## THE EYE CARE REPORTS

PLEASE READ THIS: The information contained herein is not intended as a substitute for medical advice and care from qualified, licensed health care providers. The reader should regularly consult a physician in matters relating to his or her health and particularly with respect to any symptoms that may require diagnosis or medical attention. The information is presented here to educate and inform and to guide you to an understanding of cause, prevention as well as treatment.

## ALL ABOUT EYE COLOR

Brown eyes, blues eyes, and green eyes. These are the "standard" eye colors, but we've all seen people with even different eye colors. There's also gray, "hazel", a mixed brown/green/blue, golden brown or amber, even violet. Many children a born with non-descript gray eyes and some become blue, some brown. How much do we really know about eye color?

Eye color is determined primarily by the concentration and distribution of melanin pigment on the iris fibers. The iris is located inside the eye, between the cornea (front most surface) and the internal crystalline lens. The hole in the middle is called the pupil and it changes size to regulate the amount of light entering the eye. If the iris contains pigment on both the front and back surface, the incident light that reflects off the iris is brown. Sometimes there is little or no pigment on the front surface. The light interacts with the gray iris fibers and the iris stromal cells and reflects as blue.

The size and spacing of the fibers and stromal cells determines the "blueness" or "greenness' of the reflected light. Although the majority of irises have similar pigment density on the back surface (called the iris pigment epithelium), some people have less and that allows for some reflection from the retina in the back of the eye. The retina reflects red from the network of blood vessels contained within its structure. This is also what causes the red reflex in the iris pupil seen in photographs taken with a flash. The red color interacts with the blues and browns to create aqua and violet iris colors. There's a rare genetic condition called albinism in which those individuals do not have pigment on the back of the iris and their iris color appears pink. Sometimes, the pigment

from the back surface “rolls” up onto the front surface right at the pupil border. This results in a brown ring around the pupil, which can look quite unusual in an otherwise “blue” eye.

Many of us learned in school the so-called simple Mendelian, or "two gene" genetic model to predict eye color. This model promoted the notion that blue eye color is a simple recessive trait. Based on the color of the mother and father's eyes, little Johnny or little Jill would have blue or brown eyes. This model has repeatedly been shown to be wrong, yet is still presented as an explanation for eye color. As we learned more about genetics and cell chemistry, it was determined that melanin, a brown pigment, is controlled by the brown-blue gene on chromosome 15 and the green-blue gene on chromosome 19. The new and improved genetic model still doesn't work all that perfectly and, in fact, science has discovered at least one more color-determining gene, another brown-type also located on chromosome 15. Recently, science has found a brownish yellow pigment, lipofuscin, also called lipochrome that appears in amber, green and violet irises. And there's likely at least one other gene, not yet located, that plays a role in iris color.

Many infants, notably Caucasians are born with "neutral" eye color. As the eye is exposed to sunlight, the melanocytes within the iris begin to produce melanin pigment and the eye color slowly begins to change towards its adult coloring, reaching at least 50% of adult melanin density by age one and complete pigmentation by age 3.

An interesting question about changes in adult eye color is often asked. As we have discussed previously, eye color is about reflection of ambient light from the structure of the iris. People with lightly colored irises note that their eye color changes according to the colors they wear. No mystery there, but the resultant apparent color of the eye is a combination of the color reflected from one's clothing (or even eye make up) and is not always what you might expect!

Some people have noted that when they are ill or under stress that their eye color becomes darker or lighter. Clearly there has been a change in the distribution and/or density of melanin or

lipofuscin on the iris. How this actually occurs is not fully understood, but we are beginning to have some clues as to the processes. A recent medication used to treat glaucoma, latanoprost, causes such a color change. We understand, at least partially, the mechanism of action of the drug, a prostaglandin analog, which means it mimics this hormone, which is normally present in the body. It would appear, then that hormones may have effect iris pigmentation and this might explain the change in eye color sometimes seen in adults. It should be mentioned that there are certain specific systemic and eye diseases that can cause a change in iris color and any marked change of short period of time requires prompt medical attention.

So here, in 2004, what we DO know is that eye color is a polygenic trait and that we humans have a variety of iris colors. Eye color changes in infants as a developmental response and eye color changes in adults is not well understood.

Here's an interesting statistic about the distribution of eye color. Please note that this information relates to a specific population and I do not have the actual makeup of that group.

In a sample of 324 patients from 5 "urban clinics" in Massachusetts and Maryland (therefore spanning many socioeconomic and racial groupings), those investigators reported:

32% blue/grey irises
15% blue/grey/green irises with brown/yellow specks
12% green/light brown irises with minimal specks
16% brown irises with specks
25% dark brown irises

Here's a partial list of references, some of which contributed to the information contained in this report:

http://www.ncbi.nlm.nih.gov/htbin-post/Omim/dispmim?227240

http://www.ncbi.nlm.nih.gov/htbin-post/Omim/dispmim?227220

http://madsci.wustl.edu/posts/archives/feb98/888162819.Ge.r.html

http://www.fi.edu/tfi/units/life/forums/anatomy/eyes.html