

Chemical exposure and the female reproductive system

Kyley Drach¹

Supervisors: Dr. Heidi Huttunen-Hennelly² & Dr. Kingsley Donkor³

Committee Members: Dr. Heidi Huttunen-Hennelly, Dr. Kingsley Donkor, and Dr. Mark Rakobowchuk⁴

¹MSc, Environmental Science, Thompson Rivers University, ²Department of Chemistry, Thompson Rivers University, ³Department of Chemistry, Thompson Rivers University, ⁴ Department of Biology, Thompson Rivers University.

It is estimated that individuals are exposed to hundreds of chemicals at any given time, where it is nearly impossible to find unexposed populations anywhere in the world. Exposure routes include eating, drinking, breathing, and dermal absorption. After chemicals enter the body, their impact depends on their properties, whether they are excreted or stored, and their rates of entry and excretion. Endocrine disrupting chemicals (EDCs) are of particular concern, as they may impact metabolism and interfere with homeostatic feedback regulation of various endocrine organs by interfering with hormone production. In women, this may increase the risk of negative reproductive health outcomes. Despite the inevitable exposure to EDCs, there is limited research that examines exposure routes and assessed which may have the greatest impact on female reproductive health. Therefore, the purpose of this study is to determine what areas of chemical exposure are most likely to cause menstrual irregularities and if specific lifestyle choices and health status modulate these effects.

Using an online survey, we will collect information about lifestyle choices, health status, and chemical exposure in women age 18-35 who experience a menstrual cycle to conduct our case control study. The survey will include questions regarding reproductive health, product use, general health, mental health, work, and lifestyle choices that are known to impact reproductive health. After the survey data has been collected, the data will be analyzed using a regression analysis to determine which exposure routes, lifestyle choices, or health statuses contribute to menstrual irregularities and which do not. Each category will also be ranked to see which have the greatest positive and negative effects on reproductive health.



Chemical exposure and the female reproductive system

INTRODUCTION

- Endocrine disrupting chemicals (EDCs) are chemicals that may impact metabolism and interfere with homeostatic feedback regulation of various endocrine organs by interfering with hormone production.^{1,2} Exposure routes include eating, drinking, breathing, and dermal absorption.¹ After chemicals enter the body, their impact depends on their properties, whether they are excreted or stored, and their rate of entry and excretion.¹ In women, this may increase the risk of negative reproductive health outcomes.^{1,3}

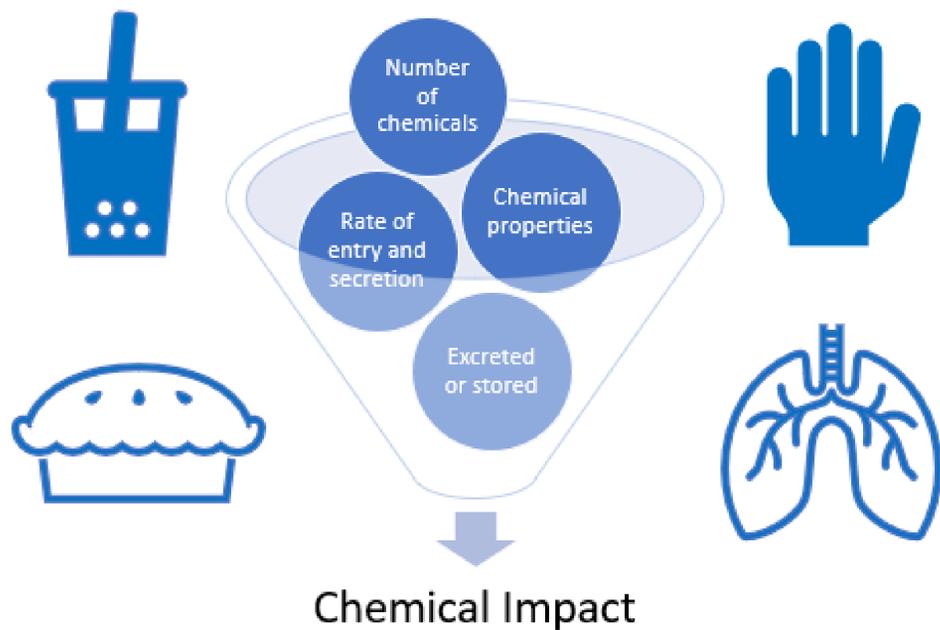


Figure 1. The number of chemicals an individual comes into contact with through various exposure routes along with the chemical properties, rate of entry and secretion, and whether the chemical is excreted or stored all affect the overall impact the chemical has on the body.

- EDCs can cause adverse health effects at both low and high doses, where their effects may differ depending on the dose.¹ This means that current safe exposure levels of many EDCs at high doses may not actually be safe for low dose exposures.⁴
- Despite the inevitable exposure to EDCs, there is limited research that examines exposure routes and which routes may have the greatest impact on female reproductive health.

OBJECTIVE

To determine what areas of chemical exposure are most likely to cause menstrual irregularities and if specific lifestyle choices and health status modulate these effects.

METHODS

Using an online survey, we will collect information on lifestyle choices, health status, and chemical exposure in women age 18-35 who experience a menstrual cycle to conduct our case study. The survey will include questions regarding reproductive health, product use, general health, mental health, work, and lifestyle choices that are known to impact reproductive health.

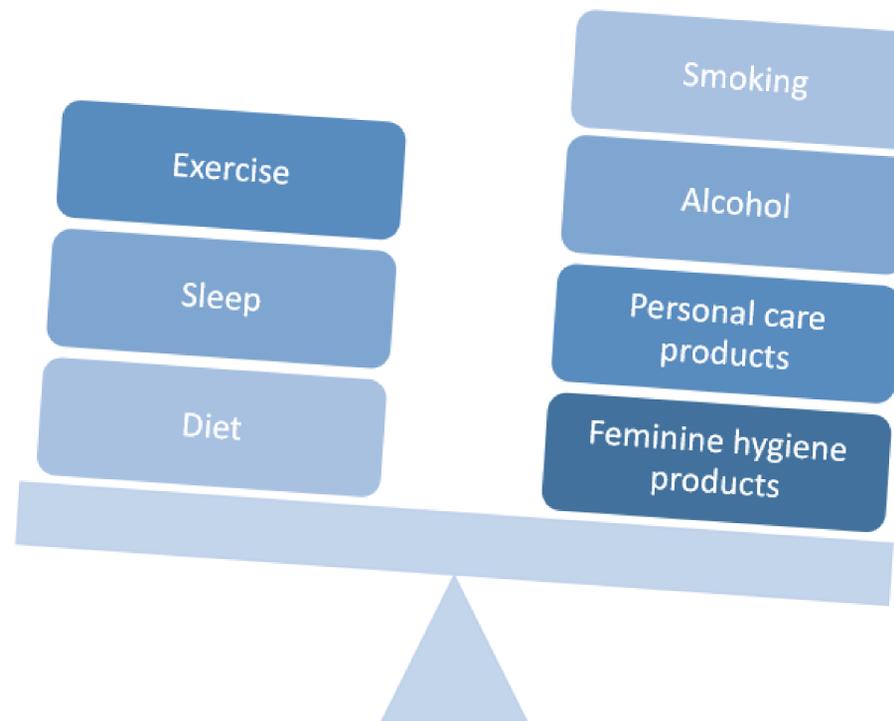


Figure 2. Some areas of EDC exposure include the use of feminine hygiene products⁵, personal care products^{5,6}, and diet⁷⁻⁹. Specific lifestyle choices that can also impact reproductive health include exercise^{10,11}, smoking^{12,13}, alcohol consumption^{14,15}, and sleep^{16,17}.

Tracking the above mentioned categories will help to determine if the menstrual irregularities seen are caused by chemical exposure, lifestyle choices, or a combination of the two.

After the survey data has been collected, the data will be analyzed using a regression analysis to determine which exposure routes, lifestyle choices, or health statuses contribute to menstrual irregularities and which do not. Each category will be ranked to see which have the greatest positive and negative effects on reproductive health.

EXPECTED RESULTS

- Women who have the greatest chemical exposure will experience menstrual irregularities more frequently than women who have less exposure to chemicals.
- Different areas of chemical exposure can be ranked to see which contribute the most to overall chemical exposure based on the menstrual irregularities they cause.
- Different lifestyle choices can be ranked to see which have the most positive and negative impacts on the reproductive system.

It is likely that diet will have the greatest impact on chemical exposure, though how other categories will rank remains unclear.



Figure 3. Diet is likely to contribute the most to chemical exposure.

Literature cited

- Woodruff TJ, Janssen SJ, Guillette LJ, Giudice LC, editors. 2010. Environmental Impacts on Reproductive Health and Fertility. Cambridge: Cambridge University Press. [accessed 2021 Feb 17]. <http://ebooks.cambridge.org/refid/CB09780511674686>.
- Exposure to toxic environmental agents. Committee Opinion No. 575. American College of Obstetricians and Gynecologists. 2013. Obstet Gynecol. 122: 931-935.
- Diamanti-Kandarakis E, Bourguignon JP, Giudice LC, Hauser R, Prins GS, Soto AM, Zoeller RT, Gore AC. 2009. Endocrine-disrupting chemicals: an Endocrine Society scientific statement. Endocr Rev. 30(4):293-342.
- Zoeller TR, Brown TR, Doan LL, Gore AC, Skakkebaek NE, Soto AM, Woodruff TJ, Vom Saal FS. 2012. Endocrine-disrupting chemicals and public health protection: a statement of principles from the Endocrine Society. Endocrinology. 153(9):4097-4110.
- Gao CJ, Kannan K. 2020. Phthalates, bisphenols, parabens, and triclocarban in feminine hygiene products from the United States and their implications for human exposure. Environ Int. 136:105465.
- Rowdhwal S, Chen J. 2018. Toxic effects of di-2-ethylhexyl phthalate: an overview. Biomed Res Int. 2018(1750368):1-10.
- Smith-Spangler C, Brandeau ML, Hunter GE, Clay Bavinger J, Pearson M, Eschbach PJ, Sundaram V, Liu H, Schirmer P, Stave C, et al. 2012. Are organic foods safer or healthier than conventional alternatives? A systematic review. Ann Intern Med. 157(5):348-366.
- Sathyarayanan S, Alcedo G, Saelens BE, Zhou C, Dills RL, Yu J, Lanphear B. 2013. Unexpected results in a randomized dietary trial to reduce phthalate and bisphenol A exposures. J Expo Sci Environ Epidemiol. 23(4):378-384.
- Barnard N, Scialli AR, Bertron P, Hurlock D, Edmunds K. 2000. Acceptability of a therapeutic low-fat, vegan diet in premenopausal women. J Nutr Educ Behav. 32(6):314-319.
- Motahari-Tabari N, Shivani MA, Alipour A. 2017. Comparison of the effect of stretching exercises and metenamic acid on the reduction of pain and menstruation characteristics in primary dysmenorrhea: A randomized clinical trial. Oman Med J. 32(1):47-53.
- Mohebbi Dehnavi Z, Jafarnejad F, Kamali Z. 2018. The effect of aerobic exercise on primary dysmenorrhea: a clinical trial study. J Educ Health Promot. 7(3):1-6.
- Parazzini F, Tozzi L, M Ezzopane R, Luchini L, Marchini M, Fedele L. 1994. Cigarette smoking, alcohol consumption, and risk of primary dysmenorrhea. Epidemiology. 5(4):469-472.
- Ju H, Jones M, Mishra GD. 2016. Smoking and trajectories of dysmenorrhea among young Australian women. Tob Control. 25(2):195-202.
- Emanuele MA, Wezeman F, Emanuele N. 2002. Alcohol's effects on female reproductive function. Alcohol Res Heal. 26(4):274-281.
- Liu Y, Gold EB, Lasley BL, Johnson WO. 2004. Factors affecting menstrual cycle characteristics. Am J Epidemiol. 160(2):131-140.
- Baker FC, Driver HS. 2007. Circadian rhythms, sleep, and the menstrual cycle. Sleep Med. 8(6):613-622.
- Figà-Talamanca I. 2006. Occupational risk factors and reproductive health of women. Occup Med (Chic Ill). 56(8):521-531.