Research Article

Determinants of Protective Behaviors Against Endocrine Disruptors in Young Korean Women

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A B S T R A C T

Purpose: A convenience-oriented lifestyle in young people is accompanied by greater consumption of and exposure to endocrine disruptors, which can affect reproductive health, especially in women. We aimed to identify factors that influence protective behaviors against endocrine disruptors among female college students in South Korea.
Methods: Using a cross-sectional survey design, we recruited 199 female college students. A self-administered questionnaire was used, and data were collected at the site.
Results: A healthy lifestyle, information utilization, receiving peer advice on avoiding exposure to endocrine disruptors, and a history of environmental illnesses were found to be significant factors, explaining 42.0% of the variance in protective behaviors against endocrine disruptors.
Conclusion: Health consequences of environmental hazards and importance of maintaining a healthy lifestyle need to be emphasized in young women's healthcare. Health professionals should advocate for and empower women to protect themselves against endocrine disruptors.
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Introduction

Endocrine disruptors are chemical agents that interfere with normal hormone function [1]. These are widely included in products that are consumed by people in daily life. Bisphenol A (BPA), phthalates (esters of phthalic acid), and phenols are found in many plastic materials, such as food containers and packaging, and even children's toys [2]. Electronical equipment, furniture, and building materials also contain brominated flame retardants and polychlorinated biphenyls [3]. Parabens, phthalates, and BPA are present in cosmetics, cleansers, and personal care products, such as toothpaste and soaps. In addition, the insecticide chlorpyrifos, which acts as an endocrine disruptor, is present in agricultural and household agents [4,5]. Consequently, endocrine disruptors permeate the human body via the ingestion of food and water,

inhalation of gases and airborne particles, as well as skin contact, resulting in continuous exposure to and accumulation of substances that influence the endocrine system [2,4,5].

Endocrine disruptors interact with estrogens, androgens, and progesterone receptors. Particularly in women, estrogen plays a critical role in the development and function of the reproductive organs. Endocrine disruptors interfere with estrogen-dependent cell signaling [2], subsequently causing endocrine imbalance, altered menstrual cycle, impaired fertility, and endometriosis of the female reproductive system [1,6,7]. Moreover, early-life exposure to endocrine disruptors is associated with adverse effects in fetal, neonatal, and childhood growth and development [8,9]. Nevertheless, a convenience-oriented and consumptive lifestyle is very popular, particularly among young people, so they are at an increased risk of being exposed to endocrine disruptors. In fact, plastic consumption per person, an indicator of hazard exposure, in South Korea, was reported to be 132.7 kg in 2015, making it third among 63 countries; this amount is expected to increase to 145.9 kg by 2020 [10]. In terms of contact with disposable containers and packaging, one study reported that about 10.0% of Korean college students consume fast food four times per week, 19.7%, two-to-three times per week, and 20.2%, at least once per week [11].

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Most people are unaware of the many sources of endocrine disruptors because of insufficient information on chemicals in products, materials, and goods, together with an insensitive social atmosphere regarding the harm caused by these substances. Rouillon et al. [12] reported that in France, 54.0% of pregnant women or those in the postpartum period were unaware of endocrine-disruptors and had limited knowledge about potential sources of exposure, indicated by knowledge scores of 42.90 out of 100 points. Sunyach et al. [13] reported that even perinatal health professionals had little knowledge about environmental toxicants. Lee [14] reported that most college students in South Korea were aware of the risks associated with environmental hormones, yet their health literacy on this information was low, and they required specific guidelines. Moreover, a study revealed that only 4.3% of young Korean college students could identify nutritional and ingredient information when eating fast foods or purchasing foods; they tended to check prices more frequently than food additives [15]. Despite the risks of endocrine disruptors, accurate information has not been shared with consumers, as evidenced by their health behaviors regarding these substances.

Most studies on endocrine disruptors in South Korea have focused on consumer behaviors and marketing strategies with respect to wellbeing products, organic items, and eco-friendly goods [16]. Few studies have investigated how women perceive the threat of endocrine disruptors and how they respond to these. A recent study on 218 Korean adolescent girls is the only such study to demonstrate that concern for the environment and self-appraisal of exposure to endocrine disruptors were significant factors explaining health behaviors [17]. In addition, women who experienced menstrual pain [18] and environmental illnesses such as allergies and asthma [19] were found to practice avoidance behaviors toward endocrine disruptors. This limited evidence warrants further investigation of the responses and actions of women toward environmental hazards.

One intervention for female college students in the United States that aimed at changing health behaviors was reported to be effective in reducing exposure to the endocrine disruptor of BPA by promoting improved hygiene habits and the use of BPA-free cosmetics and glass food and water containers [20]. Of note, economic conditions were found to account for as much as 50.0% of variance in engaging in health-enhancing behaviors, e.g., purchasing appropriate goods [21]. Regarding the personal factor, receiving peer advice and sharing health information with peers [22] were notable activities associated with women's health behaviors. As health education and interventions regarding environmental hazards are essential, particularly for women, it is necessary to identify how these factors are related to women's protective health behavior against endocrine disruptors.

Green and Krueter [23] developed the PRECEDE model, which is used to identify factors underlying any health-related problem and to establish rationales for planning health education related to that issue. The assessment components of the model, termed predisposing, reinforcing, and enabling factor [24], provided a structure of this study to understand female college women's health behaviors of protecting against endocrine disruptors.

First, the predisposing factors are supposed to motivate a behavior before or during its occurrence, which defined as economic status [21,25], interest in health [24] and concern about endocrine disruptors [17] in this study. Second, the reinforcing factors that encourage and reward the person for maintaining or repeating the behavior were defined as peer support [26], health indicators of menstrual pain [26], history of environmental illness [27], and self-appraisal of exposure to endocrine disruptors [17]. Third, the enabling factors that facilitate action and promote skills or resources included healthy lifestyle [28] and information

utilization of endocrine disruptors [12]. Thus, based on the results of previous studies, the selected factors were expected to explain young women's protective behaviors against endocrine disruptors (Figure 1).

In this study, it was aimed to identify the degree to which participants engaged in protective behaviors against endocrine disruptors and the factors related to such behaviors based on the PRECEDE model. Initially, descriptive statistics figured out the degrees of demographics, predisposing factors (self-perceived economic status, interest in health, and concern about endocrine disruptors), reinforcing factors (peer support, menstrual pain, history of environmental illness, and self-appraisal of exposure to endocrine disruptors), enabling factors (healthy lifestyle and information utilization), and protective behaviors against endocrine disruptors. Second, correlations among those factors and protective behaviors against endocrine disruptors of the participants were examined. Third, the influences of the factors on protective behaviors against endocrine disruptors were identified.

Methods

Study design and participants

This study had a descriptive cross-sectional research design. The target participants were women attending five universities located in the northeastern area of South Korea; participants were recruited from students' clubs and cafeterias in the campus using convenience sampling. Three universities were located in the metropolitan city of Seoul and the other two in mid-sized W city and C city. Women were included if they attended the school and agreed to participate in the study, based on their understanding of its purpose. Sample size was calculated using the G*power 3.1.9 program [29] to meet the criteria for multiple regression analysis with a significance level of .05, a medium effect size of .15 for the f^2 test, and a power level of .90. Anticipating a 20.0% attrition rate, the minimum sample size was estimated to be 190 participants with 11 predictors; 199 participants were ultimately included in the analysis after excluding 9 incomplete questionnaires (e.g., only demographic data provided and no data on the dependent variable).

Data collection

Four research assistants were trained in data collection, and we ensured that they understood the purpose of the research and process of questionnaire administration. Potentially eligible participants were approached by the research assistants in the cafeteria or student club rooms. After identifying their year of study, women were invited to voluntarily participate in the study after they had provided written consent. Study data were collected between December 2017 and February 2018. The four research assistants were students in the nursing graduate program with 2–6 years of experience in the clinical field. They were also trained in the data collection process. They were assigned to target students in each school year, from freshmen to seniors, to ensure that an even number of participants was recruited from each school year. A self-report survey was conducted, and the completed questionnaires were collected at the site. A gift certificate was given to women after they completed the questionnaire survey in acknowledgment of their participation in the study.

Ethical considerations

The study was approved by Yonsei university's internal review board (Approval no. YWNR–15–2-044). All participants were informed that they were free to withdraw from the study at any
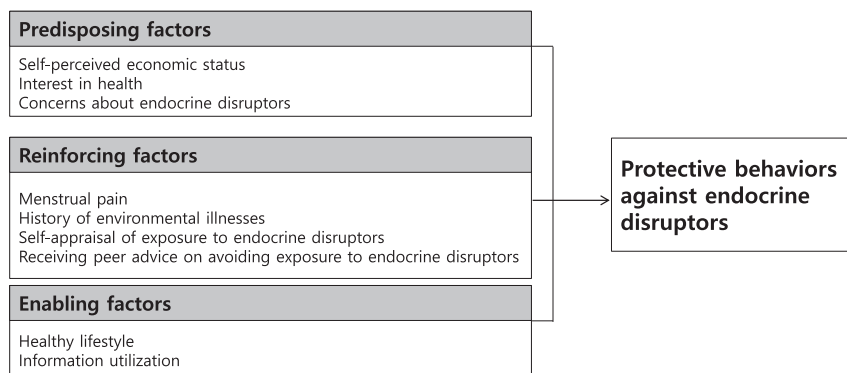
Figure 1 Conceptual framework of the study.

time and that their privacy was protected, and they were informed about the data coding process used to ensure anonymity. Contact information was provided, and personal inquiries regarding survey questions were reported to the principal investigator and addressed by telephone only when a participant had provided her phone number. Several participants requested information about where they could find details about products containing environmental hormones and about simple measures to avoid exposure to these hormones.

Measures

Protective behaviors against endocrine disruptors

Behavioral efforts of women were measured using the instrument proposed by Kim and Kim's [30] "Behaviors to Decrease Exposure to Endocrine Disruptors," with an additional item of "I use cotton sanitary pads." This instrument assesses the degree of behavioral efforts made by women to avoid harmful endocrine disruptors in their daily lives. This scale has a range of 24—96 points, with responses from "never" (1) to "always" (4) which modified to avoid moderate responding. The Cronbach's α of the original measure with 5-point Likert scale was .83 in Kim and Kim's study [30], whereas the reliability test with 33 college students yielded Cronbach's α of .95 in the pilot study and of .93 in this study.

Predisposing factors

As factors to motivate or underpin health behaviors [23], three of self-perceived economic status, interest in health, and concerns about endocrine disruptors were included. Self-perceived economic status was classified into above average, average, or below average. Interest in health was measured a single item, "To what extent are you interested in your health?" measured interest in health on a 10-point numeric scale that ranged from 1 (not at all) to 10 (extremely). Concerns about endocrine disruptors were measured on a 10-point numeric scale ranging from 1 (not at all) to 10 (extremely) by asking "To what extent are you concerned about endocrine disruptors?"

Reinforcing factors

Menstrual pain, history of environmental illnesses, self-appraisal of exposure to endocrine disruptors, and receiving peer advice on avoiding exposure to endocrine disruptors were composed as factors to encourage and reward the person for maintaining or repeating the behavior [23]. Menstrual pain was measured the degree to which menstrual pain interrupted the participant's daily life was assessed by a response of "yes" or "no." History of environmental illnesses mean that if a participant had been diagnosed with allergic rhinitis, asthma, or atopic dermatitis,

which are known to be caused by environmental pollutants and hazards, the answer would be "yes"; if there was no such history, they were to answer "no." Self-appraisal of exposure to endocrine disruptors refers to the degree to which each participant considered herself to have been exposed to endocrine disruptors, according to Park and Chung's [17] instrument. Content validity was confirmed by a gynecologist and two research nurses. This instrument consisted of 8 items, with responses given according to the following 4-point Likert scale: 1, no exposure; 2, little exposure; 3, considerable exposure; and 4, extensive exposure. The total score ranged from 8 to 32, with higher scores indicating a greater subjective sense of exposure to endocrine disruptors. The Cronbach's α has been reported to be .78 [17], and it was .77 in this study. Receiving peer advice on avoiding exposure to endocrine disruptors included a single item, "To what extent did you receive peer advice to avoid exposure to endocrine disruptors?", measured on a 10-point numeric scale that ranged from 1 (not at all) to 10 (extremely).

Enabling factors

These factors functions to facilitate action and promote skills or resources [23], which indicated by healthy lifestyle and information utilization. Healthy lifestyle was defined as a lifestyle pattern prioritizing health information seeking, purchasing healthy goods, and engaging in exercise. This measure contained six items rated on a 5-point Likert scale (1, not at all; 5, very much so), with scores ranging from 6 to 30; thus, higher scores indicated that the individual maintained a healthy daily lifestyle by engaging in behaviors that promote wellbeing [31]. The Cronbach's α was .84 in Lee's [31] study and .81 in this study. The construct validity and content validity of the instrument were verified in a previous study [31].

Information utilization was mean the degree to which participants actively obtained information about endocrine disruptors was measured with two items using a 5-point scale. Participants were asked whether they searched for articles or news about environmental issues and participated in group activities related to the environment. The scores ranged from 2 to 10, and higher scores indicated that participants engaged in more activities to obtain information about the environment.

Characteristics of the participants

Age, school year, and major of study were investigated as the participants' general characteristics.

Statistical analysis

Data were analyzed using SPSS 23.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to explore frequencies,

percentages, mean, and standard deviation of the participants' characteristics, the extent of engagement in protective behaviors against endocrine disruptors, and their related factors. Pearson's correlational coefficients analysis was conducted to examine the relationship between the dependent variable (protective behaviors against endocrine disruptors) with the nine related factors. Hierarchical regression analysis was conducted to identify the influence of each of predisposing, reinforcing, and enabling factors on the dependent variable.

Before multiple regression analyses, a multicollinearity test was conducted using the variance inflation factor and tolerance value to check for high intercorrelation or interassociation among the independent variables. Durbin Watson statistics were also calculated to detect autocorrelation among residuals. For regression analyses, self-perceived economic status (reference = above average, 0 = average or below), menstrual pain (reference = yes, 0 = no), history of environmental illnesses (reference = yes, 0 = no), and school year (reference = junior/senior, 0 = freshman/sophomore) were recoded as dummy variables.

Results

Characteristics of the participants

The study group comprised 199 female college students. Participants' mean age was 22.01 ± 2.29. Freshmen accounted for 69 (34.7%) of the sample, sophomores, 37 (18.6%), and juniors and seniors, 42 (21.1%) and 51 (25.6%), respectively. Participants were majoring in liberal arts, 106 (53.3%); natural sciences, 75 (37.7%); and art and music education, 18 (9.0%) (Table 1).

Distribution of related factors and protective behaviors against endocrine disruptors

Factors associated with protective behaviors against endocrine disruptors were classified as predisposing, reinforcing, and enabling factors, based on the PRECEDE model (Figure 1). Among predisposing factors, self-perceived economic status was mostly reported as average 152 (76.4%). As the proportion of below-average economic status was small, it was included in the average group in the analyses. Mean scores for interest in health and concerns about endocrine disruptors were 6.44 ± 2.14 and 5.67 ± 2.17, respectively, on a 10-point scale. Regarding reinforcing factors, 94 (47.2%) of participants complained of menstrual pain, and 29 (14.6%) have had a history of allergic rhinitis, asthma, or atopic dermatitis. Self-appraisal of exposure to endocrine disruptors showed a mean score of 17.55 ± 4.07 out of 32 points and receiving peer advice on avoiding exposure to endocrine disruptors had a mean score of 4.70 ± 2.02. The enabling factor of a healthy lifestyle obtained 20.01 ± 5.03 out of 30 points, and information

utilization obtained a score of 5.62 ± 1.75 out of a maximum 10 points. Among these factors, the average score of a healthy lifestyle was the highest at 66.70 ± 16.79, and the score of receiving peer advice on avoiding exposure to endocrine disruptors was the lowest at 47.08 ± 20.29. The dependent variable of protective behaviors against endocrine disruptors reached a mean score of 63.77 ± 16.55 out of 96 points (Table 2).

Correlations among related factors and protective behaviors against endocrine disruptors

Correlations among the dependent variable and the nine related factors were examined before performing multiple regression analysis (Table 3). Protective behaviors against endocrine disruptors showed a significant positive correlation with economic status (r = .30, p < .001), interest in health (r = .35, p < .001), and concerns about endocrine disruptors (r = .41, p < .001). Protective behaviors were also strongly associated with receiving peer advice on avoiding exposure to endocrine disruptors (r = .44, p < .001), a healthy lifestyle (r = .60, p < .001), and information utilization (r = .44, p < .001). These six factors were significantly correlated with each other (r = .15~.61, p < .001~.05). Notably, self-perceived economic status was found to have significant positive correlations with these five factors, as follows: interest in health (r = .27, p < .001), concerns about endocrine disruptors (r = .20, p = .006), receiving peer advice on avoiding exposure to endocrine disruptors (r = .16, p = .026), a healthy lifestyle (r = .34, p < .001), and information utilization (r = .19, p = .007). In addition, menstrual pain and a history of environmental illnesses showed a positive correlation with each other (r = .28, p < .001), although they were not associated with other factors. Interestingly, self-appraisal of exposure to endocrine disruptors had no relationship with other variables.

Factors influencing protective behaviors against endocrine disruptors

Based on the PRECEDE framework, the influence of factors on protective behaviors against endocrine disruptors was analyzed using a hierarchical regression analysis (Table 4). First, results of the multicollinearity test verified that interactions among the independent variables did not exist; tolerance values ranged from .52 to .91 (>.10) and variance inflation factor values, from 1.01 to 2.01 (<10.0). In terms of model fit, the Durbin Watson value for independence was 1.62, which met the criterion of being close to 2.0. Normality was determined using the P–P plot, and homoscedasticity was shown to be good, according to the distribution of a scatter plot with the regression-standardized prediction value.

In the first model (F = 21.66, p < .001), the predisposing factor explained 23.0% of the behaviors against endocrine disruptors. In this model, predisposing factors of self-perceived economic status (β = .18, p = .006), interest in health (β = .20, p = .003), and concerns about endocrine disruptors (β = .31, p < .001) became significant factors. In the second model (F = 12.29, p < .001), the reinforcing factor increased the explained variance to 29.0%. Receiving peer advice on avoiding exposure to endocrine disruptors was also a meaningful contributor (β = .27, p < .001) to protective behaviors against endocrine disruptors in this second model. In the third model (F = 16.60, p < .001), the enabling factors added 13.0% to the explained variance, which confirmed 42.0% of the model. In this model, healthy lifestyle was the most influential factor (β = .39, p < .001), followed by information utilization (β = .21, p < .001). After controlling for age and school year as covariates, the final model (F = 13.88, p < .001) remained significant. Significant factors

Table 1 Characteristics of the Participants (N = 199).

Characteristics	n (%) or M ± SD	Min	Max
Age (yrs)	22.01 ± 2.29	19	27
School year			
Freshman	69 (34.7)		
Sophomore	37 (18.6)		
Junior	42 (21.1)		
Senior	51 (25.6)		
Major of study			
Liberal arts	106 (53.3)		
Natural sciences	75 (37.7)		
Art and music education	18 (9.0)		

Note. M = mean; SD = standard deviation; yrs = years.

Table 2 *Descriptive Statistics of the Study Variables (N = 199).*

Factor	Variable	Classification	n (%)	Min	Max	M ± SD	Average score[b]
Predisposing	Self-perceived economic status	Above average	36 (18.1)				
		Average	152 (76.4)				
		Below average	11 (5.5)				
	Interest in health			2	10	6.44 ± 2.14	64.42 ± 21.43
	Concerns about EDCs			1	10	5.67 ± 2.17	56.78 ± 21.78
Reinforcing	Menstrual pain	Yes	94 (47.2)				
		No	105 (52.8)				
	History of environmental illnesses[a]	Yes	29 (14.6)				
		No	170 (85.4)				
	Self-appraisal of exposure to EDCs			8	29	17.55 ± 4.07	54.86 ± 12.74
	Receiving peer advice on avoiding exposure to EDCs			1	10	4.70 ± 2.02	47.08 ± 20.29
Enabling	Healthy lifestyle			8	30	20.01 ± 5.03	66.70 ± 16.79
	Information utilization			2	8	5.62 ± 1.75	56.21 ± 17.51
Protective behaviors against EDCs				24	93	63.77 ± 16.55	66.44 ± 17.24

Note. EDCs = endocrine disruptors; M = mean; SD = standard deviation.
[a] Environmental illness refers to allergic rhinitis, asthma, and atopic dermatitis.
[b] Average score range: interest in health, concerns about EDCs, receiving peer advice on avoiding exposure to EDCs: 10—100, information utilization, healthy lifestyle: 20—100, self-appraisal of exposure to EDCs, protective behaviors against EDCs: 25—100.

were found to be healthy lifestyle (β = .40, p < .001), information utilization (β = .21, p = .001), receiving peer advice on avoiding exposure to endocrine disruptors (β = .13, p = .049), and a history of environmental illness (β = −.12, p = .041), in order of its contribution.

Discussion

This study was conducted from the perspective of protecting young women's reproductive health from existing and potential influences of environmental hormones. Based on the PRECEDE model, factors related to protective behaviors against endocrine disruptors were examined. We identified evidence supporting the importance of informational and educational programs.

In regard to the predisposing factors, self-perceived economic status, interest in health, and concerns about endocrine disruptors were all significant contributors to protect themselves from exposure to endocrine disruptors. Previous studies also have showed positive relationships of parental income [25] and environmental concern [17] with environmental activism. It could be assumed that the lower-income people are likely to have lower levels of environmental concern because of their greater need for goods and services, further they might not afford environmentally goods if those charge more cost. Thus, economic status is need to be incorporated in the context of environmental concerns and related health behaviors. Women's perceptions about endocrine disruptors and interest in their own health influenced them enough to protect themselves from these environmental pollutants. Cognitive and perceptual factors were important bases upon which women take action regarding health behaviors. Strategies to guide young women's preventive behaviors regarding exposure to endocrine disruptors must be further developed and implemented in real-world settings.

In our study, peer influence also seemed to play an important role in reinforcing the steps taken by female college students to protect themselves from exposure. Young people are susceptible to environmental influences, including those from family and friends, and habits and attitudes are formed during the developmental period [32]. In fact, peers can generally improve knowledge, perceptions, beliefs, and attitudes, and dyadic peer support can influence behavioral changes and social health engagement [33] as well as disease management [34]. Thus, it could be beneficial to incorporate the peer support factor, particularly with respect to environmental health issues, to maximize the efficacy of

educational interventions in younger populations. An unexpected finding of this study was that self-appraised exposure to endocrine disruptors was not correlated with other variables and did not influence protective behaviors against endocrine disruptors. Perhaps, participants did not have accurate knowledge regarding those substances to which they had been exposed or the threat of and concerns about endocrine disruptors were obscure, thereby hindering accurate self-appraisal among participants. In fact, only 33.0% of 500 college students knew that dioxin is an environmental hormone, and 87.0% did not know that BPA, polycarbonate, and DDT are endocrine disruptors [14]. Although most people (96.1%) know that endocrine disruptors are hazardous to the human body [35], superficial knowledge does not trigger health behaviors related to endocrine disruptors [17]. Based on these findings, it is important to provide practical and specific information to reinforce women's health behaviors. For example, information should be provided about which products contain environmental hormones, how endocrine disruptors interrupt normal body functions, particularly in women, and how women can avoid the hazards of these hormones. Public campaigns and mass media have been widely used to deliver health messages and change perceptions and behaviors; however, the effects of such efforts may be difficult to determine and may differ according to demographic characteristics of the target population [36,37]. Kite et al. [38] recently reported that mass media could have an impact on the immediate outcomes of knowledge and attitudes, but it is still limited in terms of influencing behavioral changes. Thus, current environmental health issues need to be dealt with using an up-to-date approach and the media preferred by young people [39]. As such, communication technology and social networking systems that can influence health behaviors should be designed and evaluated in future studies. Interestingly, we found that current health problems, such as menstrual pain and a history of environmental illnesses (rhinitis, asthma, and atopic dermatitis), were correlated with each other; however, only a history of environmental illness was significantly associated with protective behaviors against endocrine disruptors. Despite social concerns about environmental hazards in current lifestyle patterns, there seem to be limitations in making connections between those hazards and menstrual problems.

It was apparent that enabling factors, i.e., healthy lifestyle and active information utilization, as a means for taking advantage of environmental resources, were the most significant factors that helped women protect themselves from harmful endocrine

Table 3 Correlations Among Protective Behaviors Against Endocrine Disruptors and Related Factors (N = 199).

Variable	1	2	3	4	5	6	7	8	9
1. Protective behaviors against EDCs	–								
2. Self-perceived economic status	.30**								
3. Interest in health	.35**	.27**							
4. Concerns about EDCs	.41**	.20**	.33**						
5. Menstrual pain	.01	.05	-.14	.08					
6. History of environmental illnesses	-.05	.07	.13	.06	.28**				
7. Self-appraisal of exposure to EDCs	.04	-.03	.03	.10	-.02	-.04			
8. Receiving peer advice on avoiding exposure to EDCs	.44**	.16*	.23**	.61**	.01	.00	.06		
9. Healthy lifestyle	.60**	.34**	.46**	.60**	.05	.09	.04	.50**	
10. Information utilization	.44**	.19**	.15*	.41**	.05	.03	.08	.42**	.40**

Note. EDCs = endocrine disruptors.
Predisposing factors were self-perceived economic status, interest in health, and concerns about EDCs; reinforcing factors included menstrual pain, history of environmental illnesses, self-appraisal of exposure to EDCs, and receiving peer advice on avoiding exposure to EDCs; enabling factors included healthy lifestyle and information utilization.
$^*p < .05.$ $^{**}p < .01.$

Table 4 Factors Influencing Protective Behaviors Against Endocrine Disruptors (N = 199).

Factors	Model 1				Model 2				Model 3				Model 4			
	β	t	p	VIF	β	t	p	VIF	B	t	p	VIF	β	t	p	VIF
Predisposing																
P1	.18	2.78	.006	1.09	.17	2.70	.008	1.10	.08	1.38	.168	1.16	.08	1.37	.171	1.17
P2	.20	2.96	.003	1.18	.21	3.21	.002	1.26	.11	1.81	.072	1.40	.11	1.63	.103	1.44
P3	.31	4.66	<.001	1.13	.13	1.72	.086	1.75	.04	0.62	.533	1.92	.05	0.67	.500	1.99
Reinforcing																
R1					.06	0.86	.390	1.15	.03	0.47	.632	1.16	.03	0.49	.623	1.19
R2					-.11	-1.76	.079	1.12	-.12	-2.01	.045	1.12	-.12	-2.05	.041	1.18
R3					.01	0.18	.855	1.01	.03	0.06	.954	1.07	.03	0.04	.963	1.01
R4					.27	3.63	<.001	1.60	.14	1.99	.048	1.75	.13	1.96	.049	1.75
Enabling																
E1									.39	5.12	<.001	2.00	.40	5.21	<.001	2.01
E2									.21	3.39	.001	1.32	.21	3.47	.001	1.33
Demographics																
D1													-.09	-1.31	.190	1.86
D2													.11	1.59	.112	1.90
F (df), p	21.66 (2), <.001				12.29 (6), <.001				16.60 (8), <.001				13.88 (10), <.001			
R²	.23				.29				.42				.42			
R² change					.06				.13				.01			

Note. β = standardized coefficient; Durbin Watson = 1.62; VIF = variance inflation factor.
P1 = Self perceived economic status (reference = above average); P2 = interest in health; P3 = concerns about endocrine disruptors; R1 = menstrual pain (reference = yes); R2 = history of environmental illness (reference = yes); R3 = self-appraisal of exposure to endocrine disruptors; R4 = receiving peer advice on avoiding to endocrine disruptors; E1 = healthy lifestyle; E2 = information utilization; D1 = age; D2 = school year (reference = junior & senior).

disruptors. This is consistent with the finding that individuals engaging in healthy and proenvironmental behaviors showed better adherence to a good nutritional Mediterranean diet [40]. This finding was also comparable with that of Estrada et al. [41], showing that individuals' self-efficacy and the values that concern them mediate the relationship between knowledge and proenvironmental behaviors. Therefore, young women need to be empowered to understand the value of a healthy lifestyle and to act to protect themselves from the risks of endocrine disruptors. Women need to be aware of physical symptoms related to environmental hormones and of their direct and indirect health consequences. Impacts of environmental hormones on individual's health problem or illnesses should be emphasized in nursing education. Mechanisms of common endocrine disruptors such as BPA and dioxin on the human body should be taught to future health professionals. Because digital media is a major source of health information, specific, and reliable evidences to avoid endocrine disruptors need to be provided via these routes by nurses in college health centers, community health centers, and worksites. Furthermore, lifespan-specific research can be conducted to draw attention to these risks and provide tailored guidelines for each age group of women.

However, our results should be interpreted with caution because of the limitation of the measurements. The variable of information utilization was measured by two items, and interest in health and concerns about endocrine disruptors were investigated by one item each. Although simple measurements could be useful in a survey study, there is no well-established instrument available, particularly for endocrine disruptors. In future studies, reliable and valid instruments must be established and implemented to measure cognitive and behavioral variables related to endocrine disruptors. The research team made an effort to recruit participants from five schools to minimize sampling bias, but the findings cannot be generalized to the wider population. Further studies involving diverse populations should be conducted owing to environmental differences and corresponding variations in sensitivity and coping behaviors among different populations.

Conclusion

Despite the health consequences of environmental hazards, this issue has not been adequately addressed in women's reproductive health care. To empower women to act to protect themselves against endocrine disruptors that pervade their daily life, health-

care professionals should serve as advocates and informants. Encouraging women to adopt a healthy lifestyle and improve their information utilization is a key function of health-care professionals in many fields of practice. Given the need for good reproductive health to ensure the health of future populations, it is necessary to stress on the importance of young women's health throughout their lifespan. At present, young women are responsible for maintaining a healthy pregnancy, breastfeeding, and rearing of the next generation of children. As college-aged women become independent and ready to embark on the reproduction stage of their lives, they should receive accurate information about environmental threats and be empowered to minimize the influences of environmental hazards, with the eventual goal of living healthier lives.

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Conflict of interest

All authors declare that there is no conflict of interest.

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