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Endocrine Disrupting Chemical Exposure in Feminine Hygiene Products and the Effect on the Menstrual Cycle

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**Endocrine Disrupting Chemical Exposure in Feminine Hygiene Products and the Effect on
the Menstrual Cycle**

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MPH 683: Integrated Learning Experience (ILEX)

Dr. Zahra Goliaei

August 16, 2022

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Abstract

Endocrine disrupting chemicals have been associated with a variety of harmful effects on the human body such as affecting the development, reproductive, neurological, cardiovascular, metabolic and immune systems. There are many sources that can contribute to human exposure, but some sources are not as intensely researched as others. This paper aims to identify feminine hygiene products as a source of exposure to endocrine disrupting chemicals to consumers. There are few studies that have examined these products and the levels of endocrine disrupting chemicals exposure through them. Feminine hygiene products are used globally and by many different ages. It is important for the consumers to be aware and educated on what chemicals are in their products and the potential harmful effects these chemicals may pose. This paper conducts a thorough literature review to examine the existing knowledge on chemical exposure through feminine products to create a better understanding and initiate further research, interventions, and policies and any racial/ethnic disparities to targeted minority groups. It was identified that feminine hygiene products are a source of exposure and endocrine disrupting chemicals have an effect on the menstrual cycle. Further research on this topic is needed to stop the disparities and the exposure in women who use feminine hygiene products, increase awareness and education for consumers, as well as create an opportunity to introduce stricter policies to limit the exposure that humans have to endocrine disrupting chemicals on a daily basis.

Keywords: feminine hygiene products, endocrine disrupting chemicals, menstrual cycle, consumer products, female body, racial/ethnic disparities, age, reproductive health, chemical regulation

Introduction

Endocrine disrupting chemicals can be found naturally in the environment as well as in various products that are used daily by humans which pose several harmful effects on human health throughout all stages of development. Among all women, young women and minority groups reported to have a higher chance of being exposed to endocrine disrupting chemicals, exhibiting a disparity in this topic. Although there have been plenty of studies that have examined these chemicals in products humans are constantly exposed to and studies that show the effect the chemicals have on the menstrual cycle as well as several reproductive disorders in females with many ways of being exposed, there are limited studies exploring the occurrence of these chemicals in feminine hygiene products (Gao et al., 2019) and the possible impacts on women's health outcomes.

More research is needed to examine these sources of exposure and its health impact. This paper will examine the existing literature on chemical exposure through feminine products to create a better understanding and initiate further research, interventions, and policies.

This paper will also examine any racial/ethnic disparities and if these minority groups are targeted more often. Researching this topic further, creating awareness and increasing education, and changing policies can hopefully be a solution to lessen the exposure of endocrine disrupting chemicals in women in the United States and eventually globally.

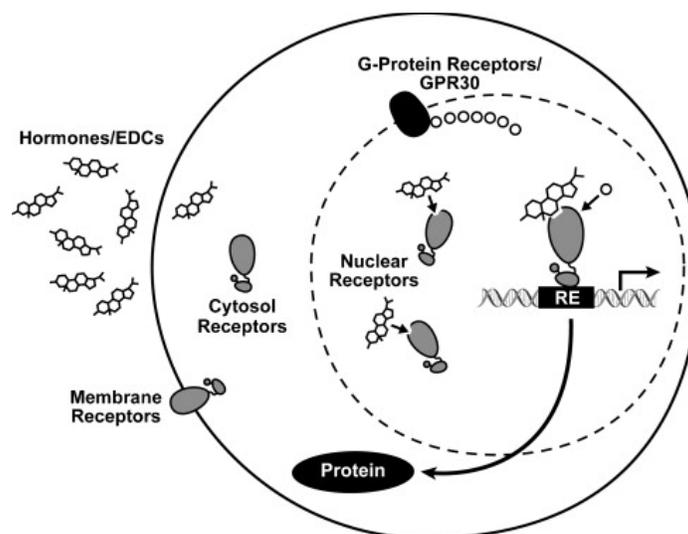
Background and Literature Review

Endocrine Disrupting Chemicals

Endocrine Disrupting Chemicals (EDC's) are known to be exogenous chemicals that can interfere with the human body's hormone function and produce complex, mosaic effects (Thomas Zoeller et al., 2012). EDC's interfere with the body's endocrine system, but that is not where the interference stops. EDC's can also affect the development, reproductive, neurological, cardiovascular, metabolic and immune systems in humans (Schug et al., 2011). Also, in the research by Schug et al (2011), it is explained that EDC's can mimic natural hormones as well as maintain similar modes of action, transport, and storage within tissues. *Figure 1* depicts an illustration showing the steroid hormone receptor signaling pathway. Common EDC's include Bisphenol A (BPA), Dioxins, Organochlorine Pesticides, Perchlorate, Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS), Phthalates, Polybrominated Diphenyl Ethers (PBDE), Polychlorinated Biphenyls (PCBS), and Triclosan.

Figure 1

Steroid Hormone Receptor Signaling Pathway



(Schug et al., 2011)

The National Institute of Environmental Health Sciences (2022) explains that EDC's can not only be found naturally in our environment, but also in many consumer products. Pesticides, metals, additives or contaminants in food, and personal care products have been shown to contain various amounts of EDC's (Monneret, 2017). Monneret (2017) also explains that exposure to EDC's can occur when ingesting food, through dust and water, inhaling gasses and air particles, through the skin, and transferred to a fetus/infant through the placenta and breast milk of a pregnant person. In a survey that measured 48 consumer cosmetic products (products included hair care products, deodorants, lotions and creams, nail products, fragrances, and body washes) it was found that most of the products contained at least one phthalate ester (Hubinger & Havery, 2006).

The U.S. Environmental Protection Agency (EPA) (2022) states that EDC's can have effects such as developmental malformations, interference with reproduction, increased cancer risk, and disturbances in the immune and nervous system function. Fruh et al. (2022) explains that phthalate metabolites have been detected in more than 90% of the United States population urinary concentrations and it is higher in reproductive women as well as higher for Black women compared to White women in the United States. Schug et al (2011) suggests that exposure to these chemicals early in life can be associated with many common health problems such as asthma, learning and behavioral problems, early puberty, infertility, breast and prostate cancer, Parkinson's disease, obesity and many others. *Table 1* explains these chemicals in more detail. For men, there are many studies that show harmful effects such as altered sperm quality and reproductive health issues (Sharma et al., 2020). After analyzing the 2005–2008 National Health and Nutrition Examination Survey (NHANES) data on urinary paraben analyte concentrations in adults 20 years or older, Hendryx and Luo (2022) found that of all the parabens studied, women

were exposed to significantly higher concentrations compared to men and were found to be at greater mortality risk.

Table 1

Common Endocrine Disrupting Chemicals

Chemical Name	Source/Usage	Diseases Associated
Bisphenol A (BPA)	Found in many plastic products	Breast/prostate cancer, Diabetes, Early puberty, Obesity, Heart disease/Hypertension
Dioxins	A byproduct in herbicide production and paper bleaching/released into the environment during waste burning and wildfires	Endometriosis
Organochlorine Pesticides	Commonly used as pesticides	Obesity, ADHD/learning disabilities
Perchlorate	A by-product of aerospace, weapon, and pharmaceutical industries found in drinking water and fireworks	Thyroid disruption
Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)	Used in industrial applications	Increased cholesterol levels, Liver changes, Increased risk of kidney or testicular cancer
Phthalates	Used to make plastics more flexible, they are also found in food packaging, cosmetics, toys, and medical devices	Infertility
Polybrominated Diphenyl Ethers (PBDE)	Used to make flame retardants	Liver tumors, Neurodevelopmental and thyroid dysfunctions
Polychlorinated Biphenyls (PCBS)	Used to make electrical equipment	Endometriosis, Stroke, ADHD/learning disabilities

Triclosan	Found in antimicrobial and personal care products	Allergies, Asthma, Eczema
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EDC's and Female Reproductive Health

EDC's can influence the entire body and cause many problems and complications. Specifically for the female body, these chemicals can cause several harmful effects when exposed with infertility, menstrual disorder, and menopause being amongst those effects (Ding et al., 2022). EDC's such as BPAs and phthalates are known as xenoestrogens, which are close enough in molecular structure to estrogen making them able to bind to estrogen receptor sites (Kumar et al., 2020). Many EDC's can take a long time to begin affecting the body after initial exposure and if exposed during critical times of development, there can be adverse effects on women's health and reproductive function and outcomes (Diamanti-Kandarakis et al., 2009).

In a case-control study conducted by Mayani et al. (1997), it was shown that there was a positive association between endometriosis and dioxin exposure among 44 women with endometriosis compared to 35 age-matched controls with tubal infertility. 18% of the women with endometriosis had detectable dioxin levels in their serum. BPA has been associated with polycystic ovary syndrome (PCOS), which is considered the most common endocrine abnormality (occurring in 4-8% of reproductive-aged females) (Crain et al., 2008). A prospective cohort study found that there was an association between triclosan and abnormal or prolonged menstruation as well as triclosan and reduced fecundability (Zhu et al., 2019). There is limited exposure data in available studies where exposure is typically inferred based on previous knowledge and not actually measured (Caserta et al., 2007).

Financial Burden of EDC's

While EDC's can be found in many consumer products and our environment as well as cause negative harmful effects, there is also the financial burden these chemicals pose to our healthcare system. In a study conducted by Attina et al. (2016), it was found that costs of EDC's in the United States were \$340 billion equating to 2.33% of the gross domestic product (GDP). This study also compared the costs in the United States to the costs in Europe (\$217 billion or 1.28% GDP) and found that the United States spent significantly more. A similar study examined EDC levels in different racial and ethnic groups in the United States to quantify disease burden and associated costs (Attina et al., 2019). They found that EDC exposure levels and associated burden of disease and costs were highest in Blacks (\$56.8 billion or 16.5% of total costs) compared with the proportions of the population that this group makes up (12.6%). Mexican Americans had associated costs of \$50.1 billion or 14.6% and Whites had costs of \$179.8 billion or 52.3%. These results suggest that there are racial/ethnic disparities when it comes to chemical exposure in the United States.

Theory

EDC's have known effects on all parts of the body and can be found in so many different areas. While there are many studies examining the exposure in consumer products, there are limited studies on the exposure from feminine hygiene products. Feminine hygiene products are a potential source of exposure to EDC's and can contribute to irregular and/or longer menstrual cycles. This paper will examine the association between EDC's and the menstrual cycle and will also examine if feminine hygiene products are a source of exposure through a literature review of

relevant studies. This paper will also look at racial and ethnic disparities as well as policies regarding EDC's in consumer products. Lastly, this paper will provide recommendations for this health concern and the associated public health implications and limitations.

Socio Ecological Model

Research and recommendations will be thought out using the Socio-Ecological Model. Studies and policies focusing on the individual, relationship, community, and society will be included as well as used to base recommendations on. To be successful in identifying feminine hygiene products as a source of exposure and examining the effects that EDC's have on the menstrual cycle, it is important to look at and review studies across multiple levels. *Figure 2* depicts the Socio-Ecological Model.

Figure 2

Socio-Ecological Model



(Dahlberg & Krug, 2002)

Methods

Research Strategy

A literature review was completed to examine studies that addressed the presence of EDC's in feminine hygiene products and the corresponding effects of EDC's on the menstrual cycle. The literature review was also used to produce recommendations.

Databases

The search was conducted using Google Scholar. Results were limited to articles with the free version available and published in English from 2007-2022 with the exception of one article published in 1997.

Keywords

Search keywords included: feminine hygiene products, endocrine disrupting chemicals, menstrual cycle, consumer products, female body, racial/ethnic disparities, and age

Recommendations

Recommendations will be based on the following information collected from the literature view. The main priorities will be increasing consumer education, addressing racial and ethnic disparities and implementing new policies for the use of EDC's.

EDC's Effect on the Menstrual Cycle

The menstrual cycle is characterized by the female body now being physically capable of becoming pregnant (Mayo Clinic, 2022). The median age at menarche in 1995 was 12.1, compared to 2013-2017 with the median age being 11.9 (Martinez, 2020). Menopause, which is

defined as 1 year of anovulation (when an egg doesn't release from your ovary during your menstrual cycle), typically occurs at age 51 in the United States (Mayo Clinic, 2020).

As stated in a previous section, there are several known harmful effects that EDC's have on the female body and female reproductive health. Among those harmful effects are issues and changes to the menstrual cycle. With feminine hygiene products being a potential source of exposure, it is important to understand how these chemicals can affect the menstrual cycle as well.

The female menstrual cycle can be very sensitive to hormonal imbalance and alteration in endocrine function, resulting in menstrual irregularities when exposed to EDC's (Kawa et al., 2021). When EDC's interfere with hormonal regulation of the menstrual cycle, fecundability could possibly be reduced as well (Crain et al., 2008). Studies also show that organochlorine exposure shortens menstrual cycles while non organochlorine is associated with long cycles, bleeding between periods, and missed periods (Crain et al., 2008). A study conducted by James-Todd, Terry, et al. (2011) examined the association between childhood hair product use and age at menarche. They found that African Americans were more likely to use hair products and reach menarche earlier than the other racial/ethnic groups in the study.

EDC's and Feminine Hygiene Products

Common feminine hygiene products used during the menstrual cycle include tampons, pads, feminine washes, sprays, powders, and personal wipes with over \$2 billion spent on these products per year in the United States (Nicole, 2014). A cross-sectional online survey in 2018 found that of the 154 women surveyed, 82% used tampons, 59% used panty liners, and 54% used maxi pads (Rai et al., 2018). There has been a concern that feminine hygiene products may

potentially be exposing consumers to EDC's, but there are limited studies exploring this. One of the more common products, sanitary napkins, or pads, are used to absorb blood during the menstrual cycle (Park et al., 2019). Products like this can be contaminated with EDC's such as phthalates as well as chemical additives used during the manufacturing of sanitary napkins consisting of, containing, or contaminated with phthalates (Koniecki et al., 2011). The concern of sanitary napkins and other feminine hygiene products being a source of exposure is due in part to these products coming into direct contact with the vulva and other membranes. The vagina and vulva can absorb chemicals very rapidly.

A study conducted in Albany, New York in 2019 measured 24 EDC's (nine phthalates, six parabens, eight bisphenols, and triclocarban (TCC)) in pads, panty liners, tampons, wipes, bactericidal creams and solutions, and deodorant sprays and powders (Gao & Kannan, 2020). They found that in more than 90% of the feminine hygiene products that were analyzed, the products contained measurable concentrations of the nine phthalates. In addition, there was more than one paraben found in all the products, bisphenols in more than 95% of the products, and TCC in 8–50% of the products.

Gao et al. (2019) conducted a similar study in China. There was a total of 120 feminine hygiene products popular in China examined for phthalate exposure. Phthalates were found in 86% of the products and for sanitary napkins specifically, over 98% of the top layers that come into contact with the skin contained phthalates. They found that feminine hygiene products are sources of phthalate exposure for women in China and that sanitary napkins consisted of a large proportion of the total exposure compared with other personal care products (e.g., face cream, face cleanser, lotion, makeup, etc.).

Tang et al. (2019) measured the levels of 15 phthalates in sanitary napkins collected from Japan, South Korea, the United States, the United Kingdom, Australia, and Germany. Six phthalates were detected in all the sanitary napkin samples as well as six other types of phthalates were found in high concentrations in 54.2-76.4% of the samples.

Branch et al. (2015) conducted a cross-sectional study in the United States on 739 women to examine the association between using tampons, sanitary napkins, vaginal douches, feminine spray, feminine powder, and feminine wipes/towelettes with urinary concentrations of monoethyl phthalate (MEP) and mono-n-butyl phthalate (MnBP). They found that those who used vaginal douches in the past month had higher concentrations of MEP but not MnBP. No other feminine hygiene product that was examined in the study was significantly associated with either MEP or MnBP.

EDC Exposure Interventions

There are very few interventions conducted to help reduce EDC exposure in women. One study conducted by Harley et al. (2016) aimed to reduce phthalate, paraben, and phenol exposure from personal care products in adolescent girls in a community based participatory research intervention. The study showed that educating consumers on how to choose safer products by reading the labels and knowing chemicals that are harmful can reduce personal exposure to EDC's. A different study aimed to implement an intervention to reduce BPA in 24 women over the course of three weeks by conducting weekly meetings with the intervention group to reduce BPA exposures from common sources (Hagobian et al., 2017). The women were also provided with BPA-free cosmetics, hygiene, glass food/water containers, and daily self-monitored major

sources of BPA. At the end, it was found that there was a decrease in urinary BPA concentrations in the women who participated in the intervention compared to the control group.

Recommendation

The literature above shows that feminine hygiene products can be a source of potential exposure to EDC's and that many consumers do not even know what is in their products. One recommendation to combat this issue is to increase consumer education to show consumers what to look for in products, what to avoid, and what all these chemicals can do to the body.

Partnering with organizations in the community to create educational materials to distribute in sexual education classes at schools, doctors' offices, hospitals, and clinics can provide the necessary knowledge to consumers. The community organizations can also hold monthly workshops equipped with trained volunteers to explain the negative effects of EDC's and ways to limit exposure in everyday products.

Many of the materials can be provided as donations from community organizations and even local businesses. Volunteers can be recruited to run the project. However, if funds are needed for this recommendation, local grant programs in specific areas can be utilized as well as programs such as the Walmart Local Community Grants (grants range from a minimum of \$250 to a maximum of \$5,000), the Bank of America Foundation: Neighborhood Excellence Initiative (\$5,000), and the Citizens Bank Foundation among others.

Distribution of EDC Exposure by Race/Ethnicity

EDC's pose a risk to every human, it has been studied that people of color, specifically women, may be at a higher risk of exposure to EDC's through personal care products (including but not limited to feminine hygiene products). In the study previously mentioned by Branch et al.

(2015), it was found that the black women that were part of the study had 48.4% higher MEP levels than their white counterparts in the study. A large portion of black women reported using vaginal douches, feminine spray, feminine powder, and wipes compared to the white and Mexican American women in the study. Vaginal douches were associated with higher concentrations while no other feminine hygiene products were.

In a cross-sectional study focusing on the douching behavior of 3,522 women, it was found that the percentage of douching in black women was 47%, 17% for white women, 12.5% for Mexico-born Mexican American women, and 19% for United States born Mexican American women (Arbour et al., 2009). This study concluded that racial status contributed to influencing douching behavior in women, especially black women. Products that are advertised for black women have been found to have higher concentrations of EDC's (Schildroth et al., 2022).

A study by James-Todd, Senie, et al. (2011) included 326 women (self-identifying as African American, African-Caribbean, Hispanic, and White) from New York. The women were interviewed in-person for 15-20 minutes and were asked about products that they have used/are currently using as well as the frequency and duration of product use. The researchers found that African American and African-Caribbean women were the highest proportion of hair product users and they used hair products for the longest duration. They also found that a majority of the commonly used hair products contained parabens. Their findings suggest that African American and African-Caribbean women are more likely to be exposed to EDC's in hair products compared to white or Hispanic women.

Recommendation

Many products used by people of color, black women especially, contain higher amounts of EDC's compared to other products as shown in the literature above. Black women

disproportionately use products containing EDC's and harmful chemicals, but there are limited studies examining this issue. More research is needed in this area to understand why this is happening. Once more research is conducted, there can start to be solutions on how to fix this disparity. With little research showing the relationship, not much can be done to combat this.

Many higher education institutions require their students to conduct some type of research. Partnering with these institutions and their masters and doctoral programs to give their students this topic to research for their courses can be a way to further examine this topic. Funding for this recommendation can be obtained from department offices of colleges and universities where they typically facilitate any grant opportunities.

Policies Related to EDC's and Consumer Products

Many chemicals in the United States are not regulated by government agencies. A report done by Women's Voices for the Earth (WVE) explains that the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) do not have direct authority to monitor or require safety testing for feminine care products (Scranton, 2013). This report also states that pads and tampons are classified as medical devices according to the FDA and products such as feminine washes, wipes, and sprays are classified as cosmetics. The FDA does not approve cosmetic products or ingredients and it is up to the manufacturer to follow industry safety guidelines and recommendations (U.S. Food and Drug Administration [FDA], 2022).

Recommendation

To combat the lack of regulations, it is recommended that new policies be implemented to prevent the use of harmful ingredients and chemicals in feminine hygiene products. Manufacturers should be prohibited from using harmful substances in any part of the product,

including the creation and manufacturing of the product. They will also be required to disclose their ingredient list on the packaging of all products used, including the ingredients of added fragrances.

Implications and Discussion

After conducting research, it was found that there are very few studies in the United States that measured and examined EDC exposure in feminine hygiene products significant enough to cause issues to the menstrual cycle. It was also shown that many consumers are unaware or not educated about what to look for and what to avoid in consumer products. There is also a disparity by race and ethnicity in exposure to these chemicals in products as well as very little interventions, policies, and regulations.

Increasing Consumer Education

One of the public health implications for this recommendation is that increasing consumer education will allow people to make healthier choices and have more control of their health. Providing consumers with the resources and education can teach them how to make healthier choices in general and to choose better products in the future to reduce their exposure to EDC's.

Some of the limitations for this recommendation is that it may be hard to find community organizations to partner with and execute the educational functions. While most of the costs would be donations, there is a potential need for funding which can be hard to find if the right grants are not applied for and if community partners cannot invest in the creation of materials

and supplies. There is also a risk that consumers will not engage in any of the educational information provided to them.

Although there are limitations, the overall public health benefits outweigh them. Teaching consumers to make the right choices when it comes to feminine hygiene products can lead the way for other areas to then be introduced. Creating materials and hosting workshops for this topic can lead to more educational materials and workshops for other topics on how consumers can protect their bodies and limit exposures to all harmful chemicals.

Addressing Racial Disparities

Addressing racial and ethnic disparities when it comes to EDC exposure and personal care products in general will help to ensure that people of color are not being unfairly targeted products that are harmful. This recommendation can also lead to an overall healthier population for all races and ethnicities. Research shows that Black women in the United States tend to use harmful products more often when compared to White women. Further research into this topic will help to start finding out the root cause and in turn, closing the gaps.

A limitation for this recommendation is that it can be difficult to find researchers willing to conduct studies on this topic. As stated above, this topic can be suggested to masters and doctoral students as part of course requirements. Researchers who have conducted similar research can be sought out to further investigate this disparity. The lack of funding is also a potential limitation, but there are many grant programs aimed to provide funding to researchers as mentioned above.

Conducting more research on the racial and ethnic disparities for this topic can open the door for more research to be done on other topics. The research done will allow many to see the problem and in turn begin to create solutions to close the gap and ensure healthy lives for all.

Creating New Policies

Creating new policies that focus on regulating feminine hygiene products to prohibit the use of harmful ingredients and chemicals in feminine hygiene products can help prevent any potential health issues derived from these chemicals.

One major limitation of this recommendation is that there may not be support for legislation regarding this topic. It may be difficult to find politicians willing to support these efforts. Tighter rules and regulations for feminine hygiene products could lead to tighter rules and regulations for other personal care products as well as products used in our daily lives. New policies for feminine hygiene products can begin to set a precedent and new standard for how chemicals can be used in the United States.

Conclusion

This research paper was able to examine the existing literature to observe feminine hygiene products as a source of exposure to EDC's. It was also observed that EDC's can affect the menstrual cycle as well as cause negative harmful effects to the human body as a whole. Exposure during critical periods of development can also be detrimental later in life. While EDC's are all around us in our environment, that does not mean that our products must also include them. Implementing education workshops and providing consumers with the tools and information to make informed decisions as well as implementing tighter rules and regulations for

manufacturers and their products can help to reduce our exposure through products. It is also important to address the racial and ethnic disparity experienced with consumer products.

References

- Arbour, M., Corwin, E. J., & Salsberry, P. (2009). Douching patterns in women related to socioeconomic and racial/ethnic characteristics. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, 38(5), 577–585. <https://doi.org/10.1111/j.1552-6909.2009.01053.x>
- Attina, T. M., Hauser, R., Sathyanarayana, S., Hunt, P. A., Bourguignon, J. P., Myers, J. P., DiGangi, J., Zoeller, R. T., & Trasande, L. (2016). Exposure to endocrine-disrupting chemicals in the USA: A population-based disease burden and cost analysis. *The Lancet Diabetes & Endocrinology*, 4(12), 996–1003. [https://doi.org/10.1016/s2213-8587\(16\)30275-3](https://doi.org/10.1016/s2213-8587(16)30275-3)
- Attina, T. M., Malits, J., Naidu, M., & Trasande, L. (2019). Racial/ethnic disparities in disease burden and costs related to exposure to endocrine-disrupting chemicals in the united states: An exploratory analysis. *Journal of Clinical Epidemiology*, 108, 34–43. <https://doi.org/10.1016/j.jclinepi.2018.11.024>
- Branch, F., Woodruff, T. J., Mitro, S. D., & Zota, A. R. (2015). Vaginal douching and racial/ethnic disparities in phthalates exposures among reproductive-aged women: National health and nutrition examination survey 2001–2004. *Environmental Health*, 14(1). <https://doi.org/10.1186/s12940-015-0043-6>
- Caserta, D., Maranghi, L., Mantovani, A., Marci, R., Maranghi, F., & Moscarini, M. (2007). Impact of endocrine disruptor chemicals in gynaecology. *Human Reproduction Update*, 14(1), 59–72. <https://doi.org/10.1093/humupd/dmm025>
- Crain, D. A., Janssen, S. J., Edwards, T. M., Heindel, J., Ho, S. M., Hunt, P., Iguchi, T., Juul, A., McLachlan, J. A., Schwartz, J., Skakkebaek, N., Soto, A. M., Swan, S., Walker, C., Woodruff, T. K., Woodruff, T. J., Giudice, L. C., & Guillette, L. J. (2008). Female

reproductive disorders: The roles of endocrine-disrupting compounds and developmental timing. *Fertility and Sterility*, 90(4), 911–940.

<https://doi.org/10.1016/j.fertnstert.2008.08.067>

Dahlberg, L. L., & Krug, E. G. (2002). *Socio-Ecological model* [Online Image]. Safe States.

<https://www.safestates.org/page/SRPFSEM>

Diamanti-Kandarakis, E., Bourguignon, J. P., Giudice, L. C., Hauser, R., Prins, G. S., Soto, A. M., Zoeller, R. T., & Gore, A. C. (2009). Endocrine-Disrupting chemicals: An endocrine society scientific statement. *Endocrine Reviews*, 30(4), 293–342.

<https://doi.org/10.1210/er.2009-0002>

Ding, T., Yan, W., Zhou, T., Shen, W., Wang, T., Li, M., Zhou, S., Wu, M., Dai, J., Huang, K., Zhang, J., Chang, J., & Wang, S. (2022). Endocrine disrupting chemicals impact on ovarian aging: Evidence from epidemiological and experimental evidence.

Environmental Pollution, 305, 119269. <https://doi.org/10.1016/j.envpol.2022.119269>

Fruh, V., Preston, E. V., Quinn, M. R., Hacker, M. R., Wylie, B. J., O'Brien, K., Hauser, R., James-Todd, T., & Mahalingaiah, S. (2022). Urinary phthalate metabolite concentrations and personal care product use during pregnancy – results of a pilot study. *Science of The Total Environment*, 835, 155439. <https://doi.org/10.1016/j.scitotenv.2022.155439>

Gao, C. J., & Kannan, K. (2020). Phthalates, bisphenols, parabens, and triclocarban in feminine hygiene products from the United States and their implications for human exposure.

Environment International, 136, 105465. <https://doi.org/10.1016/j.envint.2020.105465>

Gao, C. J., Wang, F., Shen, H. M., Kannan, K., & Guo, Y. (2019). Feminine hygiene Products—A neglected source of phthalate exposure in women. *Environmental Science & Technology*, 54(2), 930–937. <https://doi.org/10.1021/acs.est.9b03927>

- Gore, A. C., Chappell, V. A., Fenton, S. E., Flaws, J. A., Nadal, A., Prins, G. S., Toppari, J., & Zoeller, R. T. (2015). EDC-2: The endocrine society's second scientific statement on Endocrine-Disrupting chemicals. *Endocrine Reviews*, *36*(6), E1–E150.
<https://doi.org/10.1210/er.2015-1010>
- Hagobian, T., Smouse, A., Streeter, M., Wurst, C., Schaffner, A., & Phelan, S. (2017). Randomized intervention trial to decrease bisphenol a urine concentrations in women: Pilot study. *Journal of Women's Health*, *26*(2), 128–132.
<https://doi.org/10.1089/jwh.2016.5746>
- Harley, K. G., Kogut, K., Madrigal, D. S., Cardenas, M., Vera, I. A., Meza-Alfaro, G., She, J., Gavin, Q., Zahedi, R., Bradman, A., Eskenazi, B., & Parra, K. L. (2016). Reducing phthalate, paraben, and phenol exposure from personal care products in adolescent girls: Findings from the HERMOSA intervention study. *Environmental Health Perspectives*, *124*(10), 1600–1607. <https://doi.org/10.1289/ehp.1510514>
- Hendryx, M., & Luo, J. (2022). Association between exposure to parabens and total mortality in US adults. *Environmental Research*, *205*, 112415.
<https://doi.org/10.1016/j.envres.2021.112415>
- Hubinger, J. C., & Havery, D. C. (2006). Analysis of consumer cosmetic products for phthalate esters. *Journal of Cosmetic Science*, *57*(2), 127–137.
<https://europepmc.org/article/med/16688376>
- James-Todd, T., Senie, R., & Terry, M. B. (2011). Racial/ethnic differences in Hormonally-Active hair product use: A plausible risk factor for health disparities. *Journal of Immigrant and Minority Health*, *14*(3), 506–511. <https://doi.org/10.1007/s10903-011-9482-5>

- James-Todd, T., Terry, M. B., Rich-Edwards, J., Deierlein, A., & Senie, R. (2011). Childhood hair product use and earlier age at menarche in a racially diverse study population: A pilot study. *Annals of Epidemiology*, *21*(6), 461–465.
<https://doi.org/10.1016/j.annepidem.2011.01.009>
- Kawa, I. A., Akbar Masood, Fatima, Q., Mir, S. A., Jeelani, H., Manzoor, S., & Rashid, F. (2021). Endocrine disrupting chemical bisphenol a and its potential effects on female health. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *15*(3), 803–811.
<https://doi.org/10.1016/j.dsx.2021.03.031>
- Koniecki, D., Wang, R., Moody, R. P., & Zhu, J. (2011). Phthalates in cosmetic and personal care products: Concentrations and possible dermal exposure. *Environmental Research*, *111*(3), 329–336. <https://doi.org/10.1016/j.envres.2011.01.013>
- Kumar, M., Sarma, D. K., Shubham, S., Kumawat, M., Verma, V., Prakash, A., & Tiwari, R. (2020). Environmental Endocrine-Disrupting chemical exposure: Role in Non-Communicable diseases. *Frontiers in Public Health*, *8*.
<https://doi.org/10.3389/fpubh.2020.553850>
- Martinez, G. M. (2020). *Trends and patterns in menarche in the United States: 1995 through 2013–2017* (No. 146). National Health Statistics Reports.
<https://www.cdc.gov/nchs/data/nhsr/nhsr146-508.pdf>
- Mayani, A., Barel, S., Soback, S., & Almagor, M. (1997). Dioxin concentrations in women with endometriosis. *Human Reproduction*, *12*(2), 373–375.
<https://doi.org/10.1093/humrep/12.2.373>
- Mayo Clinic. (2020, October 14). *Menopause - symptoms and causes*.
<https://www.mayoclinic.org/diseases-conditions/menopause/symptoms-causes/syc->

[20353397#:~:text=Menopause%20is%20the%20time%20that,is%20a%20natural%20biological%20process](#)

Mayo Clinic. (2022, February 16). *Preparing your child for menstruation*.

[https://www.mayoclinic.org/healthy-lifestyle/tween-and-teen-health/in-depth/menstruation/art-](https://www.mayoclinic.org/healthy-lifestyle/tween-and-teen-health/in-depth/menstruation/art-20046004?reDate=20072022#:~:text=Menstruation%20typically%20begins%20at%20about,way%20to%20prepare%20your%20child%3F)

[20046004?reDate=20072022#:~:text=Menstruation%20typically%20begins%20at%20about,way%20to%20prepare%20your%20child%3F](https://www.mayoclinic.org/healthy-lifestyle/tween-and-teen-health/in-depth/menstruation/art-20046004?reDate=20072022#:~:text=Menstruation%20typically%20begins%20at%20about,way%20to%20prepare%20your%20child%3F)

Monneret, C. (2017). What is an endocrine disruptor? *Comptes Rendus Biologies*, 340(9–10), 403–405. <https://doi.org/10.1016/j.crvi.2017.07.004>

National Institute of Environmental Health Sciences. (2022). *Endocrine disruptors*.

<https://www.niehs.nih.gov/health/topics/agents/endocrine/index.cfm>

Nicole, W. (2014). A question for women's health: Chemicals in feminine hygiene products and personal lubricants. *Environmental Health Perspectives*, 122(3).

<https://doi.org/10.1289/ehp.122-a70>

Park, C. J., Barakat, R., Ulanov, A., Li, Z., Lin, P. C., Chiu, K., Zhou, S., Perez, P., Lee, J., Flaws, J., & Ko, C. J. (2019). Sanitary pads and diapers contain higher phthalate contents than those in common commercial plastic products. *Reproductive Toxicology*, 84, 114–

121. <https://doi.org/10.1016/j.reprotox.2019.01.005>

Rai, P., Shah, D., & Kelly, K. (2018). Feminine hygiene product use and awareness among

young us adults. *Value in Health*, 21, S179. <https://doi.org/10.1016/j.jval.2018.04.1192>

Raley, E., Quirós-Alcalá, L., & Matsui, E. C. (2021). Chemical exposures via personal care

products and the disproportionate asthma burden among the U.S. black population. *The*

Journal of Allergy and Clinical Immunology: In Practice, 9(9), 3290–3292.

<https://doi.org/10.1016/j.jaip.2021.04.063>

Schildroth, S., Wise, L. A., Wesselink, A. K., Bethea, T. N., Fruh, V., Taylor, K. W., Calafat, A. M., Baird, D. D., & Claus Henn, B. (2022). Correlates of non-persistent endocrine disrupting chemical mixtures among reproductive-aged black women in detroit, michigan. *Chemosphere*, 299, 134447.

<https://doi.org/10.1016/j.chemosphere.2022.134447>

Schug, T. T., Janesick, A., Blumberg, B., & Heindel, J. J. (2011). Endocrine disrupting chemicals and disease susceptibility. *The Journal of Steroid Biochemistry and Molecular Biology*, 127(3–5), 204–215. <https://doi.org/10.1016/j.jsbmb.2011.08.007>

Scranton, A. (2013). *Potential health effects of toxic chemicals in feminine care products* (No. 2). Women's Voices for the Earth. <https://www.womensvoices.org/wp-content/uploads/2013/11/Chem-Fatale-Report.pdf>

Sharma, A., Mollier, J., Brocklesby, R. W. K., Caves, C., Jayasena, C. N., & Minhas, S. (2020). Endocrine disrupting chemicals and male reproductive health. *Reproductive Medicine and Biology*, 19(3), 243–253. <https://doi.org/10.1002/rmb2.12326>

Tang, Z., Chai, M., Cheng, J., Wang, Y., & Huang, Q. (2019). Occurrence and distribution of phthalates in sanitary napkins from six countries: Implications for women's health. *Environmental Science & Technology*, 53(23), 13919–13928.

<https://doi.org/10.1021/acs.est.9b03838>

The United States Environmental Protection Agency. (2022, March 7). *What is endocrine disruption?* <https://www.epa.gov/endocrine-disruption/what-endocrine-disruption#chemicals>

- Thomas Zoeller, R., Brown, T. R., Doan, L. L., Gore, A. C., Skakkebaek, N. E., Soto, A. M., Woodruff, T. J., & vom Saal, F. S. (2012). Endocrine-Disrupting chemicals and public health protection: A statement of principles from the endocrine society. *Endocrinology*, *153*(9), 4097–4110. <https://doi.org/10.1210/en.2012-1422>
- U.S. Food and Drug Administration. (2022, February 25). *Cosmetics & U.S. law*. <https://www.fda.gov/cosmetics/cosmetics-laws-regulations/cosmetics-us-law>
- Zhu, W., Zhou, W., Huo, X., Zhao, S., Gan, Y., Wang, B., Cheng, W., Ouyang, F., Wang, W., Tian, Y., & Zhang, J. (2019). Triclosan and female reproductive health. *Epidemiology*, *30*, S24–S31. <https://doi.org/10.1097/ede.0000000000001011>

Appendix A: MPH Competencies

CEPH Foundational Competencies

Competency	Choose at least 2 foundational competencies and briefly note why you feel it is relevant to your ILEX paper or presentation.
Evidence-based Approaches to Public Health	
1. Apply epidemiological methods to the breadth of settings and situations in public health practice	
2. Select quantitative and qualitative data collection methods appropriate for a given public health context	
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software as appropriate	
4. Interpret results of data analysis for public health research, policy and practice	In my literature review I will be interpreting any results that I find on my topic
Public Health & Health Care Systems	
5. Compare the organization, structure and function of health care, public health and regulatory systems across national and international settings	
6. Discuss the means by which structural bias, social inequities and racism undermine health and create challenges to achieving health equity at organizational, community and societal levels	My topic will evaluate the inequities that minorities face with harmful products targeted towards them
Planning & Management to Promote Health	
7. Assess population needs, assets and capacities that affect communities' health	I will be researching products that are possibly affecting menstrual cycles and therefore affecting the health of communities
8. Apply awareness of cultural values and practices to the design or implementation of public health policies or programs	
9. Design a population-based policy, program, project or intervention	
10. Explain basic principles and tools of budget and resource management	
11. Select methods to evaluate public health programs	
Policy in Public Health	
12. Discuss multiple dimensions of the policy-making process, including the roles of ethics and evidence	

13. Propose strategies to identify stakeholders and build coalitions and partnerships for influencing public health outcomes	
14. Advocate for political, social and economic policies and programs that will improve health in diverse populations	
15. Evaluate policies for their impact on public health and health equity	
Leadership	
16. Apply principles of leadership, governance and management, which include creating a vision, empowering others, fostering collaboration and guiding decision making	
17. Apply negotiation and mediation skills to address organizational or community challenges	
Communication	
18. Select communication strategies for different audiences and sectors	
19. Communicate audience-appropriate public health content, both in writing and through oral presentation	I will be communicating my findings through my paper and presentation
20. Describe the importance of cultural competence in communicating public health content	
Interprofessional Practice*	
21. Perform effectively on interprofessional teams	
Systems Thinking	
22. Apply systems thinking tools to a public health issue	

MPH - Community and Public Health Practice Competencies

Competency	If CPHC is your program concentration, choose at least 2 competencies you plan to draw on and mention how it is relevant.
1. Apply qualitative methods to assess community assets for addressing public health and environmental issues	

2. Analyze how issues of power, race and ethnicity, sex and gender identify, and socioeconomic factors affect the development, implementation, and evaluation of community-based projects	
3. Develop a research project proposal using mixed methods to address a public health problem	I will be conducting a literature review to understand the relationship between chemicals in feminine products and the effect on menstrual cycles
4. Apply project management strategies to improve the quality of programs and services in public health settings	
5. Identify environmental health risks in vulnerable communities and examine strategies to reduce exposures	I will be identifying if chemicals in certain products are affected menstrual cycles