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A REVIEW STUDY ON EFFECTS OF AIR POLLUTION ON THE SKIN

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ABSTRACT

The extension of air pollution has had major effects on the human skin over time. UVradiation, polycyclic aromatic hydrocarbons, volatile organic chemicals, oxides, particulate matter, ozone, and cigarette smoke all have an impact on the skin, which is the body's outermost barrier. By causing oxidative stress, air contaminants harm the skin. Although human skin serves as a biological barrier against prooxidative chemicals and physical air pollutants, long-term or repeated exposure to excessive amounts of these pollutants may have serious consequences for the skin. Extrinsic skin aging and skin malignancies have been linked to UV radiation exposure. Cigarette smoke causes accelerated aging as well as a rise in the prevalence of psoriasis, acne, and skin malignancies. It's also linked to allergic skin disorders including eczema and atopic dermatitis. Extrinsic skin aging, pigmentation, malignancies, and acneiform eruptions are all linked to polyromantic hydrocarbons. Atopic dermatitis has been linked to volatile organic chemicals. Given the rising levels of air pollution and its negative effects on the skin, it is prudent to use air pollution reduction measures.

KEYWORDS: *Ozone, Pollution, Polycyclic Aromatic Hydrocarbons, Skin, Ultraviolet Radiation.*

1. INTRODUCTION

Pollution is the pollution of the earth's environment with elements that harm human health, quality of life, or the ecosystem's natural functioning. Water pollution, air pollution, noise pollution, and soil contamination are the four main kinds of pollution. The World Health Organization defines air pollution as any chemical, physical, or biological factor that alters the natural properties of the atmosphere and pollutes the interior or outdoor environment. Natural sources such as volcanic eruptions, forest fires, biological decay, pollen grains, marshes, and radioactive materials, as well as human-made sources such as thermal power plants, industries, vehicular emissions, household combustion devices, fossil fuel burning, and agricultural activities, are all potential sources of air pollution. Particulate pollution, carbon monoxide, ozone, nitrogen dioxide, and sulfur dioxide are all significant public health concerns. Air pollution is to blame for a significant percentage of health issues(1–3).

1.1. Mechanism of Skin Damage by Air Pollutants:

Air contaminants are inhaled by living creatures and have a significant impact on human skin. Solids, liquids, gases, and particle matter are all examples of air pollutants. These are absorbed into the subcutaneous tissue via the skin, hair follicles, and sweat/sebaceous glands. Rapid urbanization and rising energy use have exposed the human body to higher levels of ambient air pollution throughout the globe. The skin, being the biggest and most visible organ on the body, serves as a physical, chemical, and immunological barrier from the elements. Human skin is exposed to contaminants from both natural and man-made sources. 3 When the skin's natural defensive potential is exceeded by extended and repeated exposure to external stressors, the skin barrier function is disrupted, resulting in the development of different skin disorders(4–6). Solar

UV radiation, polycyclic aromatic hydrocarbons, volatile organic chemicals, and other air pollutants have a significant impact on the skin. Air pollution harms the skin through raising oxidative stress, which undermines the skin's antioxidant defenses. Enzymatic (glutathione peroxidase, glutathione reductase, superoxide dismutase, and catalase) as well as nonenzymatic (Vitamin E, Vitamin C, and glutathione) antioxidant capability are depleted. The lipid peroxidation reaction cascade is started when free radicals and reactive oxygen species interact with the lipid-rich plasma membrane. Reactive oxygen species also cause the production of proinflammatory mediators, which leads to an influx of neutrophils and other phagocytic cells, which then produce more free radicals, creating a vicious cycle.

1.2. Air Quality Guidelines:

The World Health Organization's air quality recommendations are based on particulate matter, ground-level ozone, nitrogen dioxide, and sulfur dioxide, which are the four main air pollutants. Guidelines for different air contaminants from the World Health Organization. The 2009 National Ambient Air Quality Standards (NAAQS) were revised. The air quality index, which is based on five main air pollutants controlled by the Clean Air Act: ground-level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide, is another way to assess pollution. Its value ranges from 1 to 500, with higher numbers signifying greater levels of pollution. A score of 50 on the air quality index indicates acceptable air quality with some potential for public health effects, while a value of 300 indicates dangerous air quality. In New Delhi, real-time air quality index data indicate that it is between 150 and 170, which is considered harmful(7–11).

Most ultraviolet C is absorbed by the ozone layer and oxygen in the atmosphere, whereas just 1–5% of ultraviolet A reaches the Earth's surface. Environmental contaminants such as photochemical smog, supersonic aircraft flights, and refrigerant gases deplete stratospheric ozone, allowing shorter UV wavelengths to penetrate to the ground level. UV light has different impacts on human skin depending on the wavelength. Extrinsic skin aging (photo aging) is caused by ultraviolet a radiation and is characterized by coarse wrinkles, solar elastosis, and pigment abnormalities(12–16). The interaction of inherent and external variables causes aging. Intrinsic aging refers to the basic aging process that is genetically determined and happens in all skin throughout time, while extrinsic aging refers to skin aging caused by external causes. Solar elastosis, pigment patches, coarse wrinkles, and telangiectasia's are all clinical indications of extrinsic aging.

1.3. Cigarette smoke:

Thousands of chemical compounds, including reactive oxygen species, carbon monoxide, reactive nitrogen species, and electrophilic aldehydes, make up cigarette smoke, which is a very complex aerosol. Oxidative stress or secondary oxidative events are caused by reactive oxidants and free radicals found in cigarette smoke, which limit antioxidant systems. Cigarette smoke contains chemicals that cause Trans epidermal water loss, connective tissue degeneration, and activation of matrix metalloproteinases 1 and 3, which destroy collagen.

1.4. Elastic Fibers:

Smoking accelerates the aging process, resulting in deeper periorbital wrinkles. Smoker's face was described as premature facial skin aging in smokers with a distinctive pattern of wrinkles and orange purple skin discoloration. Lines or wrinkles spreading at right angles from the upper and lower lips or corners of the eyes, deep lines on the cheekbones, or many shallow lines on the cheeks and lower jaw are common features of a smoker's face. The skin is slightly tinted gray with an orange, purple, and red complexion, and the bone outlines become more apparent. Independent of sun exposure, heavy cigarette smokers were 4.7 times more likely than nonsmokers to develop facial wrinkles, but the combination of smoking and sun exposure may have a synergistic impact.

Premature aging induced by tobacco smoking has been linked to a number of processes. Secondhand smoking, also known as environmental tobacco smoke, involuntary smoke, and passive smoke, induced accelerated aging in mouse models by increasing cytoplasmic translocation of high mobility group box 1 protein, resulting in collagen degradation. p16INK4a transcription has been linked to aging, and p16INK4a is a recognized gerontogen. Cigarette smoke and UV light have increased the transcription of p16INK4a in mouse models. In vitro investigations showed that cigarette smoke extract induced fibroblast senescence, presumably due to oxidative stress damage and suppression of antioxidant defense function. In human skin dermal fibroblasts, cigarette smoke promotes the production of cysteine rich proteins, which may be the cause of accelerated aging.

Several epidemiological studies have shown a link between cigarette smoking and psoriasis. Male smokers had a substantially higher chance of getting psoriasis, according to a Norwegian cross-sectional research. According to a met analysis, there is a strong link between smoking and psoriasis, with a relative risk of 1.88 in patients with psoriasis compared to those without psoriasis. In addition, the quantity of cigarettes smoked has a dose dependent connection with the development of psoriasis. Childhood exposure to ambient tobacco smoke was shown to be substantially linked with psoriasis in the general population, with an odds ratio of 1.28. With an odds ratio of 2.18, smokers who had smoked for more than 5 pack years had a higher risk of psoriasis. The same research found that hereditary variables could only account for 20% of the link between psoriasis and smoking, while non-shared environmental factors could only account for 8%. 42 Smoking behavior and nicotine dependency have been related to many single nucleotide polymorphisms in the CHRNA5/ A3/B4 gene cluster(4,8,17,18).

1.5. Polycyclic aromatic hydrocarbons:

Polycyclic aromatic hydrocarbons (PAHs) are among the most widely distributed and hazardous organic contaminants. In urban environments, 20 polycyclic aromatic hydrocarbons are absorbed on the surface of dispersed particulate matter. Quinines, redox cycling compounds that generate reactive oxygen species, are formed from them. They are present in nearly all internal organs, particularly the lungs and digestive system, regardless of how they entered the human body. Residual wood burning is the primary source of the polycyclic aromatic hydrocarbon benzo (a) pyrene in the atmosphere; other sources include automobile exhaust, diesel fumes, metallurgical industry, plastics production, pesticides, dyes, cigarette smoke, and smoke from the combustion of organic material. Extrinsic skin aging, pigmentation, malignancies, and acneiform eruption are all linked to polycyclic aromatic hydrocarbons. In mice, melanocyte proliferation and skin pigmentation were detected. Coal soot causes scrotal cell carcinoma. Because coal soot includes more polycyclic aromatic hydrocarbons than wood soot, it is more carcinogenic. Benzo (a) pyrene, a polycyclic aromatic hydrocarbon, has been found to induce no melanoma malignancies, whereas 12dimethylbenz (a) anthracene has been demonstrated to cause lymphoma in hamsters(19,20).

In the urban environment, ozone is a common contaminant. Its concentrations in the urban environment may vary between 0.2 and 1.2 parts per million. 59 Mexico City has the world's highest ozone levels. It's a gaseous oxidant that may be found in both the stratosphere and the troposphere. Ozone concentrations at ground level are normally modest. Ozone is a significant active component of photochemical smog when it interacts with sunlight (ultraviolet radiation), hydrocarbons, volatile organic compounds, and nitrogen oxides. The capacity of ozone to produce oxidative stress mediates its impact. It affects the epidermis' barrier function by forming peroxides, aldehydes, and lipid zonation products as a consequence of unsaturated fatty acid oxidation. According to Thiele et al., ozone reduces the levels of antioxidants like tocopherol (vitamin E) and ascorbic acid (vitamin C) in mouse skin and increases malondialdehyde, a lipid peroxidation product, impairing barrier function and inducing inflammation. Ozone exposure resulted in a 70% drop in vitamin E content in the stratum corneum and a 50% reduction in skin

microflora in human skin. Matrix metalloproteinases' activity is disrupted by ozone.

1.6. Particulate matter:

Particulate matter in the air is made up of complicated and variable combinations of various sizes and compositions. Particulate matter comes from a variety of sources, including factories, power plants, waste incinerators, automobiles, construction activities, fires, and natural windblown dust. Extrinsic skin aging is characterized by pigment spots on the face and nasolabial folds, but less so by coarse wrinkles, solar elastosis, and telangiectasia. Particulate matter penetrates skin either through hair follicles or transdermal, and exerts its negative effects by causing oxidative stress, which contributes to extrinsic skin aging. Nano size particles from traffic sources are the most hazardous components of ambient particulate matter; these particles may serve as transporters for organic compounds and metals capable of localizing in mitochondria and producing reactive oxygen species. An increase in soot (per 0.5 105/m) and traffic particles (per 475 kg per year per square kilometer) was linked to a 20 percent rise in pigment patches on the forehead and cheeks. In urban air, polycyclic aromatic hydrocarbons are adsorbed on the surface of dispersed particulate matter. Polycyclic aromatic hydrocarbons may trigger xenobiotic metabolism, which transforms the hydrocarbons to quinines. Quinones are redox cycling compounds that generate reactive oxygen species, which are responsible for the toxicity of particulate matter.

Despite the fact that numerous cohort studies have shown no link between air pollution and the incidence and prevalence of atopic dermatitis, the intensity of atopic dermatitis symptoms may be linked to higher particle matter.70 Kim et al. also found that by implementing an interior air quality improvement program, the amount of particulate matter dropped, and the prevalence and severity of atopic dermatitis fell significantly. The precise process is unknown, but particulate matter is thought to cause inflammation in the skin in a similar way as it does in the respiratory system.

1.7. Volatile organic compounds:

The use of organic solvents in paints and varnishes (aliphatic hydrocarbons, ethyl acetate, glycol ethers, methylene chloride, and acetone), vehicle refinishing products in repairing car paint, environmental tobacco smoke, stored fuels, car exhaust (benzene), and emissions from industrial facilities all contribute to the release of volatile organic compounds (tetrachloroethylene). It is a significant cause of indoor air pollution. A longitudinal research found that when children move to a new building, their symptoms of atopic dermatitis worsen owing to increased exposure to volatile organic chemicals. At ground level, volatile organic molecules, sunshine, and nitrogen oxides combine to produce photochemical oxidant products such as ozone, which causes summer photochemical smog. Ingestion of hex chlorobenzene, a volatile chemical molecule, may cause precancerous skin lesions in rats. In cultured keratinocytes, exposure to volatile organic compounds raises cytokines (interleukin8 and interleukin1B), which induce atopic dermatitis or eczema.

1.8. Oxides:

Mobile and stationary combustion sources are the primary producers of nitrogen oxides. They combine with ozone to produce nitrogen dioxide. Nitrogen dioxide is one of the nitrogen oxides that causes oxidative damage by forming free radicals that oxidize amino acids in tissue proteins and start polyunsaturated fatty acid lipid peroxidation. Fuel burning from industrial operations, volcanic activity, and forest fires all produce sulfur dioxide in the atmosphere. Carbon monoxide, a byproduct of incomplete combustion from mobile sources, affects cell metabolism by binding to home and causing it to change its function. In Taiwanese middle school students, flexural eczema was linked to traffic-related air pollution such as nitrogen oxides and carbon monoxide. A research comparing the incidence of atopic eczema in East and West Germany found that the prevalence

was greater in East Germany (sulfurous type pollution), with a stronger link to nitrogen oxides and proximity to heavy traffic.

1.9. Prevention Strategies:

Air pollution must be reduced in order to enhance health conditions. In order to avoid dermatological illnesses caused by air pollution, there are two measures to take: the first is to decrease pollution, and the second is to adopt methods to protect oneself from pollutants. In Korea, an indoor air quality improvement program was implemented in nine kindergarten classrooms, resulting in a substantial reduction in mean particulate matter 10 levels from 182.7 to 73.4 g/m3. In addition, the frequency and severity of atopic dermatitis in children, as well as the number of hospital visits each month, all dropped substantially, demonstrating the value of improved air quality. The three components of the Health Event initiative in Europe for improving indoor air quality include increasing ventilation rates, filtering of outside air, and interior source management. 78 Different cardiovascular and respiratory illnesses have improved as a result of this research. Dermatological disorders should also be investigated using such methods.

1.10. Control of air pollution:

Natural causes of pollution, such as volcanic eruptions and forest fires, are difficult to anticipate and avoid. Human-made sources, on the other hand, may be managed. Less use of personal vehicles, increased use of carpools and public modes of transportation, the supply of low-sulfur gasoline, the relocation of industries to areas outside of cities, the development and use of environmentally friendly industrial machines and methods, the avoidance of open garbage burning, the avoidance of smoking, and the avoidance of the use of wood and crop residues as fuel for the p To decrease traffic-related pollution, several techniques have been explored. In New Delhi, for example, biofuels such as compressed natural gas are utilized by all public transportation vehicles, an oddeven formula for private cars has been adopted, and outdated diesel vehicles are being phased out progressively.

2. DISCUSSION

The rise in air pollution has had a significant impact on human skin throughout time. UV radiation, polycyclic aromatic hydrocarbons, volatile organic chemicals, oxides, particulate matter, ozone, and cigarette smoke all have an impact on the skin, which is the body's outermost barrier. By causing oxidative stress, air contaminants harm the skin. Although human skin serves as a biological barrier against pro-oxidative chemicals and physical air pollutants, long-term or repeated exposure to excessive amounts of these pollutants may have serious consequences for the skin. Extrinsic skin aging and skin malignancies have been linked to UV radiation exposure. Cigarette smoke causes accelerated aging as well as a rise in the prevalence of psoriasis, acne, and skin malignancies. It's also linked to allergic skin disorders including eczema and atopic dermatitis. Extrinsic skin aging, pigmentation, malignancies, and acneiform eruptions are all linked to polyromantic hydrocarbons. Atopic dermatitis has been linked to volatile organic chemicals. Given the rising levels of air pollution and its negative effects on the skin, it is prudent to use air pollution reduction measures.

3. CONCLUSIONS

Because the skin is the biggest organ in the human body, anything that affects its health will have an effect on the whole body. Solar UV radiation, polycyclic aromatic hydrocarbons, volatile organic compounds, nitrogen oxides, particulate matter, ozone, and cigarette smoke are all major air pollutants that harm the skin. Extrinsic skin aging is influenced by sunlight, cigarette smoke, and ambient particle matter. Skin cancer, psoriasis, acne, and skin malignancy have all been linked to smoking. Urticarial, eczema, contact dermatitis, and other nonspecific eruptions have been linked to ozone exposure. Skin cancer, extrinsic skin aging, pigmentation, and acneiform

outbreaks are all caused by polyromantic hydrocarbons. Oxides have been linked to an increase in the incidence of atopic dermatitis in children, as well as exacerbations.

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