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Assessing Household Awareness of Indoor Air Pollution in Cagayan de Oro City: Implications for Health Promotion

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Abstract

Background & Aim: Indoor air pollution is a significant health threat, yet public awareness remains low, particularly in regions like the Philippines. This study assessed household awareness of indoor air pollution sources in a barangay in Cagayan de Oro City. Using the Health Promotion Model by Nola Pender and the Environmental Theory by Florence Nightingale, to understand factors influencing awareness and inform health programs. **Methods & Materials:** This study used a descriptive correlational design to explore how demographic factors influence awareness of indoor air pollution sources in a barangay in Cagayan De Oro City. Surveys, translated into the local language and validated through pilot testing, were administered to 264 randomly selected respondents. Statistical analyses, including T-tests and ANOVA, were conducted to assess associations between demographic variables and awareness levels. **Results:** Significant differences were observed in respondents' awareness levels of indoor air pollution sources across age groups, with middle-aged individuals demonstrating the highest awareness. Females exhibited consistently higher awareness compared to males across all pollution sources. Educational attainment influenced awareness levels, with postgraduates showing the highest awareness. **Conclusion:** The study revealed significant correlations between demographic factors and respondents' awareness of indoor air pollution sources. Age, gender, and educational attainment influence awareness levels, motivating individuals to prioritize proper ventilation for health preservation. These findings underscore the importance of informed action in mitigating indoor air pollution risks and promoting healthier indoor environments. **Recommendation:** Clinical practitioners should prioritize health education programs targeting middle-aged individuals, females, and those with higher educational attainment levels emphasizing the importance of proper ventilation practices for health preservation and promoting healthier indoor environments in communities.

Keywords: indoor air pollution, awareness, health promotion

INTRODUCTION

Air pollution presents a dangerous threat to well-being, especially in the context of the Filipino people. It was the contamination of the outdoor or indoor environment by hazardous substances, whether physical, chemical, or biological agents, altering the natural state of the atmosphere (1). The outdoor was more publicized and associated with pollution in the general public's perception. However, indoor air pollution, a less recognized threat, also jeopardizes well-being, considering that almost 90 percent of an individual's life is spent indoors—whether in a person's house, a shopping mall, or at school (2).

Indoor or household air pollution refers to pollutants in a confined space that harm the human body (2). Indoor air pollution was a significant hazard to human health, claiming millions of lives each year, with the World Health Organization (WHO) in 2020 attributing it to 3.2 million mortalities annually. The sources of indoor air pollution were classified and summarized into natural and human activities (3), with pollutants originating from dust, dirt, or gases in the air inside buildings, not limited to an individual's home or workplace. Exposure to such pollutants was linked to various diseases (4).

Recognizing and mitigating pollutants to enhance indoor air quality is crucial for reducing the risk of diseases (2). This research aimed to assess the awareness of indoor air pollution among households in a barangay in Cagayan de Oro City, focusing on sources of indoor air pollutants: physical, chemical, and biological. Additionally, it sought to provide data to inform health programs addressing indoor air pollution and to enhance community knowledge on the subject. The researchers, influenced by factors such as the 2020 COVID pandemic that confined people indoors, were prompted by their own experiences with indoor air pollutants to delve deeper into the topic.

In this study, the Health Promotion Model by Nola Pender (5) and the Environmental Theory by Florence Nightingale (6) were utilized. These theories provide the framework for understanding individuals' awareness of indoor air pollution sources. The Health Promotion Model elucidates the factors motivating individuals to adopt health-promoting behaviors, including personal factors like biology, psychology, and sociocultural influences, as well as situational influences (5). These factors interact to prompt health-promoting behaviors, aiming for positive health outcomes such as well-being and productive living.

Two types of factors from Pender's model—personal and situational—were identified as influencing awareness levels (5). Personal factors encompassed biological (e.g., age, sex) and sociocultural factors (e.g., education, socio-economic status), while situational influences related to the medium of information available to individuals, shaping their perceptions. These factors influenced awareness of indoor air pollution sources and subsequent behaviors.

Moreover, the Environmental Theory emphasizes manipulating the physical environment to maintain health (6). Although Nightingale's theory covers various environmental aspects, this study specifically focused on pure air, emphasizing the importance of proper ventilation to mitigate indoor air pollutants.

The independent variables identified in this study that influenced awareness of indoor air pollution sources included age, sex, education, socio-economic status, and information medium. The research examined awareness levels regarding physical, chemical, and biological sources of indoor air pollution, aiming to discern any significant differences between respondents' profiles and their awareness levels.

METHODS

Design

This study employed a descriptive correlational design, as described by Polit and Beck (7), which investigates the relationship between variables when researchers cannot manipulate a cause. It is essential to understand that correlation does not imply causation, meaning that a connection between two events does not necessarily indicate a cause-and-effect relationship.

The objective of this study was to examine the awareness of households in a barangay in Cagayan De Oro City regarding indoor air pollution sources, considering variables such as age, gender, education, socio-

economic status, and information sources. Survey questionnaires were utilized to gather data and explore correlations among these variables. This research design was deemed suitable for the study as it facilitated the examination of relationships between independent and dependent variables and provided a systematic approach to data collection.

Sample, sample size & sampling technique

The study aimed to evaluate households' awareness of indoor air pollution sources in a specific barangay in Cagayan de Oro City. Respondents were selected through simple random sampling from households within the barangay, with each household represented by one respondent. Inclusion criteria encompassed individuals aged between 18 to 55 years, of any gender, with educational attainment ranging from primary school to postgraduate level, belonging to various socio-economic classes, and having access to information mediums such as health professionals, family, social media, search engines, print media, broadcast media, and out-of-home media. Exclusion criteria included respondents with mental disabilities, illiteracy, or those unwilling to sign the informed consent form.

According to Polit and Beck (7), Simple Random Sampling is the most straightforward probability sampling design, involving the creation of a sampling frame, a list of elements from which the sample will be selected. The researchers employed Simple Random Sampling, facilitating the random selection of respondents with an equal and independent chance. With 834 families currently residing in the barangay, the Cochran formula was utilized to determine the sample size, considering the required accuracy, confidence level, and anticipated fraction of the population's aspect. After obtaining the list of individuals from the 834 households, the researchers organized them alphabetically by family name and assigned consecutive numbers from 1 to 834. They randomly selected 264 slips of paper from a bowl. This approach ensured a fair and unbiased representation of the population, with each individual having an equal probability of being selected as a respondent for the study.

Data collection process

Prior to commencing data collection, a formal request for authorization was submitted to the barangay captain seeking approval to conduct the study among households within their jurisdiction. Additionally, a consent letter, appended to the questionnaire, was distributed to potential respondents. This letter furnished them with all necessary details to make an informed decision regarding their participation in the study. This procedural step was imperative to uphold transparency and ethical standards between the researchers and the participants.

The instrument of data collection

The instrument used was a researcher-made questionnaire that underwent a validation process, including an assessment of its reliability using Cronbach's alpha, to ensure it measured what it was intended to measure. The questionnaire was translated into the local language to enhance respondents' comprehension. Pilot testing was conducted with thirty respondents from the adjacent district in the same barangay, ensuring none of the pilot testing samples was included in the survey to avoid biasing the results. The reliability of test scores was then assessed.

The questionnaire utilized in the study was structured into two distinct sections. The initial section gathered demographic data from respondents, encompassing variables such as age, sex, educational attainment, socioeconomic status, and preferred medium of information, totaling five questions. This section utilized a checklist format, enabling respondents to select relevant options based on their specific circumstances. The second section focused on assessing the respondents' knowledge of indoor air pollution sources, consisting of 30 questions. These questions provided examples of indoor air pollutants, prompting respondents to indicate their awareness levels using a four-point Likert scale based on the given statements or questions.

Data analysis

Inferential statistics utilize various analytical techniques to make inferences about population data based on sample data. In this study, both the T-test and F-test, also known as ANOVA, were employed to determine whether the mean differences within groups were statistically significant. The collected data

underwent analysis to ascertain if there existed a notable distinction between independent variables—such as age, gender, education, socio-economic status, and information sources—and dependent variables, which comprised the levels of awareness regarding physical, chemical, and biological sources of indoor air pollution.

Ethical consideration

The research focused on evaluating households' awareness of indoor air pollution sources within a specific barangay. The findings from this study were intended to enhance awareness among respondents and readers alike regarding indoor air pollution sources. After receiving clearance from the Xavier University Research Ethics Board (XU REC Package No. NSG-2023001284) and local barangay officials in Cagayan de Oro City, the researchers proceeded with data collection.

Participation in the study was entirely voluntary, with the research targeting individuals in the working age range of 18 to 55 years. Eligible participants who chose to take part were required to provide informed consent. Prior to data collection, respondents were briefed on the study's purpose and procedures. Researchers communicated key aspects, including the research objective, the voluntary nature of participation, the confidentiality safeguards, and the participants' right to request a copy of the study's findings. This information was conveyed both in written form and orally, ensuring respondents' comprehension and consent.

Results

Table 1 displays the outcomes of the ANOVA analysis concerning respondents' awareness levels of indoor air pollution sources categorized by age groups. The results reveal a significant disparity between respondents' age and their awareness of chemical and biological indoor air pollution sources, leading to the rejection of the null hypothesis. Conversely, there was no notable difference observed between respondents' age and their awareness of physical indoor air pollution sources, resulting in the retention of the null hypothesis.

Examining the data, the age brackets of 34 to 40 and 46 to 50 years old demonstrated the highest awareness of the sources of indoor air pollution. Conversely, among the three sources of indoor air pollution, respondents aged 18 to 22 exhibited the lowest degree of awareness regarding the physical, chemical, and biological sources. This finding suggests that respondents in middle adulthood had a more heightened level of awareness than other mentioned age groups

Table 1. ANOVA Results of Respondent's Level of Awareness on Indoor Air Pollution When Grouped According to AGE

Profile	Level of Awareness on Indoor Air Pollution					
Age	Physical Sources		Chemical Sources		Biological Sources	
	Mean	p-value	Mean	p-value	Mean	p-value
18 - 22 years old	3.10	0.061 ns	2.60	<0.01**	3.02	0.003**
22 - 28 years old	3.29		2.89		3.17	
28 - 33 years old	3.42		3.14		3.37	
33 - 40 years old	3.47		3.28		3.51	
40 - 45 years old	3.26		3.02		3.37	
45 - 50 years old	3.45		3.40		3.56	
50 - 55 years old	3.40		3.07		3.43	

Legend: ns = Not Significant *=Significant **=Highly Significant

Table 2 presents the respondents' awareness levels of indoor air pollution categorized by gender. The results depicted in the table reveal a substantial difference between respondents' gender and their awareness of biological indoor air pollution sources. Additionally, there was a notable distinction observed between respondents' gender and their awareness of physical and chemical indoor air pollution sources. Consequently, the null hypothesis was refuted. Females exhibited higher mean values, indicating a consistently greater knowledge of indoor air pollution sources compared to males across all three

categories. This significant difference suggests that females possess a heightened understanding of identifying items from the various sources contributing to indoor air pollution and its implications for their health in comparison to males

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Table 2. T-test Results of Respondent's Level of Awareness on Indoor Air Pollution When Grouped According to SEX

Profile	Level of Awareness on Indoor Air Pollution					
Sex	Physical Sources		Chemical Sources		Biological Sources	
	Mean	p-value	Mean	p-value	Mean	p-value
Male	3.22	0.017*	2.90	0.030*	3.18	0.003**
Female	3.40		3.11		3.43	

Legend: ns = Not Significant *=Significant **=Highly Significant

Table 3 displays the ANOVA outcomes concerning respondents' awareness levels of indoor air pollution categorized by educational attainment. The findings revealed a significant discrepancy between respondents' educational levels and their awareness of chemical indoor air pollution sources. Additionally, there was a notable difference between respondents' educational levels and their awareness of physical indoor air pollution sources. Consequently, the null hypothesis was dismissed. However, there was no significant difference noted between respondents' educational levels and their awareness of biological indoor air pollution sources. Therefore, the null hypothesis was retained. This outcome suggests that respondents with postgraduate education exhibited the highest awareness of indoor air pollution across various sources, whereas those with primary school education as their highest attainment displayed the lowest level of awareness across all categories of sources.

Table 3. ANOVA Results of Respondent's Level of Awareness on Indoor Air Pollution When Grouped According to educational attainment, socio-economic income, and medium of information

		Level of Awareness on Indoor Air Pollution					
		Physical Sources		Chemical Sources		Biological Sources	
Variable		Mean	p-value	Mean	p-value	Mean	p-value
Educational Attainment	Primary School Graduate (Kinder - Grade 6)	3.23	0.042*	2.53	<0.01**	3.27	0.583 ns
	High School Graduate (Grade 7 - Grade 12)	3.28		2.98		3.32	
	College Graduate	3.46		3.22		3.41	
	Postgraduate (Master's Degree, Doctoral Degree)	3.60		3.53		3.50	
Socio-economic Income	Less than Php 10,957	3.32	0.137 ns	3.01	0.286 ns	3.35	0.423 ns
	Php 10,958 to Php 21,914	3.31		3.05		3.32	
	Php 21,915 - Php 131,484	3.47		3.07		3.35	
	Php 131, 485 - Php 219,140	3.83		3.90		3.93	
	Above Php 219,141	3.80		3.43		3.73	
Medium of Information	Health professionals	3.43	0.503 ns	3.18	0.434 ns	3.51	0.689 ns
	Family & friends	3.09		3.08		3.31	
	Social media (e.g. Facebook, Twitter, Instagram)	3.21		2.85		3.21	
	the Internet (e.g., Google, Internet Explorer, Mozilla Firefox)	3.35		3.05		3.40	
	Broadcast media (e.g. television, radio)	3.37		2.84		3.26	
	Out-of-home media (e.g., billboards, signages outside the home)	3.42		3.48		3.28	

Multiple sources	3.37	3.05	3.35

Legend: ns = Not Significant *=Significant **=Highly Significant

Table 3 also displays the ANOVA findings concerning respondents' awareness levels of indoor air pollution categorized by socio-economic income. The p-values for physical, chemical, and biological sources were all greater than 0.05. This outcome indicates that there was no notable difference in the level of awareness of indoor air pollution sources among respondents when grouped by socio-economic income. Consequently, the hypothesis was upheld. This result suggests that regardless of their household income, respondents exhibited consistent awareness levels regarding the sources of indoor air pollution.

Table 3 also presented the ANOVA results of the respondents' level of awareness of the sources of indoor air pollution when grouped according to the medium of information. The three p-values were all greater than 0.05. The table showed that the level of awareness of indoor air pollution's physical, chemical, and biological sources was the same when grouped according to the medium of information. Therefore, the null hypothesis was not rejected. This outcome implies that regardless of the respondents' source of information, their awareness of the sources of indoor air pollution was influenced by more than just one medium of information.

Discussion

A study conducted by Odonkor and Mahami (8) revealed that respondents aged 40 years old and below exhibited the highest level of knowledge about air pollution and its sources. Conversely, in a study by Sarker et al. (9) focused on people's perception and awareness of air pollution, an inverse relationship between the age of the respondents and their awareness of indoor air pollution was identified. In contrast to the results in the Table 1 above, individuals in the middle adulthood bracket demonstrated the highest awareness, while those in early adulthood exhibited the slightest awareness, indicating a direct relationship between age and awareness. This finding suggests that individuals in the middle adulthood bracket may have accumulated more knowledge and experiences related to indoor air pollution. As the National Institute on Aging (10) noted, older adults possess more extensive vocabularies and excellent knowledge than their younger counterparts. Age can significantly influence an individual's awareness of the negative consequences associated with biological and chemical sources of indoor air pollution, leading to variations in awareness levels across different age groups.

While existing studies suggest that individuals aged 40 years and below tend to have a higher level of awareness, there is insufficient evidence or supporting literature to explain why the age bracket of 18 to 22 years old exhibits a minor level of awareness regarding the sources of indoor air pollution. The effects of age on knowledge levels may exhibit inconsistency due to cultural variations and differences in information acquisition methods across diverse environments (11). Most studies still need to provide adequate explanations for these differences, emphasizing the need for further research to comprehensively explore the relationship between a person's age and their level of awareness regarding the sources of indoor air pollution. Subsequent investigations should delve into this topic within a broader context to enhance understanding of how these factors influence awareness levels and offer valuable insights into indoor air pollution sources.

For physical sources, a study on exposure to indoor air pollution and its perceived impact on the health of women and their children by Maharana et al. (12) found that women correctly perceived indoor air pollution in their households, indicating awareness of the problem and viewing it as a potential health concern. The study also revealed that inhaling fine particles from physical sources, such as indoor smoking, carpet dust, firewood cooking, and mosquito coils, made them susceptible to respiratory tract illnesses like cough, bronchitis, pneumonia, and asthma.

Concerning chemical sources, a significant difference was observed between sex and the level of awareness of indoor air

pollution. According to a study conducted by Tariq et al. (13) on the general population of Rawalpindi and Islamabad, females exhibited a higher awareness of indoor air pollution than males. The study emphasized the respondents' recognition of chemical sources, including pesticides, as contributors to indoor air pollution. Furthermore, the respondents demonstrated awareness of the health constraints associated with indoor air pollution, such as cough, eye irritation, headache, and asthma. In a study conducted by Bala et al. (14) on the assessment of indoor air pollution levels about the energy ladder and its impact on respiratory health, respondents with high exposure to indoor air pollution exhibited symptoms associated with significant respiratory health issues, including headache, cough, shortness of breath, and wheezing.

Concerning biological sources, a highly significant difference was observed between sex and the level of awareness of the respondents regarding biological sources. In a study on women's perceptions of household air pollution by Devakumar et al. (15), researchers found that women acquired experiential knowledge through chores, enabling them to identify sources and health effects of household air pollution. Women's household activities exposed them to biological allergens found in pet dander or hair, droppings of household pests, house dust, pollen from flowering plants, mold from plumbing leaks, and waste bins that carry viruses and bacteria. Additionally, as women are more likely to spend more time at home, they have increased exposure to indoor air pollution sources compared to the opposite sex (16). Research has shown that exposure to biological allergens can cause wheezing, sensitization, respiratory infections, and respiratory allergic disorders. Moreover, indoor exposure to viruses and bacteria contributes to both infectious and noninfectious detrimental consequences on health (2).

According to Odonkor and Mahami (8), as individuals acquire a more advanced level of education, their awareness of indoor air pollution also increases simultaneously. This finding is reflected in the study as it showed that postgraduate respondents had the highest awareness of the physical, chemical, and biological sources of indoor air pollution. On the other hand, respondents who only graduated from primary school showed the slightest awareness of all sources of indoor air pollution. Another study conducted by Sarker et al. (9) established a positive correlation between an individual's educational attainment and their level of awareness towards indoor air pollution. The results of the study and the relevant literature provided are consistent, asserting that the level of education significantly influenced the respondents' capacity to acquire information regarding the sources of indoor air pollution.

Contrary to the results, Esong et al. (17) indicated that low-income households utilized biomass fuels, wood, and coal as main fuel types, which were primary sources of indoor air pollution. Meanwhile, high-income households and educated inhabitants had cleaner and safer household practices. They also had access to clean energy for cooking and heating, leading to fewer sources of indoor air pollution (18). However, a study conducted by Li (19) indicated that individuals living specifically in urbanized areas were highly aware of the effects brought about by air pollution across any income level. This study implies that even if socio-economic factors could impact the ability to address and reduce indoor air pollution, awareness of its sources could exist independently. An individual's income level did not influence whether they had high or low income. However, there needs to be more evidence or literature to back up this claim. Thus, there is a need for additional research to substantiate these results.

According to Rajper et al. (20), information distributed through the Internet, social media, print media, and broadcast media helped educate the public and change perceptions, attitudes, and practices toward reducing air pollution and its sources. Furthermore, the availability and dissemination of information through various channels influenced the awareness of the sources of indoor air pollution. As shown in the results, regardless of how different the mediums of information used by the respondents, as long as they could receive appropriate and valuable information about indoor air pollution, it indeed increased their level of awareness in all three sources. Different mediums catered to different preferences and accessibility needs, ensuring the information was accessible to a broader audience.

Additionally, using multiple mediums allowed for repetition and reinforcement of the message, aiding in internalizing the information. Collectively, these factors contributed to raising awareness effectively and motivating individuals to take action to address indoor air pollution since knowledge and awareness were gained. These results, along with supporting literature backing up this claim, suggested that regardless of the specific medium used, individuals were equally capable of acquiring information about the sources of indoor air pollution.

Conclusion

The study's conclusions were drawn from significant findings regarding age, sex, and educational attainment's impact on awareness of indoor air pollution sources. Age played a predictive role, with advancing age correlating with increased awareness of chemical and biological sources, while females showed higher awareness likely due to their roles in managing households, and higher educational attainment was linked to greater knowledge of indoor air pollution sources. These findings align with the Health Promotion Model and emphasize the importance of education and awareness in motivating individuals to maintain proper ventilation to reduce indoor air pollution. However, the study's narrow focus on demographic factors suggests the need for future research to explore additional influencers, such as cultural beliefs and media exposure, to provide a more comprehensive understanding of indoor air pollution awareness across diverse populations in the Philippines, thus guiding clinical practitioners to prioritize health education programs targeting specific demographic groups and incorporate diverse mediums of information dissemination for effective awareness campaigns.

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