eye was less than 6/6(without spectacles) then it was categorised as myopia. Using trial lens (concave) and trial frame, the subject's refractive error was corrected.

Hypermetropia- was tested in all subjects using Jaeger's chart; if the near vision of any eye without eyeglasses was less than N6 then it was categorised as hypermetropia and adequate correction with trial frame and trial lens (convex) was done.

Astigmatism- objectively determined by performing refraction test using Autorefractometer followed by confirmation with Manual Refraction test which is more reliable. Optimal vision correction was achieved using cylindrical lenses of appropriate power.

In subjects using spectacles, refractive errors were tested both with and without eyeglasses. Diagnosis of Refractive errors was made based on visual acuity without spectacles. If with spectacles the correction was inadequate then optimal corrections were done using trial frame and trial lens.

4) Data Analysis- Data was compiled in Microsoft Excel; analysed

with the help of statistical tests available in MS EXCEL and add-on Data Analysis Toolpak. Central Tendencies and suitable tests (Descriptive Statistics, Inferential Statistics) for statistical analysis were calculated to examine relationship among different variables at p≤0.05 level of significance; Pearson's Chi square test was used. The odds ratio was calculated to assess the strength of association between the variables.

RESULTS

The haemoglobin data from the study were analysed and the following statistical measures were obtained (p=0.02). Mean: 12.185 g/dL, median: 12.3 g/dL, mode: 12.3 g/dL, minimum: 7.5 g/dL, maximum: 15.5g/dL, Confidence Interval (95%): 12.185 ± 0.251 g/dL.
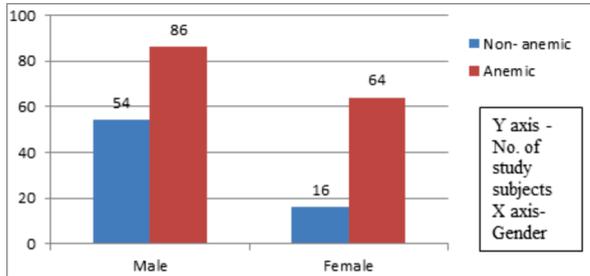

The following observations were obtained from the study (p < 0.0001):-

- 140 (63.6%) study subjects were males and 80 (36.4%) were females.
- 150 (68%) study subjects were found to be anaemic and 70 (32%) were non- anaemic.
- Among the males, 61.43% (86) were found to be anaemic and 38.57% (54) non-anaemic.
- Among the females, 80 % (64) females were found to be anaemic and 20% (16) non-anaemic.

The age (in years) distribution data from the study were analysed – mean: 20.26, median: 20, mode: 20, minimum: 18, maximum: 27, range: 9.

Out of total 220 study subjects, refractive errors were present in 191 and absent in 29. Among those in which refractive error is present, 115 (60.21%) were males and 76(39.79%) females. Among the 191 individuals who were having refractive errors; 161 had myopia, 9 had astigmatism, 4 had hypermetropia and myopia, 17 had myopia and astigmatism. Thus refractive error is prevalent in 86.82% study participants and absent in 13.18%. (p-value = 0.0000348547)
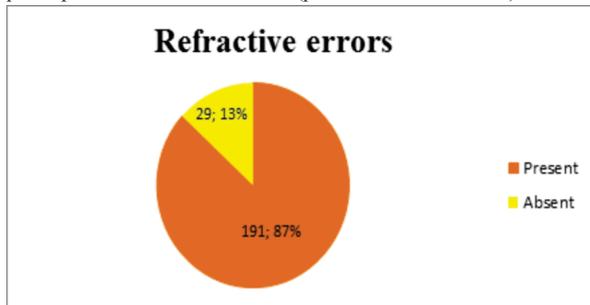
It was observed that prevalence of refractive errors in anaemic is higher than in non- anaemic.

The following table illustrates this:-

Status of anemia	Percentage of participants with refractive error.	Percentage of participants without refractive error.	Total no. of participants
Anemia present	94.67 (142*100/150)	5.33 (8*100/150)	150
Anemia absent	70 (49*100/70)	30 (21*100/70)	70
All participants	86.82 (191*100/220)	13.18 (29*100/220)	220

Statistical analysis showed that study participants having anemia had 7.607 times higher odds of having refractive error compared to those without anemia. The odds ratio was 7.607 with a p-value of <0.0001 (exact p-value = 0.0185091*10^{-27}).

This indicates a significant association between anaemia and refractive errors. The result was statistically significant. These findings suggest a noteworthy relationship between anaemia and the likelihood of refractive errors.

DISCUSSION

The association between anaemia and refractive errors is supported by theories suggesting that reduced oxygen levels hinder ocular tissue metabolism, potentially altering the eye's focusing ability. Some researchers propose that anaemia may worsen myopia by inducing compensatory elongation of the eyeball. Evidence from multiple studies reinforces this connection.[4-12]

Dr. Sood R.S. et al. (2014) reported anaemia and refractive error prevalence rates of 57% and 45%, respectively, and found that anaemia individuals were 2.5 times more likely to develop refractive errors.[4]

Tamilchudar et al. (2023) further observed a significant association between anaemia and accommodative disorders among college students. They attributed this to impaired ciliary muscle function and potential involvement of cranial nerves, affecting both accommodation and binocular vision.[5]

Dr. Nyiem M et al. (2023 study) found higher rates of both anaemia and myopia among young adults, confirming a notable correlation between the two conditions.[6]

Additionally, inadequate oxygenation may affect the optic nerve and retinal nerve fiber layer (RNFL), disrupting normal visual signal transmission.[7]

Anaemia is widely prevalent among young adults in India, particularly medical students, with estimates ranging from 40–55% and higher among females. Contributing factors include iron-deficient diets, academic stress, poor sleep, and irregular eating habits. The condition affects physical health, cognitive function, and academic performance, highlighting its multifaceted impact.[8-9]

Refractive errors are common in young adult population, with prevalence ranging from 50–87% among medical students. Increased near work, digital screen use, and limited outdoor exposure contribute significantly, with myopia being the most frequent issue. [4-12]

Al-Badran (2024 study) at Iraq found that anaemic individuals were 4.31 times more likely to have refractive errors.[12]

CONCLUSION

68% of study subjects were anaemic and 32% were non- anaemic. Refractive errors were prevalent in 86.82% study participants (60.21% males and 39.79% females) and absent in 13.18% of them. Among those with refractive errors 74.3% were anaemic and 25.7% were non-anaemic.

Statistical analysis showed that the odds ratio was 7.607 with a p-value of <0.0001. The result is statistically significant. This indicates a significant association between anaemia and refractive errors (which are more prevalent in anaemic than non- anaemic).

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