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Maternal Occupational Exposures and Adverse Pregnancy Outcomes: An Overview of Meta- Analysis

Rahele Rahimi[1], Somayeh Moeindarbary[2], Mostafa Ghasempour[3], Tahereh Galini Moghadam[4], Omolbanin Heydari[5], Zahra Ramazanian Bafghi[5], *Samaneh Norouziasl[6], Fatemeh Abdi[7], Farzane Ashrafinia[5], Sahebeh Dadshahi[8]

[1]Fellowship of Pediatric Intensive Care, Department of Pediatrics, Faculty of Medicine, Mashhad university of Medical Sciences, Mashhad, Iran. [2]Assistant Professor, Department of Obstetrics and Gynecology, Neonatal and Maternal Research Center, Mashhad University of Medical Sciences, Mashhad, Iran. [3]Department of Otorhinolaryngology, Mashhad University of Medical Sciences, Mashhad, Iran. [4]Assistant Professor of Obstetrics and Gynecology, Department of Obstetrics and Gynecology, School of Medicine, Sari Imam Khomeini Hospital, Mazandaran University of Medical Sciences, Sari, Iran. [5]Department of Nursing and Midwifery, Razi School of Nursing and Midwifery, Kerman University of Medical Sciences, Kerman, Iran. [6]Asistant Professor of Pediatric Endocrinology, Department Of Pediatrics, Faculty of Medicine, Mashhad university of Medical Sciences, Mashhad, Iran. [7]Assistant Professor, Social Determinants of Health Research Center, Alborz University of Medical Sciences, Karaj, Iran. [8]Student Research Committee. Kerman University of Medical Sciences. Kerman, Mazandaran, Iran.

Abstract

Background: Working pregnant women are exposed to numerous occupational exposures, some of which may adversely affect their reproductive health. We aimed to review the effects of maternal occupational exposures and adverse effects on the infants.

Materials and Methods: In this overview, searches were done on the online databases of Scopus, EMBASE, Cochrane, Web of Science and Medline; with no language or time restrictions (up to December 2019) to find studies that assess the relationship between maternal occupational exposures and adverse pregnancy outcomes. Two independent researchers performed the search process and a supervisor judged any disagreement in this regard.

Results: Women occupationally exposed to anaesthetic gases had increased risk of spontaneous abortion. Second study reported specific birth defects including limb defects, cleft lip and cleft palate neural tube defects, urinary tract defects and congenital heart defects. In the third study, increased risk of childhood brain tumors was seen following maternal occupational exposures to chlorinated solvents. In the fourth study, a positive relationship between maternal exposures to ambient air pollution with autism spectrum disorder. In the fifth study, a significant relationship between anesthetic gases and congenital malformation, chemotherapy agent and spontaneous abortion and between shift work and spontaneous abortion. In the sixth study, exposure to endocrine-disrupting chemicals, group at work showed an increased risk of LBW with the odds ratio of 1.25, 95% CI: 1.04, 1.49. In the seventh study, exposure to ambient air pollution increases the risk of stillbirth. In eight, a statistically significant association between childhood leukemia and parental occupation.

Conclusion: Maternal occupational exposures can be can be leading risk factors for many adverse pregnancy outcomes and birth defects.

Key Words: Exposures, Pregnancy, Outcome, Mother.

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* ***Corresponding Author:***

Samaneh Norouziasl, Asistant Professor of Pediatric Endocrinology, Department Of Pediatrics, Faculty of Medicine, Mashhad university of Medical Sciences, Mashhad, Iran.

Email: drfa_saffari@yahoo.com

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1- INTRODUCTION

Pregnancy is an important period in human development, which needs to be evaluated and monitored because of its importance in the life of the individual, and that pharmaceutical or environmental exposures during pregnancy can lead to serious defects detected after birth. Human development in post-infancy and early childhood and experience of various diseases and even malignancies are highly dependent on the growth and development in the first years of life and especially low birth weight (1). There were changes in the role of women in the second half of the 20th century. The number of women employed in the United States rose to 63.7 million in 1998 from 3.5 million in 1970, and to 70.6 million in 2006. Reportedly, 60.7% of women aged 15-44 years' work more than six months during pregnancy, 46% as full-time and 14.6% as part-time.

Women account for about 10% of the labor market of Iran (2). Reliable human and animal studies have shown that many chemicals, such as methylmercury, lead, inorganic solvents, organic solvents, insecticides and anesthetic gases, can have adverse effects on the prognosis for pregnancy of women and even fertility of males who are involved (3, 4). Some studies have shown that men and women working in the firefighting, woodworking, painting and printing industries had higher odds ratios of fetal malformations and even stillbirth (5-7). Possible mechanisms of the adverse effects of these chemicals include gene mutation or development of chromosomal abnormality in sperm and ovum (8). Fetal growth and pregnancy outcome are determined by various factors including maternal nutrition, exposure to the environmental factors and heredity. The prenatal stage is a very sensitive period so that the exposure to harmful substances can have a negative impact on the developing fetus. The effects of air pollution on fetal growth and pregnancy outcomes, especially in developed countries, have been studied and the results have been summarized in several studies (9). Niedhammer et al., after examining the pregnancy process in 1129 pregnant women, found that intense physical activity at work was associated with lower birth weight and increased preterm birth (10). A study of 1908 pregnant women by Pompeii et al., found that work during the night hours increased the risk of preterm labor (11). Pregnancy is a woman's natural right. Therefore, employers do not have the right to make a prerequisite about a woman not getting pregnant. If the disabled woman becomes pregnant due to pregnancy, childcare, or a medical problem, the employer is obliged to employ her in a less risky job and return her to her previous or a similar job after the problem has been resolved (12). The number of pregnant mothers working in the field of industry in developing countries is now high, so issues of occupational health and pregnancy health issues are always raised. On the other hand, most occupational limits are set by the priority of men (13). The purpose of this study was to review the effects of maternal occupational exposures and adverse effects on the infants.

2- MATERIALS AND METHODS

In this overview, all Meta-analysis evaluating the relationship between maternal occupational exposures and adverse effects on the infants were searched on the electronic databases of Scopus, EMBASE, Cochrane, Web of Science and Medline (via PubMed); with no language or time restrictions (up to end of December 2019). We performed the search using the following keywords: (Adverse effects, Occupational Exposure, Workplace, Mothers, Maternal, Woman, and Pregnancy), and their Persian synonyms and all their possible combinations were searched in the national databases (Magiran, SID, and Iran.Doc).

Two reviewers who initially reviewed the abstracts of searched articles and then downloaded their full texts to review carefully chose the relevant studies independently. Finally, the articles that met the inclusion criteria were enrolled in the systematic review, and their used relevant references were reviewed to find further studies. The third party judged any disagreement.

3- RESULTS

Finally, eight meta-analyses were included. The findings of meta-analysis by Siddika et al. (2016) showed an increase in the risk of stillbirth among those exposed to ambient air pollution (9). Thulstrup and Bonde (2006) in a meta-analysis regarding the association of exposure during pregnancy with the risk of birth defects identified five specific birth defects, including limb defects, urinary tract defects, congenital heart defects, cleft lip and cleft palate, and neural tube defects (14). In another meta-analysis, Peters et al. (2014), reported an increase in the risk of childhood brain tumors (CBT) following the maternal occupational exposures to chlorinated solvents (OR: 8.59, 95% CI: 0.94-78.9) any time before birth (15). In a meta-analysis by Van Maele-Fabry et al. (2010), there was a statistically significant association between childhood leukemia and parental occupation as farmers/agricultural workers. A positive association was found for maternal exposure for all study pesticides (mRR: 1.62; 95% CI: 1.22–2.16) (16) as well. Quansah et al. (2010) conducted a meta-analysis, and reported that the summary OR was between 1.05 and 1.09 for the exposure to anesthetic gases; and congenital malformation and the summary OR was between 0.97 and 1.22 for the exposure to spontaneous abortion and chemotherapy agent; Also, the summary OR was between 1.34 and 1.69 for the exposure to spontaneous abortion and shift work (17). Boivin (1997) reported an increase in the risk of spontaneous abortion in maternal occupational exposure to anesthetic gases, with overall relative risk of 1.48 at 95% confidence interval (CI) of 1.4 to 1.58 (18). Chun et al. (2020) also conducted a meta-analysis and found some evidence for positive association of maternal exposure to PM2.5 with autism spectrum disorder (ASD), poor evidence for positive association of maternal exposure to NO2 with ASD, and little evidence for association of maternal exposure to PM10 and O3 with ASD (19). In a meta-analysis of cohort-specific conducted by Birks et al. (2016) expose to endocrine-disrupting chemicals (EDCs), group at work (pregnant women) showed an increased risk of LBW (OR: 1.25, 95% CI: 1.04-1.49) (20).

4- DISCUSSION

The purpose of this study was to review the effects of maternal occupational exposures and adverse effects on the infants. The progress of human society and the active participation of women in work and social activities highlight the need for careful attention to the problems of this huge stratum. A rational look shows that the healthy working environment of these segments of society in terms of psychological, emotional, and chemical stress will guide the community toward progress and excellence in having healthy children, both mentally and physically. Among these, the role of chemical pollution of the workplace is plausible to anticipate the impact of these factors and provide appropriate strategies for addressing these concerns and pollution. The females account for a large percentage of the workforce and a significant part of them are at reproductive age (21). Nearly 70% of birth defects have unknown risk factors. Therefore, further attention to the risk of birth defects due to occupational exposure can be of great interest. Several studies have shown the association between birth defects and exposure to

chemicals, such as pesticides, glycol ethers, and inhalational anesthetics (6, 14, 22-24). Najafian and Ghomeishi (2011) in Khuzestan, Iran, showed that infertility and abortion rates were higher in the operating room women than in non-operating room group (8). Amini and Savaie (2010) in Fars, Iran, indicated that the incidence of pregnancy complications in the operating room group was not different from women working in non-operating rooms, but the experience of infertility was greater in the operating room group women than in other departments (25). Parental exposure to occupational hazards may result in the risk of developing leukemia in the offspring due to the involvement of each parent's germ cells before pregnancy. Intrauterine exposure can be through graft transmission during pregnancy or directly through breastfeeding, due to exposure to chemicals through infected persons via work clothing and/or equipment (16).

Although studies have shown an increased risk of stillbirth with exposure to ambient air pollution, further studies are needed to reach a definitive conclusion (9). In addition, evidence has shown that nurses are at risk for adverse pregnancy outcomes, though association strength is weaker in well-designed investigations. There is limited importance of findings in terms of number and heterogeneity of the studies (17). The results of meta-analysis by Birks et al. (2016), showed an increased risk of term LBW in the subjects probably or possibly exposed to EDCs during pregnancy (20). Findings showed little evidence for PM10 and O_3, weak evidence for NO2, and some evidence for PM2.5 in the studies evaluating significant association of maternal exposure to ambient air pollution with ASD in children (19). In a meta-analysis by Boivin (1997) on epidemiological examinations, the findings revealed high risk of spontaneous abortion with overall relative risk of 1.48, 95%CI: of 1.4-1.58 (18). According to the results, an increase in CBT may be related to parental occupational exposure to solvents (26-28). Regular surveys in recent years have revealed evidence of a relationship between occupational exposure of pregnant mothers and neonatal adverse outcomes. The results of these studies indicated that the pregnant women exposed to environmental hazards such as air pollutants, pesticides, solvents and heavy metals as well as chemicals such as organic pollutants are associated with adverse maternal and neonatal outcomes during pregnancy. Environmental chemicals are known as pervasive environmental chemicals, whose destructive effects have been reported in animal studies. These chemicals can affect the fertility and the maintenance of a healthy pregnancy. Therefore, attention to the process of the environmental chemicals is very important for neonatal adverse outcomes (29). Various studies have suggested that maternal occupational exposure have adverse effects on birth weight and preterm birth (7, 30).

Low birth weight and preterm births are among the most important causes of death in the world and are of the major health concerns. Approximately 13 million preterm births occur worldwide each year, accounting for a large proportion of deaths and short-term or long-term complications including developmental disorders. Low birth weight infants are exposed to problems such as neurosensory deficits, cognitive and language delays, and behavioral, psychological and social disorders (31). In this regard, Shenoy et al. (2020) evaluated the pregnancy outcome in occupational tobacco exposure and observed nicotine absorption in one-third of maternal blood exposed to occupational tobacco as well as baby's umbilical cord blood. The researchers concluded that the exposure of working women to tobacco leads to adverse pregnancy outcomes, such

as low birth weight and intrauterine growth restriction (32). In addition, Shirangi et al. (2020), showed that mothers' occupational chemical exposures are associated with abnormal fetal growth and adverse outcome of small for gestational age (SGA) newborns (33). Findings from various studies indicate that occupations, such as pharmacy, chemical engineering and dyeing in which people are exposed to solvents, increase the odds ratio of eye, cardiac, intestinal, lip and palate defects in neonates (3-8). Niknazar et al. reported that there was no association between maternal occupational exposure and neonatal congenital heart defects, whereas fathers' exposure to phthalates increased the risk of neonatal cardiac malformations (34). According to the literature review, understanding mothers' occupational parameters can help to identify non-genetic factors affecting neonatal adverse outcomes.

5- CONCLUSION

The occupational exposure of pregnant women to detrimental agents can be a leading risk factor for many adverse pregnancy outcomes and birth defects, such as childhood brain tumor, autism spectrum disorder, spontaneous abortion, congenital malformation, congenital heart defects, urinary tract defects, neural tube defects, cleft palate, cleft lip, limb defects, childhood leukemia, low-birth-weight, and stillbirth.

6- CONFLICT OF INTEREST: None.

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