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Effect of Education Sessions About Plastic Usage Hazards and Its Safe Disposal on Knowledge and Reported Practice of Female Employees at Port Said University: A Pre–Post Intervention Study

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Abstract

Background: Plastic is a major environmental hazard that poses potential threats to ecosystems and human health. Improper use and disposal of plastics contribute to pollution and health risks. Health education plays a crucial role in enhancing knowledge and promoting safe disposal practices. This study aimed to assess the effect of educational sessions about plastic usage hazards and safe disposal on the knowledge and reported practices of female employees at Port Said University.

Methods: A quasi-experimental design was conducted among female employees at Port Said University, Egypt. A purposive sample of 130 women from six randomly selected faculties participated. Data was collected before and after the intervention using a structured questionnaire assessing knowledge of plastic hazards and reported disposal practices. Statistical analysis was performed using SPSS version 26, applying paired t-tests and chi-square tests to compare pre- and post-intervention results. The study followed the STROBE guidelines.

Results: Before the intervention, only 33.1% of participants demonstrated adequate knowledge of the hazards associated with plastic use, which increased to 38.5% after the educational program. Regarding reported practices, 43.1% of participants exhibited moderate behavior prior to the intervention, which improved to 65.4% post-intervention. Statistical analysis revealed a significant improvement in overall knowledge and reported practice scores after the program ($P < 0.05$). Additionally, a significant positive correlation was found between knowledge and reported practices regarding plastic usage ($P < 0.001$), indicating that increased awareness was associated with safer disposal practices.

Conclusions: Educational sessions significantly improved female employees' knowledge and reported practices regarding plastic usage hazards and safe disposal. Workplace health education is an effective strategy for promoting environmental awareness and encouraging safer waste management behaviors. These findings support the integration of structured educational interventions in occupational health programs.

Keywords : Educational session, Plastic usage hazards, Reported practices, Safe disposal, Women's knowledge

Trial registration:
Not applicable.

Background

Plastics are synthetic polymers produced through complex chemical processes, making them non-biodegradable and environmentally persistent. They are extensively used in the manufacturing of everyday items such as food containers, water bottles, toys, clothing, and packaging materials due to their strength, light weight, affordability, flexibility, and versatility. However, many plastics contain hazardous additives, including phthalates, perfluorinated compounds, and bisphenol A (BPA), which have been linked to serious health effects such as endocrine disruption, reproductive disorders, respiratory allergies, and certain cancers [1].

Global plastic production has continued to rise, reaching approximately 400 million metric tons in 2022, with over 350 million tons of plastic waste generated annually. Egypt's plastic industry is among the fastest growing in Africa, expanding at an estimated rate of 10% per year, with around 5 million tons of plastic produced annually between 2022 and 2023 [2]. The persistence of plastics in the environment contributes to long-term pollution, the release of toxic substances, and adverse impacts on both ecological and human health.

Plastics also contain additives such as plasticizers, dioxins, and heavy metals, which enhance flexibility and durability but pose major health risks. These substances are commonly found in household products such as plastic wraps, toys, and food containers. Continuous exposure has been associated with hormonal imbalance, reproductive complications, metabolic disorders, and malignancies [3].

Despite these dangers, public awareness of the health and environmental hazards of plastics remains insufficient. Studies in Egypt show that many individuals have limited knowledge and unsafe practices regarding plastic use and disposal, even though they express positive attitudes toward reducing plastic dependency. Plastic waste—especially plastic bags—contains harmful substances such as lead, cadmium, and mercury, which can accumulate in the body through long-term exposure [4]. This highlights the urgent need for public education to encourage safe consumption and proper waste disposal practices.

Women, particularly working mothers, play a vital role in managing household plastic waste because they are typically responsible for daily activities such as shopping, food storage, and waste disposal. In Egyptian households, women continue to be the primary decision-makers in domestic environmental management [5].

Health education is therefore essential to improving women's knowledge, attitudes, and practices concerning the safe use and disposal of plastics. Community health nurses play a pivotal role in providing structured educational programs aimed at reducing plastic waste, encouraging the use of safe alternatives, and promoting environmental and public health [6]. Accordingly, this study aims to assess the effect of educational sessions about plastic usage hazards and safe disposal on the knowledge and reported practices of female employees at Port Said University.

Methods

Study design and settings

This interventional study employed a quasi-experimental one-group pre-post-test design conducted at six randomly selected faculties affiliated with Port Said University, Egypt, during the period from January to April 2025.

Population and sampling

The study population consisted of all female employees working at the selected faculties of Port Said University. A purposive sample of 130 employees who met the eligibility criteria participated in the study. Eligibility criteria included being employed at Port Said University for at least one year and willingness to participate in the educational program. Employees with prior formal training in environmental health or waste management were excluded.

Sampling strategy

A purposive sampling method was used to ensure the inclusion of female employees who are most involved in household plastic waste disposal and who would benefit from the intervention. This approach also facilitated effective program delivery within the practical constraints of the study setting.

Data collection and instrument

In this study, a needs assessment form was developed to evaluate the knowledge and reported practices of female employees regarding plastic usage hazards and safe disposal. Ethical approval and necessary permissions were obtained prior to data collection. Participants were recruited in person at their

workplaces across six selected faculties at Port Said University, and informed consent was obtained before participation.

Data were collected using a structured, anonymous, self-administered questionnaire completed by participants before the intervention and two weeks after completing the educational sessions. The questionnaire was designed based on an extensive review of current literature and relevant guidelines and was validated by a panel of experts in environmental health nursing.

Data Collection Tools

Part I: Personal Characteristics of Women Employees. This part was designed as a demographic questionnaire to collect essential background information from participants regarding plastic hazard usage. It included four items to gather the necessary data to assess the personal characteristics of the studied women employees, including age, educational level, family monthly income, occupation, and marital status. This section provided critical contextual information to examine potential relationships between demographic factors and participants' knowledge and reported practices related to plastic usage hazards. The tool was self-administered, reviewed for clarity by experts, and tested in a pilot study to ensure accuracy and relevance [7].

Tool I: Women Employees' Knowledge Questionnaire (WEKQ) The WEKQ was developed by the researchers after reviewing relevant literature [8] to assess female employees' knowledge regarding plastic hazard usage, methods of household waste disposal, and handling of waste in the household. This tool consisted of two parts. Part I included four items to collect demographic data necessary for the study, including age, educational level, family monthly income, occupation, and marital status. Part II included 27 items covering five domains: hazards of unhealthy plastics (7 items), storing and utilization of plastics (6 items), types and symbols of plastics (8 items), plastics' alternatives (3 items), and methods for reducing plastics hazards (3 items) [9]. The scoring system assigned one point for each correct answer and zero points for incorrect answers, with a total possible score of 27 points. Knowledge levels were classified as inadequate (< 50%), moderate (50%–75%), or adequate (75%–100%) [10]. The tool's validity was confirmed by a panel of seven experts in environmental health nursing, and reliability testing in a pilot study on 10% of the sample yielded a Cronbach's α of 0.91, indicating high internal consistency [11].

Tool II: Reported Practice Questionnaire Regarding Plastic Usage Hazards (RPQ) The RPQ was adapted from Minelgaitė et al. (2019) [12] to

measure female employees' self-reported practices related to plastic hazards. It consisted of 14 items covering waste separation (1 item), waste disposal (1 item), uses of plastics (8 items), and checking before purchasing plastics (4 items) [13]. Each item was rated on a five-point Likert scale (1 = Never, 2 = Very rarely, 3 = Occasionally, 4 = Frequently, 5 = Always). The total score was calculated by summing the item scores and dividing by the number of items to obtain a mean score. Practices were classified as satisfactory if the mean score was ≥ 70% and unsatisfactory if < 70% [14]. The tool's validity was confirmed by seven experts, and reliability testing during the pilot study showed a high Cronbach's α of 0.93, indicating excellent internal consistency [15].

Educational Intervention

Data collection took place over a period of six months, from 1st January to June 2024. The study was divided into four phases: assessment, planning, intervention, and evaluation.

Phase I: Assessment (Pre-Test Phase)

Before implementing the educational intervention, a baseline assessment was conducted to evaluate women employees' knowledge and reported practices regarding plastic usage hazards. The assessment was performed using the *Women Employees' Knowledge Questionnaire (WEKQ)* and the *Reported Practice Questionnaire (RPQ)*. The researcher conducted face-to-face interviews with participants at their workplace, with each interview lasting approximately 20–25 minutes. Data collection in this phase provided baseline measurements of participants' knowledge and practices, ensuring the confidentiality of all gathered information.

Phase II: Planning

During this phase, the researcher developed an educational intervention based on the needs identified in the pre-test assessment and a review of related literature. The intervention was designed to enhance participants' knowledge about plastic usage hazards and safe disposal practices. The educational content was compiled into a structured booklet validated by a panel of environmental health and community nursing experts to ensure accuracy and relevance. The booklet included information on types and symbols of plastics, hazards of unhealthy plastics, safe handling, and proper disposal methods, as well as alternatives to plastic use.

Phase III: Implementation

The educational sessions were conducted at Port Said University across the six faculties included in the study. Participants were divided into small groups of 12–15 employees to facilitate interactive learning. Each group attended three structured training sessions weekly over a period of four weeks. Each session lasted approximately 45–60 minutes and included diverse teaching methods such as posters, instructional videos, demonstrations, and distribution of the validated booklet. Sessions began with a brief review of previous content, followed by discussions on the day's objectives, practical demonstrations, and opportunities for participants to ask questions and clarify concepts. Active participation and engagement were encouraged throughout the sessions.

Phase IV: Evaluation (Post-Test Phase)

Immediately following the completion of the educational sessions, post-test data were collected using the same tools as in the pre-test phase. Comparative analysis of pre- and post-intervention scores was conducted to evaluate the effectiveness of the educational program in improving women employees' knowledge and reported practices regarding plastic usage hazards and safe disposal.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 23.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the data: categorical variables were expressed as frequencies and percentages, while continuous variables were presented as means, standard deviations, medians, and ranges. The normality of continuous data was assessed using the Kolmogorov–Smirnov test, with a p-value greater than 0.05 indicating normal distribution.

For comparisons between pre- and post-intervention phases, the Chi-square test was applied for categorical variables, while McNemar's and Marginal Homogeneity tests were used to evaluate within-subject changes in knowledge and reported practices. Paired t-tests were employed for continuous variables that met normality assumptions. Pearson's correlation coefficient was calculated to examine the relationship between women employees' knowledge scores and their reported practice scores regarding plastic usage hazards and safe disposal. The significance level of $p < 0.05$ was considered statistically significant for all analyses. The results were presented in tables and figures to facilitate interpretation and discussion.

Results

Demographic Characteristics of Women Employees

Table 1 presents the demographic characteristics of the 130 women employees included in the study. The mean age was 40.88 ± 5.85 years, with 36.9% aged between 36 and 40 years. All participants were female; the majority were married (66.9%) and held a university degree (92.3%). Nearly all (97.7%) reported their monthly income as insufficient. The main sources of information regarding plastic usage hazards were mass media (29.2%) and health workers (26.2%). Most participants were affiliated with the Faculty of Specific Education (26.2%), and dust bin disposal was the predominant waste management method (93.1%).

Knowledge Enhancement Through Educational Intervention

Figure 1 demonstrates a significant improvement in participants' knowledge regarding the hazards of plastic use following the educational intervention. The proportion of participants with adequate knowledge (≥75%) increased from 23.1% in the pre-test to 38.5% in the post-test. Those with inadequate knowledge (<50%) decreased from 23.1% to 11.5%, while participants with moderate knowledge (50–75%) declined slightly from 53.8% to 50%.

Table 2 further details the knowledge gains across specific subdomains. Knowledge of general hazard aspects increased from 61.5% to 84.6% ($p = 0.001$). Moreover, the understanding of the impacts on human beings and human health improved from 69.2% to 92.3% ($p < 0.001$) and from 65.4% to 84.6% ($p = 0.045$), respectively. Similarly, awareness of the impacts on coastal regions and coastal ecosystems rose from 58.5% to 81.5% ($p = 0.004$) and from 46.2% to 76.9% ($p < 0.001$). In addition, knowledge of environmental and animal impacts increased from 50.0% and 57.7% to 80.8% and 84.6%, respectively ($p \leq 0.002$). Furthermore, awareness of preventive actions improved substantially from 38.5% to 69.2% ($p < 0.001$). Overall, the total knowledge score increased significantly from 65.4% to 84.6% ($p = 0.006$).

Enhancement of Behavioral Practices Through Educational Implementation

Table 3 shows a significant improvement in participants' behavioral practices related to plastic usage hazards following the educational program. Positive practices, such as minimizing plastic use and adopting safe disposal methods, increased notably in the post-intervention phase compared with the pre-intervention phase. Conversely, negative behaviors, including frequent use

of single-use plastics and improper disposal, decreased significantly. Statistical analysis confirmed a significant difference between phases ($p \leq 0.05$).

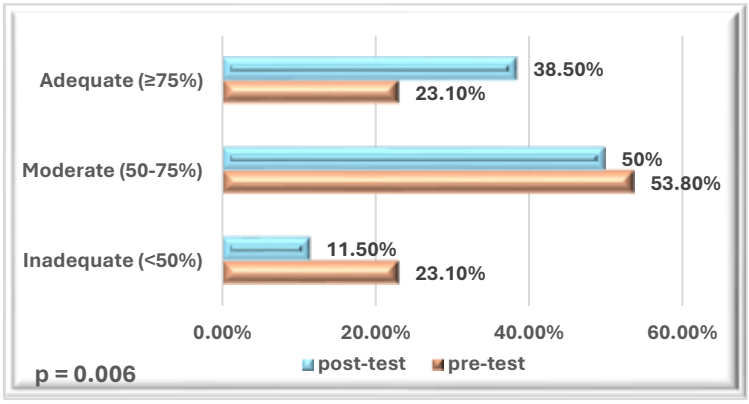
Effect of the Educational Intervention on the Correlation Between Knowledge and Behavioral Practices

Table 4 presents the correlation between women employees' knowledge and their behavioral practices regarding plastic usage before and after the educational intervention. Prior to the intervention, a statistically significant weak positive correlation was observed ($r = 0.215$, $p = 0.045$), indicating that higher knowledge levels were modestly associated with more favorable behavioral practices. After the structured educational intervention, this correlation increased to a moderate and highly significant level ($r = 0.425$, $p < 0.001$),

Table 1: Distribution of the studied women based on their socio-demographic characteristics (n = 130)

Variables	No.	%
Age		
25<30	11	8.5
31<35	4	3.1
36<40	48	36.9
41<45	28	21.5
≥ 45	39	30.0
Mean ± SD	**40.88± 5.85**	
Gender		
Female	130	100.0
Marital status		
Single	13	10.0
Married	87	66.9
Divorced	19	14.6
Widowed	11	8.5
level of education		
Illiterate	1	0.8
Diploma education	9	6.9
University education	120	92.3
Monthly income		
Enough	3	2.3
Not Enough	127	97.7
Source of information		
Mass Media	38	29.2
Health Worker	34	26.2
From relative	31	23.8
No previous knowledge	27	20.0
Name of faculty		
Faculty of Specific Education	34	26.2
Faculty of Education	25	19.2
Faculty of Arts	21	16.2
Faculty of Information Technology	22	16.9
Faculty of Sciences	16	12.3
Faculty of Rights	12	9.2
Method of waste disposal		
Open land	1	0.8
Dust bin	121	93.1
Burning	8	6.2

N: Number; SD, Standard deviation.



F: F test (ANOVA) with repeated measures p: p-value for comparing the studied periods. *: Statistically significant at p ≤ 0.05

Figure 1: Total score of women's knowledge regarding common hazards of plastic use in pre- and post-program phases (n = 130)

Table 2: Overall score of women's knowledge regarding common hazards of plastic use in pre- and post-program phases (n = 130)

Behavioral Practices	Pre-Test		Post-Test		p-value
	No.	%	No.	%	
Positive Behavior (≥ 49)	14	10.8	35	26.9	< 0.001*
Moderate Behavior (21-49)	56	43.1	85	65.4	< 0.001*
Negative Behavior (≤ 21)	60	46.2	10	7.7	< 0.001*

Variables	Pre		Post		P-value
	No.	%	No.	%	
General aspects of the hazards of plastic use					
General aspects	*80*	*61.5*	*110*	*84.6*	*0.001***
Other hazards of plastic use					
Impact on human beings	*90*	*69.2*	*120*	*92.3*	*<0.001****
Effects on human health	*85*	*65.4*	*110*	*84.6*	*0.045**
Impact on coastal regions	*76*	*58.5*	*106*	*81.5*	*0.004***
Effects on Coastal Ecosystems	*60*	*46.2*	*100*	*76.9*	*<0.001****
Environmental impact	*65*	*50.0*	*105*	*80.8*	*0.002***
Impact on animals	*75*	*57.7*	*110*	*84.6*	*<0.001****
Prevention Measures					
Preventive actions	*50*	*38.5*	*90*	*69.2*	*<0.001****
Overall knowledge	*85*	*65.4*	*110*	*84.6*	*0.006*

p: p-value for comparing the studied periods.
***: Statistically significant at p ≤ 0.05**

Table 3: Overall score of women's behavior regarding plastic usage hazards in pre- and post-program phases (n = 130)

(*) Negative statement.
p: p-value for comparing between pre and post.
*: Statistically significant at p ≤ 0.05.

Table 4: Correlation Between Women's Knowledge and Their Behavioral Practices Regarding Plastic Usage (n = 130)

Behavioral Practices	Knowledge	
	Pre-Test	Post-Test
R	0.215	0.425
P	0.045	< 0.001*

r: Pearson *: Statistically significant at p ≤ 0.05

Discussion

Educational interventions are structured processes designed to enhance awareness and promote positive behavioral change through organized learning experiences. In the present study, the structured educational program proved effective in improving women employees' knowledge and behavioral practices regarding the hazards of plastic use. The significant post-program improvement underscores the value of structured health education in fostering environmental awareness and encouraging responsible plastic practices.

The demographic findings showed that most participants were middle-aged, married, and university-educated women. These characteristics may have positively influenced their engagement and receptivity to the educational content. Similar demographic patterns have been reported in previous studies, where higher educational attainment and life experience were associated with greater responsiveness to health education [**16, 17**]. Nearly all participants reported insufficient income, which could limit their ability to purchase environmentally friendly alternatives to plastic products. This finding emphasizes the importance of integrating low-cost, accessible strategies when designing interventions that promote sustainable behaviors. Furthermore, mass media and health workers were the main sources of information about plastic hazards, confirming that these channels remain essential for disseminating public environmental education [**18**].

The current study revealed a statistically significant improvement in women employees' knowledge regarding the hazards of plastic use following the structured educational intervention. The total knowledge score increased from 65.4% to 84.6% (p = 0.006), with notable gains across all subdomains. These findings indicate the success of the intervention in improving awareness of health, environmental, and preventive aspects associated with plastic usage. The results are consistent with previous studies showing that well-designed educational programs significantly enhance environmental knowledge and awareness among workers and community groups [**19, 20**]. The improvement observed highlights the crucial role of repeated, structured education in reinforcing information retention and motivating individuals to adopt safer and more sustainable practices. Similarly, other studies have reported that targeted interventions strengthen understanding of environmental risks and promote eco-friendly behavior in both workplace and community settings [**21**].

Behavioral findings also demonstrated significant improvement following the educational program. Positive behaviors, such as reducing plastic use and adopting safe disposal methods, increased notably in the post-

intervention phase, while negative behaviors, including frequent single-use plastic consumption and improper disposal, decreased significantly. This behavioral shift demonstrates that enhanced knowledge was effectively translated into practical actions. These results align with the Knowledge Attitude &Practice framework, which suggests that improved knowledge contributes to positive attitudes and, consequently, to better practices [22]. Comparable outcomes were observed in studies by Khan et al. [23] and Sharma & Gupta [24], who reported that structured environmental education effectively fostered sustainable waste management behaviors among workers and students.

Another key outcome of this study was the strengthened relationship between knowledge and behavioral practices following the intervention. Before the program, the correlation was weak but statistically significant (r = 0.215, p = 0.045); after the intervention, it increased to a moderate and highly significant level (r = 0.425, $p < 0.001$). This finding suggests that structured educational interventions not only enhance knowledge and behavior separately but also reinforce the connection between them. The stronger correlation indicates that as participants' understanding improved, their ability to apply that knowledge in daily life also increased. This observation is consistent with previous research showing that integrated, evidence-based education promotes stronger alignment between awareness and behavior [25]. Likewise, similar studies in workplace settings have found that employees exposed to regular environmental training demonstrate a more robust correlation between knowledge, attitude, and practice, reflecting sustained behavioral adaptation [26].

Overall, the findings confirm that structured educational interventions are effective tools for enhancing environmental awareness and promoting behavioral change. Integrating such interventions within workplace health promotion initiatives can strengthen environmental responsibility, encourage safe plastic management, and reduce health and ecological risks associated with plastic pollution.

Study Limitations

Although the study achieved its objectives, several limitations should be acknowledged. First, it was conducted on a relatively small sample drawn from a single institutional setting, which may limit the generalizability of the findings. Second, the use of self-reported data could have introduced response or recall bias. Third, the short follow-up period did not allow for assessing the long-term sustainability of improvements in knowledge and behavioral practices.

Conclusion

The present study demonstrated that a structured educational intervention effectively enhanced women employees' knowledge and behavioral practices regarding the hazards of plastic use. Post-intervention improvements were significant across all knowledge domains and behavioral aspects, with a stronger correlation observed between knowledge and practice. These findings highlight the vital role of targeted health education in promoting environmentally responsible behaviors and reducing plastic-related health and ecological risks. Sustained and institutionally supported educational programs are recommended to reinforce these positive outcomes and foster a culture of environmental sustainability within workplace settings.

Ethics Approval and Consent to Participate

The present study was approved by the Ethics Committee of the Faculty of Nursing, Port Said University, Egypt (Code No. 180; Approval date: January 3, 2025). All procedures were conducted in accordance with the Declaration of Helsinki and the guidelines of the Committee on Publication Ethics (COPE). Participants provided formal informed consent after receiving full information about the study, and they were assured of the confidentiality of their data and their right to withdraw at any stage without any negative consequences.

Consent for Publication

Not applicable.

Data Availability

The datasets generated and analyzed during this study are available from the corresponding author upon reasonable request. Access to the data requires prior approval from the institutional ethics committee and adherence to ethical guidelines, including signing a data-sharing agreement to ensure confidentiality and participant privacy. Data will be shared solely for research purposes and in accordance with applicable institutional and legal regulations.

Competing Interests

The authors declare no competing interests.

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Authors' Contributions

This study is part of the requirements for the PhD degree of SR, Faculty of Nursing, Port Said University. SR was responsible for conceptualization, study design, data collection, formal analysis, and manuscript drafting. MM and GA provided supervision, critical review, and methodological guidance throughout the research process. All authors have read and approved the final manuscript.

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