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Research

Association Between Food Plastic Packaging and Dysmenorrhea in Female Adolescents

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ABSTRACT

Background: Most women experience certain pain and difficulty during menstruation or what is known as dysmenorrhea. Dysmenorrhea is a gynecological problem and is the most frequently reported chief complaint in women. Dysmenorrhea is defined as cramping in the lower abdomen that occurs before or during menstruation. The use of plastic as food and beverage packaging is still a commonly used in the community. Plastic contains several compounds, including phthalates and bisphenol-A (BPA) which have potential as endocrine disrupting chemicals (EDCs). Menstruation and dysmenorrhea are closely related to hormonal system disorders. This study aims to analyze the relationship between food plastic exposure and the incidence of dysmenorrhea among adolescents.
Subjects and Method: The design in this study is observational analytic with a cohort approach. This study was conducted at the Faculty of Medicine, Universitas Airlangga with a population of midwifery students. The sampling technique used was total sampling with a total of 149 subjects. The dependent variable was. dysmenorrhea. The independent variable was food plastic exposure. The instruments used were a visual analogue scale (VAS) questionnaire and a food plastic exposure questionnaire. The data collection was taken in 2 menstrual cycles. Data were analyzed by chi-square test.
Results: The results showed that 71.8% of the subjects experienced moderate level of exposure to food plastic. Dysmenorrhea reported that 128 subjects (86%) had dysmenorrhea. In VAS assessment, most of the subjects which was 43% experienced mild pain. This study showed that there was a relationship between exposure to plastic food and the incidence of dysmenorrhea in adolescents (p= 0.049).
Conclusion: There is a relationship between exposure to plastic food and the incidence of dysmenorrhea in adolescents.

Keywords: Plastics, BPA, Phthalates, EDCs, Dysmenorrhea.

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BACKGROUND

Dysmenorrhea, defined as menstrual pain, is the most common gynecological condition that women complain about in all circles, especially adolescents and women of reproductive age and refers to menstrual pain with severe cramps that affect the lower part of the abdomen. Dysmenorrhea is known to be the most common cause of pelvic pain (Ferries-Rowe et al., 2020). Dysmenorrhea pain can be classified from mild (does not affect daily activities), moderate (slightly interferes with daily activities) or severe (pre-

vents daily activities) (Bezuidenhout and Mahlaba, 2018).

Dysmenorrhea is a complex process that may depend on many factors. It is known that the menstrual cycle depends on changes in the concentration of hormones in the ovaries, and in addition to changes in prostaglandin levels and uterine contractile activity. The study also mentioned that one of the factors that contribute to dysmenorrhea is an increase in the concentration of prostaglandins before menstruation. Prostaglandins cause constriction of blood vessels that supply the uterus so that there is abnormal contraction activity in the uterus which causes ischemia, uterine hypoxia, and increased sensitivity of nerve endings. In addition to hormonal changes that occur in the body, other factors, including diet, early age of menarche, stress, length and severity of menstrual periods and the occurrence of premenstrual syndrome (PMS) can contribute to the pathomechanism of dysmenorrhea. In addition, menstruation can also be considered as an inflammatory event, because during menstruation there is leukocyte invasion and production of inflammatory mediators (Barcikowska et al., 2020).

The main hormones in the ovaries that regulate menstruation are estrogen and progesterone. Estrogen is able to stimulate the synthesis of PGF2α. PGF2α in combination with its receptors causes local blood vessel contractions thereby reducing blood flow to the uterus and muscles, lack of blood flow causes ischemia or hypoxia resulting in pain (Fang et al., 2017).

The use of plastic as food and beverage packaging in people's daily lives cannot be avoided. Plastic is a synthetic polymer material that is cheap and easy to obtain and very practical to use. In its manufacture, various substances which are commonly called plasticizers are added, including various phthalate compounds and bisphenol-A. The study shows that BPA and phthalate compounds are chemicals that have the potential to cause endocrine system disorders or also known as endocrine disrupting chemicals (EDCs). (Ilmiawati et al., 2017).

Endocrine disrupting chemicals (EDCs) are all types of substances that can interfere with normal hormonal activity. In some cases, EDCs bind to natural hormone receptors, for example, bisphenol A (BPA) can bind to estrogen receptors. EDCs can act as agonists, can bind to receptors as antagonists, and turn off the normal hormonal action of receptors. EDCs can interact with hormonal pathways, bypass receptors and activate or deactivate second messenger systems, interfere with gene activation, or by altering levels of hormone-binding proteins (Zlatnik, 2016).

BPA is a very common Endocrine-Disrupting Chemicals (EDCs) contained in polycarbonate, plastic, and epoxy resins manufactured for food and beverage packaging. BPA can accumulate in the reproductive organs and act as an endocrine disruptor because of its structural similarity to estrogen. It can act as a mixed agonist-antagonist to affect estrogen and other steroid hormones such as antagonists of estrogen-induced hippocampal synaptogenesis (Huo et al., 2015). The purpose of this study was to analyze the relationship between food plastic exposure and the incidence of dysmenorrhea in adolescents.

SUBJECTS AND METHOD

1. Study Design

This is a quantitative study, namely an observational analytic study with a cohort approach, this study was carried out for 2 menstrual cycles or from the first day of the last menstruation until the next menstruation and monitored once a week for plastic exposure interviews. In the study of dysmenorrhea, it was studied in the post-inter-

view of plastic exposure using the Visual Analogue Scale (VAS). This study was carried out at the Midwifery Study Program, Faculty of Medicine, Airlangga University, Surabaya from April to October 2021.

2. Population and Sample

The population in this study were all undergraduate students of Midwifery Universitas Airlangga Surabaya batch 2018 to 2020 with a total of 187 people. The sampling technique in this study is total sampling by taking into account the inclusion and exclusion criteria, therefore, 149 subjects were obtained.

3. Study Variables

The dependent variable is the incidence of dysmenorrhea. The independent variable is food plastic exposure.

4. Definition of Operational Variables

Dysmenorrhea defined as painful, cramping menstrual conditions, usually felt as a colic-like illness and most commonly felt in the abdomen and back

Food plastic exposure defined as the subject's behavior and actions related to the use of plastic for food and drink

5. Study Instruments

In the process of data collection, this study used an instrument in the form of a questionnaire to assess food plastic exposure and a measuring instrument for measuring dysmenorrhea pain using the Visual Analogue Scale (VAS).

6. Data analysis

Data analysis in this study used univariate and bivariate analysis with SPSS tools to determine the frequency distribution of each variable and the correlation between the two variables with the Chi Square test.

7. Study Ethics

This study has obtained agreement between researcher and subject, in the process of the study, the researcher carried out anonymity, confidentiality, and conducted with care throughout the study process. The study ethics permit approval letter was obtained from the Research Ethics Committee of the Faculty of Medicine, Airlangga University with Number: 220/EC/KEPK/FKUA/2021.

RESULTS

1. Univariate Analysis

Food plastic exposure variables were divided into three categories, namely low, medium, and high. Based on table 1, it can be concluded that most of the subjects were exposed to food plastic with a moderate level of exposure by 107 subjects (71.8%).

Based on table 2 it can be concluded that most of the subjects experienced dysmenorrhea with mild pain intensity by 64 subjects (43%). Then the next sequence is with moderate pain intensity by 56 subjects (37.6%).

2. Bivariate Analysis

Based on table 3, it showed that subjects who were exposed to moderate to high plastic exposure experienced dysmenorrhea with moderate pain intensity were 48 subjects or 32.2%. This intensity was measured at week 4 after the plastic exposure interview. The data above was then analyzed using the Chi Square test with a significance level of a = 5% (0.05) and the statistical test results were obtained, namely the p value = 0.049. Because the value of p < a (0.049 < 0.05), the study hypothesis was accepted, which means that there was a relationship between plastic exposure and the incidence of dysmenorrhea in adolescents.

Table 1. Frequency distribution of food plastic exposure

Food Plastic Exposure	Score Category	Frequency (n)	Percentage (%)
Low	10-19	39	26.2
Moderate	20-29	107	71.8
High	30-40	3	2.0
Dysmenorrhea Pain Intensity			
Mild	1-3	64	43.0
Moderate	4-6	56	37.6
Severe	7-10	8	5.4
No Pain	0	21	14.1

Table 2. The relationship between food plastic exposure and dysmenorrhea

Plastic Exposure	Pain Intensity								p
	Mild		Moderate		Severe		No Pain		
	N	%	N	%	N	%	N	%	
Low	20	13.4	8	5.4	4	2.7	7	4.7	0.049
Modrate – High	44	29.5	48	32.2	4	2.7	14	9.4	

DISCUSSION

1. Food Plastic Exposure

The existence of BPA in the environment is everywhere. BPA is found in the structure of products used in everyday life such as food, cosmetics, personal care products, detergents, toys, plastic bottles and paper materials such as toilet paper, shopping receipts, newspapers, and others (Atay et al., 2020). However, this study did not include other variables other than exposure through food and beverage. BPA can enter organisms through the digestive tract, respiratory tract and skin absorption, where the digestive tract is the largest source of absorption. In the human body, BPA can be detected in blood, urine, breast milk, amniotic fluid, and other fluids and tissues (Ma et al., 2019).

The plastic monomer and plasticizer bisphenol A (BPA) is one of the highest volume chemicals produced worldwide, with more than six billion pounds produced every year. It was found in the study that the distribution of bisphenol in the urine of adolescents in Flemish was detected in the study population with the most frequently detected compound was Bisphenol F (97%), followed by Bisphenol A (86%) and Bisphenol S (83%). Although BPF is the most common, BPA shows the highest concentration. In the results of studies in other countries such as the United States, Canada, and Brazil, BPA was detected with the highest frequency. Exposure to BPA in the United States reached 92.6% with an age range from 6 years old, where BPA was detected in their urine. The BPA exposure rate in Brazil was 90.9%. This illustrates that BPA is still widely used throughout the world (Gys et al., 2021).

Some evidence has been obtained from study on the biological effects of EDCs especially Bisphenol A (BPA) and Phthalates on pregnancy and fetal development. In vitro and animal models as well as by epidemiological and population studies strongly suggest that endocrine disruptors can negatively impact fetal and placental health by interfering with the developing epigenome, thereby establishing disease pathways into adulthood. In addition, EDCs can cause or contribute to the incidence of severe pregnancy conditions such as Preeclampsia (PE),

Fetal Growth Restriction (FGR) and gestational diabetes in pregnancy, obesity, diabetes, and cardiovascular complications of reproductive age (Rolfo et al., 2020).

2. Dysmenorrhea

Dysmenorrhea is defined as lower abdominal and back pain during menstruation. Based on the results of the study, it was found that most of the subjects experienced dysmenorrhea by 128 subjects. Based on data from WHO, the number of dysmenorrhea in the world is very large, on average more than 50% of women in each country experience dysmenorrhea. The figures vary greatly from country to country, ranging from 50% to 90%. In a study of university students in Turkey, the prevalence of dysmenorrhea was 87.7%, 85.4% in Ethiopia, 73% in Brazil, 88% in Australia, 85% in the United States, and 89.9% in Iran. (Armour et al., 2019).

A study in India explains that the prevalence of dysmenorrhea varies from 20% to 95%. With an average prevalence of 87.7% (Joshi et al., 2015). In a study on female students in China, it was reported that they had experienced dysmenorrhea in the past year with the prevalence of dysmenorrhea ranging from 41.7%. When it measured based on the VAS score, 35.1% experienced mild menstrual pain, 51.5% experienced moderate pain, and 13.8% experienced severe pain (Hu et al., 2020). Research about dysmenorrhea was also conducted in West Africa, namely in Ghana and the results obtained from 500 students there were only 22 students who did not experience dysmenorrhea and the remaining 478 (95.6%) experienced dysmenorrhea with the majority experiencing moderate pain (Samba et al., 2019).

According to the Indonesian Ministry of Health, the prevalence of dysmenorrhea in 2016, the prevalence of adolescent girls in Indonesia who experienced menstrual pain was around 55%. From the results of research in Indonesia, the incidence of dysmenorrhea is 64.25% consisting of 54.89% primary dysmenorrhea and 9.36% secondary dysmenorrhea (Wulanda *et al.*, 2020).

3. The relationship between food plastic exposure and the incidence of dysmenorrhea

In 2015, the European Food Safety Agency (EFSA) reduced the Tolerable Daily Intake (TDI) of BPA from 50 to 4 g/kg body weight/day (EFSA, 2015). However, it should be noted that the EFSA-TDI is still temporary. In addition, a number of studies have reported that side effects of BPA even at low doses can cause health problems such as impaired breast gland development, changes in normal behavioral parameters, or disturbances in brain development and function (Karsauliya et al., 2021).

This study is in line with research conducted by Park and Chung in 2021 showing that a 3-week trial on samples using BPA-free cosmetics and consuming food and drinks from glass containers led to a decrease in BPA levels. From these treatments, this study provides significant evidence that the dietary modification intervention is effective in reducing urinary BPA levels during the second menstrual cycle (around week 8) post-intervention and can reduce menstrual pain until the third menstrual cycle (about week 12). In a sense, these changes in BPA levels could be an important concern for facilitating action in young populations. It is also important to raise awareness for girls to form healthy eating habits to protect themselves from exposure to EDCs such as cans and plastic bottles available in the environment starting at an early age (Park and Chung, 2021).

This study is also in line with research conducted in Korea with a behavioral program to reduce exposure to EDCs in unmarried women, the results show that reducing

exposure to EDCs is effective in reducing perceived dysmenorrhea in women (Kim and Choi, 2021). Another study was also conducted in Korea which analyzed the relationship between the degree of dysmenorrhea among women in reproductive age with eating habits and risk behaviors exposed to environmental hormones. The results showed that the average rate of dysmenorrhea in women in reproductive age was 85.04%. And from the results of the correlation analysis, it was found that the more risky behaviors exposed to environmental hormones and the worse the eating habits, the higher the incidence of dysmenorrhea (Yoon, 2018).

AUTHORS CONTRIBUTIONS

Dhini Safira Maghrifi and Pudji Lestari collaborated to create a conceptual framework and study methodology. Dhini Safira Maghrifi collected the data. Pudji Lestari, Dhini Safira Maghrifi, and Ashon Sa'adi collaborated to analyze the data.

FINANCIAL AND SPONSORSHIP

This study used personal fund.

CONFLICT OF INTEREST

There was no conflict of interest in this study.

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