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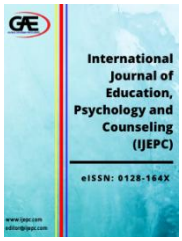

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KNOWLEDGE OF POLYPROPYLENE MICROPLASTICS AS A BREAST CANCER RISK FACTOR AMONG FEMALE EDUCATORS IN NILAI, MALAYSIA

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Abstract:

Breast cancer remains a leading cause of mortality among women worldwide, with emerging research suggesting a potential link between environmental pollutants—such as polypropylene microplastics (PPMPs)—and increased cancer risk. Despite growing concern, public awareness regarding PPMPs as a possible risk factor for breast cancer remains poorly understood, particularly among women in influential educational roles. This study aimed to assess the level of knowledge regarding PPMPs as a breast cancer risk factor among female educators and to examine associations between knowledge levels and demographic variables. A cross-sectional study was conducted among 151 female educators across multiple schools in Nilai, Malaysia, using a self-administered, validated bilingual questionnaire. Data were collected both in-person and online via convenience and snowball sampling. Descriptive and inferential statistics (chi-square test) were used to analyse the relationship between knowledge levels and variables such as age, education, marital status, household income, and health history. Over half of the respondents (52.3%) demonstrated poor knowledge of PPMPs as a breast cancer risk factor. While 72.2% were aware of a possible health risk, only 36.4% correctly identified the inflammatory mechanism associated with PPMP exposure. Significant variability in knowledge was observed across age, race, and income groups. Social media was the most common source of information, while formal education was the least common. The findings show a major lack of awareness and understanding of environmental breast cancer risk factors among educators, highlighting the need for focused education and public health efforts to raise environmental health literacy and support cancer prevention.

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Keywords:

Polypropylene Microplastics, Breast Cancer, Environmental Health, Knowledge Assessment, Female Educators, Malaysia

Introduction

Breast cancer is a significant public health challenge worldwide, affecting millions of women annually. Nearly 300,000 individuals receive invasive breast cancer diagnoses each year in the United States alone, with over half lacking identifiable risk factors such as family history, which accounts for only approximately 10% of cases (Breast Cancer Action, 2021). Breast cancer arises from a multifactorial interplay of genetic, hormonal, and environmental factors (Menon et al., 2024). The disease originates when breast tissue cells grow uncontrollably, forming tumours that can metastasize if untreated. Early detection improves survival prospects significantly (American Cancer Society, 2021).

Several risk factors contribute to breast cancer, including sex, age, estrogen exposure, genetics, and lifestyle. Notably, environmental exposures like chemical contaminants are increasingly considered relevant. Microplastics (MPs)—small plastic particles less than 5mm in diameter—have emerged as ubiquitous environmental pollutants. They originate primarily from the breakdown of larger plastic waste and are found in consumer products like cosmetics, textiles, and packaging (Lombardi et al., 2022). Due to their durability and slow biodegradation, MPs accumulate in ecosystems and enter the human body through ingestion, inhalation, and dermal contact (Park et al., 2023; Lin et al., 2023).

Among MPs, polypropylene microplastics (PPMPs) are a predominant pollutant encountered in daily life (Hu et al., 2021; M Rahim et al., 2021). These particles may carry harmful chemicals, including persistent organic pollutants, heavy metals, and endocrine-disrupting compounds (Lee et al., 2023), which may exert carcinogenic effects. Laboratory studies show that PPMPs can promote breast cancer cell proliferation and inflammatory cytokine secretion, such as IL-6, enhancing cancer progression risk (Park et al., 2023; Enyoh et al., 2020).

Despite growing scientific attention to the health implications of PPMPs, public knowledge remains limited, especially among women in educational roles who can influence community health awareness. This study aimed to assess the level of knowledge of PPMPs as a breast cancer risk factor among female educators in Nilai, Malaysia, and to explore associations between knowledge levels and demographic characteristics. Understanding these gaps is critical for designing effective health education and environmental policies to mitigate risks associated with microplastic exposure.

Literature Review

Microplastics in the Human Body

Microplastics contaminate water, soil, and food chains, and have been detected in human urine, stool, breast milk, and placental tissue (Pironti et al., 2022; Ragusa et al., 2021). This indicates systemic exposure and possible health risks during critical developmental periods (Zolotova et al., 2022; Garai et al., 2024; Abbas et al., 2025).

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Bisphenol A (BPA) as an Endocrine Disruption

BPA is a common plastic additive known as an endocrine-disrupting chemical (Ohore & Zhang, 2019). It mimics estrogen by binding to estrogen receptors, disrupting hormonal balance (Remembryo, 2023). BPA exposure has been linked to DNA damage and breast cancer progression (Hu et al., 2021; Eve et al., 2020).

BPA Desorption and Cancer Metastasis

BPA rapidly desorbs from microplastics under gastrointestinal conditions, especially from PP (Li et al., 2023). Elevated BPA levels have been found in breast tissue of cancer patients, and exposure upregulates genes linked to malignancy (Ishtiaq et al., 2023; Keshavarz-Maleki et al., 2021; Méndez-García et al., 2019). BPA promotes inflammatory cytokines like IL-1β, fostering metastatic environments (Palacios-Arreola et al., 2021).

PPMPs, IL-6 Dysregulation, and Cancer Progression

PPMPs can elevate IL-6, a cytokine associated with tumor progression and poor prognosis (Chen et al., 2022; Park et al., 2023). IL-6 enables tumor cells to evade immunity and enhances breast cancer metastasis (Manore et al., 2022; Hong et al., 2024).

Public Awareness of Microplastics

Studies show low global awareness of microplastic risks (Deng et al., 2020; Ojinnaka & Aw, 2020). Awareness varies by gender, education, and residence, with women and urban populations generally more informed (Oleksiuk et al., 2022). However, even among health-related students, knowledge is limited (Campanale et al., 2020). This underscores the need to improve environmental health literacy among educators.

Methodology

This cross-sectional study targeted female educators at three schools in Nilai, Malaysia. A bilingual self-administered questionnaire assessed demographic data (age, race, education, marital status, residence, income, health history) and PPMPs knowledge (awareness, sources, exposure, health effects). Participants were recruited through convenience and snowball sampling. Initial in-person invitations at SMK Desa Cempaka were followed by online dissemination via QR code to SMK Kompleks KLIA and SK Kompleks KLIA. Based on the Krejcie and Morgan table, the target sample size was 159; 151 valid responses were collected.

Content validity was confirmed by expert panel review, and a pilot test (10% of the target) yielded a Cronbach's alpha of 0.726. Knowledge scores were categorized as good or poor using a 50% cut-off. Ethical approval was obtained from the KPJ Healthcare University Institutional Review Board. Informed consent was secured from all participants. Data were analyzed using SPSS v29.0 with chi-square tests and binary logistic regression; $p < 0.05$ was considered significant.

Results

Of the 151 respondents, the average age was 42 years. The majority were Malay (91.4%), urban residents (83.4%), held a Bachelor's degree (75.5%), and were married (85.4%). Half of the respondents reported household incomes between RM 5,500 and RM 11,800. Approximately 30.5% reported personal health problems, and 29.1% had a family history of cancer.

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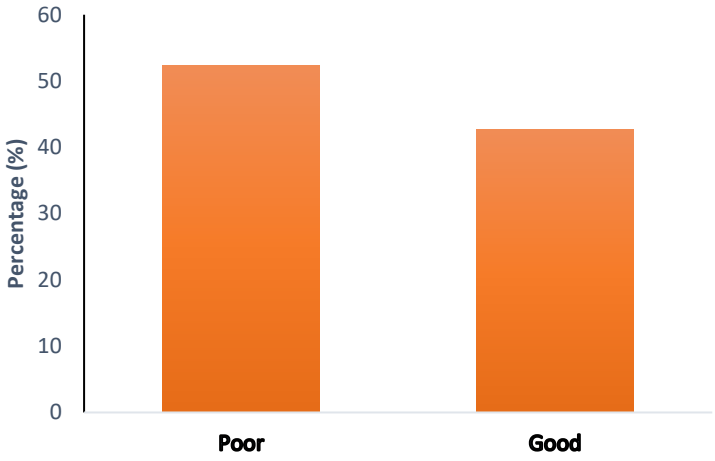

Figure 1.1 PPMPs Knowledge Level of Female Educators (n=151)

Knowledge of PPMPs as a breast cancer risk factor was generally low (Figure 1.1). Over half (52.3%) demonstrated poor knowledge, with only 42.7% showing good knowledge. Less than half (47%) had heard of PPMPs, most commonly through social media (32.5%) (Figure 1.2). Awareness of exposure routes, such as via seafood (29.1%) and PPMP presence in breast milk (15.9%), was limited. While 72.2% recognized PPMP exposure as a potential health risk, only 36.4% correctly identified the inflammatory protein production mechanism linking PPMPs to breast cancer (Table 1.1)

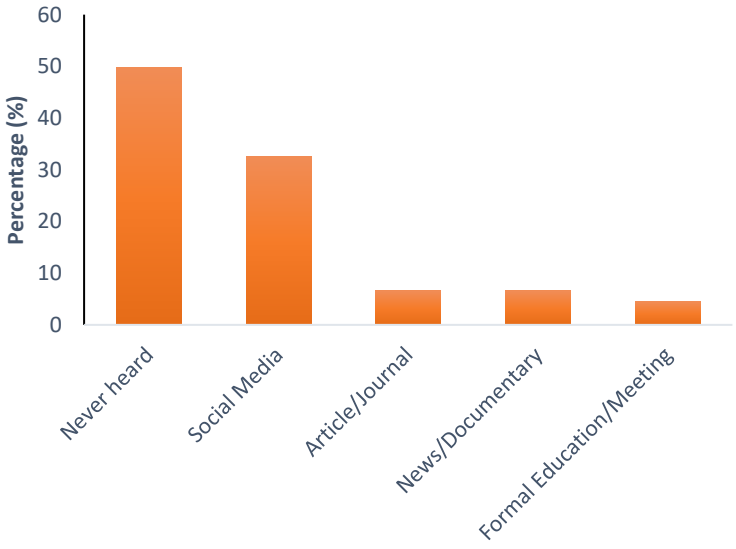

Figure 1.2 Sources of Information (n=151)

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Table 1.1 Knowledge Of Respondents (n=151)

	n (%)
Have you heard of PPMPs?	
Yes	71 (47)
No	80 (53)
Where did you hear PPMPs from?	
Never heard	75 (49.7)
Social Media	49 (32.5)
Article/Journal	10 (6.6)
News/Documentary	10 (6.6)
Formal Education/Meeting	7 (4.6)
Where can PPMPs be found?	
In paint and coating materials	3 (2.0)
In food and beverage packaging	76 (50.3)
In food and beverage packaging, in paint and coating materials	13 (8.6)
In cleaning and cosmetic products	9 (6.0)
In cleaning and cosmetic products, in paint and coating materials	1 (0.7)
In cleaning and cosmetic products, in food and beverage packaging	33 (21.9)
In cleaning and cosmetic products, in food and beverage packaging, in paint and coating materials	16 (10.6)
Did you know that MPs enter the human food system through seafood and other products?	
Yes	44 (29.1)
No	107 (70.9)
Did you know that PPMPs have been found in breast milk?	
Yes	24 (15.9)
No	127 (84.1)
Did you know that exposure to PPMPs may lead to health risks such as breast cancer?	
Yes	109 (72.2)
No	42 (27.8)
How can PPMPs increase the risk of breast cancer?	
By altering the level of Vitamin D in the body.	1 (0.7)
By increasing the production of a type of protein related to the inflammation process.	55 (36.4)
By increasing the production of a type of protein related to the inflammation process, by altering the level of Vitamin D in the body.	1 (0.7)
By causing direct damage to healthy cells through physical contact.	31 (20.5)
By causing direct damage to healthy cells through physical contact, it alters the level of Vitamin D in the body.	1 (0.7)

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By causing direct damage to healthy cells through physical contact, it increases the production of a type of protein related to the inflammation process.	2 (1.3)
By causing direct damage to healthy cells through physical contact, it blocks blood flow to the breast tissue.	4 (2.6)
It causes direct damage to healthy cells through physical contact, by blocking blood flow to breast tissue, and by increasing the production of a type of protein related to the inflammation process.	2 (1.3)
By causing direct damage to healthy cells through physical contact, by blocking blood flow to breast tissue, by increasing the production of a type of protein related to the inflammation process, and by altering the level of Vitamin D in the body.	1 (0.7)
By blocking blood flow to breast tissue.	47 (31.1)
By blocking blood flow to breast tissue, it increases the production of a type of protein related to the inflammation process.	6 (4.0)
I believe that the physical effects of PPMPs on breast cells strongly promote cancer development.	
Strongly Disagree	2 (1.3)
Disagree	0 (0.0)
Neutral	44 (29.1)
Agree	63 (41.7)
Strongly Agree	42 (27.8)
Based on my knowledge of PPMPs as a risk factor for breast cancer, I would assess it as:	
Very Low	2 (1.3)
Low	9 (6.0)
Neutral	45 (29.8)
High	62 (41.1)
Very High	33 (21.9)

Based on Table 1.2, Chi-square analysis revealed a statistically significant association between race and knowledge level (p = 0.019), with Chinese and Indian respondents showing higher knowledge levels than Malays and others. However, no significant associations were found for age (p = 0.900), education (p = 0.676), marital status (p = 0.966), living place (p = 0.2), household income (p = 0.650), personal health history (p = 0.494), or family cancer history (p = 0.715). Binary logistic regression confirmed that none of the demographic or health variables were significant predictors of knowledge.

Table 1.2 The Associations and Corresponding p-values For Each Variable Examined.

Variables	Good n(%)	Poor n(%)	p-value
Race			
Malay	64 (88.9)	74 (93.7)	0.019
Chinese	2 (2.8)	0 (0.0)	

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Indian	6 (8.3)	1 (1.3)
Others	0 (0.0)	4 (5.1)

Discussion

This study highlights low awareness of PPMPs as a breast cancer risk factor among female educators, consistent with global findings of limited public knowledge about microplastics (Deng et al., 2020; Omoyajowo et al., 2021). Social media's prominence as an information source indicates both its outreach potential and risk of misinformation. The significant race difference may reflect cultural or linguistic factors affecting access to environmental health information.

The homogeneity of the sample (mainly Malay, urban, and highly educated) likely limited variability, explaining why most demographic factors showed no association. Broader and more diverse samples are needed to clarify population-level patterns.

Conclusion

Knowledge of PPMPs as a breast cancer risk factor among female educators in Nilai was generally low. Although many were aware of potential health risks, understanding of exposure routes and biological mechanisms was poor. Social media was the main source of information, while formal education contributed minimally.

Implications: There is an urgent need for targeted educational programs and public health campaigns to enhance environmental health literacy, especially among educators who can disseminate knowledge widely.

Limitations: The sample was small, localized, and demographically homogeneous. Self-reported data may involve response bias.

Recommendations: Future research should involve larger, more diverse samples and evaluate the effectiveness of educational interventions on PPMP awareness and behavior change.

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