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ОЦЕНКА ВЫРАЖЕННОСТИ СИНДРОМА СУХОГО ГЛАЗА В УСЛОВИЯХ РАЗЛИЧНОГО УРОВНЯ ЗАГРЯЗНЕННОСТИ ВОЗДУХА ЧАСТИЦАМИ PM 2.5

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Аннотация. Актуальность. Состав аэрозолей PM 2.5 варьируется в разных городах, как и характеристики содержащихся в них частиц. Нельзя исключать их влияние на компоненты функциональной слёзной системы, что в конечном итоге может привести к развитию тяжёлых форм синдрома сухого глаза (ССГ). **Цель исследования.** Изучить степень развития синдрома сухого глаза у жителей Ташкента в условиях повышенной концентрации мелкодисперсных частиц PM 2.5 в атмосфере. **Материал и методы.** Для выполнения исследования планируется обследовать группу жителей, проживающих в определённой зоне Ташкента, где регулярно фиксируется уровень частиц PM 2.5 в воздухе. В качестве контрольной группы была выбрана однородная выборка из 60 человек, проживающих в Сырдарьинской области, где также измерялась концентрация PM 2.5. **Результаты.** По данным измерений, уровень концентрации PM 2.5 в Ташкенте составил 28,6 мкг/м3, в то время как в Сырдарьинской области он достиг 9,6 мкг/м3. Различие в концентрации частиц PM 2.5 между двумя регионами было значительным. У жителей Ташкента выявлена более выраженная симптоматика синдрома сухого глаза и ухудшение параметров слезной плёнки по сравнению с жителями Сырдарьинской области. Эти данные указывают на возможное влияние высокого уровня PM 2.5 на развитие синдрома сухого глаза и степень повреждения глазной поверхности. **Заключение.** Результаты исследования подтверждают важную роль высокой концентрации частиц PM 2.5 в воздухе в развитии синдрома сухого глаза, влиянии на параметры слезной системы и степени поражения глазной поверхности.

Ключевые слова: синдром сухого глаза; загрязнение воздуха; PM 2.5.

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ASSESSMENT OF DRY EYE SYNDROME SEVERITY IN CONDITIONS OF VARYING AIR POLLUTION LEVELS OF PM 2.5

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Abstract. Relevance. The composition of PM 2.5 aerosols varies across different cities as do the characteristics of the particles it contains. Its impact on the components of the functional tear unit cannot be ruled out, which may ultimately lead to the development of severe forms of dry eye disease (DES). **Purpose of the study.** To study the severity of dry eye syndrome in residents of Tashkent under conditions of elevated concentrations of fine particulate matter PM 2.5 in the atmosphere. **Materials and methods.** The study plans to examine a group of residents living in a specific area of Tashkent, where the levels of PM 2.5 particles in the air are regularly monitored. A homogeneous control group of 60 people from the Syrdarya region, where PM 2.5 concentrations are also measured, was selected for comparison. **Results.** According to the measurements, the PM 2.5 concentration in Tashkent was 28.6 μg/m3, while in the Syrdarya region it was 9.6 μg/m3. The difference in PM 2.5 concentration between the two regions was significant. Residents of Tashkent showed more pronounced symptoms of

dry eye syndrome and worsened tear film parameters compared to residents of the Syrdarya region. These data suggest a possible influence of high PM 2.5 levels on the development of dry eye syndrome and the degree of ocular surface damage. **Conclusion.** The results of the study confirm the significant role of high PM 2.5 concentrations in the development of dry eye syndrome, its impact on tear system parameters, and the severity of ocular surface damage.

Key words: dry eye syndrome; air pollution; PM 2.5.

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PM 2.5 ZARRACHALARI BILAN HAVONING TURLI DARAJADAGI IFLOSLANISH SHAROITIDA QURUQ KO'Z SINDROMI DARAJASINI BAHOLASH

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Annotatsiya. Dolzarbligi. PM 2.5 aerozollarining tarkibi turli shaharlarda har xil bo'lib, uning tarkibidagi zarrachalarning xususiyatlari ham farq qiladi. Ushbu zarrachalarning funktsional ko'z yoshi tizimi komponentlariga ta'sirini inkor etib bo'lmaydi, bu esa oxir-oqibatda quriq ko'z kasalligi (QKK)ning og'ir shakllari rivojlanishiga olib kelishi mumkin. **Tadqiqot maqsadi.** Tashkent aholisida quruq ko'z sindromining rivojlanish darajasini havodagi PM 2.5 mayda zarrachalarining yuqori konsentratsiyasi sharoitida o'rganish. **Material va usullar.** Tadqiqotni amalga oshirish uchun Tashkentning ma'lum bir hududida yashovchi aholi guruhini tekshirish rejalashtirilgan, bu yerda havodagi PM 2.5 zarrachalarining darajasi muntazam ravishda o'lchanadi. Nazorat guruhi sifatida Sirdaryo viloyatida yashovchi 60 kishidan iborat gomonli namuna tanlandi, bu yerda ham PM 2.5 konsentratsiyasi o'lchandi. **Natijalar.** O'lchovlar ma'lumotlariga ko'ra, Tashkentda PM 2.5 konsentratsiyasi 28,6 mkg/m³ ni tashkil etdi, Sirdaryo viloyatida esa 9,6 mkg/m³ ga yetdi. Ikki mintaqadagi PM 2.5 zarrachalari konsentratsiyasidagi farq sezilarli edi. Tashkent aholisi orasida quruq ko'z sindromining yanada kuchliroq simptomlari va yirtqich plyonkasi parametrlari yomonlashuvi aniqlangan. Ushbu ma'lumotlar PM 2.5 yuqori darajasining quruq ko'z sindromining rivojlanishiga va ko'z sirtining zararlanish darajasiga ta'sir ko'rsatishi mumkinligini ko'rsatadi. **Xulosa.** Tadqiqot natijalari havodagi PM 2.5 yuqori konsentratsiyasining quruq ko'z sindromining rivojlanishidagi ahamiyatini, ko'zning funksional yirtqich birligiga ta'siri va ko'z sirtining zararlanish darajasini tasdiqlaydi.

Kalit so'zlar: quruq ko'z sindromi; havo ifloslanishi; PM 2.5.

Iqtibos uchun:

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Introduction. The environment is rapidly changing, leaving the human body without adequate time to fully adapt to new conditions. This issue is especially pronounced among residents of large cities. The negative impact of environmental factors on the ocular surface leads to tear film disruption and the development of dry eye syndrome (DES), which is becoming increasingly relevant [1,2,3].

DES is a complex of symptoms characterized by the drying of the cornea and conjunctiva due to instability of the tear film covering the cornea. The tear film consists of three layers: lipid, aqueous, and protein. Even minor disruptions in this film can significantly affect vision. DES is one of the most common eye health issues, affecting 40-52% of the adult population in developed countries. This condition severely worsens the quality of life, negatively impacting a person's mental and physical well-being, and increases the risk of developing inflammatory eye diseases [4,5].

PM 2.5 (particulate matter) refers to suspended solid micro-particles and tiny liquid droplets (10 nm to 2.5 μm in diameter) present in the air. Unlike larger particles, PM 2.5 can penetrate biological barriers and enter the body, posing a threat to human health. Fine particulate matter exists in the air as an aerosol, both in natural environments and urban settings, but it is most dangerous in megacities. In urban areas, PM 2.5 is more prevalent, and its chemical composition is much more toxic than in the wild. The composition of PM 2.5 aerosols varies across different cities, as do the characteristics of the particles it contains. In addition to its negative effects on the lungs, blood vessels, and other bodily systems, PM 2.5 can also have harmful effects on visible mucous membranes, including the conjunctiva [6,7,8]. Its impact on the components of the functional tear unit cannot be ruled out, which may

ultimately lead to the development of severe forms of DES.

Objective. To assess the severity of dry eye syndrome development among the population of Tashkent under conditions of elevated atmospheric PM 2.5 concentration.

Materials and Methods. The study was conducted at the Department of Ophthalmology of Tashkent Medical Academy. Air pollution levels of PM 2.5 were obtained from the Environmental Research Laboratory of Tashkent Medical Academy. To investigate the characteristics of dry eye syndrome (DES), a cohort of residents from a specific area (near Tashkent State Medical Institute, Kamarniso Street, and Shifokorlar) where air quality is regularly monitored was selected for examination.

The residents of this area were examined at Family Polyclinic No. 16, which serves the population of the studied region. A total of 64 individuals (32 males and 32 females), aged 18 to 40, were examined. Individuals with ocular surface pathology (severe DES, conjunctivitis, keratitis of various etiologies, pterygium), patients with any form of glaucoma, those whose work or study involved more than two hours of computer use per day, and those whose occupations included night shifts were excluded from the study. As a result, the study participants were primarily housewives and men working in various fields, excluding programming and office jobs. Additionally, students were not included in the study. These exclusion criteria were designed to minimize the influence of other factors on DES manifestation.

A homogeneous comparison group of 60 individuals from the Syrdarya region, where PM 2.5 concentrations were also measured, was selected.

The main methods used in the study were a questionnaire-based survey using the Ocular Surface Disease Index (OSDI) to assess subjective symptoms, biomicroscopy, Schirmer's test to evaluate tear production, and the Norn test to assess tear film breakup time (TFBUT). All tests were performed using standard techniques.

For statistical analysis, basic software from MS Office 2019 was utilized.

Results and Discussion. PM 2.5 concentrations in the capital were measured daily from July to October 2023. The average value was 28.6 µg/m3, which is 5-7 times higher than the World Health Organization (WHO) recommendations. A similar value was measured by the field team of the laboratory during the scientific research in the Syrdarya region. Four measurements were taken over the same period at 1-2 week intervals, with an average value of 9.6 µg/m3.

In our study, we compared dry eye syndrome (DES) indicators between patients from Tashkent city and Syrdarya region to identify potential differences in the characteristics and progression of this condition.

We first focused on analyzing the subjective symptoms of DES, assessed using the OSDI score. In the main group, composed of the population of Tashkent city, the average OSDI score was 18.5±3.5, while in the comparison group, residing in the Syrdarya region, this indicator was lower at 11.6±2.2. Statistical analysis revealed that the differences in subjective DES symptoms between the two groups were statistically significant ($p<0.05$), indicating more pronounced symptoms in patients from Tashkent.

Tear production was also evaluated. In the main group, it averaged 14.1±1.6 mm, while in the comparison group, it was lower at 12.1±1.4 mm. The differences in tear production were statistically significant ($p<0.05$), suggesting a reduction in tear production in patients from Tashkent compared to residents of the Syrdarya region.

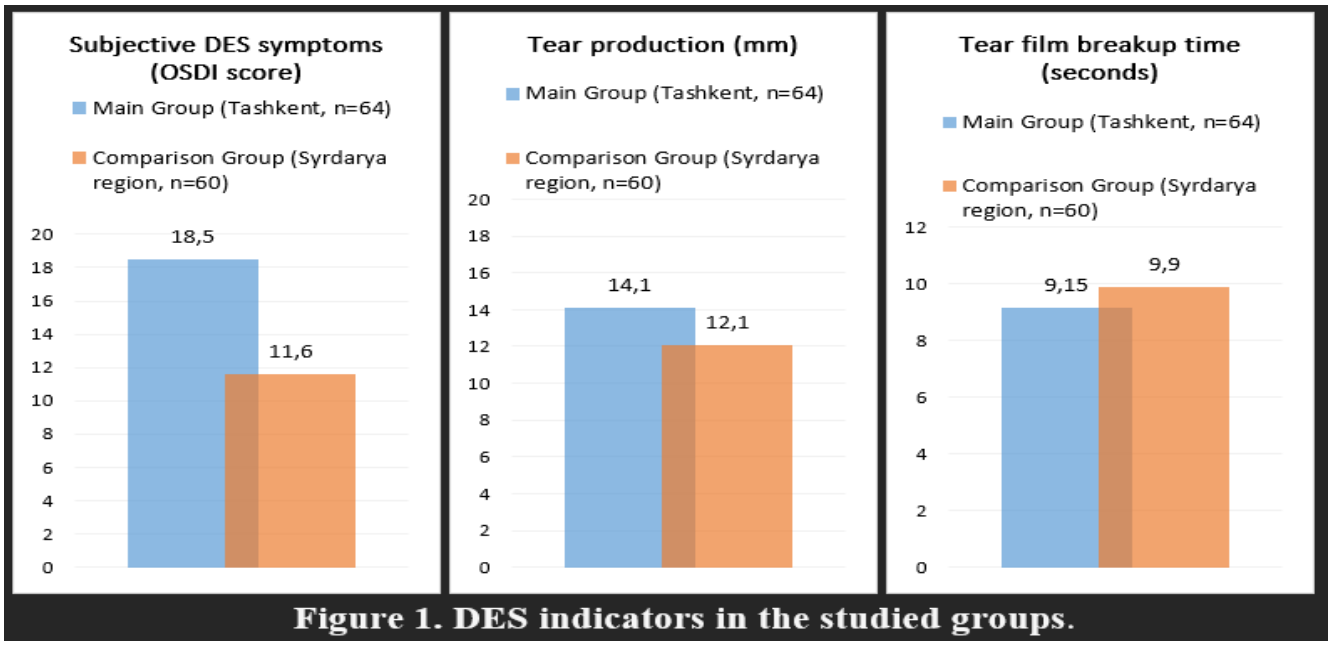

Figure 1. DES indicators in the studied groups.

An important indicator characterizing the stability of the tear film is the tear film breakup time (TFBUT),

measured in seconds. In the main group, TFBUT averaged 9.15±0.35 seconds, while in the comparison group, it was slightly higher at 9.9±0.3 seconds. Again, statistical analysis showed significant differences ($p<0.05$) between the groups, indicating faster tear film breakup in Tashkent patients.

Thus, our results demonstrate that patients from Tashkent exhibit more pronounced symptoms and tear film abnormalities compared to residents of the Syrdarya region.

Conclusion. The results obtained indicate the significant role of high PM 2.5 concentration in the air in the development of DES, its impact on functional tear unit parameters, and the severity of ocular surface damage.

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