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Article

The Relation between Heavy Elements Level and Cataracts and Glaucoma Disease

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Abstract: The pathophysiology of a number of major ophthalmological conditions, including cataracts, retinopathy caused by diabetes, age-associated macular degeneration (AMD), glaucoma, and others, are significantly impacted by trace minerals. The purpose of the research was to quantify changes in the quantities of chemical ingredients in the water-based humor of individuals having cataract procedures. It's a diagnostic research to evaluate more than 60 components found in the fluid from cataract sufferers' posterior chambers of the eyes. The aim of the study was to analysis and relationship between heavy elements level and cataracts and glaucoma disease. The intricate multivariate pathophysiology of open-angle cataracts may involve trace components. The most prevalent kind of persistent, degenerative visual neurological conditions, primary open-angle glaucoma, or POAG, is marked by a gradual deterioration of the ganglion cells of the retina and their nerve endings, which leads to a diminished vision.

Keywords: POAG, ICP-O method, Poisoning and trace minerals.

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1. Introduction

Both of the primary causes of blurred vision and deafness, cataract and glaucoma, are becoming more common with growing age. Right now, the sole curative option for aesthetically essential cataracts is the operation that involves removing the person's cataract and replacing this with a synthetic lens [1]. According to a cross-sectional investigation conducted via 2001 to 2011, roughly 23.1% of cataract individuals across the U.S. had undergone more than one surgical procedure [2].

Behind cataracts, glaucoma is one of the most common reason for vision worldwide and the main factor contributing to permanent eye loss. The 2010 World Health Organization report states that glaucoma accounts for about 8% of cases of disability. According to the National Eye Institute, the prevalence of primary open-angle glaucoma among Americans over 40 and above increased from 2.22 mm to 2.72 mm instances between 2000 and 2010. This represents 1.9% of those in this age bracket [3].

There is a lot of proof to suggest that glaucoma and oxygen consumption are related. One ecological cause of inflammation that can lead to glaucoma is the exposure to heavy metals. Researchers found that people with glaucoma had a higher amount of metal in their watery fluid than counterparts from as far back as 1990.Many newest studies have observed a strong correlation among glaucoma and toxicological indicators [4], [5].

2. Background

Due to ageing or frequent retinal diseases like glaucoma, cataracts, diabetes, or age-associated macular degeneration (AMD), numerous adults endure serious visual loss [6].

While there are medical therapies for them in their final days whose etiology continues to be not widely recognized and at a result, it's important to identify warning signs for cataracts and develop efficient preventive measures. Approximately fifty percent of sight worldwide is brought on by cataracts, which are marked by an ongoing decrease of clarity in the crystalline lens of the eyeball. The whole process of cataract genesis remains unclear at this time [7]. But a number of variables are being found to increase the possibility of cataract creation [8]: cigarette usage, a family history of cataracts, oxidative damage from exposure to ultraviolet (UV) rays, chronic illnesses like high blood pressure, diabetes, or a condition called homo drug use, such as steroid medication, and concurrent illnesses [9].

A prevalent eye ailment called glaucoma is caused by impairment to the visual courage that runs between the cerebral cortex and eyes. Although glaucoma may strike anyone at any stage in life, it tends to impact those who are 70 years of life or beyond [10]. Fluid accumulation in the anterior region of the eye is typically an indicator of glaucoma. Those that have a member of their family who has the illness are particularly prone to getting it because it may be inherited. "The many cases of glaucoma impairment can be avoided with prompt detection and efficient administration," says Mr. Saurabh Goyal, an associate optometrist with expertise in cataract and glaucoma care.

One frequent ailment that affects eyesight is cataracts. These are areas of cloudiness that grow on the eye's glass. Distorted or blurred sight is caused by cataracts, which usually afflict elderly adults [11]. They grow as clusters of protein start developing on the cornea and get larger as time passes. A person may get one or both cataracts, but they are limited to one cataract in each eye [12].

Early-stage glaucoma may completely lack signs at all. Although are multiple distinctions between glaucoma and cataracts, but both of them can present with many of the same indicators, including decreased ability to see at night, shadows surrounding illumination, and impaired vision [13].

Because the condition impairs the peripheral retina, you could experience blind spots or streaks. That happens gradually, and prior to the individual detects any serious issues; they might lose up to 80–90% of their peripheral vision [14]. Although this visual loss cannot be reversed, it can be avoided with prompt diagnosis and appropriate treatment. Individuals who have cataracts typically have foggy or fuzzy vision, as well as might be glaring at twilight [15].

3. Research Objectives

Research on cataracts has used both human lenses taken from patients and animals with artificially produced cataracts. Potentially underlying flaws in the amino acid production and architecture of the eyepiece, together with hazards and treatment for the illness, are significant fields of study in cataract investigation [16]. The goal of the Glaucoma Studies Institute is to conduct academic studies that can enhance our knowledge of glaucoma, contribute to the development of novel therapies, and finally

result in the eradication of the next most prevalent cause of disability. In this research paper interpret that the doctor who treats you for cataracts may inspect the lens regarding indications of a cataract employing an optical instrument or a lamp with a slit. However, people with glaucoma are still able to lead lives of significance. Maintaining sight is the essential aim of glaucoma counseling, as lost eyesight can't be recovered [17].

4. Research Questions

Is there scientific evidence suggesting a correlation between high heavy metal levels in the body and the development of cataracts and glaucoma?

1. What heavy elements are commonly associated with an increased risk of cataracts and glaucoma?
2. Are there any studies that investigate the specific mechanisms by which heavy elements might contribute to these eye diseases?
3. How do heavy metal exposures very in different regions, and could this impact the prevalence of cataracts and glaucoma?

5. Significance of the Study

- **Environmental Health:** Poisoning of food, water, and air may all lead to cells absorbing contaminants. Examining their effects on ocular health might reveal potential risks and highlight the necessity for pollution avoidance and initiatives to improve public health [18].
- **Professional Security:** Employees in some sectors might be more susceptible to vision disorders due to their interaction with metals that are toxic. Regulations and occupational safety measures that safeguard employees' health can be informed by this study.
- **Early identification and Therapy:** When there is a connection among excessive exposure to heavy metals and glaucoma or cataracts, testing methods for rapid detection and specialized therapies for those who are at risk may be developed [19].
- **Mechanistic insights**: By comprehending the possible roles that pollutants may play in the emergence of certain illnesses, it is possible to get a grasp of their root causes and so identify novel avenues for treatment.

6. Research Methodology

Researching the connection among levels of heavy metals and glaucoma and cataracts usually takes an integrated approach to methodology. Initially in an appropriate populace, a sectional or longitudinally cohort study is carried out to evaluate the relationship between heavy metal exposures and the incidence or prevalence of glaucoma and cataracts. This includes gathering medical records, demographic data, and measurements of metallic levels in biological specimens, including urination or plasma. Following that, relationships and possible hazards are found using statistical tools such as multivariate modeling.

Further research conducted in laboratories may be used to comprehend the fundamental workings of the link. Research both in laboratory and in animal can be used

to study the effects of contaminants on the functioning of cells and visual organs. Research involves investigating inflammatory processes, cellular ageing, and structural harm done to the retina. Furthermore, exposure to metals may be simulated and its effects on eye health studied using model organisms. By integrating both of these techniques, an extensive comprehension of the relationship among heavy components and glaucoma and cataract development is provided, with possible consequences on therapy and preventative plans.

7. Results and Discussion

Cataracts impact the cornea, whereas glaucoma damages the retinal system. It suggests a change in the course of therapy. Therapy for glaucoma includes operation or ocular medications to lower the high intraocular pressure [20]. Surgery is nearly usually necessary for cataract therapy in order to substitute a clouded lens with a synthetic one. Whenever cataracts and glaucoma develop around the same time, patients may face particular challenges that need for a physician skilled in managing both conditions.

Cataracts usually develop progressively, changing the optic nerve of the retina through decades and producing visibility that impairs eyesight. The term "glaucoma" refers to a collection of eye conditions marked by an increase in intraocular pressure, or IOP, that damages the nerve that connects the eyes and results in sight impairment [21]. Glaucoma causes blindness that is irreversible, although cataract blurred vision may be corrected surgically.

Although glaucoma and cataracts aren't usually associated, there exists a considerable likelihood of a glaucoma sufferer might develop cataracts at some stage, particularly around the age of 50 where cataracts frequently occur. This is since these eye illnesses frequently grow or become worse with age [22]. Even though treating cataracts is often seen to be a reasonably straightforward process involving minimal danger, ophthalmologists treating those with glaucoma need to take numerous things into account while determining the optimal time and method for performing the procedure in order to prevent ocular pressure from being altered. People with glaucoma frequently have a rise in eye pressure following cataract surgery, which is typically treated with treatment.

Anyone experiencing glaucoma and cataracts ought to undergo a personalized assessment to identify the healthiest and strongest cataract therapy choice, as cataract removal may cause modifications to gaze that are occasionally temporary as well as chronic [23]. Utilizing all of the cutting-edge glaucoma diagnostic and screening technologies accessible, Glaucoma Specialists of Texas offers complete treatment.

7.1. Content of Elements

115 individuals, ranging in range from 55 to 94, underwent cataract procedures, and specimens of their frontal lens fluids had been collected. the ICP-O was used to assess the levels of metal following the correct specimen processing. Table 1 compiles the obtained data. Significant differences were observed in the majority of components across patients [24]. The macro nutrients with the broadest variation include calcium (1062.194), sodium (5732.618), potassium (539.795), phosphorus (326.269), and, unexpectedly, very poisonous cesium (350.0).

Table 1. Element concentrations' descriptive statistics

Element/Wavelength [nm]	BDL (n)	ADL (n)	Mean [ppm]	SD	Median [ppm]	Min. [ppm]	Max [ppm]	Range [ppm]	CV
Ag/328.068	53	62	0.014	0.027	0.003	0.000	0.191	0.191	193.898
Al/396.152	0	115	2.427	1.678	1.948	0.029	12.449	12.420	69.146
As/188.980	106	0	0.097	0.419	0.000	0.000	3.071	3.071	434.053
Au/197.742	59	56	1.658	2.640	0.000	0.000	11.284	11.284	159.214
B/249.772	115	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba/455.403	0	115	3.547	4.551	2.869	0.005	25.461	25.456	128.288
Be/313.042	7	108	0.038	0.029	0.033	0.000	0.176	0.175	76.811
Bi/223.061	49	66	0.276	0.404	0.090	0.000	3.003	3.002	146.727
Ca/422.673	0	115	294.508	162.330	259.183	98.981	1161.175	1062.194	55.119
Cd/214.439	110	5	0.002	0.011	0.000	0.000	0.094	0.094	507.174
Ce/446.021	60	55	0.023	0.082	0.000	0.000	0.397	0.397	210.387
Co/238.892	82	33	0.039	0.114	0.015	0.000	1.171	1.170	280.103

Table 2 illustrates the fact that components with the greatest abundance are found in the 5th category. The substances in the 2nd cluster have the ranked second abundance. Since the average and percentile of the overall trend measurements have been modest, cluster 3 has the smallest component levels. Based on the proportions of the elements, the groupings are arranged in an ascending sequence namely: cluster 3, cluster 1, cluster 4, cluster 2, and cluster 5. Cluster 5 is the lowest homogeneous of the five due to the highest variation. Furthermore, the variation of the amount present grows along with the saturation levels.

Table 2. Element concentrations [ppm] descriptive statistics

Group	Min.	Median	Mean	Max.	SD
1	0	0.000	0.234	26.102	1.329
2	0	1.071	1.832	42.727	2.685
3	0	0.000	0.012	3.071	0.111
4	0	0.072	0.352	11.284	0.904
5	0	62.918	388.679	6430.328	778.327

The amounts of elements (Figure 1) represent the pattern of the median logarithmic of the component levels [25]. The ranges remain bidirectional especially when the logarithm zed levels have been aggregated. Whenever three different groups are selected, very comparable outcomes are attained. Colonies 1 and 3 are combined into a single category in this case, whereas clusters 2 and 4 are combined into second.

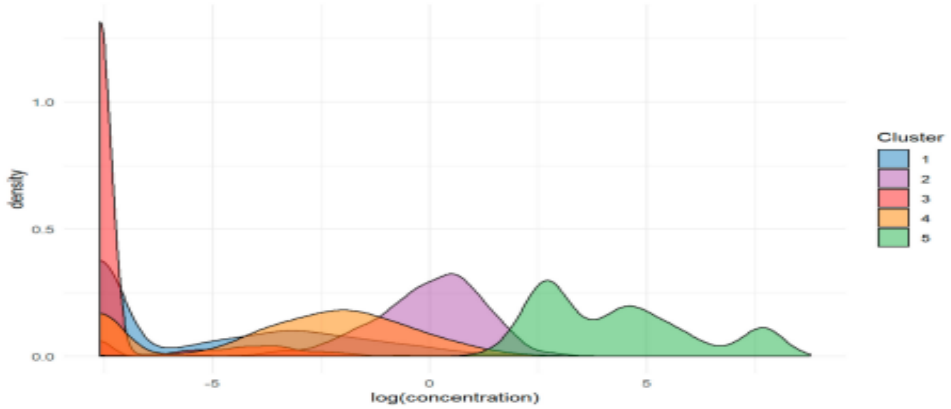

Figure 1. Element concentrations [ppm] descriptive statistics

7.2. Thick Alloys

The phrase "heavier metal in medical terminology typically implies industrial materials that are hazardous to people or the natural world. Metallic substances contain semi-metals like tellurium (Te) and arsenic (As); they may also be substances that are not metal like selenium (Se). Examples of the heavier metals are mercury (Hg), lead (Pb), cadmium (Cd), chromium (Cr), nickel (Ni), copper (Cu), zinc (Zn), and bismuth (Bi). Such "metals" are harmful because of their propensity to build up in the body, particularly in the urinary tract, mind, and skeletons. Its equivalents and ions can lead to both short- and long-term conditions of the urinary tract, neurological system, and circulation, as well as serious overdose [26].

It is possible for toxic metals to substitute for formerly bonded elements and alter the amounts of additional metals in human cells, especially cells related to the eyes. Thus, the impact of pollutants on the prevalence and severity of myopia has been studied in a number of papers that appeared in the ocular field. The content of numerous trace elements in the bloodstreams of PEX and PEG patients was determined in the study conducted. Among the components classified as being heavy metallic substances, Hg was determined to be much higher in PEX sufferers in comparison with placebo subjects.

Charcoal kiln atomic absorption spectrometer was used to detect plasma cadmium as well as lead levels, whereas the platinum aggregation technique was used to assess mercurial concentrations. During the purpose of heavy metal tests, specimens of blood were obtained and kept in trace component ethylenediaminetetraacetic acid.

Cadmium, mercury, and lead had thresholds for detection of 0.223, 0.087, and 0.05 μg/L, respectively. Each specimen had concentrations above the limits of quantitation.

The present research examined the relationship among the incidence of the OAG with regular the intensive care unit, low-teen the OAG and high-teen the OAG and three well-known harmful heavy metals: lead, mercury, and cadmium.

Plasma levels of arsenic are linked to low-teen the OAG but no correlations were detected with lead or mercury. Furthermore, we discovered that there were gender disparities in the positive correlation among contaminants and the OAG with an average background IOP, with males showing this link but women lacking.

Table 3. Shows the general wellness features and demographic of the groups having healthy IOP (intraocular pressure) and open-angled glaucoma (OAG).

Heavy metals (ppm)	Normal	OAG with normal IOP	Low-teen OAG	High-teen OAG	p[t]
Total	N=4,989	N=209	N=136	N=73	
Lead	2.23 (2.28-2.35)	2.28 (2.13-2.44)	2.38 (2.18-2.60)	2.13 (1.92-2.37)	0.671
Mercury	4.10 (4.00-4.20)	3.79 (3.34-4.30)	3.96 (3.33-4.71)	3.54 (2.97-4.22)	0.237
Cadmium	1.05 (1.03-1.07)	1.15 (1.04-1.27)	1.18 (1.06-1.30)	1.11 (0.92-1.33)	0.074
Men	N=2,440	N=133	N=79	N=54	
Lead	2.75 (2.70-2.80)	2.69 (2.52-2.87)	2.78 (2.60-2.97)	2.57 (2.28-2.91)	0.501
Mercury	4.99 (4.83-5.14)	5.03 (4.47-5.66)	5.41 (4.52-6.47)	4.58 (390-5.39)	0.891
Cadmium	0.94 (0.92-0.97)	1.10 (0.97-1.25)	1.12 (0.98-1.28)	1.07 (0.87-1.33)	0.014
Women	N=2.549	N=76	N=57	N=19	
Lead	1.97 (1.93-2.00)	1.96 (1.71-2.25)	2.10 (1.75-2.51)	1.72 (1.43-2.06)	0.940
Mercury	3.39 (3.29-3.51)	2.75 (2.16-3.48)	2.81 (2.07-3.83)	2.58 (180-3.73)	0.078
Cadmium	1.16 (1.13-1.19)	1.17 (1.01-1.34)	1.20 (1.04-1.38)	1.10 (0.81-1.49)	0.931

In summary, the study's findings point to a possible link between low-teen open-angled glaucoma (OAG)and greater blood cadmium levels, particularly in males. However, the varying connections that each OAG group has with heavy metals prevent us from drawing firm conclusions about the causal relationships among heavy metals and OAG. It is necessary to do further research to determine the precise harmful process by which heavy metals contribute to the onset of glaucomatous optic damage to nerves [23].

Nevertheless, our findings support the earlier theory that non-pressure variables can have a greater role in the pathophysiology of low-teen OAG than high-teen OAG.

8. Conclusion

A cataract is a medical condition where the typically transparent lens becomes pacified, obstructing optical flow. It is a condition that progresses over time and is an important worldwide cause of disability [24]. The patients had the most prevalent conditions that accompany cataracts, including high blood pressure, diabetes, AMD, and vision. Significant differences in chemical makeup were found across the test groups as compared to the control group, which did not have any co-existing complications, according to the statistical investigation that was conducted. The two most common reasons for blindness and blurred vision are glaucoma and cataract.

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