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Environmental factors implicated in the causation of adverse pregnancy outcome

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Abstract

Adverse pregnancy outcome from environmental factors may include congenital anomalies, increased risk for miscarriage, preterm delivery, intrauterine growth restriction and still birth. Apart from adverse pregnancy outcome, there may be effects on the other reproductive functions like menstrual disorders and infertility. Environmental factors which have been implicated in adverse pregnancy outcome include smoking, video display terminals, anesthetic gases, antineoplastic drugs and exposure to lead, selenium and inorganic mercury. Amongst these, cigarette smoking during pregnancy has been the leading environmental factor for adverse pregnancy outcome. Cigarette Smoking during pregnancy continues to be a significant public health concern. Maternal smoking during pregnancy has been associated with low birth weight (< 2500g) Mothers who smoke during pregnancy are twice likely to give birth to low birth weight infants. Similarly air pollution, pesticide exposure, stress have also been associated with low birth weight and preterm delivery. This review gives an overview of the importance of environmental factors in adverse pregnancy outcome.

Keywords

Nicotine; low birth weight; pregnancy; neuroteratogen; mercury; pesticide; video display terminals

Smoking

The harmful effects of smoking are well established. Nonetheless, smoking rates among women have remained at high levels for the past 25 years. Despite warnings of the negative consequences of smoking, approximately 20–25% of adult women in the United States are smokers(1), with even higher rates among younger women and women of lower socioeconomic status. (2) Concomitant increases in cancer, heart disease, and other diseases directly attributable to smoking have been observed in women. Women of childbearing age represent a large proportion of all female smokers. Smoking during pregnancy is associated with a number of poor birth outcomes, including low birth weight, intrauterine growth retardation (3), placental problems (4), preterm delivery and spontaneous abortion.(5,6) In Connecticut alone, there were 4381 preterm births and 3200 low birth weight babies born in the year 2000

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(CT Registration Reports, preliminary data). Mothers who smoke during pregnancy are twice as likely to give birth to low birth weight infants (LBW). These infants weigh an average of 150 to 250g less than infants born to non-smoking mothers.(7) In addition to the hazards of smoking for the mother, exposure to environmental tobacco smoke is a risk factor for Sudden Infant Death Syndrome (SIDS), ear infections, asthma and other respiratory conditions in the infant. (8) Maternal smoking during pregnancy has not only detrimental effect on placental function, nicotine also crosses the placenta to act as neuroteratogen. It interferes with the fetal development, specifically affecting the nervous system. In utero, nicotine targets the fetal nicotinic acetyl choline receptors in the brain, to change the pattern of cell proliferation and differentiation. This results in cell loss and neuronal damage. This in turn has been associated with risks of cognitive and auditory processing deficits and effects on social behavior.(9,10)

Metals

Lead, mercury, nickel and manganese have been associated with poor reproductive outcome. An increased risk for spontaneous abortion has been associated with low levels of lead exposure. This was illustrated in a nested case-control study in which women who were followed prospectively during pregnancy has an odds ratio for spontaneous abortion of 1.8 (95% CI 1.1-3.1) for every 5 mcg/dL increase in blood lead level (range 5 to 20 mcg/dL) (11) Women exposed to lead include those in paint industry or artist and painters. Lead readily crosses the placenta, and has been found to have teratogenic effects as well as is known to affect the hormonal environment needed to maintain the pregnancy. Lead has also been found to be associated with still births in humans. Women at risk of lead exposure should be monitored for blood lead levels before becoming pregnant. Mercury exposure has been identified in dental assistants preparing amalgams. This has been linked to spontaneous abortion as well as reduced fertility.(12)

Inhalational Anesthetics

Evidence supporting inhalational anesthetics and adverse pregnancy outcome are weak. Recent studies from Western countries, are often negative, emphasizing the importance of preventive measures, in reducing the risk.(13) One study did find increased risk for infertility in dental assistants exposed to higher concentration of nitrous oxide(14) Limitation of exposure should be considered for workers where operating rooms are not properly scavenged.

Organic Solvents

Women working in clothing, textile, paint and plastic industries and health care professionals are exposed to organic solvents. Khattak S et al in a prospective study demonstrated that women exposed occupationally to organic solvents had a 13-fold risk of major malformations as well increased risk for miscarriages in previous pregnancies while working with organic solvents. (15)

Air Pollution

It has been associated with congenital birth defects, as well as with low birth weight and intrauterine growth restriction. Jedrychowski et al surveyed pregnant women in Poland exposed to fine particulate matter (PM 25) and assessed its effect on birth outcomes. They showed an association with low birth weight and reduced head circumference in children born to above group of women.(16) Air pollution has also been associated with congenital cardiovascular birth defects.(17) In a meta analysis on air pollution and pregnancy outcome, author concluded that there is a causal link between air pollution and low birth weight.(18) For preterm births and intrauterine growth retardation (IUGR), they concluded that the evidence as yet is insufficient to infer causality, but the available evidence justifies further studies.

Pesticide Workers

Pregnant women working in the agricultural fields, landscape artists are at risk for pesticide exposure. The epidemiological literature do suggest increased risk of spontaneous miscarriages, low birth weight and preterm delivery in green house workers.(13) Other potential effects of exposure include infertility, reduced fecundity in women of reproductive age group. Exposed women should have urinary levels quantitated during pregnancy.

Radiation

Exposure to ionizing radiation during periconceptional period and during early gestation has been associated with congenital defects and risks of childhood cancer. Generally speaking, nowadays state laws prescribes that pregnant women should be protected from doses $> 1\text{mSv}$ through out pregnancy. Other common cause of concern is non-ionizing radiation, in particular electromagnetic field waves, as in video display terminals, daily exposure to mobile phones, heated beds, electric blankets and health professionals using diagnostic and therapeutic devices.

Video display terminals do not emit ionizing radiations, but they do emit electromagnetic radiations. Their use during pregnancy has not been associated with adverse pregnancy outcome or to any teratogenic effects. A recent meta analysis on the subject did not find any increased risk for spontaneous abortion, low birth weight and Prematurity, associated with electro magnetic radiations.(19) Long term use has been linked with carpal tunnel syndrome, due to the angling effect on the wrist.

Stress

Maternal stress has been found to be associated with birth defects, low birth weight, preterm delivery and early onset preeclampsia. A recent population based case control study found a positive association between maternal stress [two months before and after conception] and cleft lip, cleft palate and transposition of great vessels.(20) In a case-control study, job stress and chronic exposure to work has been found to be linked with preterm deliveries. This association is found to be greater in black women.(21) Increased job strain in first 20 weeks of pregnancy has been linked to increased incidence of preeclampsia. The authors attributed it to increased release of catecholamines, associated with increased job stress.(OR=2.1 95% CI 1.1-4.1)(22) Another case-control study showed that the risk of having a small for gestational age (SGA)infant increased with an irregular or shift-work schedule alone, or when combined with following occupational conditions: night hours, irregular or shift-work schedule, standing, lifting loads, noise, and high psychological demand combined with low social support.(*p* value .004) Elimination of the conditions before 24 weeks of pregnancy brought the risks close to those of unexposed women.(23)

Physical Stress

These include long hours of standing, bending, lifting heavy weights, long week hours of work. The adverse pregnancy outcome associated with it include SGA, low birth weight and preterm delivery. SGA is found to be associated with a work $> 50\text{h/ week}$, and with work involving standing $> 7\text{h/day}$. Physical strenuous work, combined with other factors like stress, poor antenatal care might increase the risk for adverse pregnancy outcome.

CONCLUSION

Environmental factors do play an important role in maternal health. They make an important contribution towards placental problems like low birth weight, intrauterine growth restriction, as well as have long term effects on neuronal and behavioral development in adult life.

REFERENCES

1. Arnett DK, Sprafka JM, McGovern PG, Jacobs DR Jr, Shahar E, McCarty M, et al. Trends in cigarette smoking: the Minnesota Heart Survey, 1980 through 1992. *Am J Public Health* 1998;88(8):1230–1233. [PubMed: 9702156]
2. Mullen PD. How can more smoking suspension during pregnancy become lifelong abstinence? Lessons learned about predictors, interventions, and gaps in our accumulated knowledge. *Nicotine Tob Res* 2004;6:S217–S238. [PubMed: 15203823]
3. Horta BL, Victora CG, Menezes AM, Halpern R, Barros FC. Low birthweight, preterm births and intrauterine growth retardation in relation to maternal smoking. *Paediatr Perinat Epidemiol* 1997;11(2):140–151. [PubMed: 9131707]
4. Raymond EG, Mills JL. Placental abruption. Maternal risk factors and associated fetal conditions. *Acta Obstet Gynecol Scand* 1993;72(8):633–639. [PubMed: 8259750]
5. Miller HC, Hassanein K, Hensleigh PA. Fetal growth retardation in relation to maternal smoking and weight gain in pregnancy. *Am J Obstet Gynecol* 1976;125(1):55–60. [PubMed: 1275014]
6. Raymond EG, Cnattingius S, Kiely JL. Effects of maternal age, parity, and smoking on the risk of stillbirth. *Br J Obstet Gynaecol* 1994;101(4):301–306. [PubMed: 8199075]
7. Andres RL, Day MC. Perinatal complications associated with maternal tobacco use. *Semin Neonatol* 2000;5(3):231–241. [PubMed: 10956448]
8. Dybing E, Sanner T. Passive smoking, sudden infant death syndrome (SIDS) and childhood infections. *Hum Exp Toxicol* 1999;18(4):202–205. [PubMed: 10333302]
9. Jacobsen LK, Slotkin TA, Mencl WE, Frost SJ, Pugh KR. Gender-Specific Effects of Prenatal and Adolescent Exposure to Tobacco Smoke on Auditory and Visual Attention. *Neuropsychopharmacology*. 2007
10. Toro R, Leonard G, Lerner JV, Lerner RM, Perron M, Pike GB, et al. Prenatal Exposure to Maternal Cigarette Smoking and the Adolescent Cerebral Cortex. *Neuropsychopharmacology*. 2007
11. Borja-Aburto VH, Hertz-Picciotto I, Rojas Lopez M, Farias P, Rios C, Blanco J. Blood lead levels measured prospectively and risk of spontaneous abortion. *Am J Epidemiol* 1999;150(6):590–597. [PubMed: 10489998]
12. Rowland AS, Baird DD, Weinberg CR, Shore DL, Shy CM, Wilcox AJ. The effect of occupational exposure to mercury vapour on the fertility of female dental assistants. *Occup Environ Med* 1994;51(1):28–34. [PubMed: 8124459]
13. Figa-Talamanca I. Occupational risk factors and reproductive health of women. *Occup Med (Lond)* 2006;56(8):521–531. [PubMed: 17151388]
14. Rowland AS, Baird DD, Weinberg CR, Shore DL, Shy CM, Wilcox AJ. Reduced fertility among women employed as dental assistants exposed to high levels of nitrous oxide. *N Engl J Med* 1992;327(14):993–997. [PubMed: 1298226]
15. Khattak S, G KM, McMartin K, Barrera M, Kennedy D, Koren G. Pregnancy outcome following gestational exposure to organic solvents: a prospective controlled study. *Jama* 1999;281(12):1106–1109. [PubMed: 10188661]
16. Jedrychowski W, Bendkowska I, Flak E, Penar A, Jacek R, Kaim I, et al. Estimated risk for altered fetal growth resulting from exposure to fine particles during pregnancy: an epidemiologic prospective cohort study in Poland. *Environ Health Perspect* 2004;112(14):1398–1402. [PubMed: 15471732]
17. Ritz B, Yu F, Fruin S, Chapa G, Shaw GM, Harris JA. Ambient air pollution and risk of birth defects in Southern California. *Am J Epidemiol* 2002;155(1):17–25. [PubMed: 11772780]
18. Sram RJ, Binkova B, Dejmek J, Bobak M. Ambient air pollution and pregnancy outcomes: a review of the literature. *Environ Health Perspect* 2005;113(4):375–382. [PubMed: 15811825]
19. Shaw GM. Adverse human reproductive outcomes and electromagnetic fields: a brief summary of the epidemiologic literature. *Bioelectromagnetics* 2001:S5–S18. [PubMed: 11170114]
20. Carmichael SL, Shaw GM, Yang W, Abrams B, Lammer EJ. Maternal stressful life events and risks of birth defects. *Epidemiology* 2007;18(3):356–361. [PubMed: 17435445]
21. Brett KM, Strogatz DS, Savitz DA. Employment, job strain, and preterm delivery among women in North Carolina. *Am J Public Health* 1997;87(2):199–204. [PubMed: 9103097]

22. Marcoux S, Berube S, Brisson C, Mondor M. Job strain and pregnancy-induced hypertension. *Epidemiology* 1999;10(4):376–382. [PubMed: 10401871]
23. Croteau A, Marcoux S, Brisson C. Work activity in pregnancy, preventive measures, and the risk of delivering a small-for-gestational-age infant. *Am J Public Health* 2006;96(5):846–855. [PubMed: 16571706]