A study on the Association between Intraocular Pressure and Spherical Refractive Errors

Thesis

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List of Abbreviations

ACD	Anterior Champer Depth
AL	Axial Length
CCT	Central corneal thickness
CH	Corneal hysteresis
D	Diopters
DCT	Dynamic contour tonometry
GAT	Goldmann applanation tonometry
IOP	Intra ocular pressure
kPa	Kilopascal (1 kPa = 1000 Pa) which is equal to one centibar.
mmHg	Millimeter mercury
NITM	Near work induced transient myopia
OAG	Open angle glaucoma
OHT	Ocular hypertension
ORA	Ocular response analyser
TM	Trabecular meshwork

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Introduction

Intraocular pressure is measured with a tonometer as part of a routine eye examination. Measured values of intraocular pressure are influenced by corneal thickness and rigidity. A newer transpalpebral and transscleral method using diaton tonometer is not influenced by corneal biomechanics and does not need to be adjusted or corneal irregularities as measurement is done over upper eyelid and sclera. [1], [2], [3]

The average value of intraocular pressure is 15.5 mmHg with fluctuations of about 2.75 mmHg. Ocular hypertension (OHT) is defined by intraocular pressure being higher than normal, in the absence of optic nerve damage or visual field loss. Hypotony, or ocular hypotony, is typically defined as intraocular pressure equal to or less than 5 mmHg. Such low intraocular pressure could indicate fluid leakage and deflation of the eyeball. [4], [5], [6], [7]

The pathological increase in the intraocular pressure is one of the major risk factors in development of glaucoma, so it is an important aspect in the evaluation of patients at risk from glaucoma. And the only one to be treated. The link between myopia and glaucoma has been explored for

nearly a century. A number of studies, including the Blue Mountains Eye Study and the Beijing Eye Study, have found that the risk of glaucoma appears to increase in persons with moderate (>-3.00 D) to high myopia (6 D or more). Some studies show that there is a relation between hyperopia and ocular hypertension.[8], [9], [10], [11]

Population-based studies demonstrated that myopic eyes had a 1.6 to 3.3 times increased risk of glaucoma. One of the reasons making glaucoma more frequent in myopic eyes seems to be higher intraocular pressure (IOP) in myopic eyes compared with non-myopic eyes. [11], [12]

Aim of the Study

This study aims to find the association between intraocular pressure (IOP) and different grades of myopia from low to high and compare it with emmetropia and hypermetropia.

I- Myopia

Myopia, also called nearsightedness and shortsightedness, is a refractive error, in which the eye does not bend or refract light properly to a single focus at the retina to see images clearly but focus in front of it. In myopia, close objects appear clear but distant objects look blurred. [13],[14]

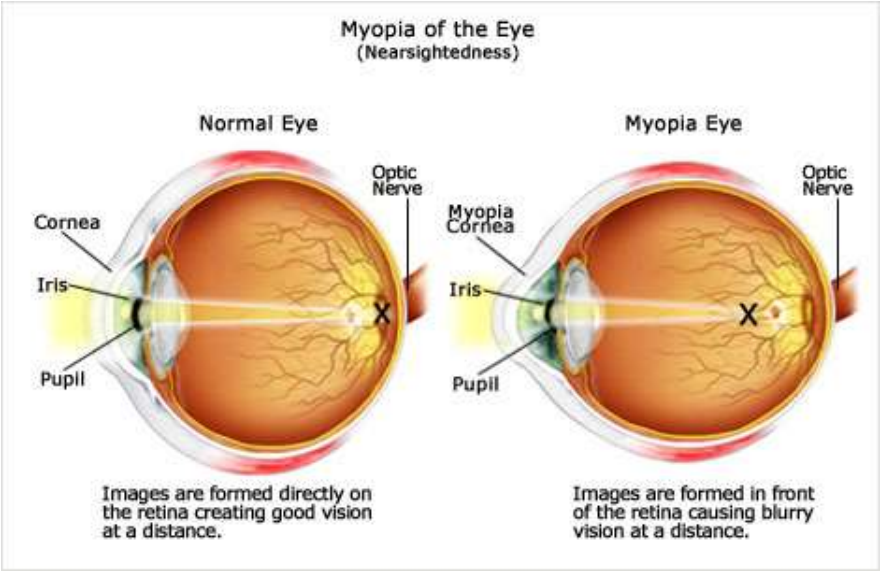

Figure (1): Myopia of the eye. [15]

The mechanisms involve the length of the eyeball being too long (lenghth) or less commonly the lens refractive power being too strong (index). The cause is believed to be a combined effect of environmental and genetic factors. Risk factors include doing work which

needs close objects focusing, greater indoors time, and a family history of myopia. [13],[16],[17],[18]

Epidemiology:

Global refractive errors have been estimated to affect 800 million to 2.3 billion. The incidence of myopia within sampled population often varies with age, country, sex, race, ethnicity, occupation, environment, and other factors. Variability in testing and data collection methods makes comparisons of prevalence and progression difficult.[19],[20]

The prevalence of myopia has been reported as high as 70–90% in some Asian countries, 30–40% in Europe and the United States, and 10–20% in Africa. Myopia is less common in African people. In Americans between the ages of 12 and 54, myopia has been found to affect African Americans less than Caucasians.[19],[20]

Classification of Myopia:

Myopia can be classified in many ways according to its cause, clinical appearance, degree and age of onset.

According to the cause;

Myopia classified by cause to:[21],[23]

Axial myopia: is caused by an increase in the axial length of the eyes.

Refractive myopia: is caused by the condition of the refractive elements of the eye. Which is further sub classified in to:

Curvature myopia: is due to excessive or increased curvature of one or more of the refractive surfaces of the eye, either the cornea or the lens.

Index myopia: is due to variation in the refractive index of one or more of the ocular media.

Elevation of blood-glucose levels can also cause edema (swelling) of the crystalline lens as a result of sorbitol (sugar alcohol) accumulating in the lens. This edema often causes temporary myopia (near-sightedness). Nuclear cataracts may lead to index myopia.[21],[22]

According to the clinical entity;

Various forms of myopia have been described by their clinical appearance:

- Simple myopia, more common than other types of myopia, is characterized by an eye that is too long for

its optical power (which is determined by the cornea and crystalline lens) or optically too powerful for its axial length. Both genetic and environmental factors, particularly significant amounts of near work, are thought to contribute to the development of simple myopia.[23]

- Degenerative myopia, also known as malignant, pathological, or progressive myopia, is characterized by marked fundus changes, such as posterior staphyloma, and associated with a high refractive error and subnormal visual acuity after correction. This form of myopia gets progressively worse over time. Degenerative myopia has been reported as one of the main causes of visual impairment.[21],[23],[24]

- Nocturnal myopia, also known as night or twilight myopia, is a condition in which an individual has a greater difficulty seeing in low-illumination areas, even though his or her daytime vision is normal. Essentially, the eye's far point of an individual's focus varies with the level of light. Night myopia is believed to be caused by pupils dilating to let more light in, which adds aberrations, resulting in becoming more near-sighted. A stronger prescription for myopic night drivers is often

needed. Younger people are more likely to be affected by night myopia than the elderly.[25],[26]

- Pseudomyopia is the blurring of distance vision brought about by spasm of the ciliary muscle.[27]
- Induced myopia, also known as acquired myopia, results from exposure to various pharmaceutical drugs, increases in glucose levels, nuclear sclerosis, oxygen toxicity (e.g., from diving or from oxygen and hyperbaric therapy) or other anomalous conditions. The encircling bands used in the repair of retinal detachments may induce myopia by increasing the axial length of the eye.[23],[28]
- Form deprivation myopia occurs when the eyesight is deprived by limited illumination and vision range, or the eye is modified with artificial lenses or deprived of clear form vision. In lower vertebrates, this kind of myopia seems to be reversible within short periods of time.[29],[30]
- Near work-induced transient myopia (NITM) is defined as short-term myopic far point shift immediately following a sustained near visual task. Some authors argue for a link between NITM and the development of permanent myopia.[31],[32]

- Instrument myopia is defined as over-accommodation when looking into an instrument such as a microscope.[33]

According to the degree;

Myopia, which is measured in diopters by the strength or optical power of a corrective lens that focuses distant images on the retina, has also been classified by degree or severity:

- Low myopia usually describes myopia of −3.00 diopters or less (i.e. closer to 0.00).[21],[23]
- Moderate myopia usually describes myopia between −3.00 and −6.00 diopters. Those with moderate amounts of myopia are more likely to have pigment dispersion syndrome or pigmentary glaucoma.[21],[23],[34]
- High myopia usually describes myopia of −6.00 or more. People with high myopia are more likely to have retinal detachments and primary open angle glaucoma. They are also more likely to experience floaters.[21],[23],[35],[36],[37]