The Frequency of Eye Color Variation by Age Group, its Effects on Aging Human Health, and Preventive Measures in Hyderabad, Sindh, Pakistan

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Abstract

The distinctive tint that a person's eyes exhibit is known as their eye color. It can include rich browns, vivid blues, enthralling greens, gentle grays, and charming hazels. The amount and distribution of melanin in the iris, the colored portion of the eye, determines the color. Every eye color has an attractive appeal of its own and could vary tremendously from person to person.

It's amidst the numerous unique traits that set each person apart. Due to heritage and the distinct gene combination that each person acquires from their parents, everyone has various eye colors. Melanin and lip chrome are the two principal pigments that are involved. Individual variances in the genes governing the creation and distribution of these pigments may contribute to variations in eye color. Thus, the stunning arrays of eye hues we see in the world are determined by a genetic lottery. The eye contributes in object representation along with color, light, and depth perception. This article addresses the frequency of eye color among individuals of various ages. In the current research, seven out of a hundred randomly selected individuals were discovered to have remarkably varied eye colors, reaming with brown and black shades and pertaining to varying age groups. It doesn't seem to gender-specific. It is comprised of five females (♀) and two adolescents (♂) in the age group of Hyderabad, Sindh, Pakistan. Black and brown were the most often noticed hues in the most recent investigation.

Keywords

Frequency, Eye Color, Age Group, Aging Impact, Preventive Measures, Hyderabad, Sindh, Pakistan

1. Introduction

The color of the eye is a heritable phenotypic attribute that is altered by the iris's pigmentation and scattering of light. The light penetrates the eye through the pupil, which is the center black opening surround by a ring of muscle and fibers of collagen. To describe the color of the iris which includes; blue, gray, green, hazel, and brown. The formal classification for an eye color range from simple three-color systems to those that take into account several colors inside a single eye since eye color varies across a continuous spectrum. The environment's dynamic light levels also have an effect on eye color, which causes varying opinions on an individual's eye color. Geographically and within subpopulations, the frequency of each eye color varies. Since the early 1900s, when researchers began studying patterns in children's and parents' eye colors and concluded that brown eyes are consistently more common than blue ones, eye color has been recognized to be a heritable character.

The two major attributes in the building up of an appearance of an individual within a population are eye and hair colour. The colour of the eyes and hair is very heritable. The percentage of heritability in eye colour varies with 61-100 per cent and the same is found in hair. Both the eye color and the hair color exhibits an immense disparity because of the type and the level of melanin pigmentation and the sensitivity to the ultraviolet radiations both in and among the populations. One of the most variable and having certain characteristics, human skin coloring of the eye and hair is primarily affected by the conjunction of hormonal and genetic conditions, in addition to being related to the environment and drugs, with age and exposure to the UV. One of the proteins that largely causes pigmentation of eye, hair and skin is melanin. Melanin is manufactured in melanin cells and is able to further manufacture two forms; eumelanin and pheomelanin. Eumelanin deals with brown and black colour whereas pheomelanin, with yellow and red. Melanogenesis plays an important role in SLC24A5 and ASIP gene [1].

The simplest way is the inheritance of the eye color is a Mendelian trait. 1 But on the greater part of the detection of more than two phenotypes, the eye color has a more complicated pattern of inheritance. Different shades of brown, gray,

hazel, green, blue, violet and red are the different shades of eye colors. The conventional opinion stood to be accurate when an allele that encodes brown over powers green or blue and green precedes blue [2].

It had been thought that Mendelian dominant and recessive heredity compensated for the genetics underpinning human eye color. In fact, the variables influencing eye color are much more diverse. However, numerous characteristics of eye color are programmed by several genes. Some genes, such as OCA2 and HERC2, have widely recognized functions, despite it is unclear what specific involvement other genes play in determining eye color. Iris patterning, containing pigment (per pupillary) rings and furrows, is also apparently determined by other genes, which also seems to be heritable. The two mechanisms that light enters the eye and interacts with the iris (reflection) and (scattering) are the main sources of variation among eye color. Light reflection is modified by the quantity and distribution of the pigment melanin in the iris; higher melanin concentrations reflect more light wavelengths, giving the appearance of eyes. Eyes look blue due to the preferential scattering of short, blue wavelengths of light by collagen fibers. There are different types of melanin which determine various colors like; the pheomelanin which induces colors like green and hazel, the eumelanin that offers a dark brown color these are the two major form of melanin found in the iris. Brown eye is linked to a combination of pheomelanin and eumelanin whereas blue eye color is linked to low levels of eumelanin. The volume of melanin that may be noticed in the iris varies according to the size, shape, and quantity of (Melanosomes) organelles that store melanin within melanocytes, or cells that create melanin in the skin and eyes. Iris patterning might influence how eye color is interpreted, making it difficult to assess variation in eye color.

Color discrimination in human beings is based on disparate stimulation of three (red, green and blue) cone types by lights with various wavelengths. The normal color vision of humans is trichromatic on the basis of three spectrally-distinct photoreceptors (types of cone) present in the retina that are maximally sensitive to light of 420, 530 and 560 nm (short, middle and long wavelength sensitive cones; S, M and L, respectively). Inherited mutation and rearrangement of the genes that code on the long- wavelength sensitive cone pigment, the middle wavelength sensitive cone pigment, and the short wavelength sensitive cone pigment have caused congenital defect in color vision.4 A new study found the missense mutation in a hybrid L/M cone opsin gene that causes X-related cone dystrophy and color vision deficiency.

A single category is inadequate to describe the colors of an eye since iris patterns offer variance to eye color. For instance, the obvious inner band of an individual hue that borders the pupil is called a pigment ring. Fuchs' crypts are pits between collagen threads that resemble pigment-free windows to deeper tissue. A nevus is a tiny, freckle-like patch of pigment on or in the eye. Collagen fibers combine together to generate wölfflin nodules, which are light spots on the iris's surface. Iris tissue folds that resemble tiny lines encircling the pupil are called contraction furrows. A malignant syndrome called conjunctival melanoma leads a pigmented lesion that appears on the surface of the eye [3].

Brown eyes are thought to be the most prevalent eye color in the world, with (70-79%) of people having them. The American Academy of Ophthalmology (AAO) claims that approximately 10,000 years ago, all people on earth planet had brown eyes.

As a complex hereditary characteristic, iris colour is different in individuals of different races and ethnicity. The eye gets pigmented because it contains a polymer called melanin which is made of Eumelanin and Pheomelanin which regulates normal pigmentation. Eumelanin exists in black-brownish colours and they are found in the dark-hairs, dark-circles and the dark-coloured skin. The Pheomelanin on the other hand is yellow reddish in colour which occurs on light hairs, eyes and light skin colour opposed to the Eumelanin. In the case of eyes, the proportion of the eumelanin and pheomelanin is important. Most eye colour are dominated by the pigment eumelanin as pheomelanin occurs only in traces. As an instance, the content of pheomelanin is identical in blue and brown eyes. This is leeway in the case of green eyes where concentration of pheomelanin is high compared to eumelanin. Besides colour, there are other distinguishing biochemical characteristics that exist in eumelanin and pheomelanin. Eumelanin is a photo protective and an antioxidant that protects against damage of harmful UV rays. Photo reactive and oxidative pheomelanin on the other hand is anti the opposite of pheomelanin. Up to date there are several researches that have been carried out in coming up with a universal classification of eye colour. In the first classification of eye colors, Pertrequin in 1843 divided the eye colors in to blue, grey, black and auburn. Other types of blue eye colors were later on increased in 1854 to grey, green and blue with the brown eye colors subdivided as black shades, dark brown, hazel and auburn. In 1903 a colour chart was designed on the basis of 16 eye colour combinations which ranged between the darkest brown shade (number 1) to the lightest blue shade (number 16). In the future, computerizes standardized colour were applied against digital images [4].

A report by the American Academy of Ophthalmology, around half of Americans and a larger percentage of individuals in Asia and Africa have brown eyes these days. In contrast to people with lighter eyes, those with brown eyes are less likely to develop diabetic retinopathy, muscular degeneration, and eye cancer. However, as they age, persons with brown eyes are prone to get cataracts. The majority of cataracts occur when the tissue that makes up the eye's lens gets weakened by aging or trauma. The lens's fibers and proteins start to deteriorate. This results in foggy or cloudy vision. Your risk of cataracts may be increased by certain conditions inherited from your parents that lead to other health problems. Other eye disorders, prior eye surgery, and illnesses like diabetes can also result in cataracts. Cataracts can also form as a result of long-term usage of steroids. You can check for cataracts at home. Keep an eye out for frequent symptoms of cataracts, such as halos, light sensitivity, fading colors, blurred vision, or poor night vision. These signs can be indicative to an underlying issue and signal that it's time to visit your optometrist. There is no proven method to

stop cataracts from developing or to decrease their progression. However, medical experts believe a number of approaches could be advantageous, such as:

(1) Routine eye checkups: early detection of cataracts and other eye conditions can be facilitated by eye exams. Find out from your medical team how frequently you should get your eyes checked.

(2) Stay away from smoking: Ask a member of your medical team about quitting smoking. You can get assistance from medications, therapy, and other methods.

(3) Tackle other health issues: If you have diabetes or other medical conditions that might increase your risk of cataracts, stick to your treatment plan.

(4) Make a nutritious food choice that is high in fruits and vegetables: You may be sure you're getting plenty of vitamins and nutrients by include fruits and veggies in your diet. Antioxidants are abundant in fruits and vegetables. Antioxidants support eye health preservation. Antioxidants taken as supplements are not believed to prevent cataracts. However, a recent substantial population study found that a vitamin- and mineral-rich diet decreased the incidence of cataract growth. Numerous health benefits of fruits and vegetables have been established. You are capable of getting adequate vitamins and minerals in your diet by eating them.

(5) Put on some sunglasses: Cataracts may be carried on by the sun's ultraviolet radiation. When you're outside, put on sunglasses that prevent UVB rays.

(6) Cut back on the intake of alcohol: Consuming excessive amounts of alcohol enhances the risk of getting cataracts.

Eight to ten percent of people are said to have blue eyes, making it the second most prevalent eye color in the world. That percentage is greater in the United States, at roughly (27%). According to scientists, all blue-eyed people may be traced back to a common ancestor who most likely had a genetic mutation that decreased the quantity of melanin in their iris. The majority of blue-eyed folks are European. Hazel eyes are a mix of different colors which include; green, orange, and gold, and they are found in about (5%) of the world's population and 18% of Americans. Hazel eyes are more prevalent among those with Spanish ancestry, Brazil, the Middle East, and North Africa population. About (5%) of the population globally has amber eyes, which have a little more melanin than hazel eyes but less than brown eyes. Amber eyes are most common in people of Asian, Spanish, South American, and South African origins. Green eyes are quite uncommon usually, with about (2%) of people worldwide thought to have them. Nonetheless, in other regions of the world, such as Scotland and Ireland, green eyes are extremely prevalent. About 9% of people in the United States, where many people have ancestry from Scotland and Ireland, have green eyes. Gray eyes affect around (3%) of people worldwide. Humans with gray eyes have more collagen in the stroma, a region of the eye, but little or no melanin in the irises. The eyes appear gray due to the way the light reflects off the collagen. The iris of people with albinism or ocular albinism typically has little or no melanin. Red or violet eyes are a manifestation of this pigment insufficiency. Those who have ocular albinism frequently experience vision issues since eye pigmentation plays a crucial role in vision. A person with ocular albinism may have poor depth perception or extremely hazy vision. Less than (1%) of people have heterochromia, which is the condition in which a person has more than one eye color. It's possible that the two eyes are completely different from one another, or that one iris element differs from the others. According to the (American Academy of Ophthalmology) people who have central heterochromia have two rings of various colors on their iris, but those with complete heterochromia have one iris that is a different color from the other. Some people have heterochromia from birth. In others, it may be put on by an eye injury or medical condition.

Pakistan ranks sixth in population among the most populous countries in the world having a population of over 212 million people. Pakistan is linked and attached with Central Asia, South Asia and West Asia and it has known various episodes of human settlement in this area since recorded history. Currently, the Pakistani population has been segregated into 18 ethnic groups and over 60 various languages have been reported. The Pakhtun are the biggest community in the Khyber Pakhtunkhwa district and 2nd largest community in Pakistan (15.4%). There are very little writings available to date, on forensically informative DNA markers in this large population. Thus there is a need to document this prevalence of the eye colour and additionally there is a requirement of validating the Irsisplex system on the Pakhtoon people in the Malakand Division. Findings of this research can be useful to the researchers concerned with population genetics, anthropology and forensic genetics [5].

2. Material and Methods

In the current research, seven out of a hundred randomly selected individuals were discovered to have remarkably varied eye colors, remaining with brown and black shades and pertaining to varying age groups. It doesn't seem to gender-specific. It is comprised of five females (♀) and two adolescents (♂) in the age group of district Hyderabad, Sindh, Pakistan. The number of black eyes were (30 %) and (63 %) were with brown color. The study was conducted on the basis of questionnaire which is comprises of father and mother eye color, age, males and female. The data has been collected with consent of the individuals. The samples were observed with different hues of eye color which includes; Blue, Steel blue, Jade, Hazel and Grey respectively.

3. Results and Discussion

The percentage of pigment in the iris of blue eyes is small. Because blue eyes are frequently recessive, they are getting rarer due to inter-racial marriage, according to scientists who recently revealed that everyone with blue eyes has a connection. [6].

The dark bluish gray is the steel blue. The iris, the colorful portion of the eye, regulates the color of the eye. There are two layers in the iris: Pigment epithelium: The front layer scatters light, providing eyes a blue, brown, hazel, or green appearance. The back layer contains brown pigment. Because blue eyes have less melanin in their iris than eyes that contain more melanin, they may be more vulnerable to light damage. Ocular melanoma, or melanoma in the eye, may be more common in those with blue or gray eyes. Blue-eyed humans can use photochromic lenses in order to protect their eyes from the sun [7].

Green eyes are the rarest eye color in the world, and Jade green eyes are very unusual. Natural green eyes can be observed in just around 2% of the world's population. A genetic mutation referred to as "Green eyes" provides low melanin levels, however more melanin than blue eyes [8]. Usually, hazel eyes are a mix of gold, green, and brown. Typically, hazel eyes are a mix of gold, green, and brown. Hazel eyes can occasionally also appear blue or even amber. Hazel eyes commonly have a unique tint around the pupil than the outer rim. Hazel eyes may appear to have a "sunburst" impression making due to this color gradient [9].

Black eyes tend to be dark brown and closely related to pupils; they are not a natural eye color. The iris's high melanin content is what gives it its dark hue. On rare occasions, especially in low light, it can be hard to distinguish between the pupil and the iris. Aniridia, an eye condition which causes in a big pupil encircling a small ring of iris tissue, is another condition that can make the eyes seem black. A chromosomal alteration is the cause of this. Humans cannot have irises that are completely black. The quantity and kind of pigment primarily melanin that are present in the iris characterize its color. Very dark brown irises still retain some brown pigmentation, yet they could appear black in some lighting conditions. The irises of nearly all mammals are darkly colored or brown [10].

About 79% of people worldwide have brown eyes, making it the most prevalent eye color in humans [11].

The stroma of the iris possesses a fairly large quantity of melanin, which absorbs both shorter and longer wavelengths of light, which leads to brown eyes [12] and [13].

Table 1. Different Human Eye color in age group of District Hyderabad, Sindh, Pakistan.

Samples	Gender	Sample No	Age	Father's Eye Color	Mother's Eye Color	Target's Eye Color
Sample 1	Female	(1)	2 years	Black	Black	Blue
Sample 2	Male	(1)	46 years	Dark brown	Olive green	Steel blue
Sample 3	Female	(1)	8 years	Brown	Brown	Jade
Sample 4	Male	(1)	42 years	Dark brown	Olive green	Hazel
Sample 5	Female	(1)	22 years	Black	Light brown	Grey
Sample 6	Female	(1)	20 years	Brown	Brown	Hazel
Sample 7	Female	(1)	1 years	Light brown	Brown	Jade
Sample 8	Male	(10)	1 to 30	Brown	Brown	Black
Sample 9	Female	(53)	1 to 20	Brown	Black	Black
Sample 10	Male	(7)	1 to 45	Balck	Black	Black
Sample 11	Female	(23)	1 to 18	Black	Black	Black

Table 2. Percentage of different Human Eye color in age group of District Hyderabad, Sindh, Pakistan.

Samples	Gender	Sample No	Age	Target's Eye Color	Percentage %
Sample 1	Female (♀)	(1)	2 years	Blue	1 %
Sample 2	Male (♂)	(1)	46 years	Steel blue	1 %
Sample 3	Female (♀)	(1)	8 years	Jade	1 %
Sample 4	Male (♂)	(1)	42 years	Hazel	1 %
Sample 5	Female (♀)	(1)	22 years	Grey	1 %
Sample 6	Female (♀)	(1)	20 years	Hazel	1 %
Sample 7	Female (♀)	(1)	1 years	Jade	1 %
Sample 8	Male (♂)	(10)	1 to 30	Black	10 %
Sample 9	Female (♀)	(53)	1 to 20	Black	53%
Sample 10	Male (♂)	(7)	1 to 45	Black	7%
Sample 11	Female (♀)	(23)	1 to 18	Black	23 %

4. Conclusion

The Black and brown were the most often noticed hues in the most recent investigation. Current study reflects the highest frequency of Brown eye color in females followed by males. However, as they age, brown eyes human is prone to get cataracts. This article addresses the high frequency rate of brown eye color among females as well brought about the awareness about the cataract which is liable to occur in brown-eyed old age people. Present research status revealed that brown eye color is very been common among all colors accordingly.

Ethical Consideration

In District Hyderabad, Sindh, Pakistan, voluntary participation was noted during the data collection process. Before signing on to participate, the participants are aware of the study's goals, positive aspects, and potential hazards.

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