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Assessing Environmental Health Hazard Awareness for Sustainability: A Survey of Adults in Saudi Arabia

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Abstract: Rapid modernization in Saudi Arabia has led to environmental challenges like pollution. Public understanding of pollutants is crucial for public participation in Saudi government efforts to monitor and mitigate impacts. This cross-sectional observational study aimed to assess the awareness and perceptions of environmental pollutants among 817 adults in Saudi Arabia's Jazan region. The online survey identified transportation and industrial emissions as widely recognized hazards, but there were gaps regarding risks like asbestos. Illegal dumping and junk houses were major concerns. Females had 1.86 times higher adjusted odds of concern about outdoor environmental risks compared to males (AOR: 1.86; 95% CI: 1.12–2.84; $p = 0.004$). Participants with high school education or above had significantly increased odds of concern about outdoor hazards, with 4.27 times higher odds for those with high school education (AOR: 4.27; 95% CI: 1.92–9.52; $p < 0.001$) and 3.51 times higher odds for those with university education or above (AOR: 3.51; 95% CI: 1.59–7.72; $p = 0.002$). Self-reported environmental interest was strongly associated with concern about outdoor and indoor air pollution, with 4.89 times higher adjusted odds of concern about outdoor air pollution (AOR: 4.89, 95% CI: 3.02–7.93, $p < 0.001$) and 2.86 times higher adjusted odds of concern about indoor air quality (AOR: 2.86, 95% CI: 2.86–4.47, $p < 0.001$). Overall, Jazan residents display general but incomplete awareness of health hazards, signaling a need for expanded educational efforts to improve consciousness of less visible pollutants. Effective public communication strategies built on these insights can strengthen societal environmental awareness in Saudi Arabia and promote sustainability.

Keywords: environmental health; hazard awareness; risk perception; health literacy; sustainability; Saudi Arabia; education level; communication campaigns; health behaviors

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Citation: Alqassim, A.Y.; Alharbi, A.A.; Muaddi, M.A.; Jurebi, R.M.; Daak, L.I.; Moafa, A.I.; Masmali, M.A.; Salami, R.N.; Zakri, H.Y.; Wafi, A.M.; et al. Assessing Environmental Health Hazard Awareness for Sustainability: A Survey of Adults in Saudi Arabia. *Sustainability* **2024**, *16*, 593. https://doi.org/10.3390/su16020593

Academic Editor: Elena Cristina Rada

Received: 13 December 2023
Revised: 5 January 2024
Accepted: 8 January 2024
Published: 10 January 2024

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1. Introduction

Environmental health has become a global concern, as people are increasingly aware of the impact of environmental factors on public health [1,2]. Environmental health hazards such as noise pollution, radiation, climate change, and air and water pollution contribute to a quarter of all global fatalities [3].

Saudi Arabia has made significant progress in adopting the concept of sustainable development in the recent years [4]. The Presidency of Meteorology and Environment (PME) is the primary public agency in Saudi Arabia with responsibility for environmental

issues [5]. As a result of economic progress, ongoing population growth, fast urban development, and rising demand for water and energy, Saudi Arabia faces several environmental issues. As a result, national efforts are being made to protect the environment and its resources by launching various initiatives and projects, such as the Energy and Environment Research Fund (EERF) project and the Saudi Green Initiative (SGI), because Saudi Arabia is aware of its responsibility for the climate crisis as one of the world's largest oil exporters [6]. One of the primary responsibilities of the General Authority for Meteorology and Environmental Protection in Saudi Arabia is to ensure air quality [5]. The primary national challenge is the preservation of air quality in big cities due to overpopulation in these areas [7]. The enormous number of vehicles in major cities also has an impact on air quality [7]. In Saudi Arabia, exposure to petrol fumes is common at gas stations and auto repair shops [8]. The majority of vehicle workshops and gasoline stations in Jeddah City are open and through way. As a result, their employees are exposed to petroleum vapors, used diesel oil, vehicular exhaust, and other contaminants. Saudi Arabia has experienced tremendous population growth, which has resulted in a significant increase in the number of houses, religious centers, schools, hospitals, hotels, and offices, among others [9]. Moreover, while the quality of ambient air has been a source of debate and concern in the developing world, Saudi Arabia has paid attention to indoor air hazards [10]. The total amount of Saudi Arabian Wastewater production increased from 2125 million cubic meters in 2007 to 2884 million cubic meters in 2018 [11]. Wastewater is treated in a total of 99 wastewater treatment plants. In 2019, the amount of treated wastewater reused amounted to 4.9 million m^3/day, which is equivalent to 17.26% of the total quantities of treated wastewater [12]. In recent years, people in Saudi Arabia have resorted to bottled drinking water compared to public water supplies [13]. This can be primarily due to apprehension concerning contaminants in natural water resources [14]. Sales of drinking water have escalated, further resulting in accessibility of countless brands of drinking water in Saudi Arabia. The standard of drinking water depends on their labelled mineral content, though the majority do not pay enough attention to the current contents [15]. In Saudi Arabia, 80% of its food need is satisfied by imports from other countries due to its low agricultural productivity [16]. Such a situation could cause a significant threat to the national economy, food safety, nutrition, and public health. In addition, food safety in Saudi Arabia confronts a variety of challenges, including a lack of risk analysis training programs, scientific organizations, specialized training programs, and a scarcity of food safety science programs [17].

Previous studies on environmental health awareness in Saudi Arabia have found knowledge gaps among certain demographics [18,19]. A study in Dammam city showed that environmental hazard awareness and empirical data on public understanding of environmental health risks are crucial for achieving the country's sustainability goals [17]. Another study indicated limited understanding of food safety issues among hospital staff [19]. However, research has not focused specifically on hazard awareness in the Jazan region.

The Jazan Economic City (JEC) was launched by the Saudi government in 2006 and includes industries such as a refineries, power plants, and water desalination plants [20]. Groundwater is the only source of drinking water in the area, and its suitability for drinking and domestic use is a public concern. It was found that one well in the area had a nitrate concentration above the permitted level. The lack of a complete piped sewage infrastructure and high agricultural activity in Jazan may also pose a risk of groundwater pollution [21]. The southern province cement company in Alahad, Jazan, is a source of environmental pollution in the area.

This study aims to assess the awareness and perceptions of environmental health hazards among residents in the Jazan region of Saudi Arabia. With growing awareness of environmental health and its impact on public health, it is important to understand the environmental health hazards in the region and take steps to mitigate them. An online survey in the native language was distributed to residents of the Jazan region [19]. The sur-

vey included questions on knowledge of 16 specific environmental pollutants. Participants were selected using statistical sampling methods to obtain a representative sample.

2. Materials and Methods

2.1. Study Design, Settings, and Population

The study design was an observational, cross-sectional, online, self-administered survey targeting a sample of people in Jazan region. The study was conducted among adults aged 18 years or older in Jazan, Saudi Arabia, from April to October 2023. Jazan is one of the 13 provinces of the Saudi Arabian territory. It is located on the south-western border of Saudi Arabia, with more than 1.6 million residents, according to the 2019 census conducted by the Saudi General Authority of Statistics [9].

2.2. Sampling Method and Sample Size

A convenient sampling technique was used to recruit participants. This involved approaching potential participants in public locations across Jazan and inviting them to participate if they met the eligibility criteria. A final sample size of 823 adults was obtained. The formula is developed to calculate a representative sample for proportions and is written as follows: $[n= Z^2_{(1-\alpha/2)} \times P(1 - \mathrm{P})/d^2]$, where n is the initial sample size; p is an anticipated population proportion; Z is the standardized variable that corresponds to 95% confidence level; and d is the desired marginal error. The calculation of the sample size was based on 95% confidence level with ±3.5% precision and anticipated population proportion (P) = 50%, because this is the safest choice for (P) since the sample size is the largest when P = 50%. Moreover, we assumed a non-response rate of 5%.

The sample of this study was highly representative of the larger population in the Jazan region. The gender distribution, age range, educational level, income level, and residential location of the participants closely mirrored the demographic characteristics of the Jazan population as per the 2019 census [9]. This representative sample strengthens the validity and generalizability of our findings to the larger population in Jazan. Further studies could extend this research to other regions in Saudi Arabia to understand the nationwide awareness levels of environmental health hazards.

2.3. Data Collection Instrument

Data were collected using an Arabic self-administered structured questionnaire. The questionnaire was adapted from an English version used in a similar study conducted in the US in 2007 [22]. The instrument was translated by two bilingual professionals to ensure the accuracy and appropriateness of the instrument wording. A panel of experts then discussed and assessed the validity and suitability of the instrument for use on adults. The panel edited a few questions to accommodate the local culture of Saudi people. The survey included a total of 42 questions. The first section deals with demographics and socioeconomic information. The 6 remaining sections consists of questions that focus on the five broad areas of environmental health issues (indoor air hazards, outdoor air hazards, public health nuisances, household hazardous waste, water hazards, and food protection). The translated version of the questionnaire was then pilot-tested among 25 participants to evaluate the reliability and validity of the study tool and to ensure that it captured the intended data accurately. The internal consistency and split-half reliability of the final questionnaire were evaluated. Cronbach's alpha for the 34 questionnaire items was 0.906, indicating excellent internal consistency reliability. The split-half reliability was also strong, with a Guttman split-half coefficient of 0.923 and a Spearman–Brown coefficient of 0.928. These results demonstrate that the questionnaire has high reliability, with the items measuring the same underlying construct. The high Cronbach's alpha and split-half coefficient values confirm that the final questionnaire has robust internal consistency and split-half reliability.

2.4. Data Analysis

Data were coded, entered, and analyzed using Microsoft Excel software program version 16.80. The data were then imported into SPSS (Statistical Package for Social Sciences) software program version 25.0 for analysis. Descriptive statistics including frequencies and percentages were used to summarize demographic variables. A relative importance index (RI) was calculated to determine the relative importance of each survey statement on environmental health awareness. Chi-square tests assessed associations between levels of concern about indoor and outdoor hazards and demographic factors. Logistic regression modeling identified sociodemographic predictors of indoor and outdoor environmental concern levels by estimating adjusted odds ratios and 95% confidence intervals. A p-value < 0.05 was considered statistically significant for all analyses.

3. Results

A total of 817 people participated in this study. Table 1 summarizes the sociodemographic characteristics of the study participants. We have noted that the study sample was distributed by gender in similar proportions, where the percentage of females was 50.43%, while the percentage of males was 49.57%. In addition, we have noted that the distribution of the sample according to age varies, ascendingly and then descending, with the most significant percentage of those aged 21–24 years reaching 46.14%. In comparison, the percentage of those under 21 years old reached 29.13. Most of the participants were high school or bachelor's degree holders (88.21%). The most significant proportion of the sample were those whose annual low-income level is (less than $16,000) at 57.3%. The percentage of those living in the countryside was 55.20. Most participants lived in families with more than two individuals (93.02%).

Table 1. Sociodemographic characteristics of the study participants.

Variable	Group	N	%
Gender	Male	405	49.6
	Female	412	50.4
Age	18–21 years	238	29.1
	21–24 years	377	46.1
	25–34 years	118	14.4
	35–44 years	51	6.2
	45–54 years	26	3.2
	55–64 years	7	.9
Educational level	Less than high school	42	5.1
	High school graduate	246	30.1
	Some vocational/technical school but no degree	35	4.3
	Bachelor's	475	58.1
	Master's	12	1.5
	PhD	7	.9
Annual Income Level	Less than $16,000	468	57.3
	$16,000–$32,000	138	16.9
	$32,000–$48,000	91	11.1
	More than $48,000	120	14.7
Residential place	City	366	44.8
	Village	451	55.2
Family size	One person	14	1.7
	Two people	43	5.3
	Three or more people	760	93.0

Table 2 shows the awareness of the participants regarding outdoor air hazards. The majority of participants believed that transportation exhausts (75.6%), industry fumes (84.5%), stoves (60.6%), and agricultural dust burning (74.4%) are considered environmental health issues. However, participants' responses were not conclusive regarding outdoor fire,

livestock feedlot odor, and lagoon odor. In addition, most of the participants (54.1–78.6%) believed that radon, mold, secondhand smoke, carbon monoxide, and lead represent environmental health hazards, while they were not conclusive regarding asbestos as an occupational health issue.

Table 2. Participants' level of concern regarding indoor and outdoor environmental hazards.

	Statement	Not a Problem	A Problem *	Mean	SD	Relative Importance
Outdoor Air hazards	How much of an environmental health problem are emissions or exhaust	24.4	75.6	4.14	1.01	82.8
	How much of an environmental health problem are industry fumes	15.6	84.5	4.43	0.92	88.6
	How much of an environmental health problem are stove and fireplaces (use fuels including wood corn pellets	39.4	60.6	3.82	1.12	76.4
	How much of an environmental health problem are outdoor fire pits/campfires/fireplaces	50.3	49.8	3.53	1.20	70.6
	How much of an environmental health problem is agricultural dust burning	25.5	74.4	4.13	1.04	82.6
	How much of an environmental health problem is livestock feedlot odor	49.4	50.5	3.46	1.32	69.2
	How much of an environmental health problem is lagoon odor	50.4	49.5	3.42	1.36	82.8
Indoor Air hazards	How much of an environmental health problem is radon?	46	54.1	3.64	1.25	72.9
	How much the asbestos is an occupational health problem?	49.6	50.4	3.51	1.27	70.2
	How much of an environmental health problem is Mold?	37.7	62.3	3.84	1.19	76.8
	How much of an environmental health problem is environmental tobacco smoke "secondhand smoke"?	21.4	78.6	4.33	1.00	86.6
	How much of an environmental health problem is Carbon monoxide?	42.1	57.9	3.72	1.20	74.3
	How much of an environmental health problem is Lead?	45.4	54.6	3.63	1.27	72.6

* A problem = (a problem + a serious problem) of the five Likert scale responses.

In Table 3, 60.9 and 66.9% stated that overuse of recreational water and fertilizer runoff are environmental health hazards, respectively. Most participants stated that industry runoff (72.4%) and improper sewage disposal (70.2%) are not considered environmental health issues. The majority of participants (65.4–78.8%) believed that abandoned wells that are not sealed and contaminated drinking water are environmental health issues. The participants were not conclusive regarding their opinions on food safety standards.

Figure 1 shows the participants' perceptions of public health disturbances. Most participants (66.8–88.2%) considered environmental health disturbances as having relative importance or real concern. Most participants (66.8–88.2%) believed public health disturbances are either problems or serious problems. These disturbances include illegal dumps, junk houses, methamphetamine laboratories, vectors, and rodents.

Table 4 shows factors associated with the level of concern regarding indoor and outdoor environmental hazards. Females showed higher level of concern than males regarding indoor (86.7 vs. 80.5%) and outdoor environmental hazards (80.6 vs. 75.3%). Increased educational level was relatively related to raised concerns regarding indoor and outdoor environmental hazards. The interest in environmental health was an essential determinant of awareness of indoor and outdoor environmental hazards.

Table 3. Participants' perception regarding water pollution and food safety.

	Statement	Not a Problem	A Problem *	Mean	SD	Relative Importance
Desalination water	How much of an environmental health problem are public pools and spas?	54.7	45.2	3.6	1.23	71.8
	How much of an environmental health problem are Lakes and swimming?	46.9	53.1	3.4	3.36	67.2
	How much of an environmental health problem is Industry runoff?	72.4	27.5	4.1	1.08	81.8
	How much of an environmental health problem is Agricultural runoff as feedlots and pesticides?	58.7	41.3	3.7	1.15	74.8
	How much of an environmental health problem is Overuse of recreational water by campers and boaters?	39.1	60.9	3.2	1.27	63.6
	How much of an environmental health problem is Improper sewage disposal?	70.2	29.7	4.1	1.11	82.0
	How much of an environmental health problem is Fertilizer runoff?	33.0	66.9	3.0	1.32	59.6
Drinking water	How much of an environmental health problem are Abandoned wells that are not sealed?	34.6	65.4	3.9	1.29	78.4
	How much of an environmental health problem are Contaminated public drinking water?	19.7	80.3	4.4	0.96	87.6
	How much of an environmental health problem is Contaminated private drinking water?	21.2	78.8	4.4	0.97	87.0
Food protection	To what degree are food health and safety standards addressed in the following areas Food in restaurants?	54.5	45.4	3.4	1.08	68.8
	To what degree are food health and safety standards addressed in the following areas Food in grocery and convenience stores and meat market?	53.6	46.4	3.4	1.09	68.8
	To what degree are food health and safety standards addressed in the following areas food prepared for and served at community events, such as celebration feast?	51.4	48.7	3.5	1.10	70.0

* A problem = (a problem + a serious problem) of the five Likert scale responses.

Table 4. Factors associated with the level of concern regarding indoor and outdoor environmental hazards.

Factors		Outdoor Air Hazards				Indoor Air Hazards			
		Not a Problem		A Problem		Not a Problem		A Problem	
		N	%	N	%	N	%	N	%
Gender	Male	79	(19.5)	326	(80.5)	100	(24.7)	305	(75.3)
	Female	55	(13.3)	357	(86.7) *	80	(19.4)	332	(80.6)
Age groups	18–21 years	33	(13.9)	205	(86.1)	56	(23.5)	182	(76.5)
	21–24 years	62	(16.4)	315	(83.6)	76	(20.2)	301	(79.8)
	25–34 years	20	(16.9)	98	(83.1)	30	(25.4)	88	(74.6)
	More than 35 years	19	(22.6)	65	(77.4)	18	(21.4)	66	(78.6)
Educational Level	Less than High School	13	(31.0)	29	(69.0)	14	(33.3)	28	(66.7)
	High School or equivalent	42	(14.9)	239	(85.1)	57	(20.3)	224	(79.7)
	University and above	79	(16.0)	415	(84.0) *	109	(22.1)	385	(77.9)

Table 4. *Cont.*

Factors		Outdoor Air Hazards				Indoor Air Hazards			
		Not a Problem		A Problem		Not a Problem		A Problem	
		N	%	N	%	N	%	N	%
Annual household income	Less than $16,000	80	(17.1)	388	(82.9)	107	(22.9)	361	(77.1)
	$16,000–$32,000	18	(13.0)	120	(87.0)	34	(24.6)	104	(75.4)
	$32,000–$48,000	10	(11.0)	81	(89.0)	11	(12.1)	80	(87.9)
	More than $48,000	26	(21.7)	94	(78.3)	28	(23.3)	92	(76.7)
Residential place	City	64	(17.5)	302	(82.5)	84	(23.0)	282	(77.0)
	Village	70	(15.5)	381	(84.5)	96	(21.3)	355	(78.7)
Environmental Interest	Not Interested	33	(32.7)	68	(67.3)	41	(40.6)	60	(59.4)
	Interested	101	(14.1)	615	(85.9) *	139	(19.4)	577	(80.6) *

* Significant at 5% based on Chi Squared test.

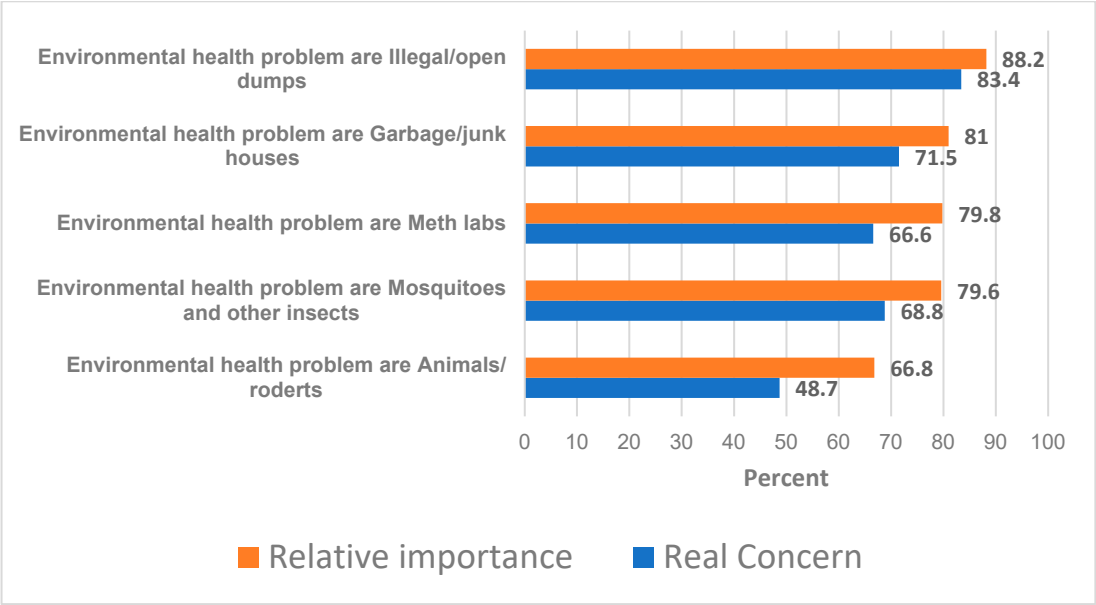

Figure 1. Participants perceptions regarding public health disturbances.

Figure 1 presents the population views on public health disturbances illustrated by percentages and the relative importance index. The highest ranking was for illegal/open dumps (RI = 88.2), followed by garbage/junk houses (RI = 81.0). The lowest concern was animals and rodents, which was ranked as RI = 66.8. The figure further showed that 83.4% of study participants perceived that illegal/open dumps are a real concern, while (8.7% indicated that animals such as rodents are a real concern.

Table 5 shows the sociodemographic predictors of the level of concern regarding indoor and outdoor environmental hazards based on multiple logistic regression. Females were 68% more likely than males to be concerned about outdoor environmental risks [AOR: 1.86; 95% CI: 1.12–2.84; $p = 0.004$]. Moreover, participants with high school or equivalent and university and above level of education were also associated with increased concern with outdoor hazards [AOR: 4.27; 95% CI: 1.92–9.52; $p < 0.001$] and [AOR: 3.51, 95% CI: 1.59–7.72, $p = 0.002$], respectively. Respondents who reported self-interest in environmental issues were [AOR= 4.89; 95% CI: 3.02–7.93; $p < 0.001$] concerned about health risks and hazards associated with outdoor air pollution and [AOR= 2.86, 95% CI: 2.86–4.47, <0.001] about indoor air quality.

Table 5. Sociodemographic predictors of level of concern regarding indoor and outdoor environmental hazards based on multiple logistic regression.

Factors	Outdoor Air Hazards				Indoor Air Hazard			
	p Value	AOR	95% C.I. for AOR		*p* Value	AOR	95% C.I. for AOR	
			Lower	Upper			Lower	Upper
Age groups								
Less than 21 years		REF				REF		
21–24 years	0.375	0.78	0.46	1.34	0.462	1.17	0.77	1.79
25–34 years	0.771	0.90	0.44	1.85	0.588	0.86	0.50	1.49
35 and above	0.196	0.63	0.32	1.27	0.470	1.26	0.67	2.35
Gender								
Male		REF				REF		
Female	0.004	1.86	1.22	2.84	0.064	1.38	0.98	1.95
Educational Level								
Less than High School		REF				REF		
High School or equivalent	<0.001	4.27	1.92	9.52	0.106	1.85	0.88	3.88
University and above	0.002	3.51	1.59	7.72	0.227	1.57	0.76	3.27
Environmental Interest								
Not Interested		REF				REF		
Interested	<0.001	4.89	3.02	7.93	<0.001	2.86	1.83	4.47
Place of residence								
City		REF				REF		
Village	0.211	0.77	0.51	1.16	0.408	0.86	0.61	1.22

Abbreviations: REF = references; AOR = adjusted odds ratio; C.I = confidence interval.

4. Discussion

The study provides valuable insights into environmental health hazard awareness in Jazan, Saudi Arabia. Results indicate that residents have general but incomplete knowledge, with heightened concern about prominent transportation and industrial risks yet uncertainty regarding less visible hazards like asbestos. The majority deemed illegal dumping as a serious issue. Additionally, gender, education level, and preexisting environmental interest emerged as factors associated with greater awareness, aligning with past research. Younger adults showed particular gaps. This highlights the need for tailored educational campaigns and messaging targeting specific groups to enhance understanding of environmental health threats. Outreach should focus on less conspicuous risks and empower diverse segments of the Saudi public to make informed choices, reducing personal exposures. Building strategic, culturally centered awareness and strengthening capacity represent critical first steps toward protecting community health in Jazan and beyond. This study makes a good contribution by providing the first in-depth investigation of environmental health awareness exclusively among residents of Jazan, Saudi Arabia. The findings offer new insights tailored to this understudied region and population.

Previous studies have highlighted the importance of general population awareness regarding environmental health hazards [23,24]. Improving understanding of risks is crucial, as environmental issues like poor recreational water quality can significantly impact public health and quality of life [25,26].

However, surveys have shown that knowledge gaps exist, especially surrounding less visible hazards. For instance, research in Saudi Arabia found residents had limited awareness of indoor risks including radon and asbestos [18,27], mirroring the current study's findings of uncertainty about asbestos. Similarly, studies of Saudi undergraduate students and mothers [27–29] revealed low familiarity with certain environmental hazards.

Educational attainment appears to play a key role in awareness levels. A study in Saudi Arabia found higher rates of environmental health hazard awareness among more educated participants versus those with less education [18]. This aligns with research in the United States indicating 58% of the general public is knowledgeable about risks [24]. Taken together, the evidence underscores the need for expanded educational efforts tailored to the awareness levels and needs of specific audiences to ensure that all groups gain a vital under-

standing of environmental health threats. Integrating environmental health education into school science curricula and medical training could promote early literacy. Communication campaigns, multi-language outreach, and clinical screening represent potential strategies to build critical risk awareness and mitigation capacities within communities.

Previous research has investigated food safety knowledge and environmental contamination in Saudi Arabia, with findings that relate to the current study. Regarding food safety, studies of hospital staff [19] and the general public [30] found an incomplete understanding of risks and safe practices, with knowledge dependent on demographics like gender, age, and education level. Though the present study did not focus on food safety, it similarly indicates a need to expand public education to address knowledge gaps. In terms of environmental contamination, a study detected concerning levels of heavy metals like mercury in palm farm soils around Riyadh city, Saudi Arabia [31]. While not directly measuring contaminants, the current study found that participants were concerned about illegal dumping, suggesting that further investigation and potential remediation of hazardous waste sites is warranted in the Jazan region.

The study findings align with core constructs of the Health Belief Model (HBM), illuminating factors that may influence environmental hazard concern. The HBM posits that perceived susceptibility and severity of risks, along with cues to action, shape health behaviors [32]. Accordingly, participants with higher education may perceive greater personal susceptibility to hazards, while preexisting environmental interest could act as an internal cue prompting engagement. The results suggest that educational campaigns and media drawing attention to risks may enhance perceived severity and external cues to action, while persuasive messaging could enable groups to understand personal consequences. Overall, the research lends support for leveraging HBM constructs to inform communication strategies aimed at improving environmental health literacy and preventive behaviors. Tailored messaging that targets awareness levels and emphasizes susceptibility may effectively promote protective actions among the Saudi public.

The research reinforces theoretical frameworks identifying knowledge as a vital precursor to preventive health behaviors [33], while illuminating key factors shape environmental hazard awareness in Saudi Arabia. The findings provide an empirical foundation for targeted communication efforts to enhance environmental health literacy among youth and less educated groups where deficiencies persist. This highlights the need for tailored interventions vs. one-size-fits-all approaches. Integrating environmental health evaluation into routine clinical practice could also promote early identification and mitigation of threats [34]. Overall, the study lays groundwork for evidence-based, culturally centered communication strategies to empower diverse segments of the Saudi public to understand risks and adopt informed protective actions [35]. It provides a launch point for further research on effective messaging approaches that motivate voluntary behavior changes to reduce environmental exposures. With strategic efforts to strengthen risk awareness and self-efficacy, Saudi communities can be equipped to proactively safeguard their health.

The study reveals critical environmental health awareness gaps in Jazan requiring an expanded public education response. Tailored educational campaigns, multi-language outreach targeting youth and immigrants, integrating environmental health into medical curricula, routine clinical screening, and strategic engagement of media and thought leaders could increase understanding of less visible risks like air pollution and asbestos. Additionally, policies strengthening hazardous waste regulation and transparent monitoring of environmental threats are warranted. Ultimately, a comprehensive communication strategy should be pursued, encompassing grassroots community partnership, healthcare provider training, and modern media campaigns, to enhance literacy and promote preventive behaviors among Saudi Arabia's diverse demographics. This systems-based approach combining targeted education, enabling regulation, and innovative communication could help build environmental health capacities and empower communities to proactively safeguard well-being.

Limitations

This study has several limitations. It was confined to adults lacking perspectives of other age groups. Additionally, the research relied solely on subjective perceptions rather than objective environmental health measures. Finally, the cross-sectional survey design precludes insights into changes over time and evaluation of educational interventions. Overall, while this study provides an initial snapshot of environmental health awareness among Saudi adults in Jazan, future research with broader, representative sampling and mixed methodologies is needed to fully elucidate awareness gaps across Saudi Arabia's diverse demographics and drive systemic improvements.

5. Conclusions

This study gathered information from Jazan residents on key environmental health hazards like air pollution and contaminated drinking water. The findings showed general but incomplete awareness, with knowledge gaps regarding specific risks like asbestos. Overall, the results suggest a need for expanded environmental health education in Saudi Arabia's Jazan region, helping to address a lack of empirical data on this topic. The research also has global implications for promoting sustainability worldwide. Countries could implement tailored educational campaigns and integrate environmental health into medical training, as guided by the study findings. These practical steps can enhance literacy and empower diverse communities to make informed choices reducing environmental exposures. Ultimately, improving the understanding of environmental risks and sustainable practices enables people to take greater ownership over protecting their health and future. This represents an inspiring vision for communities across Saudi Arabia and around the world.

This research has important global implications for promoting environmental sustainability and sustainable development. Assessing and improving public understanding of environmental health hazards is crucial for engaging communities in sustainable waste management, pollution mitigation, and other green practices. Expanded educational efforts and communication strategies tailored for local contexts as informed by this study can empower diverse people worldwide to make sustainable lifestyle choices that reduce environmental risks. Additionally, the findings can guide healthcare policy and infrastructure development aligned with sustainability principles on an international scale, such as green building design and renewable energy adoption to minimize hazards. Ultimately, this research provides an evidence-based foundation for culturally centered interventions. These interventions can enhance environmental health literacy and public participation in sustainable development initiatives globally.

Author Contributions: Conceptualization, A.Y.A. (Ahmad Y. Alqassim) and A.A.A.; methodology, A.Y.A. (Ahmad Y. Alqassim), A.A.A., M.A.M. (Mohammed A. Muaddi), R.M.J., L.I.D., A.I.M., M.A.M. (Marwa A. Masmali), R.N.S., H.Y.Z., A.M.W., A.Y.A. (Abdulrahman Y. Alqasem) and M.S.M.; software, M.A.M. (Mohammed A. Muaddi); validation, A.Y.A. (Ahmad Y. Alqassim), A.A.A. and M.A.M. (Mohammed A. Muaddi); formal analysis, R.M.J.; investigation, A.Y.A. (Ahmad Y. Alqassim); resources, L.I.D.; data curation, A.Y.A. (Ahmad Y. Alqassim), A.A.A., M.A.M. (Mohammed A. Muaddi), R.M.J., L.I.D., A.I.M., M.A.M. (Marwa A. Masmali), R.N.S., H.Y.Z., A.M.W., A.Y.A. (Abdulrahman Y. Alqasem) and M.S.M.; writing—original draft preparation, A.Y.A. (Ahmad Y. Alqassim); writing—review and editing, M.A.M. (Marwa A. Masmali) and R.N.S.; visualization, H.Y.Z.; supervision, A.Y.A. (Ahmad Y. Alqassim) and A.Y.A. (Abdulrahman Y. Alqasem); project administration, A.Y.A. (Ahmad Y. Alqassim). All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki. The study protocol was approved by the Institutional Review Board of Jazan University (protocol code REC-43/06/138, date of approval 1 February 2022). All participants were informed about the study's objectives and assured that no harm was expected from participation. Participants

were also assured about the anonymity and confidentiality of their data. Written informed consent was obtained from all participants prior to enrollment.

Informed Consent Statement: This study was conducted in accordance with the Declaration of Helsinki. The study protocol was approved by the Institutional Review Board of Jazan University (protocol code REC-43/06/138, date of approval 1 April 2022). Written informed consent was obtained from all subjects involved in the study prior to their participation. Participants were informed about the study objectives and any potential risks/benefits. They were also assured about confidentiality of their data. Additionally, written informed consent for publication has been obtained from all participating patients who can be identified.

Data Availability Statement: The data that support the findings of this study are also available from the corresponding author upon reasonable request.

Acknowledgments: The authors would like to thank the Family and Community Medicine Department in the Faculty of Medicine at Jazan University for facilitating this work. The department provided invaluable support and resources that enabled the successful completion of this research study.

Conflicts of Interest: The authors declare no conflicts of interest.

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