# Enhancing Environmental Health Literacy Among Health Professionals Regarding Endocrine Disrupting Chemicals

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***Abstract*—Endocrine Disrupting Chemicals (EDCs) interfere with hormonal functioning and may cause reproductive, developmental, and metabolic disorders. These chemicals are found in our personal, essential products that are used by all age groups on a daily basis. The truth of these products must be taken to the laymen as early as possible to minimize the harmful outcome. Awareness among nursing students is vital for promoting preventive health practices in medical settings and communities. A Quasi-experimental one-group pre-test post-test design was used among 30 nursing students of C.S.I. St. Luke's College of Nursing, Thirumaraiyur–Nazareth. A self-structured knowledge questionnaire was used for data collection. Descriptive and inferential statistics (t-test and chi-square) were applied. Mean pre-test score was 10.3 (SD = 2.8) and mean post-test score was 18.7 (SD = 2.5). The calculated t-value ($t = 9.45$, $p < 0.001$) indicated a significant improvement in knowledge. The educational intervention effectively enhanced students' knowledge of EDCs. Incorporating such environmental topics into the nursing curriculum can empower students to educate communities regarding chemical safety.**

***Index Terms*—Endocrine-disrupting chemicals, educational intervention, Knowledge, Nursing students, Environmental health**

## I. INTRODUCTION

The endocrine system plays a crucial role in regulating metabolism, reproduction, and growth. However, it is increasingly being affected by endocrine disrupting chemicals (EDCs) substances that mimic, block, or interfere with hormone actions. These chemicals are commonly found in pesticides, plastics (such as BPA and phthalates), detergents, cosmetics, food packaging, and industrial waste.

According to the World Health Organization (WHO, 2012), more than 800 chemicals are suspected to interfere with hormonal activity, and global exposure has increased by 40% over the past two decades due to urbanization and industrial growth. The Endocrine Society (2015) reported that exposure to EDCs contributes to infertility, breast and prostate cancers, thyroid dysfunction, obesity, and neurodevelopmental disorders.

Globally, about 23% of reproductive health disorders are linked to chemical exposure, while in India, studies by the Indian Council of Medical Research (ICMR, 2021) estimate that nearly 1 in 5 women of reproductive age show endocrine abnormalities potentially linked to environmental exposure. Moreover, high pesticide residues in fruits, vegetables, and groundwater have been reported in several Indian states including Punjab, Tamil Nadu, and Kerala.

Despite such alarming trends, awareness about EDCs remains low. A survey by the National Institute of Environmental Health Sciences (2020) showed that only 28% of healthcare students were aware of EDC sources and preventive measures. Nursing students, as future health educators, are in a strategic position to spread awareness and advocate for safer environmental practices.

Hence, this study was conducted to assess the effectiveness of an educational intervention on knowledge regarding endocrine disrupting chemicals among nursing students at C.S.I. St. Luke's College of Nursing, Thirumaraiyur–Nazareth.

### 1.1 Statement of the problem

A study to assess the effect of educational intervention on knowledge regarding endocrine-disrupting

chemicals among nursing students at C.S.I. St. Luke's College of Nursing, Nazareth.

1.2 Objectives

1. To assess the pre-test and post-test level of knowledge regarding endocrine-disrupting chemicals among nursing students.
2. To evaluate the effectiveness of an educational intervention on knowledge regarding endocrine-disrupting chemicals.
3. To associate the pre-test level of knowledge with selected demographic variables.

1.3 Hypotheses

1. There is a significant difference in the effectiveness of an educational intervention on knowledge regarding endocrine-disrupting chemicals.
2. There is a significant association between the pre-test level of knowledge and selected demographic variables.

1.4 Methodology

- Research Design: Quasi-experimental one-group pre-test post-test design.
- Population: Nursing students of C.S.I. St. Luke's College of Nursing.
- Sample Size: 30 students selected through purposive sampling.
- Tool: Self-Structured knowledge questionnaire (30 items).
- Intervention: Structured teaching program on EDCs using PowerPoint presentation, charts, and interactive discussion.
- Data Analysis: Descriptive statistics (mean, SD, percentage) and inferential statistics (paired t-test, chi-square test).

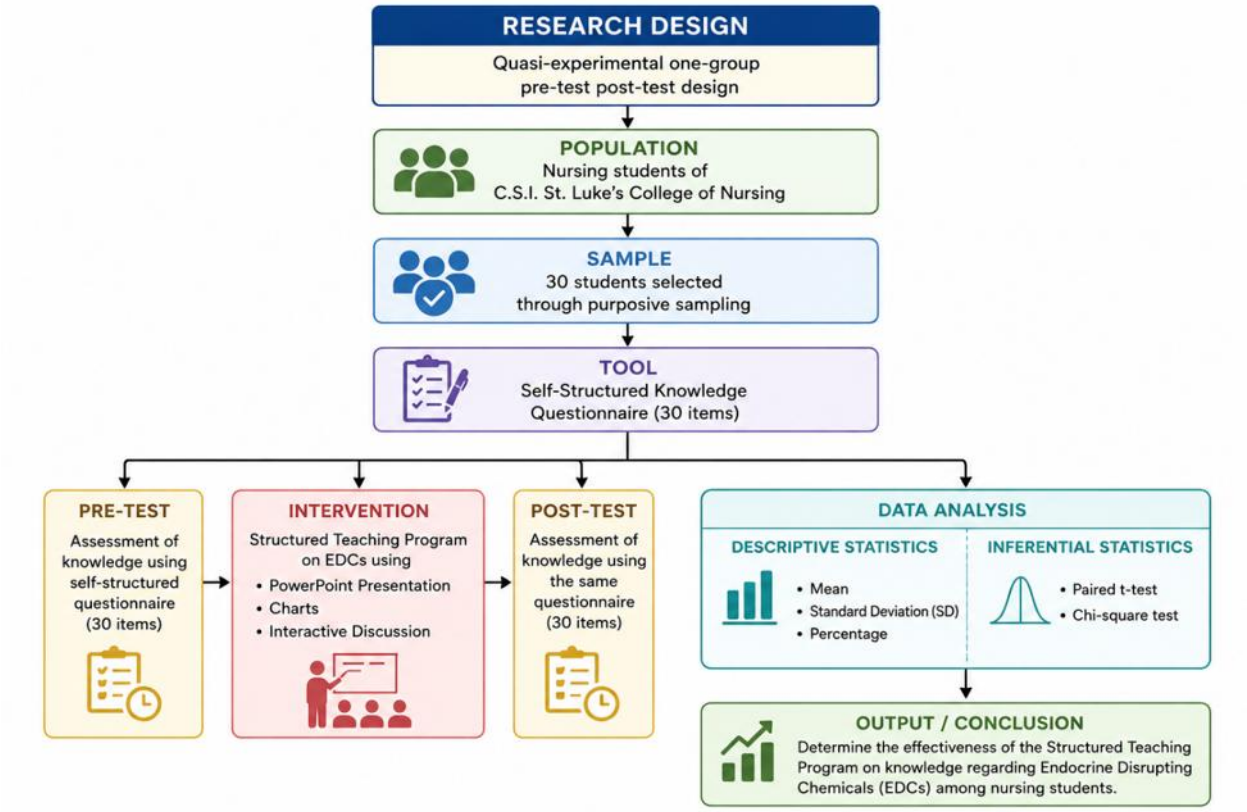


Figure 1: Schematic Representation of the Research Methodology (Source: ChatGPT)

## II. PILOT STUDY

The pilot study was conducted with 10% of the total sample (i.e., 3 samples), and the outcomes were assessed.

### 2.1 Tool Description

he tools consist of demographic data and a self-structured knowledge questionnaire.

The demographic data consisted of age, family income, mode of purchase, experience in purchasing household products, use of near-expiry products and use of cosmetics

The questionnaire used in this study consisted of 30 items, which were self-structured knowledge questions. Various experts validated the questionnaire and modifications were made.

## III. DATA COLLECTION PROCEDURE

Prior to data collection, formal permission was obtained from the Principal of C.S.I. St. Luke's College of Nursing and ethical clearance was secured from the Institutional Ethics Committee. The purpose and objectives of the study were explained to the participants, and informed consent was obtained from all the nursing students who were willing to participate. Confidentiality and anonymity of the participants were assured.

The data collection was carried out among 30 nursing students selected through purposive sampling. Initially, the investigator established rapport with the participants and explained the procedure of the study. A pre-test was conducted using a self-structured knowledge questionnaire consisting of 30 items to assess the existing level of knowledge regarding Endocrine Disrupting Chemicals (EDCs). Approximately 20–30 minutes were allotted for completing the questionnaire.

Following the pre-test, a structured teaching program on Endocrine Disrupting Chemicals was administered by the investigator. The educational intervention included PowerPoint presentations, charts, and interactive discussions covering the definition, sources, health effects, risk factors, prevention, and control measures related to EDC exposure. The teaching session lasted for approximately 45–60 minutes. After an interval of seven days, a post-test was conducted among the same participants using the same self-structured knowledge questionnaire to evaluate the effectiveness of the structured teaching program. The responses obtained from the pre-test and post-test were coded and organized systematically for statistical analysis.

Administrative Permission and Ethical Clearance
↓
Selection of 30 Nursing Students
(Purposive Sampling)
↓
Explanation of Study and Obtaining Informed Consent
↓
Pre-test Assessment
(Self-Structured Knowledge Questionnaire – 30 Items)
↓
Structured Teaching Program on EDCs
(PowerPoint Presentation + Charts + Interactive Discussion)
↓
Interval Period (7 Days)
↓
Post-test Assessment
(Same Knowledge Questionnaire)
↓
Compilation and Coding of Data
↓
Statistical Analysis and Interpretation

## IV. RESULTS AND INTERPRETATION

Table 1: Frequency and Percentage Distribution of Demographic Variables (n = 30)

| S. No. | Demographic Variables | Category | f | % |
|---|---|---|---|---|
| 1 | Age (years) | 17–18 | 1 | 3 |
| | | 19–20 | 23 | 76 |
| | | 21–22 | 5 | 16 |
| | | 23–24 | 1 | 3 |
| 2 | Family Income (₹) | < 5000 | 1 | 3 |
| | | 5000–10000 | 15 | 50 |

| | | | | |
|---|---|---|---|---|
| | | 10000–15000 | 10 | 33 |
| | | > 15000 | 4 | 13 |
| 3 | Mode of Purchasing | Online | 3 | 10 |
| | | Shopping mall | 7 | 23 |
| | | Pharmacy | 1 | 3 |
| | | Grocery store | 19 | 63 |
| 4 | Experience in Purchasing Household Products | Yes | 22 | 73 |
| | | No | 8 | 27 |
| 5 | Use of Near-Expiry Products | Rarely | 14 | 46 |
| | | Always | 5 | 16 |
| | | Frequently | 1 | 3 |
| | | Never | 10 | 33 |
| 6 | Cosmetic Users | Yes | 11 | 36 |
| | | No | 19 | 64 |

Table 1 showed that most of whom were aged 19–20 years (76%). Half of the participants reported a family income between ₹5,000 and ₹10,000, followed by 33% earning ₹10,000–₹15,000. Grocery stores were the primary mode of purchasing household products (63%), while shopping malls (23%) and online platforms (10%) were less preferred. A majority of respondents (73%) had prior experience purchasing household products. Regarding the use of near-expiry products, 46% reported rare usage, whereas 33% indicated never using such products. Cosmetic usage was reported by 36% of respondents, while 64% did not use cosmetic products.

Table 2: Comparison of Pre-Test and Post-Test Knowledge Scores (n = 30)

| Test | Mean | SD | Mean Difference | t-value | p-value |
|---|---|---|---|---|---|
| Pre-Test | 10.3 | 2.8 | 8.4 | 9.45 | $p < 0.001$ |
| Post-Test | 18.7 | 2.5 | | | |

Table 2, the mean pre-test score was 10.3±2.8, and the mean post-test score was increased as 18.7±2.5. The obtained t-value (9.45) was greater than the table value at the 0.05 level, indicating a highly significant difference between pre-test and post-test knowledge scores.

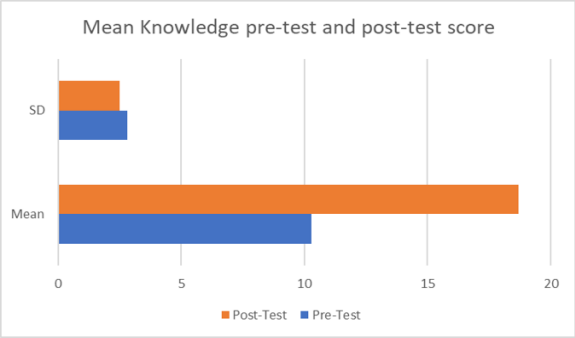


Figure 2: Comparison of Pre-Test and Post-Test Mean Knowledge Scores

## V. DISCUSSION

The findings of the present study demonstrated a marked improvement in the knowledge scores of nursing students regarding Endocrine Disrupting Chemicals (EDCs) following the implementation of the structured teaching program. The increase in post-test scores indicates that planned educational interventions are effective in enhancing awareness and understanding of environmental health hazards among nursing students. These findings suggest that structured teaching can serve as a valuable strategy for promoting environmental health literacy and preparing future nurses to address emerging public health concerns.

The results of the present study are consistent with the findings of Meenakshi and Rajalakshmi (2018), who reported a 45% increase in post-test knowledge scores among nursing students following an educational session on endocrine-disrupting chemicals. Their study concluded that structured educational interventions significantly improve students' awareness and understanding of environmental health issues.

Similar findings were reported by Sharma and Kaur (2019), who found that a planned teaching program on environmental hazards significantly enhanced knowledge levels among undergraduate nursing students, emphasizing the importance of incorporating environmental health concepts into nursing education. Likewise, Patil et al. (2020) observed a statistically

significant increase in knowledge scores after a video-assisted teaching program on chemical hazards among healthcare students, demonstrating the effectiveness of audiovisual teaching methods.

The present findings are also supported by WHO (2013), which emphasized that exposure to endocrine-disrupting chemicals poses serious risks to reproductive, developmental, neurological, and metabolic health. The report highlighted the need for strengthening awareness and educational initiatives among healthcare professionals to reduce exposure and promote preventive practices.

Furthermore, the joint report by World Health Organization (WHO) and United Nations Environment Programme (UNEP) (2013) entitled State of the Science of Endocrine Disrupting Chemicals emphasized that healthcare professionals, including nurses, should be equipped with adequate knowledge regarding the sources, health effects, and preventive measures related to EDC exposure. The report recommended integrating environmental health education into professional training programs to enhance public awareness and disease prevention.

The findings are also in agreement with Diamanti-Kandarakis et al. (2009), who reported that endocrine-disrupting chemicals are associated with various adverse health outcomes, including infertility, obesity, diabetes, thyroid dysfunction, and developmental abnormalities. The authors stressed the importance of educating healthcare providers to facilitate early recognition and prevention of environmental health risks.

Similarly, Gore et al. (2015), in the Endocrine Society's Scientific Statement, concluded that increasing awareness among healthcare professionals is essential for reducing exposure to endocrine disruptors and minimizing their impact on human health. Their report emphasized that educational interventions are a key component in improving preventive healthcare practices.

The findings of the present study are further supported by Zoeller et al. (2012), who highlighted that nurses and other healthcare professionals play a crucial role in disseminating information regarding endocrine disruptors and promoting healthy lifestyle practices. Increased awareness among nursing students can contribute to better patient education and community health promotion.

The significant improvement in knowledge observed in the present study underscores the necessity of integrating environmental health and endocrine-disrupting chemical education into nursing curricula. As frontline healthcare providers, nurses are uniquely positioned to identify environmental risk factors, educate individuals and communities, and advocate for safer practices. Enhanced knowledge will enable nurses to actively participate in health promotion, disease prevention, and policy development aimed at reducing exposure to harmful chemicals.

Moreover, the findings indicate that structured teaching programs, supplemented with audiovisual aids and interactive discussions, are effective educational approaches for improving environmental health literacy. Strengthening nursing education in this area will contribute to the development of environmentally conscious healthcare professionals capable of addressing contemporary public health challenges.

## VI. NURSING IMPLICATIONS

Implications and Recommendations of the Study

1. Nursing Education

The findings of the study emphasize the need to strengthen environmental health content in nursing curricula. Structured modules on Endocrine Disrupting Chemicals (EDCs) and their health consequences should be incorporated into undergraduate and postgraduate nursing programs. Topics such as sources of EDC exposure, associated reproductive and metabolic disorders, preventive strategies, and environmental sustainability should be included. Interactive teaching methods, including case studies, simulation exercises, seminars, workshops, and audiovisual aids, can enhance students' understanding and promote active learning. Periodic continuing education programs and in-service training should also be organized to keep nursing students and practicing nurses updated on emerging environmental health issues.

2. Nursing Practice

Nurses play a pivotal role in promoting environmental health and preventing disease. The knowledge gained through structured teaching programs can enable nurses to educate individuals, families, and

communities regarding the harmful effects of EDC exposure. Nurses should provide health education on:

- Safe use and storage of plastics and consumer products.
- Avoidance of excessive exposure to pesticides, cosmetics, and industrial chemicals.
- Selection of environmentally friendly products.
- Adoption of healthy lifestyle practices that minimize chemical exposure.

Community health nurses can integrate awareness programs on environmental hazards into school health services, maternal and child health programs, and public health campaigns. By acting as health educators and advocates, nurses can contribute significantly to disease prevention and health promotion.

3. Nursing Administration

Nursing administrators and educational leaders should encourage the integration of environmental health principles into institutional policies and practices. Clinical and academic institutions should establish guidelines for minimizing exposure to hazardous chemicals and promoting safe environmental practices. Administrators can:

- Organize continuing nursing education (CNE) programs, workshops, and seminars on environmental health.
- Facilitate access to updated educational resources and evidence-based guidelines.
- Encourage interprofessional collaboration among nurses, physicians, environmental scientists, and public health experts.
- Promote environmentally sustainable practices within healthcare institutions.
- Develop policies that support environmental safety and occupational health for healthcare personnel and patients.

Such administrative initiatives can enhance awareness and ensure the provision of environmentally responsible healthcare services.

4. Nursing Research

The present study provides a foundation for further research in the area of environmental health and endocrine-disrupting chemicals. Future studies are recommended to:

- Assess the long-term retention of knowledge following structured teaching programs.
- Evaluate changes in attitudes and behavioral practices related to reducing EDC exposure.
- Conduct comparative studies using different educational interventions such as video-assisted teaching, e-learning modules, and simulation-based training.
- Explore the effectiveness of awareness programs among different populations, including adolescents, pregnant women, healthcare workers, and community members.
- Undertake studies with larger sample sizes and diverse settings to improve the generalizability of findings.
- Investigate the relationship between environmental health literacy and health outcomes.
- Examine the impact of educational interventions on community awareness and preventive behaviors.

Continued research in this field will contribute to evidence-based nursing practice and support the development of effective strategies for minimizing exposure to endocrine-disrupting chemicals and promoting environmental health.

## VII. RECOMMENDATIONS

1. Conduct similar studies with larger sample sizes and in different geographical regions to improve the generalizability of the findings.
2. Employ comparative and experimental research designs to evaluate the effectiveness of various teaching strategies and educational interventions.
3. Develop multimedia and technology-based learning modules to enhance awareness regarding Endocrine Disrupting Chemicals (EDCs).
4. Extend the study to diverse populations, including community health workers, school teachers, healthcare professionals, and the general public.
5. Undertake longitudinal studies to assess long-term knowledge retention and behavioral changes following educational programs.
6. Explore the relationship between knowledge, attitudes, and preventive practices related to EDC exposure among different age groups and vulnerable populations.
7. Conduct qualitative and interdisciplinary research to understand perceptions, barriers, and the role of

healthcare professionals in environmental health promotion.

8. Evaluate the impact of community-based awareness programs and policy initiatives on reducing exposure to endocrine-disrupting chemicals and improving environmental health literacy.

## VIII. CONCLUSION

This study demonstrated that a structured educational intervention significantly improved the knowledge of nursing students regarding endocrine disrupting chemicals. Before the intervention, the majority had only a basic understanding of EDCs; after the session, there was a marked rise in comprehension of sources, effects, and preventive measures. Given the increasing exposure to environmental toxins globally, nursing professionals must be empowered with scientific knowledge to mitigate chemical hazards. By integrating EDC awareness into nursing education, future nurses can serve as change agents—spreading awareness, advocating for policy reform, and promoting eco-friendly lifestyles in the community.
Thus, this study not only emphasizes the effectiveness of educational programs but also underlines the vital role of nurses in environmental health promotion and sustainable public health development.

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