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Tobacco, Alcohol, and the Environment

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Tobacco
Clinical significance
Globally, 22% of the world’s adult population aged 15 years and over are estimated to be current tobacco smokers, including 36% of men and 8% of women. The World Health Organization European and Americas regions have the highest prevalence of current tobacco smoking among adult women. There is a stark difference in smoking rates between women of low income countries (whose tobacco smoking rates are low to very low) and women of middle and high-income countries (whose tobacco smoking rates are high to very high). Global tobacco use continues to shift to low and middle-income countries, with a recent increase in the rates of tobacco smoking among women, which is expected to rise to 20% by 2025. About 250 million women worldwide are daily smokers. Women 18–19 years old show the highest prevalence (17.1%); 26% smoked half a pack or more of cigarettes a day. An estimated 19.8 million women in the United States smoke. The annual average rate of past month cigarette use in 2012 and 2013 among women aged 15 to 44 who were pregnant was 15.4 percent. Rates of current cigarette use in 2012–2013 among pregnant women aged 15 to 44 were 19.9 percent in the first trimester, 13.4 percent in the second trimester, and 12.8 percent in the third trimester. The women most likely to smoke are among the most vulnerable—those disadvantaged by low income, low education, and mental health disorders, further exacerbating the adverse health effects from smoking on mothers and their offspring. Women in these groups are also less likely to quit smoking when they become pregnant and are more likely to relapse after delivery.

Tobacco exposure in pregnancy is associated with an increased rate of adverse outcomes including low birth weight, resulting from preterm birth.
and/or fetal growth restriction. In 2003 in the United States, nonsmokers had a rate of 7.7% of low-birth-weight babies compared with 12.4% born to smokers. Tobacco dependence is a chronic addictive condition that requires repeated intervention for cessation. Although a light smoker is defined as a cigarette smoker of fewer than 10 per day, smoking is unsafe at all levels, as is exposure to any form of tobacco in pregnancy. Tobacco cessation in pregnancy results in reduction in preterm birth, fetal growth restriction, low birth weight and perinatal death, as well as in improved neonatal outcomes. It is the most important preventable cause of low birth weight.

Pathophysiology
Tobacco smoke contains thousands of compounds that may have adverse effects. The major compounds suspected of causing harm to the developing fetus are nicotine and carbon monoxide. Nicotine crosses the placenta and can be detected in the fetal circulation at levels that exceed maternal concentrations by 15%, while amniotic fluid concentrations of nicotine are 88% higher than maternal plasma. The actions of nicotine include vasoconstriction and decreased uterine artery blood flow. Carbon monoxide also crosses the placenta rapidly and is detectable in the fetal circulation at levels that are 15% higher than maternal. It has a higher affinity for hemoglobin than oxygen to form the compound carboxyhemoglobin that shifts the oxygen dissociation curve to the left. Consequently, the availability of oxygen to fetal tissues is decreased. Levels of cyanide in the circulation are higher in smokers, a substance that is toxic to rapidly dividing cells. In addition, smokers frequently have other clinical characteristics that may account for some adverse pregnancy outcomes, such as poor nutrition, and alcohol or drug abuse.

Screening for tobacco exposure and increasing tobacco cessation
Smoking cessation interventions for pregnant women result in fewer low-birth-weight newborns and perinatal deaths, fewer physical, behavioral and cognitive problems during infancy and childhood, and important health benefits for the mothers. Women who discontinue smoking even as late as 30 weeks of gestation have infants with higher birth weight than those who continue smoking. In contrast, “cutting down” seems to improve fetal growth only slightly.

Smoking cessation interventions should be included as part of prenatal care. Women are more likely to quit smoking during pregnancy than at any other time in their lives. An office-based cessation counseling session of 5–15 minutes, when delivered by a trained provider with the provision of pregnancy-specific educational materials, increases rates of cessation.
among pregnant smokers. Trials have shown that a five-step intervention program (the 5 As) is effective:

1. **Ask** pregnant women about smoking status using a multiple-choice question method to improve disclosure.

2. **Advise** women who smoke to quit smoking, with unequivocal, personalized and positive messages about the benefits for her, the baby and family. Review the risks associated with continued smoking. Congratulate women who have quit and reinforce the decision by reviewing the benefits resulting from not smoking.

3. **Assess** the woman’s willingness to make an attempt to quit smoking within the next 30 days. If the woman wants to try to quit, the provider should move to the next step, Assist. For women who are unwilling to attempt cessation, the advice, assessment and assistance should be offered at each future visit.

4. **Assist**
   - Provide self-help smoking cessation materials that contain messages to build motivation and confidence in support of a cessation attempt.
   - Suggest and encourage the use of problem-solving methods and skills for cessation for issues that the woman believes might adversely influence her attempt to quit. Avoid “trigger situations.”
   - Arrange social support in the smoker’s environment by helping her identify and solicit help from family, friends, co-workers and others who are most likely to be supportive of her quitting smoking.
   - Provide social support as part of the treatment. This means that the counselor is encouraging, communicates care and concern, and encourages the patient to talk about the process of quitting.

5. **Arrange** follow up. Smoking status should be monitored throughout pregnancy, providing opportunities to congratulate and support success, reinforce steps taken toward quitting, and advise those still considering a cessation attempt.

Pharmaceutical cessation aids such as nicotine replacement therapy (NRT), varenicline, or bupropion SR have efficacy as first-line agents in the general non-pregnant population. The use of these medications is not yet routinely recommended in pregnancy, as there is inconclusive data of their effectiveness and safety. NRT is available in transdermal patch, nasal spray, chewing gum, or lozenge. If used, it should be with extreme caution and women should be warned of uncertain side effects in pregnancy. Bupropion SR is an atypical antidepressant that has been approved by the FDA for use in smoking cessation. It is contraindicated in patients with bulimia, anorexia nervosa, use of MAO inhibitors within the previous 14 days, or a known or history of seizures. It carries a black box warning due to an association of antidepressant medications with suicidality in children, adolescents, and young adults under the age of
24 years. Varenicline is approved for smoking cessation in the general population. Serious neuropsychiatric symptoms have been associated with its use including agitation, depression, and suicidality. The FDA issued a public health advisory in 2008 cautioning its use in populations with a history of psychiatric illness. To date, contingency management, or the use of tangible reinforcement to promote desired behaviors, is the most promising technique to achieve smoking cessation and has been shown to be an effective motivational tool for overcoming other addictions, including alcohol and substance abuse. Four small randomized trials and a recent systematic review of the published literature of contingency management in pregnancy demonstrate an increase in smoking quit rates and potential beneficial effects in reducing adverse pregnancy outcomes. However, the generalizability of these studies in the U.S. and globally is limited especially for women of lower socio-economic status. Adequately powered randomized controlled trials are needed in the US and globally to determine the effectiveness and cost-effectiveness of this intervention.

An increasing proportion of smokers are now using e-cigarettes, either for nicotine delivery or as an attempt to stop smoking. There are limited data on e-cigarettes in pregnancy. In addition to nicotine, some of the e-cigarettes may contain other chemicals such as preservatives. Pregnant women should be discouraged from using e-cigarettes.

ACOG and other organizations including the Centers for Disease Control and Prevention have a number of resources to assist providers in counseling and managing smokers in pregnancy (CDC’s Smoking Cessation for Pregnancy and Beyond: A Virtual Clinic: www.smokingcessationandpregnancy.org, ACOG’s Smoking Cessation During Pregnancy: A Clinician’s guide to helping pregnant women quit smoking: https://www.acog.org/~/media/Departments/Tobacco%20Alcohol%20and%20Substance%20Abuse/SCDP.pdf, and Clean Air for Healthy Children: www.cleanairforhealthychildren.org).

Complications

Pregnancies among women who smoke have been associated with increased risks for miscarriage, ectopic pregnancy, fetal growth restriction, placenta previa, abruptio placentae, preterm birth, premature rupture of the membranes and low birth weight. Overall, the perinatal mortality rate among smokers is 150% greater than that in nonsmokers.

The progeny of smoking mothers face additional risks during childhood. There is a strong association between maternal smoking and sudden infant death syndrome, and a clear dose–response relationship has been demonstrated. Prenatal and postnatal tobacco smoke exposure also has been associated with increased risk of persisting reduced lung function, respiratory infections, and childhood asthma. Recent studies suggest that
infants born to women who smoke during pregnancy may be at increased risk for childhood obesity. In addition, there is evidence suggesting a neurotoxic effect of prenatal tobacco exposure on newborn behavior, i.e., being more excitable and hypertonic. The behavioral and cognitive deficits associated with utero exposure to tobacco seem to continue into late childhood and adolescence with increased risk for attention-deficit hyperactivity disorder and conduct disorder.

Follow up and prevention
It is essential to identify the pregnant woman who is a smoker, ideally before pregnancy, when the risks associated with smoking in pregnancy should be discussed and the benefits of smoking cessation emphasized. Cotinine, a metabolite of nicotine, is an accurate assay for nicotine exposure when measured in urine and can be part of a cost-effective cessation program. Studies indicate higher success rates when participants are aware that compliance is measured with biochemical tests. Postnatal relapse rates are high, averaging 50–60% in the first year after delivery. Counseling should be continued at each postpartum visit including unequivocal, personalized and positive messages about the benefits to the patient, her baby and family resulting from smoking cessation. If indicated, pharmacotherapy could be recommended to the lactating woman, after giving consideration to the risk for the nursing infant of passage of small amounts of the medications through breast milk, compared to the increased risks associated with smoking for children such as sudden infant death syndrome, respiratory infections, asthma, and middle ear disease.

Alcohol

Clinical significance
In the mother, chronic alcohol abuse is associated with pneumonia, hypertension, hepatitis and cirrhosis, among other serious medical complications. For the fetus, it is a known teratogen. Alcohol exposure in pregnancy is the leading known cause of mental retardation and the leading preventable cause of birth defects in Western societies. As many as 1 in 100 births are affected in the United States. Fetal alcohol syndrome is characterized by fetal growth restriction, central nervous system abnormalities and facial dysmorphology, with an average IQ of 70. Functionally, the spectrum of disease even when fetal alcohol syndrome is not fully expressed includes hyperactivity, inattention, memory deficits, inability to solve problems, and mood disorders.

It has been estimated that the risk of fetal alcohol syndrome is 20% if the pregnant woman consumes four drinks per day, increasing to 50% with
eight drinks per day. No safe level of exposure to alcohol has been identified, thus alcohol consumption during pregnancy should be avoided.

Public health warnings about the importance of avoiding alcohol in pregnancy were initiated 30 years ago. Despite this, the 2007 National Survey on Drug Use and Health found that among pregnant women between 15 and 44 years of age, 11.6% used alcohol in the previous 30 days and 0.7% were classified as heavy drinkers (five or more drinks on one occasion, on 5 or more days in the last 30 days) and 6.6% reported binge drinking in the first trimester.

Screening for alcohol abuse in pregnancy
Identifying women who drink during pregnancy is difficult. While a recent report reveals that 97% of women are asked about alcohol use as part of their prenatal care, only 25% of practitioners use standard screening tools.

There is no validated biological marker for alcohol available for use in the clinical setting. Healthcare providers have to rely on self-reported use, resulting in significant underreporting. Of available screening tools, the T-ACE is validated for pregnant women.

Tolerance (T): The first question is “How many drinks can you hold?” A positive answer, scored as a 2, is at least a 6-pack of beer, a bottle of wine or 6 mixed drinks. This suggests a tolerance of alcohol and very likely a history of at least moderate to heavy alcohol consumption.

Annoyed (A): “Have people annoyed you by criticizing your drinking?”

Cut down (C): “Have you felt you ought to cut down on your drinking?”

Eye opener (E): “Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover?”

These last three questions, if answered positively, are worth 1 point each. A score on the entire scale of 2 or higher is considered positive for excessive or risk drinking. Follow up of a positive screen should include questions about volume and frequency. A report of more than seven standard drinks per week, less if any single drinking episode involves more than three standard drinks, should be considered at risk. A standard drink is defined as 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of liquor in a mixed drink. The T-ACE has been reported to identify 90% or more of women engaging in risk drinking during pregnancy.

Treatment of risk drinking in pregnancy
Advice by the healthcare provider is valid, effective and feasible in the clinical office setting. Brief behavioral counseling interventions with follow up in the clinical setting have been demonstrated to produce significant reductions in alcohol consumption lasting at least 12 months. Practitioners need to be aware of the possibility of concurrent psychiatric and/or
social problems. Consultation with mental health professionals and social workers is indicated and can be powerful adjuvants to assist women to discontinue use of alcohol.

Brief interventions for pregnancy risk drinking generally involve systematic counseling sessions, approximately 5 minutes in length, which are tailored to the severity of the identified alcohol problem. In the first intervention, the provider should state her/his concern, give advice, and help to set a goal. Educational written materials should be provided. Routine follow up is essential and should involve encouragement, information and re-evaluation of goals at each prenatal visit. Women who are actually alcohol-dependent may require additional assistance to reduce or eliminate consumption during pregnancy. For these women, referral for more intensive intervention and alcohol treatment needs to be recommended. No randomized clinical trials for pregnant women enrolled in alcohol treatment in pregnancy have been conducted to test the use of pharmacological or psychosocial interventions as reported by the Cochrane collaboration.

Environmental hazards

In 1970, the Occupational Safety and Health Act was implemented with a surge of interest in the reproductive effects of working and the workplace. While an adult worker with an occupational exposure is best served by referral to an occupational medicine specialist, workplace exposures of pregnant women tend to be avoided by occupational physicians and the responsibility for these issues thus falls to the obstetrician. In their Guidelines for Perinatal Care, the American Academy of Pediatrics and the American College of Obstetricians and Gynecologists include environmental and occupational exposures among the components of the preconceptional and antepartum maternal assessment and counseling. Help is available in the form of Teratogen Information Services, accessed through local health departments, and via the databases, such as REPROTOX (http://reprotox.org/) and TERIS (http://depts.washington.edu/~terisweb/teris/), which were set up to provide information to physicians and the Teratogen Information Services on potential teratogens from any source, including the workplace.

Physical agents
Heat
The metabolic rate increases during pregnancy, and the fetus’s temperature is approximately 1°C above the mother’s. Because pregnant women have to eliminate the physiological excess heat, they may be less tolerant of high
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environmental temperatures. Exposure to heat and hot environments can occur in many occupations and industries. Few studies specifically address the hazards of occupational heat stress in pregnancy. Data from animal studies and fever during pregnancy indicate that core temperature elevations to 38.9°C or more may increase the rate of spontaneous abortion or birth defects, most notably neural tube defects. Women with early pregnancy hyperthermic episodes should be counseled about possible effects and offered alpha-fetoprotein screening and directed sonogram studies.

Chemical exposures

Hairstylists

Hair colorants and dyes contain aromatic amines that may be absorbed through the skin. These agents are mutagenic but are not teratogenic in rats and cause embryotoxicity in mice only at high doses that are also maternally toxic. Permanent wave solutions may cause maternal dermatitis but are not known to be teratogenic in animals.

There is no direct evidence that hair dyes and permanent wave solutions are teratogenic in human pregnancy, but very limited data are available. One study found a higher rate of spontaneous abortion among cosmetologists. Exposure to these agents should be minimized by the use of gloves and, if possible, reduction of chronic exposures in the first trimester.

Painters and artists

Organic and inorganic pigments may be used in paints. The raw materials for organic pigments may contain aromatic hydrocarbons, such as benzene, toluene, naphthalene, anthracene, and xylene. Inorganic pigments may contain lead, chromium, cadmium, cobalt, nickel, mercury, and manganese. Workers in battery plants and those involved in the removal of old paint are also exposed to lead salts.

Reproductive concerns about inorganic pigments are focused primarily on lead, which is readily transferred across the placenta. Inorganic lead salts have been associated with increased spontaneous abortion, infant cognitive impairment, and stillbirth rates in humans, and central nervous system abnormalities and clefting in rodents. Women at risk of lead exposure should be monitored for blood lead levels before becoming pregnant. If blood lead concentration is greater than 10 micrograms/mL, the patient should be removed from exposure and chelation considered before pregnancy. Chronically exposed workers will have significant bone lead stores and should remain in a lead-free environment until safe lead levels are reached before attempting pregnancy. There is no consensus on how to manage elevated blood lead levels during pregnancy as chelation will at least temporarily elevate blood lead levels by releasing bone stores. Further,
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the chelating agent, calcium edetate, may be developmentally toxic, probably by decreasing zinc stores.

**Solvent workers**

Some organic hydrocarbons may cause a fetal dysmorphogenesis syndrome comparable to fetal alcohol syndrome if ingested in large amounts. This has best been evaluated for gasoline, in a group of individuals who habitually “sniffed” the fuel for its euphoric effects. An excess of mental retardation, hypotonia, and microcephaly was found in the offspring. The effects of lower levels of gasoline are not known. Similar effects were reported with toluene sniffing.

Ethylene glycol is another solvent used in a large number of industrial processes (paint, ink, plastics manufacture). No human studies exist, but in rodents many studies report abnormal development and skeletal and central nervous system abnormalities. If a woman has a considerable exposure level as determined by blood and urine levels or abnormal liver function tests, increased monitoring of fetal development is recommended.

**Pesticide workers**

Pesticides are often encountered in agricultural workers and landscape artists. Two common agents are carbaryl and pentachlorophenol. A suspected workplace exposure may be quantitated by urine levels. Human studies for these agents are not available but animal studies suggest that high doses, particularly those that produce maternal toxicity, may impair reproductive success and be responsible for skeletal and body wall defects. These outcomes may be related to maternal toxicity and may not be a specific developmental effect.

**Exposure to inhalational anesthetics**

The studies that have suggested an association between occupational exposure to inhalational anesthetics and adverse reproductive outcomes have been heavily criticized. The available scientific evidence, while weak, does lead to concern over occupational exposure to inhalational anesthetics in the trace concentrations encountered in adequately scavenged operating rooms. Recommending limitation of exposure may be reasonable in environments where scavenging equipment is not available, such as some dentists’ offices.

**Other occupational hazards**

**Air travel**

The environment in passenger cabins of commercial airlines is maintained at the equivalent of 5000–8000 feet. While living at high altitude has significant effects on maternal and fetal physiology, air travel has not been
associated with harmful fetal effects because of the short duration of most flights. Adequate hydration is essential as the humidity is also reduced to less than 25% in most cabins. Intermittent ambulation and changing posture is recommended in order to prevent deep vein thrombosis. Reports indicate that flight attendants experience twice the incidence of first trimester spontaneous abortions as other women, but not other employed women. Most airlines restrict the working air travel of flight attendants after 20 weeks of gestation, and restrict commercial airline pilots from flying once pregnancy is diagnosed. Counseling for women with medical or obstetric complications should be individualized. It should be noted that air travel could contribute to background radiation. The magnitude of in-flight exposure to radiation depends on altitude and the solar cycle. A round trip between New York and Seattle can result in exposure to 6 mrem (0.06 mSv), well below the safe upper limit accepted by most experts. Because the effect may be cumulative, frequent flyers need to keep track of their exposure. Patients and physician can consult the FAA’s radiation estimation software (http://jag.cami.jccbi.gov/cariprofile.asp) to calculate the exposure and the National Oceanic and Atmospheric Administration (http://www.sec.noaa.gov) to check for solar flares.

Suggested reading

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U.S. Department of Health and Human Services Substance Abuse and Mental Health Services Administration Center for Behavioral Health Statistics and Quality. National Survey on Drug Use and Health, 2013. Inter-University Consortium for Political and Social Research (ICPSR) [distributor].

Alcohol


Substance Abuse and Mental Health Services Administration. Results from the 2007 National Survey on Drug Use and Health. (www.oas.samhsa.gov/nsduh/reports.htm).

Environmental agents


