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Developmental and Reproductive Toxicology due to Chemicals and Pollutants

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Abstract: ***Harmful chemicals and pollutants are free into the atmosphere as a consequence of a diversity of usual and/or artificial procedures, and they can detriment human health and the ecology. The study aimed to review several studies targeting chemical, water and air pollution. 15 eligible researches were examined in the study after scanning 1397 studies extracted from different search engines. The extracted data was further examined using PRISMA guidelines. After multiple screenings, the data that were included in the study is familiar to our title and area of research respectively. The studies were sorted collectively into three main determinants chemical, water and air pollution. A favorable correlation was found among chemical and pollutants and their effect on human health. The developed ecological model for chemical and pollutants determinants may be used as an exploratory tool to better understand for the individual. This review determines an impression on the present state of research concerning the significance of air, water and chemical pollution and its possible toxicological effects.***

Keywords: pollution, chemical contamination, air pollution, toxicology, environment

1. Introduction

Global warming and climate change, species extinction, sea deceased regions, attaining energy sustainability, expanding populace (projected to reach nine billion by 2050), resource overconsumption, surplus treatment, and soil, water, and air pollution are just a few of the major issues that humanity faces. These are major obstacles that might threaten our future. Since Second World War, a plethora of synthetic compounds have been emitted into the environment, some in massive quantities. In 2015, the European Union (EU28)'s member states produced 323 million tons of chemicals, with 205 million tones classified as dangerous to human health [1, 2]

The connection among human and physical surrounding was discussed in many studies as the activities performed by humans will directly affect the surrounding. In the ecosystem, the biological (living creatures and germs) and biogenic (inanimate objects) spheres meet (lithosphere, atmosphere & hydrosphere). Contamination is a reservoir of toxic materials to humans and other animal creatures in the biosphere. The quality of air is not suitable because of many factors such as contaminated fluids, toxicants, gases and solid that directly affects the quality. All the circumstance in surrounding is polluted the water we drink, and the land in which our food commodities grow and the environment in which we respire and all these consequences portray negative impact. Industrialization was a huge factor in the success of invention, civilization, and the supply of a broad array of services, but it also led in the discharge of large volumes of toxic fumes that are detrimental to health. Deprived of any doubt various ecological disintegration is portraying as the threat to public health around the globe and due to this many people will suffer from many diseases. This huge subject is tangled with communal, monetary, and political matters, as well as existence factors. Urban development and materialism are obviously reaching extraordinary and frightening levels around the planet in our day. Polluted air caused by humans is one of the world's most significant public health hazards, accounting for one-third of all fatalities worldwide [3].

1.1. Translational applications—bridging the gap

The capacity to forecast and assess the possible harm of the surroundings to public health is a primary objective of toxicological study. Regulated toxicological investigations, on the other hand, are frequently carried out in laboratory mice due to the cost of utilizing them in massive quantities, as well as the fact that controlled; manipulative research in people is rarely practical. The legitimacy of extrapolating rodent reactions to people is a fair critique of this method. This is especially true in generative physiology, which is characterized by variety of species. As a result, the ideal objective is to organize human data on exposure effects with data from animal research.

1.2. Human to animal

An identifiable consequence in males (decreased sperm development, ineffectiveness, unproductiveness), females (acyclicity, overdue period to beginning, initial menopause), or pregnancy consequence is typically the starting point for assessing reproductive impacts in humans (spontaneous abortion). In general, because it depends on populace-based and scientific explanations, identifying reproductive impacts in people takes a long time [3,4]. Nevertheless, there have been a few instances when human reproductive consequences have been connected to acquaintances previously animal studies have anticipated the consequences. Infertility was identified in a number of males working in a California pesticide industry, for example [5]. 1,2-dibromo-3-chloropropane is responsible for the possible cause of (DBCP). The main impacts seen in these males were azoospermia or oligospermia, as well as higher mingling stages of LH and FSH. According to the outcomes of many types of research, it was concluded that DBCP is poisonous to sperm and these researches will be conducted on rats by continual testing [6].

More lately, contact with the industrial chemical 2-bromopropane has been linked to reproductive consequences in both males and females (2BP). A group of females conducting small-sized tangible change assemblage in an electric facility in the areas of South Korea were having amenorrhea in the early 1990s, according to a workplace

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health supervisor [7]. In early 1994 it was found that the ozone layer was disintegrated by many factors but the major cause was 2BP was introduced for the replacement of the solvent that is chlorofluorocarbons. And these substances were supposed to be quasi because at the time there was no data available on toxicity issues, even no protective environment was engaged. 16 and 25 women groups were classified that were exposed to the environment in which higher LH & FSH levels were exposed for the demonstration of bone-marrow effects. Six of the eight males subjected, on the other hand, experienced azoospermia or oligospermia, as well as sperm motility impairment. 2BP destroys reproductive cells at all phases of development in mice, validating the cause of menstrual irregularities and elevated reproductive hormones in female workers [8]. Eggs and sperm has been discovered as an objective in male mice, validating the lower sperm quantities [9].

1.3. Animal to human

Human risk analysis in epidemiological research is based on findings in cohorts or groups of individuals. By assessing routes of exposure, cellular processes and dose–responses, a toxicological method employing in vitro and whole animal investigations of putative risks can offer a detailed justification of harm to reproductive function. Before allowing recourse to a well-formulated corpus of human knowledge, a rather detailed characterization of multiple endpoints in animal research drove the discovery of putative reproductive toxicants in humans in these cases. This strategy of identifying probable reproductive toxicants is frequently used, and other instances may be presented. Cadmium's (Cd) capacity to target the prostate is one such example. Environmental contaminants have been implicated as causative variables in prostatic disorders in a small number of studies, and they are nearly entirely focused on prostate cancer.

Metal ions are expected to be important among environmental elements hypothesized to be causative in cancer. Cd is a pollutant that is produced through zinc removal and smelting, dirt sludge discarding, manufacturing usage, municipal trash burning, and fossil fuel combustion [10]. Aside from workers exposed, the wider populace is likely to be exposed to low amounts of Cd via infected fisheries, water contamination, toxic air, and smoking cigarettes. The National Toxicology Program categorized it as a possible humanoid hazardous tumor initiation compound (NTP). Many reports were found in association to CD and exposure to development of tumor, observational data have not repeatedly maintained this. Animal studies, on the other hand, have shown a more convincing relationship with prostatic consequences. The ventral prostate of rats injected with modest doses of Cd developed atypical dysplasia, hyperplasia, adenocarcinomas, and adenomas [11]. Higher Cd dosages produced testicular regression in rats, which resulted in prostate atrophy. When Cd was inserted unswervingly into the ventral prostate, it caused severe dysplasia and aggressive carcinomas in a large percentage of the patients [12]. As a result, these findings imply that males who are revealed to extremely high levels of Cd may be at a higher jeopardy for the progress of tumors.

1.4. Heavy Metal pollution

Metals have been shown interacting with nuclear proteins and DNA, resulting in site-specific damage. There are two sorts of harm that might occur: "direct" and "indirect." The metal causes structural changes in the biomolecules in "direct" damage. Heavy metal, on the other side, produces "indirect" damage as a result of responsive O_2 and N_2 species such as hydroxyl and hydrogen peroxide, superoxide radicals, nitric oxide, and other endogenous oxidants being produced. Toxic substances have been shown to trigger signal transduction pathways. Metal poisoning produces free radicals, which leads to DNA methylation, disturbance of the sulfhydryl balance, and lipid peroxidation. Cellular injury, which triggers a variety of calcium-dependent processes, notably endonucleases, has also altered metal-mediated calcium homeostasis. Copper, iron, nickel, cadmium, and chromium have all been studied for free radical formation. The cancer-causing possessions of the latter three metals have been established (Fig 1) [13].

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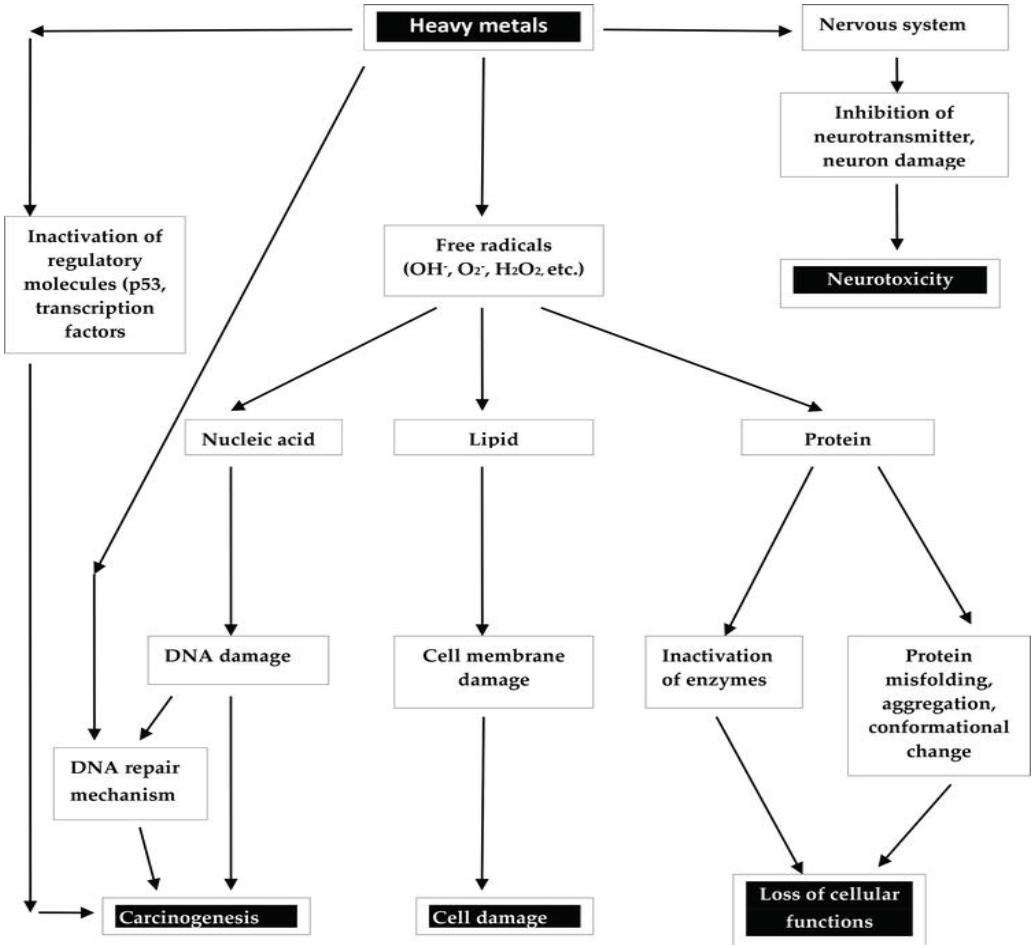

Figure 1: Sources of heavy metals and their contact with individuals [13].

1.5. Chemical emissions and their toxicological effects

An ecological destiny factor, a human health risk component, a human toxicity influence component, and a toxicity-effect damage component combine to form the impact mechanisms for human toxicity. The fate factor represents the dispersion and transformation of environmental pollutants, the interaction factor represents the relationship between chemical mass in the environment and human exposure, the effect factor represents potential human toxicity effects per unit of chemical exposure, and the damage factor represents the relationship between potential health and developmental damages Figure 2 [14].

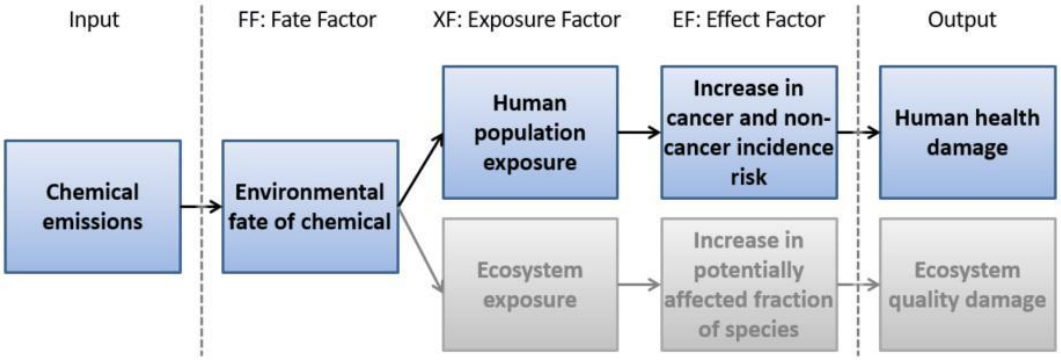

Figure 2: Chemical emissions and their toxicological effects [14]

1.6. Air pollution

According to early studies, maternal active and passive smoking may have a deleterious effect on fertility results. Negative gestation outcomes will appear if the pregnant female will exposed to contaminated environment as this would be the similar affect to intake of tobacco. The negative birth consequences were seen from the early ages 1990's yet finding there are many studies that are linked to contaminated air and negative pregnancy results.PM, NOx, SO2, ozone &CO are examples of air pollutants that have been studied for their deleterious effects on embryonic development, gestational period, and other biological results. In current history, adverse pregnancy consequences such as birth weight (LBW: birth weight less than 2,500g) and premature delivery (PTD: birth before 37 weeks of

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pregnancy) have become more common. Between 1990 and 2006, the rates of PTD and LBW in the United States increased by 21% and 19%, respectively [15]. According to research, LBW or PTD is linked to not just children's illness and death, but also the incidence of adult disorders including heart disease and diabetes [16-19]. In mother and child health, preventing negative pregnancy outcomes has resurfaced as a national and worldwide concern [20].

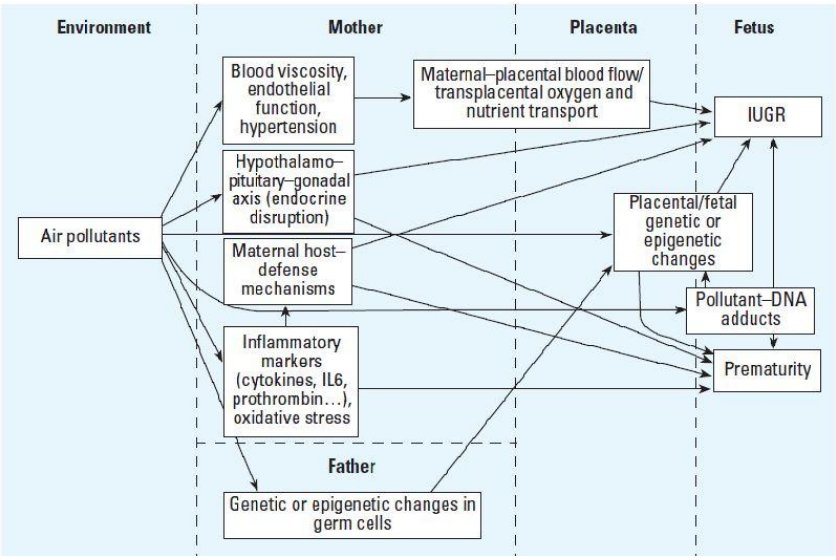

Figure 3: Biological processes that may alter pregnancy outcomes in terms of contaminated air [21]

The change in the biosphere-atmosphere is due to many factors but somehow air pollution is the major cause. Therefore, numerous toxicological effects can be seen with the passage of time the cellular mechanism by which most of the pollutants give adverse effects on human health is that these pollutants stimulate oxidative stress and initiation of provocative reactions. Air pollutants prime to an increase in the free radicals' components in the human body that cause DNA methylation and the production of carcinogenic components yet finding that it also promotes oxidative stress due to which many degenerative diseases occur figure 4 [22].

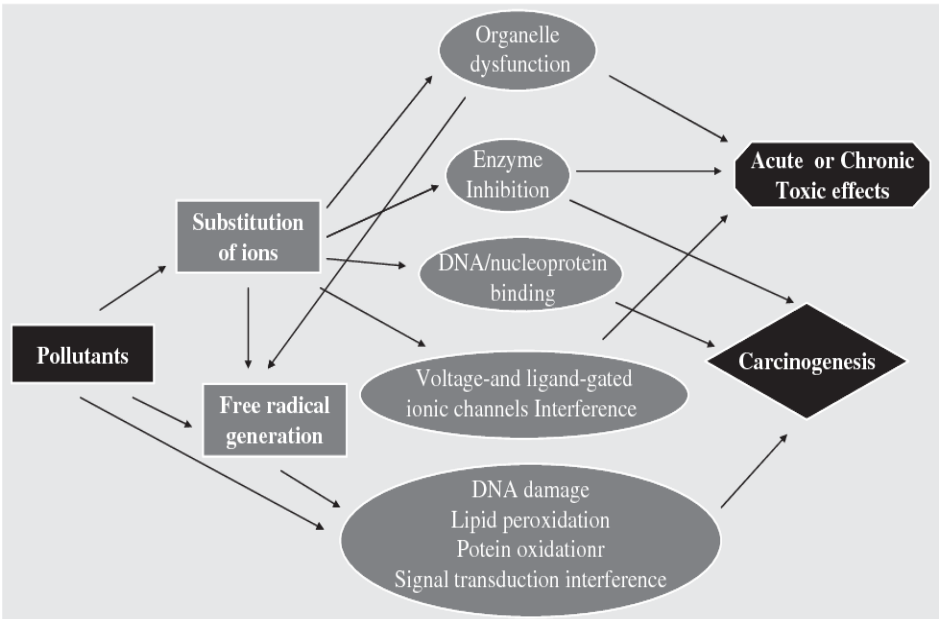

Figure 4: Basic mechanism of carcinogenesis [15].

1.7. Chemical threats to human health

Environmental contaminants leave a long-lasting 'chemical footprint' due to their amount, residence period, and mobility [23]. Because of their widespread and pervasive release, dissemination, and disposal, all humans have currently been exposed to contaminants from both point and widely discrete bases figure 5 [24].

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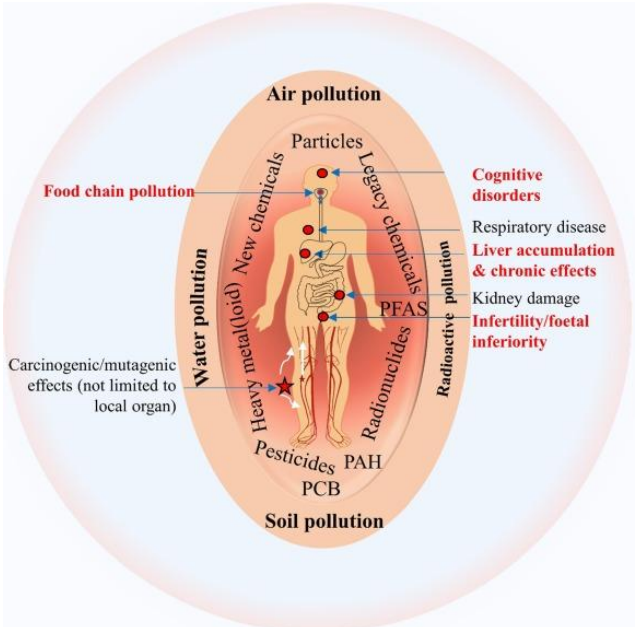

Figure 5: Even for people who want to live healthy lifestyles, it is practically impossible to avoid chemical contamination due to current human civilization behaviors. Throughout their lives, chemical pollutants enter people's systems in a variety of ways. These include I chemical usage in insecure ways, (ii) existing in a point-source contaminated atmosphere, and (iii) eating foods harvested from contaminated environments. PFAS, PCB, and PAH are acronyms for per- and polyfluoroalkyl substances [17].

1.8. Health effects on natal defects

Some other type of detrimental birth outcome that has recently been related to environmental pollution in several research is birth abnormalities. Birth flaws like heart abnormalities and cleft palate have both been related to air pollution. Ritz et al estimated the influence of pollutants in the atmosphere such as NO2, CO, PM10 & O3 on heart and image requires anomalies in southern California. After controlling for ethnic background, parental age, education, and admittance to prenatal care, period of birth, the identity of baby, equalization and period since the previous gestation, delivery type, and other atmospheric contaminants, they discovered that 2nd month O3 and CO exposures were strong predictors of heart discrepancies [25].

Another study looked at the possessions of black smoke and SO2 on inherited cardiac abnormalities in the northeast of England. There was a weak link between parental contact to black smoke and cardiac abnormalities in this study, but not for SO2 [26].

1.9. Water pollution

Water is an essential part of life; no living organism can survive without it. But the major concern in today's life is contaminated water. Yet finding that there are many sources that would be the possible cause of contamination and due to which major health problems are identified. All around the globe contaminated water was the major cause of several fatal diseases and around 14,000 people died yearly due to water pollution. The most recurrent and possible contaminants in water are categorized into two classes. Pathogens (viruses, protozoa & bacteria), contamination of chemicals (toxic substances), anions and cations, and some of the water-soluble compounds. Organic substances such as oil and pesticides are also regarded as possible water quality issues. All of these compounds are toxic and cause significant health issues in people and other species in the environment if they surpass a certain threshold level. Microbiological pollution, hazardous elements such as lead, copper, chromium, nickel, chemicals, and, in certain cases, nitrates and fluorides, all pose serious hazards to water quality [27].

1.9.1. Hygiene and Potable Water Worldwide Health Issues

The key encounter in underdeveloped nations is most difficult to implement such technologies that can be helpful in terms of cleanliness, hygiene, and to purify water that is acceptable for human consumption without any potential hazards. In the upcoming 20 to 30 years the developed nations have many jobs with high income & those industries will provide the preservation and purity of water for consumption. Sewage water is a main possible cause of different potential hazards in underdeveloped nations as the sewage water is directly discharged into the pure water without any treatment that is used for consumption purposes. Nevertheless, since urban areas will account for the vast majority of national development, current forecasts suggest that by 2030, 67 percent of the world's population would still lack access to urban sewer lines [28].

As a result, 1.1 billion people do not have satisfactory hygiene, and 2.6 billion do not have adequate water supply atmosphere, mainly in developing countries, and there is a difference in access to better cleanliness and safe water consumption sources between rural and urban areas. Rural areas are home to four out of every five individuals in the universe who do not possess access to fresh intake water [29].On a global basis, a poor approach to potable water and better sanitation causes 1.6 million fatalities each year [30], with undeveloped nations accounting for nearly 99 percent of these deaths. In nine out of ten cases, children are involved, and Sub-Saharan Africa accounts for half of all baby fatalities [31]. Water pollution, sanitation, and cleanliness are responsible for 6.1 percent of every health-concerned death; according to one research, water contamination is responsible for 15% to 30% of digestive issues [32].

In poor and transitory nations, the greatest acute illness risk linked with consuming water is caused by common viruses, microbes, and parasites that outspread via the fecal-oral pathway [33]. Waterborne disease epidemics are at the top of the list, according to WHO statistics of emerging infectious diseases in 132 countries (from 1998 to 2001). Cholera is the second most common illness, trailed by severe diarrhea, legionellosis, and typhoid temperature [34]. It is concerning that cholera has returned to Africa after almost a century's absence, accounting for 94 percent of all recorded worldwide cholera cases over this time span. In contrast to cholera, (para) typhoid fever (produced by S. Typhi and Staphylococcus saprophyticus, respectively) was the most common waterborne illness epidemic. There are many microbial aspects that were linked to improper sanitation and

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supply of water such as rotavirus, parasitic protozoa, and Hepatitis A and E viruses [32]. In recent research, it was found that 75% of children who were suffering from diarrheal diseases are mainly due to the development of different microbes such as Cryptosporidium Partum, enterotoxigenic, and enteropathogenic, Shigella spp., and Vibrio cholera. In developed countries E. coli and cryptosporidiosis, while Legionella pneumophila is frequently found inside temperate aquatic sources and centrally conditioning arrangements of huge structures, such as clinics. Typhoid outbursts happen seldom.

2. Related Studies

Telma Encarnação(2019) in his study ***"Human health, animals, and the environment are all affected by endocrine disruptive substances"*** investigated that endocrine unsettling elements are a class of impurities that can disrupt the endocrine coordination and cause illnesses and dysfunctions throughout an organism's lifecycle. They're everywhere. They also exist in the atmosphere humans inhale, the meal one intakes, and the liquid we consume. They can also be originated in individual maintenance items, housework goods, equipment, and kid's toys in our daily life. Hundreds of novel chemicals are created and placed into the marketplace every year without any evaluation and end up in our systems through ordinary goods. Everlasting introduction to such chemicals may exacerbate or perhaps be the primary root of illnesses like type 2 diabetes, obesity, cardiac illness, and some malignancies. In the current era, regulations and guidelines have been enacted with the goal of limiting the discharge of potentially harmful endocrine disruptive chemicals, with the precautionary principle being used. On the basis of the data from animal and human investigations, the goal of this assessment is to offer an impression of examination on ecological features of endocrine-disrupting substances and their influence of it on mortal well-being. Three widespread and persistent chemical families, polychlorinated biphenyls, polybrominated diphenyl ethers, and organochlorine insecticides, are highlighted, as well as two non-persistent yet universal compounds, bisphenol A and phthalates. A few particular ancient instances are mentioned, as well as successful regulatory and legislative cases. As a result, there was a reduction in exposure and, as a result, the impacts of these substances were minimized. There are recommendations from professionals in this sector, as well as the World Health Organization, systematic papers, and the Endocrine Society [35].

Andressa Gonsioroski (2020) in her study ***"Endocrine Disruptors in Water and Their Effects on the Reproductive System"*** The study looked at whether environmental chemicals in freshwater pose harm to pregnancy and childbirth. Hormonal disruptions are widely used in a number of these chemicals (EDCs). EDCs have the ability to alter the hormonal system, affecting both non-human and human development and reproduction. Contamination in water can result from a number of places, notable leftovers from water treatment processes, emissions from industrial and livestock, and sewage-discharged pharmaceuticals. Decontamination byproducts, fluorinated chemicals, bisphenol A, phthalates, insecticides, and estrogens are examples of EDCs found in water, as well as their detrimental generative effects on non-human species and humans [36].

Fatemeh Amereh (2019) in her study "***The emerging risk of exposure to nano(micro)plastics on endocrine disturbance and 2 reproductive toxicities: From a hypothetical scenario to a global public health challenge".*** Humans may be exposed to nano(micro)plastics, but little is known about how they interact with human tissues and cells. This is particularly factual when it originates to nano-sized plastic particles, which are a particularly dangerous type of plastic pollution. The potential endocrine disturbances of polystyrene Nano plastics were inspected in masculine pests using biosignature of sperm value, variations in the hormonal milieu, and molecular markers of endocrine disturbance, as well in a theoretical situation in positions of dosage (1, 3, 6, and 10 mg/kg-day) and contact period, although in a suppositious setting in expressions of quantity. Semen DNA reliability and chromatin assembly were studied as well. PS NP exposure was shown to have significant negative relationships with serum estrogen, luteinizing hormone, and follicle-stimulating hormone concentrations. Cell & organ abnormalities occurred at their minimum verified prescription, while the criticalness of lesions tracked a vibrant dose-retort arrangement. In reaction to the dosage of exposure, DNA impairment, as well as modifications in sperm morphology and capability, was observed. According to the findings of physio-histological changes and fluorescence figuring, substantial down-regulation of PLZF, DAZL, FSH, and LH genetic factor expression was identified in scrotums of creatures that were exposed, showing that radiation interacts within sperm production as well as the HPT-axis. Participants who got the highest stimulation dosage, on the other hand, had significantly increased FSH and LH expressions [37].

Yanmin Ma (2018) in her study ***"Effects of environmental contaminants on fertility 3 and reproductive health"*** investigated that the rate of human infertility is rising. Environmental toxins are potentially key causative agents connected with this trend, despite the fact that different causes for the rising infertility rate have been proposed. Chemical pollutants are ubiquitous in our atmosphere, and human contact is almost inescapable. Although the general role of ecological exposure to sterility is uncertain, research including occupational exposure and animal trials imply that environmental pollutants may have a negative impact on fertility. We looked at the negative impact of exposure to the environment on fertility and associated reproductive outcomes. Heavyweight metals, organic diluters, insect killers, and endocrine-disruptingcompounds are among the environmental pollutants considered in this analysis. This review is intended to draw attention to the need for more study in this area [38].

Alexander Suvorov(2018) in his study ***"Perinatal exposure to low dose 2,2,4,4 -tetrabromodiphenyl ether (BDE-47) alters sperm DNA methylation in adult rats"*** Polybrominated diphenyl ethers (PBDEs) are a category of procreative poisons which are extensivelyutilized. We assume that PBDEs affect semen DNA methylation because

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spermatogenesis necessitates substantial epigenetic alterations. Pregnant Wistar mice were given 0.2 mg/kg 2,2,4,4-tetrabromodiphenyl ether perinatally, and caudal epididymal spermatozoa from offspring were taken upon PNDs 65 as well as 120. A total of 18.0 million exclusive reads per model were sequenced using libraries made from sperm DNA. The MethPipe program was used to find DMRs (differentially methylated regions). On PND 65, BDE-47 revelation enhanced DNA methylation of epididymis sperm in genes, promoters, and intergenic sections; though, methylation in such genomic areas was reduced on PND120. In spermatozoa composed on PND65 and PND120, we found 21 and 9 disclosure-related DMRs, respectively. Among the two time points, two DMRs overlapped. This is the initial investigation to show that naturally significant prenatal PBDE exposure causes long-term methylation alterations in sperm DNA [39].

Yuling Zhang (2017) in his study "***Maternal urinary cadmium levels during pregnancy associated with risk of sex-dependent birth outcomes from an e-waste pollution site in China".*** The researchers wanted to examine if cadmium (Cd) intake throughout gestation is connected with a greater threat of poor neonatal consequences in a sex-reliant way. Cd contents in mother's urine models were analyzed in 237 individuals from Guiyu and 212 individuals located in Haojiang. The relevance criterion considered p0.05 in all studies. The nurturing U-Cd ranks in Guiyu inhabitants were observed markedly larger than in Haojiang residents. The research identified considerable opposite relations among U-Cd intensities and biological anthropometry (birth weight, Head Circumference, Apgarmarks and birth length with 1 and 5 minutes) in feminine newborns, but no potential issues in male newborns after modification, excluding Apgar (1 min.) score. Female babies had a higher relationship concerning Cd and bad birth results than male newborns, showing that the link in the middle of Cd and poor birth outcomes is gender precise[40].

Sue Chang (2018) in his study ***"Reproductive and developmental toxicity of potassium perfluorohexanesulfonate in CD-1 mice."*** In CD-1 mice, the reproductive/developmental toxicity of potassium perfluorohexanesulfonate was investigated. Earlier tobreeding, for a leastof 42 days in F0 males, and via gestation and lactation in F0 females, up to 3 mg/kg-dK+PFHxS was given (n = 30/sex/group). After weaning, F1 pups were given a direct dosage of K+PFHxS for 14 days. By 1 and 3 mg/kg-d, there existed an ambiguous reduction in live litter size, but the pup-born-to-implantation proportion remained unaltered. Adaptive hepatocellular enlargement was found, and it was associated with lower serum cholesterol and elevated alkaline phosphatase in 03 mg/kg-d F0 males. On multiplicative limits, hematology/medical pathology/TSH, neurobehavioral impacts, or histopathology, there were no further toxicologically relevant discoveries [41].

Alexander V.Sirotkin (2017) in his study ***"Influence of oil-related environmental pollutants on female reproduction"*** Benzene, ethylbenzene, toluene, o-xylene& m/p-xylene, are petroleum low-weight aromatic compounds that are one of the most common sources of pollution. The effects of BTEX on fertility, reproductive gland, Central Nervous System (CNS), spermatocyte, germ cells, and fallopian tube, as well as neurogenetics of somatic and multiplicative cells, cell gesturing classifications, and hypothalamus, pituitary, and marginal generative hormones are discussed. According to available research, BTEX has a deleterious impact on the CNS-pituitary-ovarian axis, their motioning particles, receptors, corpora lutea, Graafian follicles, oocytes, oviducts, embryos, ovarian cycles, offspring viability, as well fertility. BTEX's capacity to break chromosomes, impact cell breakdown, comprising formation of unrestricted radicals, and impact the issue of hormonal controllers of procreative procedures and intracellular protein kinases might overall contribute to these effects [42].

Gaurav Saxena in his study "***Environmental Pollution, Toxicity Profile and Treatment Approaches for Tannery Wastewater and Its Chemical Pollutants***" assess textile companies are important contributions to the economies of several emerging economies, but owing to the accompanying destruction of the environment, they are experiencing major difficulties from the community and policymakers. The release of possibly dangerous effluent with an alkaline pH, dark brown color, disagreeable odor, significant biological and chemical oxygen availability, TDS, and a combination of contaminants has sparked public outrage. Several environmental organizations have designated a number of compounds as hazardous, limiting their usage in textile industries; yet, several of these substances are utilized and released in wastewater. As a result, appropriate treatment/detoxification of tannery effluent is critical for ecological sustainability. This article examines the ecological contamination and hazardous characteristics of industrial effluents and compounds in greater depth. Moreover, the current state and progress of current remediation skills for the management and/or refinement of manufacturing effluents have been examined at both the laboratory and pilot/industrial levels. In contrast, developing therapy techniques have been examined, either alone or in conjunction with physiological effective treatments. Furthermore, the limits of the present and new therapeutic options have been outlined, as well as possible topics for additional research. In contrast, sustainable waste disposal, regulation, and management technologies are presented. Ultimately, the worldwide legal situation on industrial effluents sewage and hazardous outflow limitations has been examined state by state, along with effluent regulations for industrial effluents sewage pollution control [43].

Md. Khalid Hasan (2019) in his study "***Water pollution in Bangladesh and its impact on public health"*** investigated that Bangladesh, one of the largest and utmost populous nations, has abundant water resources, however these resources are constantly contaminated. Various hazards, such as harmful toxic elements, coliforms, and other chemical pollutants, are found in both surface water and groundwater supplies. Since the mainstream of the populace devours these foundations of water, chiefly underground origin, which increases the concentration of arsenic crosswise the nation, the well-being hazard accompanying with intake water is quite significant. In Bangladesh,

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demises from water-borne contagions are mutual, particularly amid youngsters. The major causes to freshwater impurity are human activities such as unprocessed untreated wastewater, inappropriate sewage disposal, and agricultural runoffs. To assess the danger to the public, it is necessary to assess the nation's economic water pollution state, as well as the origins of this severe situation. We analyzed thousands of well-known domestic and international journals, conference papers, and other associated documents for this objective in order to create a comprehensive picture of current water contamination condition and its influence on global health, as well as the causes of water contamination [44].

Adel Ghorani-Azam (2016) in his study ***"Effects of air pollution on human health and practical measures for prevention in Iran"*** investigated that pollution has become a serious subject in the contemporary biosphere, with substantial toxicological significances for environmental and well-being. Though there are a variability of anthropogenic emissions, automobiles and industrial applications description for the mainstream of air quality. Particulate contamination, ground-level ozone, CO, SO2, nitrous oxides, and principal are six key air impurities, as per the Department of Well-being. Extended and temporary contact to air-borne pollutants has a diversity of cytotoxic possessions on individuals, involving breathing and circulatory ailments, neuropsychiatric problems, dry eyes, autoimmune conditions, and protracted persistent systemic diseases. Many revisions have found a clear connection among deprived air eminence and an upsurge in cause of death and disability, mostly owing to cardio - respiratory disorders. Polluted air is a key etiological factor for ailments including allergies, lung disease, ventricular hypertrophy, Alzheimer's and Parkinson's diseases, emotional problems, autism, blindness, foetal growth, and premature birth, among others. We wanted to cover the toxicity of main contaminants, their foundations of emission, and their influence on human health. We've also offered some practical ways for Iran to decrease pollution levels [45].

Iwona Sidorkiewicz (2017) in her study "***Endocrine-disrupting chemicals—Mechanisms of action on male reproductive system"*** External substances known as endocrine disrupting substances (EDCs) can damage the hormonal system and have a variety of negative health consequences by targeting various parts of the system in the human body. Global pollution has arisen from mass manufacturing output and wide applications of EDCs. According to collecting information, humans are exposed to EDCs is linked to male sexual result of decline and can disrupt other hormonal changes controlled metabolic functions, especially if exposure occurs throughout initial stages. The focus of this work is a study of papers not included in earlier reviews and a conceptual of the negative belongings of EDCs on the effective of the male generative method. The first step is to look for papers that describe substances that disrupt the estrogen system. Second, the effects of androgen-signaling pathway changes on androgen-sensitive muscles are investigated. Third, the assessment of steroidogenesis dysfunction is explored by concentrating on the EDC-targeted steroid hormone biosynthesis route. Finally, the potentially harmful effects of reactive oxygen species (ROS) on semen function are explored. Because spermatogenesis is such a complicated procedure, several investigations have identified distinct dysfunctions based on the phase of growth at which the contact occurred. In future study, it will be necessary to account for key windows of acquaintance, such as the prenatal, perinatal, and pubescent phases, as well as the impacts of combinations of various substances [46].

Stavros Sifakis (2017) in his study "***Human exposure to endocrine disrupting chemicals: effects on the male and female reproductive systems"*** Endocrine disrupting chemicals (EDCs) are a class of chemical substances that have been intensively studied owing to their possible negative possessions on human health. The detrimental possessions of EDCs on the reproductive organs have established a lot of consideration in recent years. Estimating populations exposed to EDCs, which may be divided into occupational and environmental exposure, has proven difficult owing to the structural complexity of the compounds, which are produced from a variety of sources at dosages underneath the limit of quantification of standard techniques. Endocrine disruptive drugs alter the hormone-dependent processes involved for masculine and feminine gonadal growth, according to experimental and in vitro research, either by direct contact with growth factors or through genomic and cell–cycle regulating mechanisms. The amount of research in human groups show a link among EDC contact and male and female reproductive system diseases include fertility issues, menstruation, cancer, testicular cancer, and poor spermatozoa and/or performance. Owing to the difficulty of the diagnostic procedures utilized, the extent of work-related or ecological contact, the dedication of the measurement items, and the sample size of the matters inspected, a fundamental association amid reproductive ailments and exposure to particular toxic elements has yet to be formed, based on these previous discoveries. Future research should concentrate on developing a consistent approach for analyzing human populations' acquaintance to individual EDCs and their direct effects on the reproductive organs [47].

Shuk-MeiHo (2017) in his study "***Environmental factors, epigenetics, and developmental origin of reproductive disorders"*** investigate Growth factors have a big role in gender- divergence, growth, and operation of the sexual organs. As a result, contact to estrogenic and anti-androgenic endocrine disrupting chemicals (EDCs) during childhood is linked to infertility in adulthood. Multiple generation's research on children of diethylstilbestrol-exposed mothers/grandmothers provide humanoid indication in favor of "Developmental Origins of Health and Disease" (DOHaD). Animal studies show that EDCs like bisphenol A, diethylstilbestrol, genistein, p, p′-dichlorodiphenyl-dichloroethylene, polyaromatic hydrocarbons, and phthalates can cause DOHaD impacts on ovarian function, female cycling, adult vaginal anomalies, spermatozoa, urinary tract illness, and breeding behavior. Immediate mimicking of hormone levels or morphogens, as well as interaction with epigenetics remodeling throughout cell / organ development, are among the processes generating these EDC effects. EDC activity is associated to aberrant DNA damage and other epigenetic changes, as well as changed regulation of gene

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expression critical for reproductive organ growth and differentiation. The evidence on the links among developmental exposure to EDCs and adolescent infertility, as well as the processes behind these effects, is reviewed here [48].

Ellen Webb (2014) in her study "***Developmental and reproductive effects of chemicals associated with unconventional oil and natural gas operations***" Unconventional oil and gas (UOG) strategies have the promising to pollute the air and water in areas where they operate. Environmental damage can occur at any step of the UOG activity, from well building to collection, management, shipping, and marketing. Thousands of compounds are used in the unusual oil and ordinary gas extraction procedure. In this paper, we examine the empirical proof that individual and initial exposure to toxic substances linked with UOG activities can have negative reproductive problems consequences in individuals. VOCs and substantial metals (comprising lead, arsenic, and cadmium) are only a rare of the recognized causes to poor air and water eminence, all of which are harmful to human development and reproduction. Environmental variables, such as air and water contamination, are especially harmful to a growing foetus. Chemical acquaintances can cause possibly lasting harm to the developing embryo and foetus at important windows of sensitivity throughout prenatal and early postnatal development, according to research. Numerous of the air and water pollutants discovered at UOG activities locations are known to be prenatal and reproductive toxins, thus there is a pressing need to learn more about the possible health effects of these compounds on individuals, babies, and kids.

2. Methodology

The systematic review was executed with respect to implementing the PRISMA checklist and guidelines (Sidorkiewicz et al., 2017), as presented in **Appendix 1.**

2.1. Literature collection criteria

This systematic review made use of search engines such as Google Scholar. To sort the data, certain filter tools in the search channels are used. We looked at articles that were published between January 2014 and January 2022. Several keywords linked to the review were utilized, including water pollution, Air pollution, toxicity, effect on the reproductive system. The terms for study design (longitudinal, prospective, cohort, and follow-up) were added to the previous vocabulary. The keywords that were used are shown below in Table 1.

Search framework	keywords
Environment	The toxicity level of hazardous compounds, Composition of gases in the air
Air pollution	Human Health, Cellular action, and Detoxification
Water pollution	Micropollutants, Sewage, Industrial effluent, and pathogens
Reproduction	Endocrine disruptors, Female organs, fertility, menstrual cycle, and sperms

2.2. Exclusion and Inclusion criteria

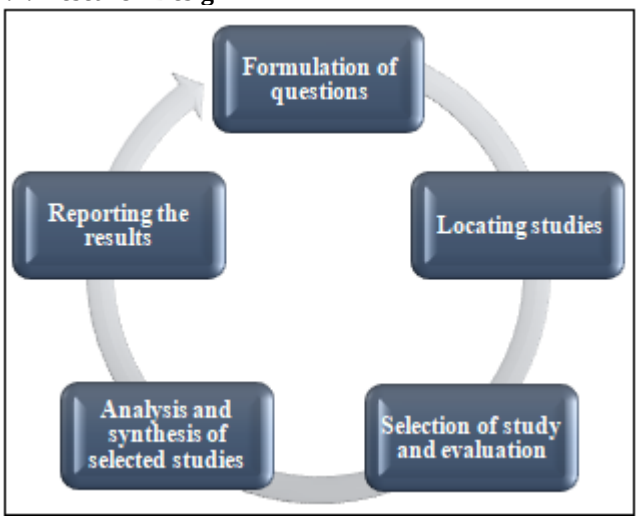
The majority of recent research publications related to our issue were inclusive. Journals with a high impact factor were used to gather high-quality research. Articles were to be (1) published in the native tongue or English, (2) focused on toxicity and pollution, (3) published in peer-reviewed journals between January 2016 and January 2022, and (4) include a prospective cohort design.

We looked at studies that used original and relevant data. We only preserved research that was published in peer-reviewed journals, excluding conference papers and dissertations when data from the same sample was used in several publications [49].

2.3. Data Extraction

A consistent form was used to capture data on the year of publication, region, setting, features of study participants, toxicity level, impact on individual health, and environmental consequences. The collected papers from each experiment were examined for uniformity, and any inconsistencies were resolved by a conversation with other investigators.

2.4. Research Design



3. Results

3.1. Study selection

1391studies were extracted using multiple databases. The studies altogether were exported to a citation software Mendeley (Version 1.17.13) where studies with duplicate data were excluded (n=221). Abstract and titles were screened to sort the relevant topics and if the abstract and title were provided enough information, full articles were obtained and screened based on eligibility criteria. Further were excluded and not retrieved due to inaccessibility and eligibility criteria. After multiple reviews (n=76) were successfully retrieved and altogether (n=15) articles were included to be the part in this review, as shown in the flow diagram **Figure 6.**

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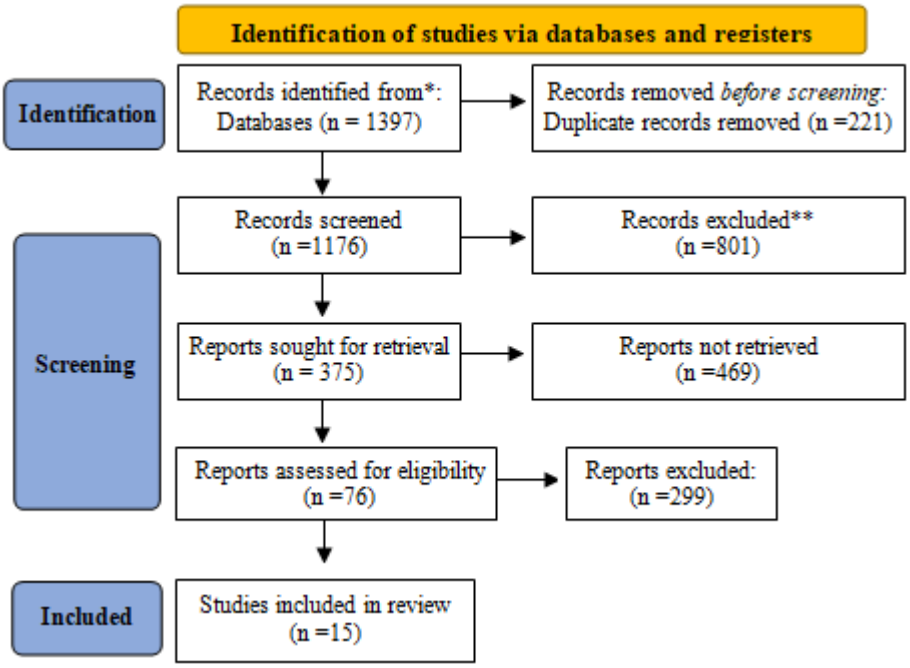

Figure 3: The PRISMA flow diagram

Studies included in the review

15 studies were finalized after multiple reviews and consideration to be the best pick to review the effects of chemicals and pollution on human health. The studies were published between 2014 and 2022. The studies reviewed during the research were not only conducted on the effects on human health, but they also varied to other living organisms as well. Every other research and review involved in the study resulted in some association between chemicals and pollution.

Table 1: List of the studies that were included in the review

Author	Topic	Description
Encarnação et al., 2019	Human health, animals, and the environment are all affected by endocrine disruptive substances	Investigated number of chemicals and their toxicity
Gonsioroski et al., 2020	Endocrine Disruptors in Water and Their Effects on the Reproductive System	Environmental pollution that harm to pregnancy and birth
Amereh et al., 2019	The emerging risk of exposure to nano(micro)plastics on endocrine disturbance and 2 reproductive toxicities: From a hypothetical scenario to a global public health challenge	Micro plastic pollution and it effect on human health
Ma et al., 2018	Effects of environmental contaminants on fertility 3 and reproductive health	Investigated the rate of human fertility due to environmental pollution
Suvorov et al., 2018	Perinatal exposure to low dose 2,2,4,4 -tetrabromodiphenyl ether (BDE-47) alters sperm DNA methylation in adult rats	Investigation to show that naturally significant prenatal PBDE exposure causes long-term methylation alterations in sperm DNA
Zhang et al., 2017	Maternal urinary cadmium levels during pregnancy associated with risk of sex-dependent birth outcomes from an e-waste pollution site in China	link in the middle of Cd and poor birth outcomes is gender precise
Chang et al., 2018	Reproductive and developmental toxicity of potassium perfluorohexanesulfonate in CD-1 mice	Toxicity of potassium perfluorohexanesulfonate
Sirotkin et al., 2017	Influence of oil-related environmental pollutants on female reproduction	Different chemicals and their effect on female reproduction
Saxena et al., 2016	Environmental Pollution, Toxicity Profile and Treatment Approaches for Tannery Wastewater and Its Chemical Pollutants	Ecological contamination and hazardous characteristics of industrial effluents and compounds in greater depth
Hasan et al., 2019	Water pollution in Bangladesh and its impact on public health	water contamination condition and its influence on global health
Azam et al., 2016	Effects of air pollution on human health and practical measures for prevention in Iran	Toxicity of main contaminants, their foundations of emission, and their influence on human health
Sidorkiewicz et al., 2016	Endocrine-disrupting chemicals—Mechanisms of action on male reproductive system	Potentially harmful effects of reactive oxygen species (ROS) on semen function are explored
Sifakis et al., 2016	Human exposure to endocrine disrupting chemicals: effects on the male and female reproductive systems	Fundamental association amid reproductive ailments and exposure to particular toxic elements has yet to be formed, based on these previous discoveries
MeiHo et al., 2017	Environmental factors, epigenetics, and developmental origin of reproductive disorders	Links among developmental exposure to EDCs and adolescent infertility

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Webb et al., 2014	Developmental and reproductive effects of chemicals associated with unconventional oil and natural gas operations	UOG activities locations are known to be prenatal and reproductive toxins

3. Discussion

Despite the fact that information on the major and rising issue of chemical, air, and water pollution's hazardous impacts on people is currently insufficient, the amount of research has just recently begun to grow. According to the result of this research, contamination and chemicals are the primary causes of ecological and sexual impacts on human health. These study subjects eventually drew more interest as people became more aware of their possible effects on the human body. We looked at new research that linked toxic pollutants to human contraceptives, including fertility problems. Atmospheric pollutants have been shown to interact with the reproductive capabilities of both females and males, according to substantial evidence. Metals, chemical agents, poisons, and endocrine-disrupting chemicals are among the substances found in babies. Whereas these findings emphasize the possible biological consequences of environmental pollutants, the pathways of impacts for these substances are complicated, and the impact of environmental pollutants on male reproduction is still a subject of debate.

Nayana et al., 2017 An increasing body of research suggests that societal pollutants are found in water around the globe and that they can harm quasi animals and people. These contaminants can affect the reproductive function explicitly or implicitly, limiting growth and ovulation. Because these substances may be ingested in a variety of ways other than drinking, the effects of radiation to some of these substances can be significantly greater than those from liquid simply. To investigate the protracted repercussions of exposure to chemicals contained in liquid and their biological impacts, more research is needed in a range of populations and species. Quasi animal studies act as a base for research exploration because they give molecular, efficacy, and ecological details regarding EDCs, despite the fact that chemical effects vary by species. In order to imitate typical environmental contact in livestock, feral creatures, and people, it is also required to evaluate the consequences of combinations of pollutants from other categories. More research in a range of different people is required to see if the impacts of pollution toxins on fertility vary between populations in various regions of the globe [50].

Campanele et al., 2020 Many researchers view plastic particles as significant markers of the past and present period, designating a new historical epoch: The Plasticene, due to their widespread dispersion and quantity. The consequences of plastic particles, on the other hand, are not yet well established. Because of the many physical-chemical characteristics that make microplastics multifunctional disruptors, understanding their influence is rather difficult. On the one hand, plastic particles convey dangerous substances across environments, but they are also a mixture of toxic components that are introduced willingly as additives to boost polymer characteristics and extend their life.There is currently a significant paucity of understanding about the primary compounds of interest employed in the polymer industry, their destiny after plastic particles enter the atmosphere, and their subsequent consequences on human health when linked with micro and nanostructures. To consolidate existing understanding and better target future research, we did a comprehensive survey on micro and nano plastic exposure routes and their possible hazard to public health [51].

Verma et al., 2016 Plastic trash incineration in an open field is a major cause of air pollution. Most municipal solid waste, which contains around 12% plastics, is burned, releasing harmful substances such as dioxins, furans, mercury, and polychlorinated biphenyls into the atmosphere. Additionally, destroying Poly Vinyl Chloride releases harmful halogens and pollutes the air, resulting in climate change. The poisonous compounds discharged, as a result, threaten the ecosystem overall, as well as to plants, humans, and wildlife. The Entire Nervous Center is harmed by plastic. Brominated chemicals are known to be carcinogens and genetic mutations. Carcinogens accumulate on plants and in our rivers, where they ultimately make their way into our meals and, as a result, our bodies. The most hazardous constituent of these Dioxins, 2,3,7,8 tetrachlorodibenzo-p-dioxin (TCDD), also called agent orange, is a poisonous chemical that causes illness and neurological problems, as well as disrupting the hormonal, thyroid, and respiratory systems. As a result, burning plastic garbage raises the risk of heart disease, aggravates respiratory conditions like asthma and emphysema, and causes rashes, nausea, and headaches, as well as harming the neurological system. As a result, environmentalists and scientists must take immediate action to take a meaningful step toward a safer and greener world someday [52].

Khan et al., 2014Textile manufacturing is one of the earliest and most technically complicated businesses in the world. The company's essential strength stems from its diverse manufacturing base of fibers/yarns ranging from environmental fibers. Factory system and their effluent have grown in case of an increase in the market for textile materials, generating a serious environmental concern throughout the globe. Several substances that were used in textile mills are environmentally destructive and human health. Colorants are deemed contaminants among the numerous compounds found in textile effluent. Polluted water produced by the release of industrial effluents and dangerous substances usage, particularly during manufacturing, are two of the most common environmental problems related to the textile sector. Because of the existence of hydrosulfides, the wastewater has a significant reduction in oxygen levels and hinders the passage of light through the water body, which is harmful to the aquatic ecology. Textile wastewater contributes to severe biodiversity loss as well as human sickness. Around 40% of the world's colorants include naturally linked chloride, which is a recognized toxin. Chemicals vaporize we breathe or are inhaled via our skin, causing allergic responses and perhaps harming infants before they are born. The regular working of molecules is disrupted as a result of chemical contaminants, which can lead to changes in the metabolism and biochemical systems of animals,

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impairing critical activities such as respiration, osmoregulation, reproduction, and even death. Pollutants in textile mills' wastewater are not recyclable, thus they collect in the body's key organs and fester over age, causing a variety of illnesses. As a result, untreated or incompletely treated textile effluent can harm marine and riparian life by disrupting natural ecosystems and inflicting protracted health impacts [53].

4. Limitations

One of the limitations of the study was the sample size. Therefore, regardless of multiple cohort studies, the data is insufficient to derivate the entire toxicological effects. In addition, the study collected and reviewed in this systematic review were only in English due to the language barriers and open access to every audience.

The study can be assessed in future with a diverse pool of data, and in-depth quantitative or mixed-method analysis can be carried out on different variables. In addition, there is a good possibility that data hidden in other languages possess information more innovative for this cohort study.

5. Future Scope

Chemical pollution and its biological, social, behavioral, and psychological determinants were shown to have a positive relationship in the studied data. Other variables connected with chemicals and pollution can be explored and worked on in the future to improve the protective strategies.

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Appendix 1

PRISMA Checklist

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	4
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	4
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	5
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	5
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	5
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	5
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	5
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	5
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	5
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	6
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	6-7
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	5
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	6
	13d	Describe any methods used to synthesise results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	5
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	5
	13f	Describe any sensitivity analyses conducted to assess the robustness of the synthesised results.	5
Reporting bias assessment	14	Describe any methods used to assess the risk of bias due to missing results in a synthesis (arising from reporting biases).	5
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	5
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the	6

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Section and Topic	Item #	Checklist item	Location where item is reported
		search to the number of studies included in the review, ideally using a flow diagram.	
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	6-7
Study characteristics	17	Cite each included study and present its characteristics.	7
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	6-7
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	6-7
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	6-7
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	6-8
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	6-8
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesised results.	Appendix 2
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Appendix 2
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Appendix 2
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	11-13
	23b	Discuss any limitations of the evidence included in the review.	13
	23c	Discuss any limitations of the review processes used.	13
	23d	Discuss implications of the results for practice, policy, and future research.	13
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	-
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	-
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	-
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	-
Competing interests	26	Declare any competing interests of review authors.	-
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	-

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