

**Short Communication**

**PERCEPTION OF AIR AND WATER POLLUTION AND ITS ASSOCIATION WITH CANCER  
RISK PERCEPTION IN A REGION WITH HIGH CANCER MORTALITY IN MEXICO.  
AN EXPLORATORY STUDY**

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**ABSTRACT**

The environment has considerable effects on the health status and wellbeing of individuals and its perception determines judgments, decisions and behaviors that lead to actions with consequences on health. The aim of this study was to investigate the public's perception of air and water pollution in an area with high cancer mortality. We applied a survey to an aleatory sample of inhabitants of Cuatro Ciénegas and De la Madrid in the state of Coahuila, Mexico. Of the inhabitants, 5.1 % perceived both air and water as highly polluted. Also, 23.9 % have a high perception of the risk of developing cancer. Conclusions: The perception of water pollution was associated with the perception of developing cancer.

Palabras clave: contaminación ambiental, concientización, mortalidad, salud

**RESUMEN**

El ambiente tiene un efecto considerable en la salud de las personas y la percepción que se tenga de éste va a determinar juicios, decisiones y comportamientos, los cuales pueden llevar a acciones que tengan consecuencias en la salud. El objetivo de este estudio fue evaluar la percepción de la contaminación del aire y del agua en un área con tasa alta de mortalidad por cáncer en México. Se aplicó una encuesta a una muestra aleatoria de los habitantes de Cuatro Ciénegas y De la Madrid en el estado de Coahuila, México. El 5.1 % de los habitantes percibe al aire y al agua como muy contaminados. Asimismo, el 23.9 % tiene una percepción alta de desarrollar cáncer. En conclusión, la percepción de la contaminación del agua estuvo asociada con la percepción de riesgo de cáncer.

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## INTRODUCTION

Environment and health are inextricably interlinked. In this sense, drinking water, sanitation, housing, and air, have considerable effects on the health and wellbeing of people (Irfan 2010). Exposure to environmental pollution remains a major source of health risk throughout the world. This risk is generally greater in developing countries, where poverty, lack of investment in modern technology, and weak environmental legislation cause high pollution levels. Associations between environmental pollution and health outcome are, however, complex and often poorly characterized (Briggs 2003).

The World Health Organization (WHO) estimates that about a quarter of the diseases facing mankind today occur because of prolonged exposure to environmental pollution (Prüss-Üstün and Corvalán 2006). Most of these environment-related diseases are, however, not easily detected and may be acquired during childhood and manifested later in adulthood (Kimani 2007).

Public perception of pollution is important since it determines judgments, decisions and behaviors that lead to actions with consequences in health. Increased perception and knowledge is a cornerstone for intervention in promoting protective behavior (Egondi et al. 2013). In this sense, research on the public's perception of pollution and its health risks in Latin America has been limited, even though megacities that have serious air contamination problems, such as Mexico City, Sao Pablo and Rio de Janeiro, are located there (Catalán-Vázquez 2006). A study carried out in middle school students in Mexico City on the perception of air pollution and health-disease-death, concluded that focalizing components of the perception must be involved in environmental policies to make environmental programs more effective at the local level (Catalán-Vázquez 2009).

In Mexico, the main air pollution problems are found in megacities such as Mexico, Monterrey and Guadalajara, and in industrial states such as Coahuila. In the latter, the industrial and energy activity related to the combustion of mineral coal puts it in second place in greenhouse gas emissions nationwide. In addition, the aquifers have considerable levels of mineral salts as arsenic, which is a metal with considerable toxicity to humans (SEMA 2012).

Considering the importance of environmental pollution perception and since there are few studies on this topic in Mexico, the aim of this study was to investigate the public's perception of air and water

pollution and its association with cancer risk perception in a region with high cancer mortality.

## METHODS

### Area of study

The area of study were the municipalities of Cuatro Ciénegas and La Madrid, both located in the state of Coahuila in northeast Mexico. According to the Instituto Nacional de Geografía y Estadística (INEGI, 2016), this state is among those with the highest cancer mortality rate. La Madrid is located in the center of the state, at 101° 47' 41" W, 27° 2' 59" N, and 640 masl. Cuatro Ciénegas is also located in the center of the state at 102° 03' 59" W, 26° 59' 10" N, and 740 masl. Subjects were contacted directly in their homes. We randomly chose a sample of 83 houses in downtown Cuatro Ciénegas and of 50 in La Madrid. The first individual that opened the door was invited to participate. In cases where children opened the door, they were requested to inform an adult of the intention of our visit. The survey was applied to an individual above 18 years of age and was self-administered with supervision.

### Instrument

The questionnaire is composed of two sections. The first section includes questions on sociodemographic data such as age, gender, level of education and marital status; the second section includes questions on environmental pollution perception, and perception of developing cancer. The answer to these last questions includes a five-point ordinal scale, which ranges from without pollution to totally polluted, and from low to very high probability of developing cancer, respectively. The raw data are available at figshare.com. (Esquivel-Ferriño et al. 2016).

### Analysis

We calculated frequencies of perception of air and water pollution according to sex, education level, and marital status. Differences in perception among sex, education level and marital status were performed with a chi-square test. Correlation between the perception of air and water pollution and cancer risk was performed with the Spearman's correlation coefficient. The statistical software NCSS-10 was used for all analyses.

### Ethical considerations

The study was carried out in compliance with the principles of the Declaration of Helsinki. The

subjects were given oral information about the study and were informed that participation was anonymous and voluntary. By filling in the questionnaire, verbal consent to participation was given.

## RESULTS

One hundred eighteen persons accepted to participate in the study, while 15 refused. The mean age was 44.7 years, 71.1 % were married, 22.9 % had a secondary school level, and 29.7 % had a family member with cancer. Males had a mean age of 47.1 years, 76.7 % were married, 32.4 % had a secondary school level and 35.3 % had a family member with cancer. In the case of women, the mean age was 43.9 years, 69.0 % were married, 23.8 % had a high school level, and 27.4 % had a family member with cancer (**Table I**).

**TABLE I.** CHARACTERISTICS OF THE STUDY POPULATION

Characteristic	Total	Male	Female
<b>Age</b>			
Mean	44.78	47.1	43.9
Median	43	43	42
Standard deviation	14.43	14.63	14.34
<b>Marital status (%)</b>			
Single	19.30	16.67	20.24
Married	71.05	76.67	69.05
Divorced	5.26	6.67	4.76
Widow	4.39	0.00	5.95
Total	100	100	100
<b>Education (%)</b>			
Illiterate	22.03	32.35	17.86
Primary	14.41	8.82	16.67
Secondary	22.88	32.35	19.05
High school	19.49	8.82	23.81
College	21.19	17.65	22.62
Total	100	100	100
<b>Family member with cancer (%)</b>			
	29.66	35.29	27.38

With respect to environmental pollution perception, 5.1 % of all inhabitants perceived both the air and water as very highly polluted, while 58.5 % and 55.9 % perceived the air and water as slightly polluted (**Table II**). The fraction of

individuals that perceived air and water as polluted was mostly composed of men, married and illiterate. In this sense, 5.9 % of men and 4.7 % of women perceived both air and water as very polluted. Among married people, 6.2 % and 4.9 % considered the air and water very polluted, respectively. In the case of illiterate people, 11.5 % believed that both the air and water were very highly polluted. There was no significant association in perception of both water and air pollution with sex and marital status of those interviewed. Likewise, there was no association between air pollution perception and level of education. There is a significant association between level of study and cancer risk perception and between level of study and water pollution perception.

Overall, 23.9 % of those surveyed had a high perception of developing cancer. According to sex, the proportion of subjects who perceived a high probability of developing cancer was 26.5 % in men and 22.9 % in women. There was no significant difference according to gender (**Table II**). In the same way, widows and undergraduate individuals perceived a high probability of developing cancer (40 % and 48 %, respectively). There was a significant difference in perception according to the level of education ( $p < 0.01$ ).

According to the Spearman correlation coefficient, the perception of both air and water pollution was not associated linearly with age and level of education. However, water pollution did show a positive correlation with perception of cancer risk ( $R = 0.296$ ;  $p < 0.05$ ) (**Table III**).

## DISCUSSION

In this study we analyzed the perception of environmental pollution and the cancer risk perception in an area with high levels of cancer mortality. Risk perception is an essential component of healthy behavior overall in cancer, and particularly in hereditary cancers. Knowledge of cancer risk factors has the potential to engage the public in preventive behaviors (Abiodun et al. 2014). In fact, the creation of awareness is very crucial to the success of prevention programs (for example, cervical cancer).

In our study, we found that illiterate people have major concerns regarding water pollution in contrast with individuals with higher levels of education ( $p = 0.04$ ). These results are similar to some but not all studies (Klaeboe et al. 2000, Catalán-Vázquez et al. 2001, Jacquemin et al. 2007, Semenza et al. 2008, Kim et al. 2012). We speculate that place of residence

**TABLE II. PERCEPTION OF AIR, WATER POLLUTION AND CANCER RISK**

Air (%)	Total	Gender		Marital status				Level of study				
		Male	Female	Single	Married	Divorced	Widow	Illiterate	Primary	Secondary	High school	University
Unpolluted	25.42	26.47	25.00	23.81	28.40	33.33	0.00	34.62	23.53	29.63	34.78	4.00
Mild	58.47	58.82	58.33	61.90	53.09	66.67	100	42.31	70.59	51.85	52.17	84.00
Moderate	11.02	8.82	11.90	14.29	12.35	0.00	0.00	11.54	5.88	14.81	8.70	12.00
High	5.08	5.88	4.76	4.76	6.17	0.00	0.00	11.54	0.00	3.70	4.35	4.00
p value		0.92				0.92				0.42		
Water (%)												
Unpolluted	28.81	23.53	30.95	14.29	33.33	50.00	50.00	15.38	41.18	40.74	43.48	8.00
Mild	55.93	55.88	55.95	80.95	48.15	50.00	50.00	53.85	52.94	48.15	43.48	84.00
Moderate	10.17	14.71	8.33	0.00	13.58	0.00	0.00	19.23	5.88	7.41	4.35	12.00
High	5.08	5.88	4.76	4.76	4.94	0.00	0.00	11.54	0.00	3.70	8.70	0.00
p value		0.54				0.35				0.04		
Cancer												
Low	48.72	58.82	44.58	28.57	54.32	50.00	40.00	34.62	64.71	66.67	45.45	36.00
Intermediate	27.35	14.71	32.53	52.38	23.46	16.67	20.00	38.46	23.53	22.22	36.36	16.00
High	23.93	26.47	22.89	19.05	20.99	33.33	40.00	26.92	11.76	11.11	18.18	48.00
p value		0.07				0.07				<0.01		

**TABLE III.** ASSOCIATION BETWEEN SOCIODEMOGRAPHIC VARIABLES, AIR AND WATER POLLUTION AND CANCER RISK PERCEPTION

Spearman correlation	Age	Education	Family member with cancer	Air pollution perception	Water pollution perception	Cancer risk perception
Age	1					
Education	0.011	1				
Family member with cancer	0.199	0.287*	1			
Air pollution perception	-0.092	0.1	-0.049	1		
Water pollution perception	-0.031	-0.042	0.02	0.564*	1	
Cancer risk perception	-0.013	0.157	0.367*	0.099	0.296*	1

\* $p < 0.05$

could explain these contrasting results, since illiterate people tend to live in marginalized areas where pollution might be more visible.

We did not find a difference in risk perception of air and water pollution according to marital status ( $p = 0.54$  and  $p = 0.07$ , respectively). This finding is different than those reported by Kim et al. (2012) and Egondi et al. (2013), where married people had a high perception of pollution. One possible explanation that authors give is that spouses are a source of information about pollution.

The perception of water pollution was positively associated with risk cancer perception (Table III). This finding could indirectly suggest that people consider pollution as a cause of cancer. Others studies had shown that people consider air and water pollution as a cause of cancer when they are questioned directly about these this association (Rice et al. 2015, Peretti-Watel et al. 2016). The reasons that only water pollution was related could be explained by the fact that water is scarce in the studied region and hence more valued.

Several studies have found that the perception of air and water pollution may be influenced by other factors such as occupation and number of offspring. However, the impact of these can be very different or even opposite depending on the place of study. Existing literature on this topic is highly heterogeneous and difficult to synthesize as a single holistic theory (de Franca-Doria 2010, Shi and He, 2012); therefore, more studies are needed.

Since perception can affect human behavior and because it is considered an important component of behavioral change, increasing people's perception and knowledge about the health consequences of exposure to environmental pollutants is a cornerstone for interventions, especially to promote protective

behavior and lifestyle changes directed at reducing health risks. For this reason, and considering the high rates of cancer mortality in Coahuila and the low perception of air and water pollution observed in the studied area, our results may encourage decision makers to design educative strategies for inhabitants regarding risk of environmental pollution on cancer development. In addition, our results could be useful to assess the progress when these educative strategies are implemented.

Studies of air and water pollution monitoring are necessary to establish levels of pollution in the studied area. The high cancer mortality rate and the high mining activity in the region justify these studies. The establishment of a program of air monitoring in Torreón-Matamoros, Saltillo-Ramos Arizpe, Monclova, Frontera, Sabinas, Nueva Rosita, Piedras Negras and Acuña is a great advancement (Subsecretaría de Gestión Ambiental 2013). Its purpose is to characterize air contaminants, including sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), ozone (O<sub>3</sub>), carbon monoxide (CO), particulate matter with an aerodynamic diameter less than 10 and 2.5 μm (PM<sub>10</sub> and PM<sub>2.5</sub>). However, it is necessary to start with water monitoring since the high rates of cancer could be due to the presence of metals such as arsenic, which is a proven carcinogen and whose cancer-death risk—which has been estimated to be 21/1000—is associated with the daily consumption of 1.6 liters of water with inorganic arsenic (50 μg/L) (Martínez et al. 2011).

### Limitations

Our results should be interpreted with caution because of the small sample size. We applied the survey in the month of June, which is within a holiday period. This could affect people's mood and hence



their perception of air and water pollution. In addition, other factors that can impact perception such as occupation, religion, and the number of children were not included in the analysis.

## CONCLUSIONS

The perception that air and water are highly polluted is low in the inhabitants of the studied region. The perception of water pollution was associated with cancer risk perception. More studies are needed in the region.

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