

Exposure to toxic environmental agents

ACOG Committee Opinion No. 575

The American College of Obstetricians and Gynecologists Committee on Health Care for Underserved Women, American Society for Reproductive Medicine Practice Committee, and The University of California, San Francisco Program on Reproductive Health and the Environment

Reducing exposure to toxic environmental agents is a critical area of intervention for obstetricians, gynecologists, and other reproductive health care professionals. Patient exposure to toxic environmental chemicals and other stressors is ubiquitous, and preconception and prenatal exposure to toxic environmental agents can have a profound and lasting effect on reproductive health across the life course. Prenatal exposure to certain chemicals has been documented to increase the risk of cancer in childhood; adult male exposure to pesticides is linked to altered semen quality, sterility, and prostate cancer; and postnatal exposure to some pesticides can interfere with all developmental stages of reproductive function in adult females, including puberty, menstruation and ovulation, fertility and fecundity, and menopause. Many environmental factors harmful to reproductive health disproportionately affect vulnerable and underserved populations, which leaves some populations, including underserved women, more vulnerable to adverse reproductive health effects than other populations. The evidence that links exposure to toxic environmental agents and adverse reproductive and developmental health outcomes is sufficiently robust, and the American College of Obstetricians and Gynecologists and the American Society for Reproductive Medicine join leading scientists and other clinical practitioners in calling for timely action to identify and reduce exposure to toxic environmental agents while addressing the consequences of such exposure. (*Fertil Steril*® 2013;100:931–4. ©2013 by American Society for Reproductive Medicine.)

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REPRODUCTIVE ENVIRONMENTAL HEALTH

Robust scientific evidence has emerged over the past 15 years, demonstrating that preconception and prenatal exposure to toxic environmental agents can have a profound and lasting effect on reproductive health across the life course (1–3). Exposure to toxic environmental agents also is implicated in increases in adverse reproductive health outcomes that emerged since World War II; these

changes have occurred at a rapid rate that cannot be explained by changes in genetics alone, which occur at a slower pace. For additional information, a detailed review is available at www.acog.org/goto/underserved.

Exposure to environmental chemicals and metals in air, water, soil, food, and consumer products is ubiquitous. An analysis of National Health and Nutrition Examination Survey data from 2003–2004 found that virtu-

ally every pregnant woman in the United States is exposed to at least 43 different chemicals (4). Chemicals in pregnant women can cross the placenta, and in some cases, such as with methyl mercury, can accumulate in the fetus, resulting in higher fetal exposure than maternal exposure (5–7). Prenatal exposure to environmental chemicals is linked to various adverse health consequences, and patient exposure at any point in time can lead to harmful reproductive health outcomes. For example, prenatal exposure to certain pesticides has been documented to increase the risk of cancer in childhood; adult male exposure to pesticides is linked to altered semen quality, sterility, and prostate cancer; and postnatal exposure to some pesticides can interfere with all developmental stages of reproductive function in adult females, including puberty, menstruation and ovulation, fertility and fecundity, and menopause (8). A group of chemicals called

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endocrine disrupting chemicals has been shown to interfere with the role of certain hormones, homeostasis, and developmental processes (9). They represent a heterogeneous group of agents used in pesticides, plastics, industrial chemicals, and fuels. One study shows that the endocrine disrupting chemical bisphenol-A works in a fashion that is comparable to diethylstilbestrol at the cell and developmental level (10). Likewise, research has clearly shown that many industrial chemicals can affect thyroid function (9, 11). Because of deficiencies in the current regulatory structure, unlike pharmaceuticals, most environmental chemicals have entered the marketplace without comprehensive and standardized information regarding their reproductive or other long-term toxic effects (12).

VULNERABLE POPULATIONS AND ENVIRONMENTAL DISPARITIES

Although exposure to toxic environmental agents is ubiquitous among all patient populations, many environmental factors harmful to reproductive health also disproportionately affect vulnerable and underserved populations and are subsumed in issues of environmental justice. In the United States, minority populations are more likely to live in the counties with the highest levels of outdoor air pollution (13) and to be exposed to a variety of indoor pollutants, including lead, allergens, and pesticides than white populations (14). In turn, the effects of exposure to environmental chemicals can be exacerbated by injustice, poverty, neighborhood quality, housing quality, psychosocial stress, and nutritional status (14, 15).

Women with occupational exposure to toxic chemicals also are highly vulnerable to adverse reproductive health outcomes (16). For example, levels of organophosphate pesticides and phthalates measured in occupationally exposed populations are far greater than levels measured in the general population (17, 18). Furthermore, low-wage immigrant populations disproportionately work in occupations associated with a hazardous workplace environment (19, 20).

As underscored by a groundbreaking 2009 report by the National Academy of Sciences, the effects of low-dose exposure to an environmental contaminant may be quite different based on vulnerabilities, such as the underlying health status of the population and the presence of additional or “background” environmental exposure (21). Recognition of environmental disparities is essential for developing and implementing successful and efficient strategies for prevention.

PREVENTION

The evidence that links exposure to toxic environmental agents and adverse reproductive and developmental health outcomes is sufficiently robust, and the American College of Obstetricians and Gynecologists (the College) and the American Society for Reproductive Medicine (ASRM) join numerous other health professional organizations in calling for timely action to identify and reduce exposure to toxic environmental agents while addressing the consequences of such exposure (1, 22, 23). Reproductive care providers can be effective in preventing prenatal exposure to

environmental threats to health because they are uniquely poised to intervene before and during pregnancy, which is a critical window of human development. An important outcome of pregnancy is no longer just a healthy newborn but a human biologically predisposed to be healthy from birth to old age (3, 24).

PROVIDING ANTICIPATORY GUIDANCE

It is important for health care providers to become knowledgeable about toxic environmental agents that are endemic to their specific geographic areas. Intervention as early as possible during the preconception period is advised to alert patients regarding avoidance of toxic exposure and to ensure beneficial environmental exposure, eg, fresh fruit and vegetables, unprocessed food, outdoor activities, and a safe and nurturing physical and social environment. By the first prenatal care visit, exposure to toxic environmental agents and disruptions of organogenesis may have already occurred. Obtaining a patient history during a preconception visit and the first prenatal visit to identify specific types of exposure that may be harmful to a developing fetus is a key step and also should include queries of the maternal and paternal workplaces. A list of key chemical categories, sources of exposure, and clinical implications are provided in the online companion document to this Committee Opinion (www.acog.org/goto/underserved). Examples of an exposure history are available at http://prhe.ucsf.edu/prhe/clinical_resources.html. Once this exposure inventory has been completed, information should be given regarding the avoidance of exposure to toxic agents at home, in the community, and at work with possible referrals to occupational medicine programs or United States Pediatric Environmental Health Specialty Units if a serious exposure is found (25).

Reproductive care professionals do not need to be experts in environmental health science to provide useful information to patients and refer patients to appropriate specialists when a hazardous exposure is identified. Existing clinical experience and expertise in communicating risks of treatment are largely transferable to environmental health. Physician contact time with a patient does not need to be the primary point of intervention; information and resources about environmental hazards can be successfully incorporated into a childbirth class curriculum or provided in written materials to help parents make optimal choices for themselves and their children (26).

Reporting identified hazards is critical to prevention. For example, the reproductive toxicity of a common solvent used in many consumer products was first described in a case report of a stillbirth (27). Physicians in the United States are required to report illnesses or injuries that may be work related, and reporting requirements vary by state. No authoritative national list of physician-reporting requirements by state exists. Resources for information about how to report occupational and environmental illnesses include local and state health agencies and the Association of Occupational and Environmental Clinics (<http://www.aoc.org/about.htm>). Illnesses include acute and chronic conditions, such as a skin disease (eg, contact dermatitis), respiratory disorder

(eg, occupational asthma), or poisoning (eg, lead poisoning or pesticide intoxication) (28).

Patient-centered actions can reduce body burdens of toxic chemicals (ie, the total amount of chemicals present in the human body at any one time) (29–32). For example, research results document that when children's diets change from conventional to organic, the levels of pesticides in their bodies decrease (29, 30). Likewise, study results document that avoiding canned food and other dietary sources of bisphenol A can reduce measured levels of the chemical in children and adult family members (31), and that short-term changes in dietary behavior may significantly decrease exposure to phthalates (32).

Clinicians should encourage women in the preconception period and women who are pregnant or lactating to eat fruit, vegetables, beans, legumes, and whole grains every day, to avoid fast food and other processed foods whenever possible, and to limit foods high in animal fat, while providing information about how certain types of food affect health and how individuals can make changes. Also, patients should be advised that some large fish, such as shark, swordfish, king mackerel, and tilefish, are known to contain high levels of methylmercury, which is known to be teratogenic. As such, women in the preconception period and women who are pregnant or lactating should avoid these fish. To gain the benefits of consuming fish, while avoiding the risks of methylmercury consumption, pregnant women should be encouraged to enjoy a variety of other types of fish, including up to 12 ounces a week (two average meals) of a variety of fish and shellfish that are low in mercury. Five of the most commonly eaten seafood items that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish. White (albacore) tuna has more mercury than canned light tuna and should be limited to no more than 6 ounces per week. Pregnant women and breastfeeding women should also check local advisories regarding the safety of fish caught in local lakes, rivers, and coastal areas. If no advice is available, they should consume no more than 6 ounces per week (one average meal) of fish caught in local waters and no other fish during that week (33).

PRIMARY PREVENTION: THE ROLE OF REPRODUCTIVE CARE PROFESSIONALS BEYOND THE CLINICAL SETTING

Ultimately, evidence-based recommendations for preventing harmful environmental exposure must involve policy change (34). Action at the individual level can reduce exposure to some toxic chemicals (29, 31, 32) and informed consumer-purchasing patterns can send a signal to the marketplace to help drive societal change (35). However, individuals alone can do little about exposure to toxic environmental agents, such as from air and water pollution, and exposure perpetuated by poverty. The incorporation of the authoritative voice of health care professionals in policy arenas is critical to translating emerging scientific findings into prevention-oriented action on a large scale. Accordingly, many medical associations have taken steps in that direction (23).

For example, in 2009, the Endocrine Society called for improved public policy to identify and regulate endocrine

disrupting chemicals and recommended that “until such time as conclusive scientific evidence exists to either prove or disprove harmful effects of substances, a precautionary approach should be taken in the formulation of EDC [endocrine disrupting chemical] policy” (36). Consistent with the clinical imperative to “do no harm,” the precautionary principle states, “When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically” (37).

The College and the ASRM join these associations and call on their members to advocate for policies to identify and reduce exposure to environmental toxic agents while addressing the consequences of such exposure. Advancing policies and practices in support of a healthy food system should be pursued as a primary prevention strategy to ensure the health of pregnancies, children, and future generations. The College and ASRM urge the U.S. Environmental Protection Agency and other federal and state agencies to take all necessary actions when reviewing substances to guarantee health and safety. In addition, the College and ASRM fully support rigorous scientific investigation into the causes and prevention of birth defects, including linkages between environmental hazards and adverse reproductive and developmental health outcomes. Timely and effective steps must be taken to ensure the safety of all mothers and infants from toxic environmental agents. Because data are lacking on the safety of most chemicals, careful consideration of the risks posed must be given while the potential immediate and long-term health and genetic risks are evaluated. A chemical should never be released if a concern exists regarding its effect on health.

REFERENCES

1. Diamanti-Kandarakis E, Bourguignon JP, Giudice LC, Hauser R, Prins GS, Soto AM, et al. Endocrine-disrupting chemicals: an Endocrine Society scientific statement. *Endocr Rev* 2009;30:293–342.
2. Woodruff TJ, Janssen S, Guillette LJ Jr, Giudice LC. *Environmental impacts on reproductive health and fertility*. New York: Cambridge University Press; 2010.
3. Boekelheide K, Blumberg B, Chapin RE, Cote I, Graziano JH, Janesick A, et al. Predicting later-life outcomes of early-life exposures. *Environ Health Perspect* 2012;120:1353–61.
4. Woodruff TJ, Zota AR, Schwartz JM. Environmental chemicals in pregnant women in the United States: NHANES 2003–2004. *Environ Health Perspect* 2011;119:878–85.
5. Barr DB, Bishop A, Needham LL. Concentrations of xenobiotic chemicals in the maternal-fetal unit. *Reprod Toxicol* 2007;23:260–6.
6. Rollin HB, Rudge CV, Thomassen Y, Mathee A, Odland JO. Levels of toxic and essential metals in maternal and umbilical cord blood from selected areas of South Africa—results of a pilot study. *J Environ Monit* 2009;11:618–27.
7. Stern AH, Smith AE. An assessment of the cord blood: maternal blood methylmercury ratio: implications for risk assessment. *Environ Health Perspect* 2003;111:1465–70.
8. Sutton P, Perron J, Giudice LC, Woodruff TJ. *Pesticides matter: a primer for reproductive health physicians*. San Francisco (CA): University of California, San Francisco. 2011. Available at: http://prhe.ucsf.edu/prhe/pdfs/pesticides_matter_whitepaper.pdf. Retrieved July 22, 2013.
9. Bergman A, Heindel JJ, Jobling S, Kidd KA, Zoeller RT, editors. *State of the science of endocrine disrupting chemicals-2012*. Geneva: World Health Organization. 2013. Available at: http://www.who.int/iris/bitstream/10665/78101/1/9789241505031_eng.pdf. Retrieved July 22, 2013.

10. Doherty LF, Bromer JG, Zhou Y, Aldad TS, Taylor HS. In utero exposure to diethylstilbestrol (DES) or bisphenol-A (BPA) increases EZH2 expression in the mammary gland: an epigenetic mechanism linking endocrine disruptors to breast cancer. *Horm Cancer* 2010;1:146–55.
11. Zota AR, Park JS, Wang Y, Petreas M, Zoeller RT, Woodruff TJ. Polybrominated diphenyl ethers, hydroxylated polybrominated diphenyl ethers, and measures of thyroid function in second trimester pregnant women in California. *Environ Sci Technol* 2011;45:7896–905.
12. Vogel SA, Roberts JA. Why the toxic substances control act needs an overhaul, and how to strengthen oversight of chemicals in the interim. *Health Aff* 2011;30:898–905.
13. Woodruff TJ, Parker JD, Kyle AD, Schoendorf KC. Disparities in exposure to air pollution during pregnancy. *Environ Health Perspect* 2003;111:942–6.
14. Adamkiewicz G, Zota AR, Fabian MP, Chahine T, Julien R, Spengler JD, et al. Moving environmental justice indoors: understanding structural influences on residential exposure patterns in low-income communities. *Am J Public Health* 2011;101(suppl 1):S238–45.
15. Morello-Frosch R, Zuk M, Jerrett M, Shamasunder B, Kyle AD. Understanding the cumulative impacts of inequalities in environmental health: implications for policy. *Health Aff* 2011;30:879–87.
16. Figa-Talamanca I. Occupational risk factors and reproductive health of women. *Occup Med* 2006;56:521–31.
17. Centers for Disease Control and Prevention. Fourth national report on human exposure to environmental chemicals. Atlanta (GA): CDC. 2009. Available at: <http://www.cdc.gov/exposurereport/pdf/FourthReport.pdf>. Retrieved July 22, 2013.
18. Hines CJ, Nilsen Hopf NB, Deddens JA, Calafat AM, Silva MJ, Grote AA, et al. Urinary phthalate metabolite concentrations among workers in selected industries: a pilot biomonitoring study. *Ann Occup Hyg* 2009;53:1–17.
19. McCauley LA. Immigrant workers in the United States: recent trends, vulnerable populations, and challenges for occupational health. *AAOHN J* 2005;53:313–9.
20. Pransky G, Moshenberg D, Benjamin K, Portillo S, Thackrey JL, Hill-Fotouhi C. Occupational risks and injuries in non-agricultural immigrant Latino workers. *Am J Ind Med* 2002;42:117–23.
21. National Research Council. Science and decisions: advancing risk assessment. Washington, DC: National Academies Press; 2009.
22. Zoeller RT, Brown TR, Doan LL, Gore AC, Skakkebaek NE, Soto AM, et al. Endocrine-disrupting chemicals and public health protection: a statement of principles from The Endocrine Society. *Endocrinology* 2012;153:4097–110.
23. University of California San Francisco, Program on Reproductive Health and the Environment. Professional statements database. Available at: <http://prhe.ucsf.edu/prhe/professionalstatements.html>. Retrieved July 22, 2013.
24. Sutton P, Woodruff TJ, Perron J, Stotland N, Conry JA, Miller MD, et al. Toxic environmental chemicals: the role of reproductive health professionals in preventing harmful exposures. *Am J Obstet Gynecol* 2012;207:164–73.
25. Sathyanarayana S, Focareta J, Dailey T, Buchanan S. Environmental exposures: how to counsel preconception and prenatal patients in the clinical setting. *Am J Obstet Gynecol* 2012;207:463–70.
26. Ondeck M, Focareta J. Environmental hazards education for childbirth educators. *J Perinat Educ* 2009;18:31–40.
27. Solomon GM, Morse EP, Garbo MJ, Milton DK. Stillbirth after occupational exposure to N-methyl-2-pyrrolidone. A case report and review of the literature. *J Occup Environ Med* 1996;38:705–13.
28. Centers for Disease Control and Prevention. National Institute for Occupational Safety and Health. Available at: <http://www.cdc.gov/niosh>. Retrieved July 22, 2013.
29. Lu C, Toepel K, Irish R, Fenske RA, Barr DB, Bravo R. Organic diets significantly lower children's dietary exposure to organophosphorus pesticides. *Environ Health Perspect* 2006;114:260–3.
30. Smith-Spangler C, Brandeau ML, Hunter GE, Bavinger JC, Pearson M, Eschbach PJ, et al. Are organic foods safer or healthier than conventional alternatives? A systematic review [published errata appear in *Ann Intern Med* 2012;157:532; *Ann Intern Med* 2012;157:680]. *Ann Intern Med* 2012;157:348–66.
31. Rudel RA, Gray JM, Engel CL, Rawsthorne TW, Dodson RE, Ackerman JM, et al. Food packaging and bisphenol A and bis(2-ethylhexyl) phthalate exposure: findings from a dietary intervention. *Environ Health Perspect* 2011;119:914–20.
32. Ji K, Lim Kho Y, Park Y, Choi K. Influence of a five-day vegetarian diet on urinary levels of antibiotics and phthalate metabolites: a pilot study with "Temple Stay" participants. *Environ Res* 2010;110:375–82.
33. American Academy of Pediatrics, American College of Obstetricians and Gynecologists. Guidelines for perinatal care. 7th ed. Elk Grove Village (IL): AAP; Washington, DC: American College of Obstetricians and Gynecologists; 2012.
34. Sathyanarayana S, Alcedo G, Saelens BE, Zhou C, Dills RL, Yu J, et al. Unexpected results in a randomized dietary trial to reduce phthalate and bisphenol A exposures. *J Expo Sci Environ Epidemiol* 2013;23:378–84.
35. Bailin PS, Burne M, Lewis S, Liroff R. Public awareness drives market for safer alternatives: bisphenol A market analysis report. Falls Church (VA): Investor Environmental Health Network. 2008. Available at: <http://www.iehn.org/documents/BPA%20market%20report%20Final.pdf>. Accessed July 22, 2013.
36. Endocrine Society. Endocrine-disrupting chemicals. Chevy Chase (MD): Endocrine Society. 2009. Available at: <https://www.endocrine.org/~media/endosociety/Files/Advocacy%20and%20Outreach/Position%20Statements/All/EndocrineDisruptingChemicalsPositionStatement.pdf>. Accessed July 22, 2013.
37. Science and Environmental Health Network. The wingspread statement on the precautionary principle, 1998. Available at: <http://www.sehn.org/state.html#w>. Accessed July 22, 2013.