REVIEW ARTICLE

Impact of Air Pollution on Reproductive Health in Afghanistan

Khalid Akbari[1], Taj Mohammad Khaksar[2*]

Abstract

Background: The presence of one or more contaminants (harmful substances) in the atmosphere in a specific quantity, for such duration, which is injurious or tends to be injurious to human health, welfare, animal, or plant life is called air pollution. Air pollutants are of commonly two types, which are produced through natural pollutants; they include dust (crustal material), sea salts, biological material, pollen, spores or plant-animal debris, volcanic eruptions (which release a very large quantity of gases and particles into the atmosphere), periodic forest fires, thunderbolts, wind erosion, and low concentration ozone. Other types of pollutants are produced in human-made (technical) environments, like mobile sources (cars, trucks, airplanes, marine engines, etc.) or point sources (factories, electric power plants, etc.).

Result: The high level of air pollution is a big problem all over the world and also in Afghanistan, and all residents of this country are severely exposed to this ever-worsening situation. Air pollution and other extraordinary environmental problems are factors that threaten the livelihood of millions of Afghans, as a study report shows that 60% of Kabul's residents are exposed to increased levels of harmful toxins, such as, nitrous oxides and sulfur dioxide. According to the State of Global Air report, more than 26,000 afghan deaths could be attributed to pollution in 2007, but United Nations Assistance Mission in Afghanistan (UNAMA) documented nearly 3,500 civilian casualties from the war for the same time period, so air pollution is killing more Afghans than war because they burn anything possible to get energy and heat they need. Result of air sampling in major urban centers of Afghanistan shows high amounts of particulate matters (PM), benzo-a-pyrene, and polycyclic aromatic hydrocarbons (PAHs) originating from vehicle exhaust emission. The highest concentrations were founded in Kabul and Mazar-e-Sharif (13.6 ng/m^3). The absence of industrial parks, nonconformity of environmental protection rules, especially by industries, urbanization, degradation of fertile lands, deforestation, seasonal winds, drought, internal migration, and low knowledge about pesticides and herbicides use, are factors that boost the severity of air pollution in Afghanistan. In Afghanistan, women are more exposed to high levels of indoor air pollution because they spend more time at home due to their cultural rules; also, women have responsibility for household activities, working in the kitchen to prepare food, they are exposed to poor sanitation and contaminated water supplies, they clean and sweep rooms and yards with inadequate protection equipment, which are significant sources of dust, so they are often exposed to high levels of smoke and dust for long periods.

Keywords: Air pollution, Carbon monoxide, Nitrogen oxides, Particulate matters, Polycyclic aromatic hydrocarbons, Reproductive health, Sulfur dioxide.

Journal of Applied Pharmaceutical Sciences and Research, (2020); DOI: 10.31069/japsr.v3i2.1

Reproductive Health

World Health Organization (WHO) defines reproductive health as a state of complete physical, mental and social well-being, and not merely the absence of reproductive disease or infirmity, reproductive health involves all of the reproductive processes, functions, and systems at all stages of human life. Men and women have the right to be informed and to have access to safe, effective, affordable and acceptable methods of family planning of their choice that are not against the law; they are able to have a satisfying and safe sex life, have access to appropriate health care services that will enable women to go safely through pregnancy and childbirth, as well as, to provide couples with the best chance of having a healthy infant. Reproductive health is a fundamental component of an individual's overall health status and a central determinant of quality of life.

Reproductive health is a crucial feature of healthy human development and general health, and many internal and external factors may challenge an individual's reproductive health. While some factors may be pre-determined, such as, genetic susceptibility to a particular disease but others will be behavioral and involve an individual's participation in risky practices.[1]

[1]Assistant Professor, Department of Internal Medicine, Paktia University, Afghanistan

[2]Assistant Professor, Department of Para Clinic, Paktia University, Afghanistan

Corresponding Author: Taj Mohammad Khaksar, Assistant Professor, Department of Para Clinic, Paktia University, Afghanistan, Email: tajmohammad.khaksar123@gmail.com

How to cite this article: Akbari K, Khaksar TM. Impact of air pollution on reproductive health in Afghanistan. Journal of Applied Pharmaceutical Sciences and Research. 2020; 3(2):1-8

Source of support: Nil

Conflict of interest: None

Different natural and physical factors, biological factors, socioeconomic factors, individual characteristics and behaviors, availability and access to health care professionals and reproductive health services, educational service, poverty, demographic factors, community, culture, political situation, and environmental factors have direct or indirect effects on reproductive health periods, such as, preconception, conception, fertility, pregnancy, child, adolescent, and adulthood.[2]

Nowadays, population growth, urbanization, industrialization, economic development, consumed energy types and much more, brought more comforts and expectancies to people's lives, but they turned the environment strongly polluted and unhealthy, which increased the burden of fatal and life-threatening disorders, like cardiovascular disease, cancers, disabilities and pregnancy outcomes.[3] One of these problems is air pollution; WHO had found its carcinogenic effects on humans and estimated that 90% of the world population was exposed to higher levels of particulate matter than WHO air quality guidelines in 2012.[4]

It is estimated that from 1990 to 2013, air pollution was the fourth-leading fatal health risk factor,[5] and due to the latest available estimates, air pollution causes over 6 million deaths worldwide in 2016, which is six times more than from malaria, four times more than HIV/AIDS,[5] and twice as many as AIDS, tuberculosis, and malaria combined.[6] Otherwise, exposure to air pollution cost the world economy some 5.11 trillion dollars in 2013 [is equivalent to 7.4 percent of South Asia, and 7.5 percent of East Asia and the Pacific gross domestic product (GDP)].[5]

WHO's 2015 survey shows that the global focus on mother and child health has decreased maternal mortality by 44% from 1990 until 2015. However, unfortunately, 303,000 maternal deaths were still estimated in 2015 [66% of the total maternal deaths occurred in sub-Saharan Africa (26% of the number of birth worldwide) and 22% in Southern Asia (8% of the number of birth worldwide)].[4] In addition to this, in 2013, air pollution was responsible for about 5% of under-five children deaths and 10% of over-fifty adult deaths.[5] Under-five children mortality due to air pollution in low-income countries is 60 times more than from high-income countries.[5]

Air pollution is the great cause of the non-communicable disease (NCD) as an estimated 3% of cardiopulmonary, and 5% of lung cancer deaths are globally ascribable to PM, although a recent study of the global burden of the disease shows 7.5% of global deaths were from air pollution in 2016.[6]

According to the State of Global Air 2019 report, current levels of air pollution have reduced worldwide life expectancy by one year and eight months. The report also notes that toxic air reduces average life expectancy by almost as much as tobacco use. The severity and the importance of air pollutants' health effects are related to the type of pollutant, absorbed dose by an organism, which depends on air pollutant concentration, duration of exposure, pulmonary ventilation, physical activity, and individual susceptibility.[7]

More susceptible groups to air pollution adversely affect our elders, children, smokers, those who have a history of cardiopulmonary disease, and pregnant women.[2] There is ample evidence that air pollution in combination with poverty, lack of economic and social justice, lack of opportunities, lack of perfect and adequate health services and awareness, biodiversity, and low knowledge from healthy lifestyles are major life-threatening factors in Afghanistan.[8]

Overall, 85% of women and 41% of men are illiterate in Afghanistan.[9] Illiteracy is an important factor in environmental pollution and its effects on humans, because of illiterates, out of ignorance, with inappropriate use of different pollutants, which can unconsciously harm themselves, their families, and the environment where they live.

Air pollution has also been identified as a global health priority in the sustainable development agenda. WHO has responsibility for stewarding three air pollution-related indicators for monitoring progress against the sustainable development goals: in health (Goal 3.9: by 2030, substantially reduce the number of deaths and illness from hazardous chemicals and air, water, and soil pollution and contamination), in energy (Goal 7.1: universal access to energy), and in cities (Goal 11.6: by 2030, reduce the adverse per capita environmental impact of cities, including, by paying special attention to air quality, municipal, and other waste management).[10]

What is Air Pollution?

The presence of one or more contaminants (harmful substances) in the atmosphere in a specific quantity, for such duration, which is injurious or tends to be injurious to human health, welfare, animal, or plant life.[11] In other words, all chemical, biological, and physical agents that modify the natural characteristics of the atmosphere are referred to as "air pollutants."[7]

Air pollutants are of commonly two types, which are produced through a natural process in the environment is called natural pollutants; they include dust (crustal material), sea salts, biological material, pollen, spores or plant-animal debris, volcanic eruptions (which release a very large quantity of gases and particles into the atmosphere), periodic forest fires, thunderbolts, wind erosion, and low concentration ozone.[3,7,11] Other type pollutants are produced in a human-made (technical) environment, like mobile sources (cars, trucks, airplanes, marine engines, etc.), or point source (factories, electric power plants, etc.).[7]

Air pollutants are also classified as either primary or secondary pollutants. Primary pollutants are directly produced by a process, such as, ash from volcanic eruptions or carbon monoxide gas from a motor vehicle exhaust, and secondary pollutants are produced from primary pollutants in the lower atmosphere by solar radiation, heat or chemical reactions, such as, ozone, hydrogen peroxide, H_2SO_4, and other photochemical pollutants.[3,7]

Primary and secondary pollutants are divided into two types, i.e., particulate matter and gases pollutants. Particulate matters are released from burning fuels, they are suspended in the air as dust, vapor, and smoke for an extended time period, they have different physical and chemical properties, particle size can be from 0.005 to 100 microns in diameter, but particles which are small than 10 microns (PM_{10}) and smaller than 2.5 microns ($PM_{2.5}$) are more severe, and should cause more health problems.[11]

Particulate matters include metals as silicon, asbestoses, lead (Pb), mercury (Hg), and inorganic ions, such as, sodium, potassium, calcium, magnesium, cadmium, copper, nickel, zinc, and biological components as allergens or microbes.[6] Due to Environmental Protection Agency, annual standards for particulate matters ($PM_{2.5}$) level is below 8 μg/m^3, and its background level is about 5 μg/m^3,[12] but the WHO guideline values are 10 μg/m^3 annual mean or 25 μg/m^3 24-hour mean for $PM_{2.5}$, and 20 μg/m^3 annual mean or 50 μg/m^3 24-hour mean for PM_{10}.[10]

Gases pollutants group include noxious gases and their chemical compounds, such as, carbon dioxide (CO_2), carbon monoxide (CO), sulfur oxides as SO_2, SO_3, and H_2SO_4, hydrogen sulfide (HS), ammonia as NH_2, and NH_3, hydrocarbons as polyaromatic hydrocarbons (PAH), radon, persistent organic pollutants (POPs), chlorofluorocarbons (CFCs), volatile organic compounds (VOC), and ozone (bad ozone).[3,6,11] WHO's global comparative analysis of air pollution shows an 8% increase from 2008 until 2013.[6]

Health Effects of Air Pollution

For the first time (73 AD), a fatal respiratory disorder induced by natural air pollution in Plinius, who moved to Pompei (Italy) to observe the eruption of Mount Vesuvius, and had breathed air pollutants emitted by the volcano.[2] Henry Hyde Salter defined the link of "impure air" with asthma in his book "On Asthma," published in London in 1860.[7]

Concerns about the effects of air pollution (particulate matter) on health date back to the historic pollution episodes in London in 1952, when a weather inversion leads to high levels of particulate matter air pollution, and subsequent increases in mortality and morbidity.[13]

To date, air pollution [ambient (outdoor) and household (indoor)] is the biggest environmental risk to health, which is responsible for about one in every nine deaths annually, or ambient (outdoor) air pollution alone kills around 3 million people each year, mainly from NCDs.[10]

Globally, 534,000 deaths of under-five children were attributed to indoor air pollution,[14] and 3 million deaths were attributable to ambient air pollution in 2012.[10] About 87% of these deaths occur in low-, middle-income countries, which represent 82% of the world's population,[10] with the majority of these deaths caused by acute lower respiratory infections.[14] There is a verified link between indoor air pollution with low birth weight, tuberculosis, ischemic heart disease, cataracts, asthma, and nasopharyngeal and laryngeal cancers.[6,14]

There is a significant association between air pollutants and several adverse health effects in the world population, especially when air pollution combines with other factors. These effects range from subclinical effects to premature death,[1,6,15] as 3.8 million die prematurely every year from household air pollution, which is produced by using kerosene and solid fuels in stoves, open fire, and lamps for cooking (2011. WHO. Clean air for health). In these deaths,

- 18% from strokes,
- 27% from ischemic heart disease,
- 20% from chronic obstructive pulmonary disease,
- 8% from lung cancer, and
- 27% from pneumonia.

Other health effects of air pollution in long and short term exposure are[6,15]:

- Reduced physical activity and performance
- Hypertension, diabetes mellitus
- Eye irritation
- Depleted immune system
- With long-term exposure, increase in the carcinogenic mortalities
- Alzheimer's and Parkinson's disease
- Children development outcomes
- Reproductive health outcomes as low birth weight, intrauterine growth retardation, preterm birth, etc.

Additionally, air pollutants can have different effects on agricultural productivity, transport system, and cultural and historical assets,[11] which indirectly affects human health.

Air Pollution Effects on Reproductive Health

Human reproduction is a series of complex events in a specific time period, such as, intrauterine life (congenital anomalies, fetal growth, rates of abortions, stillbirths, and preterm births), puberty onset, fecund period (gametogenesis, pregnancy time, embryo's implantation, and menopause onset), and breastfeeding period (the health of the pregnant and lactiferous woman).[4]

Air pollution can affect different aspects of reproduction, especially on fetal and infant mortality, fetal size outcomes, such as, low birth weight (LBW) (< 2,500 grams), very low birth weight (VLBW) (< 1,500 grams), small gestational age (SGA), intrauterine growth retardation (IUGR) (birth weight below the 10th percentile for the gestational age), preterm birth defects (birth at < 37 weeks of gestation), ova genesis, hypertension of pregnancy, smaller placentas, reduction in the placental blood supply, spermatogenesis, effects on the endocrine system, and other aspects of reproductive health.[4,12,16,17]

Pregnant mothers' exposure to air pollution causes the likelihood of obesity in their children and can affect the function of the thyroid gland, which has direct effects on normal growth and brain development, and also effects on menstruation cycle in teenage girls.[12]

Air pollutants may be part of a complex set of factors that increase the risk of preterm birth or LBW through processes related to inflammation, oxidative stress, endocrine disruption, and impaired oxygen transport across the placenta.[18]

As air pollution has lots of components, so it is more difficult to identify specific pollutant, which can actually affect on mentioned aspects of reproductive health but in reported effects, the effects of PMs on birth outcomes are more famous than other pollutants especially on birth outcomes.[19]

Inflammatory placental lesions are more prevalent when pregnant women get exposed to increasing concentration of $PM_{2.5}$; also, CO exposure is most closely linked with thrombotic placental pathology. Household air pollution has a significant association with hypoxic or other placental lesions.[20]

Higher exposure to pollutants during the early stages of intrauterine life may be responsible for impaired growth, LBW, intrauterine growth retardation in the prenatal, early postnatal period, increase mortality and morbidity in childhood, and diseases like noninsulin-dependent diabetes, hypertension, and coronary heart diseases in the middle age.[17,21-23]

Exposure to air pollution, especially to ultra-fine particles (< 1 μm), has been shown to induce oxidative stress and inflammation (Terzano *et al*., 2010) because they can penetrate the alveolar wall, and enter to the maternal bloodstream, such that, particles and inflammatory mediators may reach the placenta and the fetus.[22]

A retrospective cohort study which was conducted on Korean women shows that serum lead (Pb) level was significantly associated with a higher number of spontaneous abortions, as one unit increase in serum level Pb increases the risk for spontaneous abortions rate three times.[24]

Exposure to air pollution early in pregnancy may adversely affect fetal growth (biparietal diameter, femur length, abdominal diameter, estimated fetal weight measured in late pregnancy and birth weight, and head circumference),[22] as the active components of PMs, like PAH, may be inhaled and absorbed into the maternal bloodstream, and might interfere with some processes in the development or nourishment of the fetus (IUGR), and increased PAH-DNA adducts in leukocytes from umbilical cord blood, which inversely correlated to birth weight and head circumference.[17,21]

The most potent pregnancy and fetal development toxin in urban air pollution and indoor air pollution are the chemicals, like PAH attached to particulate matter and produced from wood smoke, industrial pollution, traffic flow, and such others, rather than the particles themselves.[12]

Women who are exposed to air pollution, carcinogenic PAHs, smoke cigarettes, or were exposed to environmental tobacco smoke also had increased DNA adducts in their placenta that is associated with IUGR in their newborn, as a 10 ng/m^3 increase in carcinogenic PAHs increase 1.22 relative risk of IUGR,[17,26] birth weight, birth length, and head circumference.[25] IUGR is the most common consequence of mutagenic exposure in the time of implantation. Reduced fetal growth is an important predictor of neonatal morbidity and mortality.[21,23]

PAHs and its metabolites in urban air bind to aryl hydrocarbon receptor and accumulate in the nucleus of cells, and cause most of the mutagenic and antiestrogenic activities through increased metabolism and depletion of endogenous estrogens, thus, disrupting the endocrine system by altering steroid function,[25] so PAHs are a major cause of genotoxic and embryotoxic activities of organic mixtures in urban air particles.[1,12,17,25]

Environmental pollutants do not affect only the embryo development but also affect their chromosomic content; the presence of benzene and limonene affect the embryos mitochondria during the blastocyst stage.[24]

Air pollution acts on fetal development and has severe morphologic birth defects, and subtle functional changes, which affecting their carriers throughout their lives.[1] Susceptibility of the population to such factors is determined by genetic polymorphisms, as well as, metabolic polymorphisms (GSTM1, NAT2, and CYPIAI).[21,25]

Expose to increased concentration of particulate matters during the first and third trimester of pregnancy is associated with 33% birth weight reduction and increases more than 15%[17] of preterm birth risk, 4.5% of SGA risk, 6 to 7% of IUGR risk,[17,19] increased infant mortality from respiratory deaths, sudden infant death syndrome, and others.[12]

PMs have caused 2.7 million preterm births per year, 18% of all preterm birth defects (PTD) in the United States of America, which is a considerable public health problem because it increases the risk of numerous adult-onset diseases, impaired organ development, and an enormous economic liability.[12]

Nitrogen oxides, carbon monoxide (CO), and sulfur dioxide (SO_2) are other pollutants; exposure to them during pregnancy is associated with birth weight reduction, IUGR, and risk of preterm birth defects.[19,17,25] Exposure to CO during pregnancy was associated with the risk of tetralogy of Fallot, PM_{10}, and SO_2 were also found to be significantly associated with isolated arterial septal defects and isolated ventricular septal defects.[19,25]

SO_2, total suspended particles, and other indoor pollutants from coal combustion, which include carbon monoxide, carbon dioxide, and volatile organic compounds, may be absorbed into the maternal bloodstream, cross the placental barrier, and have direct toxic effects on the fetus.[26]

The New England Journal of Medicine showed that long term exposure to acceptable levels of $PM_{2.5}$ or ozone increased the risk of death in older persons.[12] In 2013, air pollution-related deaths in older persons were highest (106/100,000 people) in South Asia to lowest (85/100,000 people) in America, but, unfortunately, Afghanistan, Turkmenistan, and Yemen's people are at the extremely highest risk of death, approximately 120/100,000 people due to $PM_{2.5}$ exposure.[5]

The menstrual cycle is one of the more important cyclic processes in reproductive health. It occurs approximately 450 times for modern women during the childbearing period (15–49 years of age), and control by hormonal changes and feedback mechanisms occurring during ovarian and uterine cycles.[4] The female menstrual cycle is regulated by specific hormones. Luteinizing hormone and follicle-stimulating hormone promote ovulation and stimulate the ovaries to produce estrogen and progesterone. These two hormones

stimulate the uterus to prepare for potential fertilization.[1] More studies from 2005 to 2016 show that different environmental exposures as pesticides, organochlorine compounds, chlorination by-products, parabens, and endocrine disruptors are supposed to influence this cycle.[4]

Endocrine disruptors act by mimicking or antagonizing naturally occurring hormones in the body as estrogen, and through hormonal changes may impact physiological processes as homeostatic mechanisms, may permanently damage the function of hormonal signaling pathways, may produce transient changes in the nervous system, during neural development may induce changes in neurobehavioral function, specifically sex-related behavior.[1,27]

When males reach puberty, spermatozoa are created continuously in the testis. Spermatogenesis lasts approximately 74 days to obtain spermatozoa from a spermatogonium.[4] A very large volume of 20 to 375 million individual sperms is produced every day.[1]

Different factors as age, lifestyle, and estrogenic or other hormonally active environmental exposures during fetal and childhood development, influencing spermatogenesis and semen parameters.[4]

Air pollutions can impair all aspects of human reproduction, as impacts on the endocrine and hormonal system, decrease sperm quality and sperm production, especially Y chromosome carrying sperm, which decreases the percentage of male newborns,[12] may cause male infertility.[28]

A study on men's samples from the Czech Republic (Teplice district high polluted area) found an association between air pollution and sperm DNA chromatin abnormalities, aneuploidy, and changes in sperm motility and morphology that cause adverse effects on male fertility and male-mediated pregnancy outcomes.[28,34]

Male children who were exposed prenatally to polychlorinated biphenyls had a high proportion of sperm morphological abnormality, and reduction in sperm motility. In addition, boys who were older than 13 years and were exposed to PCBs and polybrominated diphenyl ethers had a lower level of their serum level sex hormone due to higher thyrotrophin-stimulating hormone (TSH) and lowered T4 hormone levels.[1,2]

Adult men who were exposed postnatally to PCBs had oligospermia and reduction in their sperm penetration capability to oocytes.[28]

A cross-sectional study on American men showed that polybrominated diphenyl ether levels in house dust strongly decrease serum concentrations of of Luteinizing Hormone and Follicle Stimulating Hormone (LH and FSH), but increase sex hormone-binding globulin.[28] Similarly, a Canadian study had found a negative relation between polybrominated biphenyl ethers with semen mobility.[28]

Though thousands of studies conducted in different countries find air pollution effects, but need further investigations in this field to show the effects of air pollution on human reproductive health in all ages and sex.

Air Pollution Effects in Afghanistan

The high level of air pollution is a big problem all over Afghanistan, and all residents of this country are severely exposed to this ever-worsening situation, but public media and state authorities are as ignorant of the situation. Also, no systematic study has been carried out to find the amount of suspended particulates, their health effects, and control solutions.[8]

Air pollution and other extraordinary environmental problems are factors that threaten the livelihood of millions of Afghans, endanger the continuity of ancient civilization, decrease gross domestic products, and damage land's and its coping capacity that have direct adverse effects on public health, especially mothers and children health.[8]

Poverty, ongoing war, durable use of chemical weapons and gunpowder's, illiteracy, no existence of perfect health services and awareness, ancient living systems, smoking, especially at closed area and children living rooms, high levels of biodegradable and non-biodegradable wastes generation, low-quality fuel consumption, the existence of Pb in the fuel, use of solid fuel for cooking such as, wood, animal dung, rubber, plastics, motor tiers or straw/ shrubs/ grass (67% of households, 16% in urban, and 84% in the rural area), and indoor cooking systems (more than 55% people cook inside the house in a closed area),[9,29] which induce a large amount of CO, CO_2, PM, PAHs, and other air pollutions that have general and RH adverse effects.[9]

Use of kerosene and solid fuel for energy production, agricultural waste incineration, certain agroforestry activities, old and damaged machinery, and others, produce complex mixtures of pollutants include CO, nitrogen oxides (NO_x), Pb, arsenic, mercury, SO_2, PAHs, and PMs.[30] A study report shows that 60% of Kabul's residents are exposed to increased levels of harmful toxins, such as, NO_x and SO_2.[35] According to the State of Global Air report, more than 26,000 Afghan deaths could be attributed to pollution in 2017, but United Nation Assistance Mission in Afghanistan(UNAMA) documented nearly 3,500 civilian casualties from the war for the same period, so air pollution is killing more Afghans than the war because they burn anything possible to get energy and heat they need.[34]

Absence of industrial parks, nonconformity of environmental protection rules, especially by industries, absence of occupational protection rules (who work in mines), urbanization, degradation of fertile lands, deforestation, seasonal winds, drought, water and soil pollution, non-existence of sanitation, internal migration, and low knowledge about pesticides and herbicides use, are factors that boost the severity of air pollution.[29,32]

National Environmental Protection Agency (NEPA) has been established on 10th May 2005 but does not have proper capacities, budget, and governance support to plan, formulate, implement, and manage environmental policies, and to incorporate these programs into its overall efforts that worsen air pollution situations in Afghanistan.[29,32] As the deputy head of Afghanistan's NEPA said, "when the agency shuts down a company or factory because of burning

substandard fuels, different sections of the government override NEPA. They interfere with our work. Some of them say close those departments and factories that burn substandard fuels, and others say not to close and allow them to stay open."[31]

Due to the latest report of the Institute's State of Global Air project, air pollution ($PM_{2.5}$, ozone, and indoor pollution) were attributable to 51,600 people's death in 2016, with 406 deaths/100,000 annual rate, which shows the worst situation of air pollution in Afghanistan.[36]

Results of air sampling in major urban centers of Afghanistan show high amounts of PM, benzo-a-pyrene, and PAHs originating from vehicle exhaust emissions; the highest concentrations were founded in Kabul and Mazar-e-Sharif (13.6 ng/m^3).[8] Detected pollutants increase risks of lung cancer, hypertension, type II diabetes,[17] oligospermia, decrease sperm motility, and serum level of LH and FSH hormones in adults,[28] increased respiratory diseases, IUGR, PTD, decrease LBW, and head circumference in the fetus.[17,21]

Unfortunately, there is no data or study about air pollution effects on reproductive health in Afghanistan, but due to the studies in the other countries, high level of air pollution in Afghanistan and worst situation of reproductive health, like high maternal mortality (1,291/100,000 live births), high quantity of fatal anomalies as LBW, IUGR, high rate of infant and child mortalities (neonatal MR 22/1,000 births, infant MR 45/1,000 live births) (35/1,000 in the urban area and 54/1,000 in the rural area), U5MR is 55/1,000 live births (43/1,000 live births in urban and 67/1,000 live births in the rural area), and prenatal MR is 36/1,000 pregnancies (20/1,000 pregnancies in urban and 41/1,000 pregnancies in the rural area),[9] and morbidities, high level of NCDs, and caners can say that air pollution in Afghanistan has significant effects on reproductive health outcomes.

In Afghanistan, women are more exposed to high levels of indoor air pollution because they spend more time at home due to their cultural rules; also, women have responsibility for household activities, working in the kitchen to prepare food, they are exposed to poor sanitation and contaminated water supplies, they clean and sweep rooms and yards with inadequate protective equipment which are the big source of dust, so they are often exposed to high levels of smoke and dust for long periods.[3]

Furthermore, the women are usually responsible for caring for ill children and elders, who consecutively increase their exposure to disease-causing pathogens and factors, especially to contaminable disease. Pregnant and lactating mothers are more vulnerable to the risk, and they are doubly affected by air pollution, first because of poverty and weak nutritional situation, and second because of their role and status in their traditional patriarchal society. In such a setting, environmental degradation and air pollution have placed an unbalanced burden on women, because they are severely exposed to a large number of air pollutants, but, they know nothing about exposure and its effects on them and children, and this is the major risk factor of maternal and child mortality and morbidity in Afghanistan, which takes the lives of thousands each year.[13,33]

Conclusion

Air pollution is one of the great factors that threaten human lives and environment, bring different health and reproductive health adverse effects that are highly fatal, or cause disabilities.

Air pollution rises from different natural and human-made sources, but the human-made source is a major source in Afghanistan. Air pollution increases the burden on NCDs, prepares an opportunity to infectious diseases, and have worst effects on reproductive health as increasing pregnancy outcomes, mutagenic effect, DNA adducts, infant and child mortality, the effect on male sperm motility and morphology, endocrine disruptor, hormonal and menstruation changes in female, and such others.

To prevent adverse health effects of air pollution in Afghanistan, we will try to improve air quality and inspection regimes, change heating and burning solid fuel, cities, home, and all environment, manage traffic, control industries, fuel commerce, decrease deforestation, land degradation, and contamination, prepare policies for sustainable urban development, implement national air quality standards and policies, and attract international support.

Recommendations

Environmental protection, prevention of disease, and improving health is each person's responsibility, no one can protect all people, but everyone can protect themselves.

As the Hazrat-e-Mohammad (PBUH) said, "every one of you are custodian and everyone is responsible to protect their nation, wealth, and environment. So all of us are responsible to protect our environment from degradation and change all the factors that destroy the environment, if we don't change them Allah will never change them, as Allah said in Holy Quran."

Hazrat-e-Mohammad (PBUH) persistence in another place about environment protection and said, "every person how cultivate an earth to protect environment, it is his ownership." (Al Bukhari) To protect the environment and decrease its adverse effects on human health, especially on reproductive health, we must apply the following suggestions:

Protect children and women from air pollution effects through:

- Reduce air pollution
- Reduce people, especially children's and women's exposure to air pollution
- Improve overall health services, specifically children and women's health services
- Improve policies and monitoring of air pollution

To achieve these four recommendations, the responsibilities of each person or department is as below:

- People's awareness about air pollution effects on health and human livelihoods will be increased through schools, health facilities, mosques, and other educational approaches. Adequate policy measures and awareness campaigns have to be implemented at national and community levels.
- NEPA is foremost responsible to:
  - » Design and implement campaigns against environmental pollutions and their effects.
  - » Recruit governance and international donors and support them in making policies, and create capacities.
  - » Run campaigns, regulatory rules, and community awareness programs against air pollution.
- Ministry of Public Health (MoPH), NEPA, and other stakeholders as ministries of commerce and economy are compelled to ban the low-quality fuels, industries, which are near to the cities, tobacco production and importation, smoking in a closed and common place. Encourage people to use liquid gas for energy production.
- Managing traffic, maintenance of old smoking vehicles, change the public transport to the electrical bus system, increase awareness among people to use public transport, and extend and construct roads to decrease motor exhaust air pollution.
- Ministry of Water and Energy is responsible for preparing enough energy for the people to decrease the use of substandard fuel, cool, dung, etc.
- MoPH is responsible for increasing access and quality of health and reproductive health care services in all urban and rural areas, increase health education and people awareness about air pollutants, their effects, and preventive measures.
- The government is responsible for attracting donors' assistance to help Afghanistan to modernize and promote their health service, production process, receive and adopt new technologies and innovations to decrease environmental pollution and its risks.
- The government is responsible for applying NEPA and MoPH strategies to decrease pollutions and promote health.
- Educational institutions are responsible for increasing environmental protection subjects in all fields and awareness of students in informing all types of pollutants in their work area, their effects on humans and the environment, and its solution strategies.
- Community elders, mullahs, and all of us are responsible to aware people of pollution effects and prevent any type of pollution everywhere and any time, to reduce their dangerous effects.
- House leaders are responsible for regulating cooking, sweep, and other dust inducing works for women to decrease exposure to indoor pollutants, change house energy systems, prepare a separate room for cooking with perfect ventilation, and aware family members to use protection equipment during daily works.
- Finally, health professionals have a critical role to:
  - » Inform their patients about air pollution effects
  - » Recognize exposures and related health conditions
  - » Conduct, publish, and disseminate researches in air pollution effects
  - » Prescribe solutions, and educate families and communities
  - » Educate colleagues and students
  - » Advocate solutions to other sectors, policy, and decision-makers

References

1. Introduction to Reproductive health and the Environment, Children's Environmental Health, Public Health and the Environment, World Health Organization, Nov.2011, retrieved from: https://www.who.int/ceh/capacity/introduction_reproductive.pdf?ua=1
2. Chapter – v, Factors influence Reproductive Health, Shodhganga, Pp.154-189, retrieved from: http://www.shidhganaga.inflibnet.ac.factors_influence_reproductive_health.pdf
3. Michelle L. Bell and Jonathan M. Samet, Environmental health: from global to local / Howard Frumkin, editor. —2nd ed, Part Three: environmental health on the regional scale, Chapter 12: Air pollution, copyright 2010, John Wiley and Sons, Inc. All rights reserved, Printed in the United States of America, no Retrieved but can request from the permission Department, John Wiley and Sons, Inc., 111 River street, Hoboken, NJ07030, 201-748-6011 fax 201-748-6008, or online at www.wiley.com/go/ permission
4. Giorgis-Allemand L. *Atmospheric pollution and Human reproduction* (Doctoral dissertation).
5. Washington TW. for HM and EU of The Cost of Air Pollution: Strengthening the Economic Case for Action. The World Bank and Institute for Health Metrics and Evaluation University of Washington, Seattle. 2016.
6. LI M. SCOR Paper.
7. Pénard-Morand C, Annesi-Maesano I. Air pollution: from sources of emissions to health effects. Breathe. 2004 Dec 1;1(2):108-19.
8. Montt GU. The gendered effects of air pollution on labour supply. ILO Research Department Working Paper. 2018 Mar(27).
9. Central Statistics Organization (CSO), ministry of Public Health (MoPH), and ICF. 2017. Afghanistan, Demographic and Health Survey 2015. Kabul, Afghanistan: Central Statistics Organization, retrieved from: https://reliefweb.int/sites/reliefweb.int/files/resources/afdhs_2015.pdf
10. Franţ EA. The link between environmental factors and abortion. Journal of Public Administration, Finance and Law. 2015(07):158-63.
11. O.P. Singh,Environmental and Natural resources: Ecological Q9and Economical prespectives, chapter 7 AIR POLLUTION: SOURCE, TYPES AND ABATEMENT, Retrieved from: http://www.researchgate.net/publication/215766051_Air_Pollution_types_sources_and_Abatement/link/5567f7be08aefcb861d38ed9/download
12. UTAH physicians for a healthy environment, 2017 report on air pollution and health research, 2007, retrieved from: http://uphe.org/wp-content/uploads/2018/02/2017-Air- Pollution-and-Health-Research-Report-UPHE.pdf
13. Woodruff TJ, Grillo J, Schoendorf KC. The relationship between selected causes of postneonatal infant mortality and particulate air pollution in the United States. Environmental health perspectives. 1997 Jun;105(6):608-12.

14. UNICEF. Clear the air for children. The impact of air pollution on children. New York, NY: UNICEF Division of Data. Research and Policy. 2016
15. Iarla Kilbane-Dawe PhD (Cantab) BA (Mod) and Leon Clement MA (King's Lond.) BA (Hons), The impacts of air pollution on health, Review of recent science on the impacts of air pollution on health, Parliament Hill Research, published in London, 2014, retrieved from: https://www.adb.org/sites/default/files/institutional-document/32177/environment-assessment.pdf
16. SPEAKER'S KI. Goods Movement Fact Sheet.
17. World Health Organization WHO.. Mental health: facing the challenges, building solutions: report from the WHO European Ministerial Conference. WHO Regional Office Europe; 2005.
18. Fleischer NL, Merialdi M, van Donkelaar A, Vadillo-Ortega F, Martin RV, Betran AP, Souza JP, Marie S. O´ Neill. Outdoor air pollution, preterm birth, and low birth weight: analysis of the world health organization global survey on maternal and perinatal health. Environmental health perspectives. 2014 Apr;122(4):425-30.
19. Xu X, Kan H, Ha S. Ambient Air Pollution and Reproductive Health. The Impact of Air Pollution on Health, Economy, Environment and Agricultural Sources. 2011 Sep 26:93.
20. Wylie BJ, Matechi E, Kishashu Y, Fawzi W, Coull B, Hauser R, Ezzati M, Roberts D. 590: Placental pathology associated with household air pollution in a cohort of pregnant women from Dar es Salaam, Tanzania. American Journal of Obstetrics and Gynecology. 2016 Jan 1;1(214):S316.
21. Sram R. Impact of air pollution on reproductive health.
22. Malmqvist E, Liew Z, Källén K, Rignell-Hydbom A, Rittner R, Rylander L, Ritz B. Fetal growth and air pollution-a study on ultrasound and birth measures. Environmental research. 2017 Jan 1;152:73-80.
23. Ritz B, Wilhelm M, Hoggatt KJ, Ghosh JK. Ambient air pollution and preterm birth in the environment and pregnancy outcomes study at the University of California, Los Angeles. American journal of epidemiology. 2007 Nov 1;166(9):1045-52.
24. Yu E, Sim C, Park D, Koh Y, Heo J, Choe S, Kim J, Koong M, Kang I, Yoon TK, Kim Y. Relationship between heavy metal concentration and number of spontaneous abortion experiences in Korean women: a retrospective study of the 6th Korean national health and nutrition examination survey. Fertility and Sterility. 2017 Sep 1;108(3):e320.
25. Šrám RJ, Binková B, Dejmek J, Bobak M. Ambient air pollution and pregnancy outcomes: a review of the literature. Environmental health perspectives. 2005 Apr;113(4):375-82.
26. Wang X, Ding H, Ryan L, Xu X. Association between air pollution and low birth weight: a community-based study. Environmental health perspectives. 1997 May;105(5):514-20.
27. CDC A. National Environmental Public Health Tracking.
28. Hsu PC, Guo YL, Smith DR, Lin YS, Tseng LH, Lee CW, Chen JR. Airborne persistent organic pollutants and male reproductive health. Aerosol and Air Quality Research. 2013;14(4): 1292-1298.
29. Discussion draft Asian Development Bank and the Clean Air Initiative for Asian Cities (CAI-Asia) Center, Country synthesis report on urban air quality management Afghanistan, published by Asian Development Bank, Dec 2006, retrieved from: https://cleanairasia.org/wp-content/uploads/portal/files/documents/afghanistan_0.pdf
30. Adair-Rohani H. Air Pollution and Child Health: Prescribing Clean Air. World Health Organization; 2018.
31. Ivan Flores, Afghanistan's Air is deadlier than its war, 26 May. 2019, retrieved from: https://foreignpolicy.com/2019/05/26/afghanistans-air-is-deadlier-than-its-war/
32. Sediqi A, PG I. A preliminary assessment of air quality in Kabul. reason. 2010;250(78.92):792-67.
33. Retrieved from: https://www.unenvironment.org/news-and-stories/story/gasping-air-kabul
34. Rubes J, Selevan SG, Sram RJ, Evenson DP, Perreault SD. Impact of air pollution on reproductive health in northern bohemia. In Reproductive Health and the Environment 2007 (pp. 207-224). Springer, Dordrecht.
35. Abdullah Qazi, air pollution, last updated, 21 Sept. 2008, retrieved from: https://www.afghan-web.com/environment/air-pollution/
36. Report of arab news about Kabul air situation and National Environment protection day, retrieved from: http://www.arabnews.com/node/1435541/world