

Assessment of Local Public Perceptions as a New Technique to Indicate Air Pollution and Coping Strategies of Social Advertising

Kunal Sinha*, Tripta Sinha, Dr. S. N. Sahdeo

Department of Management, BIT Lalpur, Ranchi, Jharkhand, India

ABSTRACT

Air quality is a major concern in India and throughout the world. The purpose of the present study is to explore citizens' perception on local air pollution, its causes and impacts and thus utilize it as a technology to indicate local air pollution. Advertisements on air pollution found to be an effective tool in bringing awareness of the state of air quality and its health impact in citizens. Thus, social advertising strategies and its effects are also studied. A questionnaire was individually applied to a sample of 994 participants. Relationships between demographic features and the perception on air quality were analysed using a logistic regression, its odds ratio (OR), and a Chi-square test. Eighty percent of the respondents perceive their local air quality as either bad or fair, 65% recognize particulate matter as the main local air pollutant, and 90% recognize negative impacts on people's health as the main consequence of air pollution. Such findings suggest people's opinions can be used as provisional indicators in cities without data, as well as to monitor the results of local air quality management. The technique is so easy to adapt and can be applied to any place in the world. As a complementary process, or at the same level of importance given to technical based policy, citizen participation can contribute to a collective construction of local air pollution control strategies.

Keywords: Public Perception, AIDA model, Air Pollution, urban area, social advertisement

I. INTRODUCTION

In India, air pollution is a major concern [1] [2] [3] [4]. According to the monitoring made by national environmental authorities, particulate matter (PM) levels are well above national standards [5] [6]. Moreover, there is strong local evidence showing an association between low air quality conditions with higher rates of respiratory diseases [7] [8] [9] [10]. In many Indian areas, public health authorities indicate that respiratory illness is the leading cause of morbidity and mortality among children under five years of age and represent one of the top causes of mortality across the entire population [11] [12] [13]. This condition has aroused the interest of the academia and scientific community to support the

identification and characterization of the air pollution problem in different areas [14]. Advertisement is one of the popular means by which government attempt to update, convince and remind public about air pollution [67][68][69]. Such studies have supported the technical formulation of public policy strategies aiming at improving air quality. Despite these efforts, much is yet to be done towards an improved understanding of the air pollution problem at a local level. While most of the research in India has been focusing on the physical and chemical characterization of the problem, relatively no attention has been given to the socio-cultural aspects that underlie it. For instance, it has been neglected how different people from different strata perceive air pollution problems and what is their level of concern;

both individually and collectively. Different reasons support the incorporation of social factors, in addition to economic and technical analysis, in the design and implementation of air quality policies. A comprehensive air quality management process requires information that reveals implicit socio-cultural aspects and the incorporation of a social value dimension [15]-[20]. Several case studies in policy making, demonstrate how public perception is crucial for environmental policies success. Delving into the social aspects can encourage public participation in air pollution control programs, especially if public is involved since early stages in decision-making processes [21]. Public consultation can be also useful to empower public in requesting the compliance to air quality standards [16]. And results of perception studies after social advertising on air pollution have an additional value, as they could be useful to enrich the analysis of scientific data or technical information. In India, there are few researches linking socio-cultural variables to air pollution. In the research world, some of the authors have analyzed the perception on environmental noise caused by vehicular traffic [23] [24] and the perception on air pollution problems coming from solid waste disposal [25]. The designing of Bogota's Air Quality Management Plan included a participation process where several communities within the city were asked about their perception on air pollution, its causes and solutions [26]. Ariza et al. [27] also studied citizens' perception on the impact of air quality on health and quality of life in four localities in Bogota. Within this context, this research aims to explore citizens' perception on local air pollution, its causes and consequences and then utilize it as an indicator of local air pollution.

II. METHODS

Study area

Jharkhand State of India is extended approximately from 21° 55' north to 25° 35' north and 83° 20' east to 88° 02' east. The state falls in the Chotanagpur Plateau region (Banik P. et al., 2003). The characteristic feature of this hilly and undulating plateau is its

tropical forests and tribal settlements. We have selected three places in Jharkhand for the study of people's perception on air quality and these are Ranchi, Jamshedpur and Dhanbad. Over these regions, a plenty of thermal plants, industries and coal mines are situated. The areas are affected by the residual of thermal plants, coal mines and biomass burning. Besides, these places are comparatively more developed in context of infrastructure, transportation, medical and educational facilities than the other places of Jharkhand. Students of three leading engineering colleges of the state have been selected as respondents. The idea behind this selection is- these are the people who are more aware about social and environmental issues, they have possibilities to get more affected by advertisements and thus make perceptions on any issue.

Participants and Sample

Participants were Environmental Engineering students from Birla Institute of Technology Mesra, NIT Jamsedpur and ISM Dhanbad. Students under this learning methodology have knowledge about air pollution and understand the advertising message. This allows having a sample with participants living in three different districts of Jharkhand. The objective population was 1775 people, which corresponds to the total enrolled students in the mentioned academic programs during the time-period of study (October 2016 to November 2017). The statistically representative size of the sample was calculated to be of 667, considering an error of 3%, a confidence level of 95% ($\alpha = 0.05$) and a distribution of responses of 50%. However, the final sample was made up of 994 participants, geographically distributed.

Questionnaire and Survey Method

The questionnaire designed for the study included 15 questions, grouped in four sections: demographic characteristics, effectiveness of advertisement on air pollution, recognition of local environmental issues and understanding of the local air pollution condition (see Table 1). Questions were closed-answer except

for some requesting additional description. The questionnaire was applied individually.

Table 1. Questionnaire format.

Parameters	Question subject
Demographic Characteristics	Name
	Gender
	Age
	Place
Local environmental issues	Socioeconomic conditions
	Identification of environmental problem
	Perception on air quality condition
	Emission sources
	Air pollutants
	Magnitude of the impact
Local air pollution	Impacts description
	Health related impact perceived
	Characteristics of the affected population

AIDA Model

The purpose of any advertisement is to grab attention, then to generate interest, to convince, so to create the belief. If an advertisement contains these three qualities, it is a successful advertisement[70].

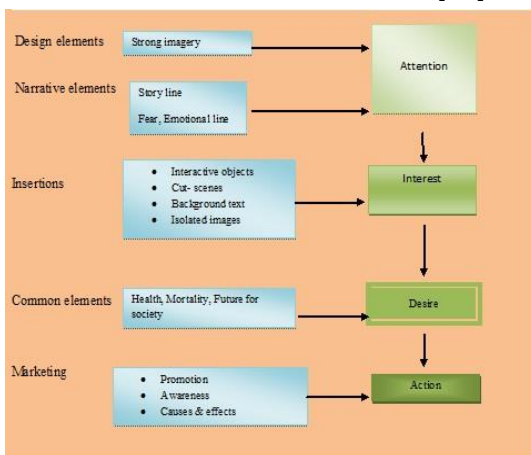


Figure1. AIDA Model

AIDA MODEL

AIDA is the acronym for Awareness Interest desire Action (Lombardo). This is an approach used in advertising to describe different phases of consumer association with an advertisement. The model was first developed by E.St. Elmo Lewis in 1898. AIDA is used in the field of marketing and advertising management. The model describes a common list of events that may occur when a consumer engages with an advertisement (see Figure 1). A - Attention (Awareness): It is the process of attracting the attention of the customer. In developing an advertising program, marketing managers should always start by identifying the targeted audience and its reasons to purchase a specific product or service. I - Interest: This can be defined as the process of raising customer interest by focusing on and demonstrating advantages and benefits (instead of focusing on features, as in traditional advertising). It must use emotions to address the fact that this purchase is a good bargain, the right step, a sound decision, etc. In addition to that it is also essential to let the customer know the dark side if he/she doesn't buy the product or service. D - Desire: It is the way to convince customers that they want and desire the product or service and that it will satisfy their needs. There is huge difference between being interested in something and desiring it. A television ad must create a strong urge inside the consumers mind and generate a need or stimulate their latent need. This can happen only if the ad has used the correct combination of all 5 M's (Mission, Message, Media, Money, Measurement) into the advertisement. A - Action: It is the final phase that leads customers towards taking action i.e. purchasing and doing positive word of mouth. When a company promotes its brand image through advertisements, the level of persuasion must be ensured or it must make the consumers inquisitive enough to know more about the brand. The applicability of AIDA model in marketing is to attract the attention from potential clients, arouse their interest and desire for final buying action. Researchers found that repetition in the

advertisement hit the mind of the customers which leads to repeat purchase [71]. Marketing strategy of this model generally is to increase the conversion rate (Potential client becomes a real buyer). This can be further explained as below

Statistical Analysis

Questionnaire responses tabulation and graphical summaries were completed with Microsoft Excel 2016, while statistical analyses were carried out using SPSS v.22 and R v.3.3.1 packages. To examine relationship between demographic characteristics and the perception on air quality, a logistic regression was used. The odds ratio (OR) analysis consider that values of OR different than 1, with confidence intervals that do not include that value, express significant levels of association. The Chi-square test was used to assess the level of dependency between the demographic traits having the largest influence on air quality perception (according to the previously estimated OR) and other variables that could be potentially predictors of the local air pollution problem understanding (e.g., pollution sources). A p-value less than 5% was the criterion used to consider the test result as statistically significant.

III. RESULTS

Sample Characterization

Table 2 shows the demographic characterization of the sample. Most respondents are women between 18 and 30 years of age. As shown in Figure 1, we have a sample from different administrative regions in Jharkhand with the number of participants at each department representing a percentage of the total that varies from 0.2 to 26.8. Participants were categorized in five classes according to the size of their city or town (see Table 2).

Table 2

	Crude Odds Ratio (OR)		
	OR	95% CI	P-Value
Gender			
Male to female	0.896	(0.693, 1.158)	0.404

Age			
18 < Age ≤ 30 to Age < 18	0.797	(0.329, 1.939)	0.616
30 < Age ≤ 40 to Age < 18	0.656	(1.266, 1.646)	0.369
40 < Age to Age < 18	0.916	(0.318, 2.648)	0.872
Socio-economic strata			
3-6 to 1-2	0.677	(0.367, 1.256)	0.214
Population in thousands			
50 < Size ≤ 100 to Size < 50	1.641	(1.032, 2.624)	0.037
100 < Size ≤ 250 to Size < 50	2.879	(1.982, 4.202)	<0.001
250 < Size ≤ 500 to Size < 50	2.308	(1.494, 3.585)	<0.001
500 < Size to Size < 50	7.553	(5.222, 11.001)	<0.001

Relevance of Air Pollution as a Local Environmental Concern

When asking participants about the three-main local environmental issues in their cities or towns of residence, water pollution was included in this list 77.8% of the times, air pollution (together with offensive odors and noise) 74%, inadequate solid waste management 65.3%, and deforestation 35.7%. Other environmental issues mentioned in a lesser extent were soil degradation (29.2%), loss of plant and animal species (11.5%), agrochemicals food contamination (7.8%) and illegal wildlife trade (2.5%). However, when deciding the leading environmental problem in the city, about 40% of the participants selected air pollution among the others.

Perception on Local Air Quality

Among the 994 responders, 80% perceive their city air quality as either bad or fair (see Figure 4). Table 3 lists the crude odds ratios (OR), confidence intervals

(CI) and p-values result from the multivariate regression analysis. For these specific analysis, age and socioeconomic strata variables were grouped in three and two categories respectively. Participants with more than 55 years of age were included in the >40 class and respondents from socioeconomic strata 3, 4, 5 and 6 were grouped to make this class equivalent in terms of size of the sample. With $OR \geq 1$, confidence intervals >1 and p-values < 0.05, we found an association between the size of the participant's city of residence and the perception of high local air pollution. This means a person living in a larger city is likely to have a negative perception on its air quality condition. Other variables such as gender, age and socioeconomic strata showed not statistical significance.

Perception on Air Pollution Sources and Impacts

According to the Chi-square test level of significance, variables such as "type of contaminant" and "pollution sources" are dependent on the variable "size of the city" ($p = 0.02$ y $p < 0.001$, respectively). Figure 2 shows that for all the three city classes, participants consider particulate matter (PM) as the main local air pollutant. In the cities with greater population this opinion becomes stronger. When asking participants about the primary source of air pollution in their location, 37% of those considering PM as the main air pollutant, mentioned local area sources as the most important ones (mining, infrastructure construction and use of artisan furnaces in production processes located in the same area). On the other hand, 72% identified road traffic as the main source of PM. More than 90% of the responders perceive air pollution as a negative factor affecting people's health. Statistical evidence ($p < 0.001$) demonstrates that the largest the city, the higher the participants' perception on the link between air quality and negative health impacts. Between those who perceive such relationship, more than 90% identified respiratory diseases as the main effect on health. The remaining percentage is distributed among other impacts such as eye pain, stress, headache and premature deaths. About 60% of

those living in towns associate their homes with high levels of air pollution exposure. Participants from bigger cities perceive roadsides as an important place to be exposed to bad air quality. When asking about the scale of the impacts of air pollution, 62% of those recognizing the link between bad air quality and negative health effects, mentioned that impacts are predominantly manifested at a local level (i.e., in the city area), 20% at regional level (i.e., beyond the municipality) and 18% at a microscale level (i.e., neighborhood or village).

IV. DISCUSSION

These results contribute with evidence about citizens' perception on environmental issues in Jharkhand's urban and rural areas. As well as previous studies [33]-[38], our findings aim to improve the understanding of Jharkhand's urban and rural air pollution condition and to highlight the potential of including citizen's perception as a way to support local action to address environmental problems. Taking advantage of the methodology of the undergraduate academic programs, we were able to have about 1000 respondents' sample, from different geographical regions in Jharkhand. As far as we are aware, this is the first study in the country and one of the few with this number of participants, from different locations, examining opinions about air quality, its causes and impacts. There is a widespread concern about air quality within the participants. What local environmental authorities have identified regarding air pollution as a major problem in Jharkhand cities is also perceived by the community. Contrary to preceding research [39] [40], no associations were found between perception on air quality and the three first factors in Table 2 describing respondents' personal characteristics (e.g., gender, age-group and socioeconomic strata). The fact that all participants were undergraduate students from environmental programs is of course giving a certain homogeneity to the sample, but it must however be noticed that it cover people from a broad

range of ages and different socioeconomic levels. One factor we found associated with participant's perception was the size of the municipality. With different and higher than 1 value of OR, confidence intervals not crossing 1 and p-values less than 0.05, the bigger the city of residence, the higher the probability to perceive air quality issues. This is consistent with previous research that highlight how town or city features have a significant influence on perceived levels of air pollution at the local level [41] [42] [43]. In particular, city size in terms of population appears to be a predictive factor, for the physical, social and cultural characteristics that it implies. Despite most small and mid-sized cities do not have air quality monitoring networks and the fact that in Jharkhand air quality data is limited [5] [44] [45], 80% of respondents rated their local air quality condition as poor or fair. This means that citizens are aware of their own local environmental deterioration expressed as dust or some kind of smog and offensive odors [46] [47], but also that media (newspaper, television, online technical reports) might have an effect on participants' perception [38] [48] [49] [50]. These results provide an additional reason for local environmental and health authorities to implement measuring systems in those cities where air quality is not yet monitored. Other authors have previously remark that air quality problems are especially critical in large cities with high population density [51] [52]. Consistently with that, about 60% of the responders from cities with more than 500,000 inhabitants perceived air pollution as the major environmental problem. When asking about the main local air pollutant, the majority (65%) identified it with PM. This is also consistent with international and national reports that highlight the concern about the importance of PM levels in urban areas [4] [45] [53] [54] [55] [56] and its implications on human health [57], climate change [58], economy [59] and infrastructure [60]. Species such as greenhouse gases, associated to climate change, do not appear in the responses, which is interesting because it shows the level of knowledge of the respondents on this topic.

There is a statistical evidence for the relationship between perception on the emission sources and size of the city ($X^2 = 166.98$, $p < 0.001$). In general, local area sources and forest fires have more relevance in small cities, while the importance of vehicular traffic as a source of air pollution, rises as the size of the city increases. Industries are more frequently mentioned as the main source of air pollution in mid-size cities (population between 100,000 and 250,000 inhabitants). This is in accordance with results from previous studies, where characteristics such as the predominant economic activities in small and intermediate cities, and urban transport in larger cities, highly influence participants' perception on air quality [42] [43] [61]. Regarding the consequences of air pollution, although more than 90% of the total responders associated negative impacts on people's health, those living in major cities were more likely to recognize such harmful effect. Similarly, when asked about the place where people are more exposed to air pollution, participants of the largest cities mentioned roadsides in greater percentage in comparison to those in small and mid-size cities. However, in both small towns and large cities, respondents coincide on the household as the place where they are more exposed to air pollution. Such results reinforce the suggestion about the importance of considering concepts of healthy-home when designing housing projects. Air pollution problems are complex and multidimensional, which demands to involve different perspectives for its analysis and management [17] [62] [63]. It is not about reducing the discussion to relativistic approaches, but a complete understanding of the local air quality scenario should include people's perception of the problem as a part of its indicators. In Jharkhand, and its cities, it is time to start building local environmental polices together with people. We consider this is crucial since citizen participation in such public agenda can lead to generate strategies for a better environment. One first thing we suggest to do is to make environmental authorities more visible for the public, letting them know its presence, social objectives and institutional

goals. Another key action should be to start monitoring air quality where it is not done today and make such data publicly available. An informed citizenry can make better decisions and will be empowered to follow the progress of the air pollution control actions [64] [65] [66].

V. CONCLUSIONS

Citizens' perception on local air pollution, its causes and consequences were explored in different municipalities in India. Limitations notwithstanding, the authors want to highlight the questionnaire design and implementation process as a replicable instrument for broader studies in the nation and it is also implacable to the world. It is motivating fact that participants were students since they are the future decision-makers, in both public and private sectors. The widespread perception of poor air quality should be a call for the authorities to initiate or intensify monitoring, and emissions control programs. Particulate matter was identified as a critical pollutant and people recognized adverse health effects as a main air pollution impact. Such findings suggest people's opinion can be a way to have indicators in cities without data, but also a way to track local air quality management. Moreover, this type of data may be used by environmental authorities to prioritize cities/regions to start acting.

VI. ACKNOWLEDGEMENTS

This study was supported by Birla Institute of Technology, Mesra, NIT Jamshedpur and ISM Dhanbad of Jharkhand, India. The authors especially thank those respondents who voluntarily agreed to participate in the study by answering the questionnaire.

VII. REFERENCES

- [1]. OPS/Pan American Health Organization (2005) Assessment of Air Pollution Effects on Health in Latin America and the Caribbean. OPS/OMS, Washington DC.(In Spanish)
- [2]. WMO—World Meteorological Organization (2012) Impacts of Megacities on Air Pollution and Climate.GAW Report No.205, World Meteorological Organization, Geneva.
- [3]. Romero-Lankao, P.and Gnatz, D.(2013) Exploring Urban Transformations in Latin America.Current Opinion in Environmental Sustainability, 5, 358-367.<https://doi.org/10.1016/j.cosust.2013.07.008>
- [4]. WHO—World Health Organization (2016) Preventing Disease through Healthy Environments: A Global Assessment of the Burden of Disease from Environmental Risks.WHO Document Production Services, Geneva.
- [5]. MAVDT—Ministry of Environment, Housing and Territorial Development (2010) Air Pollution Prevention and Control Policy.MAVDT, Bogota.(In Spanish)
- [6]. IDEAM—Institute of Hydrology, Meteorology and Environmental Studies (2012) Report of the State of Air Quality in Colombia 2007-2010.IDEAM, Bogota.(In Spanish)
- [7]. Ramirez, A., Sarmiento, O., Duperly, J., Wong, T., Rojas, N., Arango, C., Maldonado, A., Aristizabal, G., Perez, L.and Lobelo, F.(2012) Should They Play Outside Cardiorespiratory Fitness and Air Pollution among Schoolchildren in Bogota.Revista de Salud Publica,14, 570-583.
- [8]. Beleno, R., Quijano, A.and Melendez, I.(2013) Mutagenic and Genotoxic Activity of Particulate Matter PM2.5 from Cucuta, Colombia.Revista MVZ Cordoba,18, 3731-3737.(In Spanish)
- [9]. Estevez, J., Rojas, N.and Rodriguez, A.(2013) Occupational Exposure to Air Pollutants: Particulate Matter and Respiratory Symptoms

- Affecting Traffic-Police in Bogota. *Revista de Salud Publica*, 15, 889-902.
- [10]. Ortiz, E. and Rojas, N. (2013) Estimating Air Quality Change-Associated Health Benefits by Reducing PM10 in Bogota. *Revista de Salud Publica*, 15, 90-102. (In Spanish)
- [11]. Hernandez, L., Aristizabal, G., Salgado, Y., Cantor, L., Medina, K. and Reyes, J. (2012) Association between Air Pollution and Morbidity from Acute Respiratory Illness in Children under Five in Three Locations in Bogota. *Pediatrics*, 45, 124-138. (In Spanish)
- [12]. Franco, J., Rojas, N., Sarmiento, O. and Behrentz, E. (2013) Urban Air Pollution in School-Related Microenvironments in Bogota, Colombia. *Revista Ingenieria e Investigacion*, 33, 42-48.
- [13]. Hernandez, L., Aristizabal, G., Quiroz, L., Medina, K., Rodriguez, N., Sarmiento, R. and Osorio, S. (2013) Air Pollution and Respiratory Illness in Children Aged less than 5 Years-Old in Bogota, 2007. *Revista de Salud Publica*, 15, 503-516. (In Spanish)
- [14]. Pachon, J. (2013) Research Trends Regarding Air Quality in Colombia, Based on the Results of the 4th Colombian Congress and International Conference on Air Quality and Public Health, 2013. *Revista Epsilon*, 21, 13-40. (In Spanish)
- [15]. Buttel, F. and Tylor, P. (1992) Environmental Sociology and Global Environmental Change: A Critical Assessment. *Society & Natural Resources*, 5, 211-230. <https://doi.org/10.1080/08941929209380788>
- [16]. Bickerstaff, K. and Walker, G. (2001) Public Understandings of Air Pollution: The "Localization" of Environmental Risk. *Global Environ Change*, 11, 133-145. [https://doi.org/10.1016/S0959-3780\(00\)00063-7](https://doi.org/10.1016/S0959-3780(00)00063-7)
- [17]. Lezama, J. (2004) The Social and Political Construction of the Environment. *El Colegio de Mexico, Mexico*. (In Spanish)
- [18]. Hyland, J. and Donnelly, P. (2015) Air Pollution and Health—The Views of Policy Makers, Planners, Public and Private Sector on Barriers and Incentives for Change. *Journal of Transport & Health*, 2, 120-126. <https://doi.org/10.1016/j.jth.2015.03.006>
- [19]. Ngo, N., Kokoyo, S. and Klopp, S. (2017) Why Participation Matters for Air Quality Studies: Risk Perceptions, Understandings of Air Pollution and Mobilization in a Poor Neighborhood in Nairobi, Kenya. *Public Health*, 142, 177-185. <https://doi.org/10.1016/j.puhe.2015.07.014>
- [20]. Fischhoff, B., Lichtenstein, S., Slovic, O., Derby, S. and Keeney, R. (1981) *Acceptable Risk*. Cambridge University Press, Cambridge.
- [21]. Pidgeon, N. (1998) Risk Assessment, Risk Values and the Social Science Programme: Why We Do Need Risk Perception Research. *Reliable Engineering System Safety*, 59, 5-15. [https://doi.org/10.1016/S0951-8320\(97\)00114-2](https://doi.org/10.1016/S0951-8320(97)00114-2)
- [22]. Daniels, F., Martínez, E., Quinchía, R., Morales, O., Romero, A., Marín, A. and Arbeláez, M. (2007) Air Pollution and the Population's Health Effects. *Medellin and Its Metropolitan Area*. Universidad de Antioquia, Medellin. (In Spanish)
- [23]. Narvaez, C., Ortiz, W. and Guerrero, R. (2011) Pasto Inhabitants' Perception on Environmental Noise Pollution Caused by Traffic Flow. *Revista Unimar*, 45, 5-14. (In Spanish)
- [24]. Ramirez, A. and Dominguez, E. (2014) Objective and Subjective Indicators of Traffic Noise Pollution in Chapinero District (Bogota City, Colombia). *Revista Gestion Ambiente*, 17, 45-54. (In Spanish)
- [25]. Valencia, J., Espinosa, A., Parra, A. and Peña, M. (2011) Perception of Risk Arising from Atmospheric Emissions from an Open Solid-Waste Disposal Site. *Revista de Salud Pública*, 13, 930-941. (In Spanish)

- [26]. SDA/Department of Environment (2010) Bogota's Ten-Year Air Decontamination.SDA/Transmilenio SA/Universidad de Los Andes/Universidad de La Salle, Bogota.(In Spanish)
- [27]. Ariza, L., Sanchez, M.and Franco, J.(2013) Citizen Perception about the Impact of Air Pollution on Their Health and Quality of Life: Pilot Study.Revista Epsilon, 21, 173-187.(In Spanish)
- [28]. Fox, J., Murray, C.and Warm, A.(2003) Conducting Research Using Web-Based Questionnaires: Practical, Methodological and Ethical Considerations.International Journal of Social Research Methodology, 6, 167-180.<https://doi.org/10.1080/13645570210142883>
- [29]. Pardos, S.(2006) Observation Techniques of Public Opinion in the Environmental Field.In: Coord, A.E., Eds., Public Opinion and the Environment,Editorial Grao, Barcelona, 70-118.(In Spanish)
- [30]. Kreuter, F., Presser, S.and Toureangeau, R.(2008) Social Desirability Bias in CATI, IVR and Web Surveys.Public Opinion Quarterly,72, 847-865.<https://doi.org/10.1093/poq/nfn063>
- [31]. Vehovar, V., Manfreda, K.and Koren, G.(2008) Internet Surveys.In: Donsbach, W.and Traugott, M., Eds., The Sage Handbook of Public Opinion Research,Sage, Thousand Oaks.
- [32]. Chang, L.and Krosnick, J.(2010) Comparing Oral Interviewing with Self-Administered Computerized Questionnaires: An Experiment.Public Opinion Quarterly,74, 154-167.<https://doi.org/10.1093/poq/nfp090>
- [33]. Garcia, A.and Jaula, J.(2006) Environmental Perception of University of Pinar del Rio Students.Innovacion Educativa,6, 39-45.(In Spanish)
- [34]. Sosa, M., Alcala, J., Soto, R., Lebgue, T.and Quintana, C.(2008) Perception Environmental College Students through Environmental Variables.Revista Latinoamericana de Recursos Naturales,4, 178-184.(In Spanish)
- [35]. Evrekli, E.and Balım, A.(2010) Effects of Mind Map and Concept Strips Use in Science and Technology Education on Students' Academic Achievement and Perception of Inquiry Learning Skills.Batı Anadolu Eğitim Bilimleri Journal,1, 76-98.
- [36]. Ercan, F.(2011) Student Perceptions and Solutions about the Matters of Environment.Procedia—Social and Behavioral Sciences, 19, 450-452.<https://doi.org/10.1016/j.sbspro.2011.05.153>
- [37]. Karatekin, K.(2013) Perception of Environmental Problem in Elementary Students' Mind Maps.Procedia—Social and Behavioral Sciences, 93, 868-872.<https://doi.org/10.1016/j.sbspro.2013.09.295>
- [38]. Ramirez, O.(2015) Identification of Environmental Problems in Colombia from the Social Perception of University Students Located in Several Places of the Country.Revista Internacional de Contaminacion Ambiental,31, 293-310.(In Spanish)
- [39]. Kohlhuber, M., Mielck, A., Weiland, S.and Bolte, G.(2006) Social Inequality in Perceived Environmental Exposures in Relation to Housing Conditions in Germany.Environmental Research, 101, 246-255.<https://doi.org/10.1016/j.envres.2005.09.008>
- [40]. Atari, D., Luginaah, I.and Fung, K.(2009).The Relationship between Odour Annoyance Scores and Modelled Ambient Air Pollution in Sarnia, "Chemical Valley", Ontario.International Journal of Environmental Research and Public Health, 6, 2655-2675.<https://doi.org/10.3390/ijerph6102655>
- [41]. Wakefield, S., Elliot, S., Cole, D.and Eyles, J.(2001) Environmental Risk and (Re) Action: Air Quality, Health, and Civic Involvement in an Urban Industrial Neighbourhood.Health & Place, 7, 163-177.[https://doi.org/10.1016/S1353-8292\(01\)00006-5](https://doi.org/10.1016/S1353-8292(01)00006-5)
- [42]. Howel, D., Moffatt, S., Prince, H., Bush, J.and Dunn, C.(2002) Urban Air Quality in North-

- East England: Exploring the Influences on Local Views and Perceptions. *Risk Analysis*, 22, 121-130. <https://doi.org/10.1111/0272-4332.t01-1-00010>
- [43]. Day, R.(2007) Place and the Experience of Air Quality. *Health & Place*, 13, 249-260. <https://doi.org/10.1016/j.healthplace.2006.01.002>
- [44]. MADS—Ministry of Environment and Sustainable Development (2013) Urban Environmental Quality Index—ICAU.MADS, Bogota.(In Spanish)
- [45]. MADS—Ministry of Environment and Sustainable Development (2015) National Urban Environmental Quality National Report: Urban Areas with Population above 500,000.MADS, Bogota.(In Spanish)
- [46]. Elliott, S., Cole, D., Krueger, P., Voorberg, N.and Wakefield, S.(1999) The Power of Perception: Health Risk Attributed to Air Pollution in an Urban Industrial Neighbourhood. *Risk Analysis*, 19, 621-634. <https://doi.org/10.1111/j.1539-6924.1999.tb00433.x>
- [47]. Howel, D., Moffatt, S., Bush, J., Dunn, C.and Prince, P.(2003) Public Views on the Links between Air Pollution and Health in Northeast England. *Environmental Research*, 91, 163-171. [https://doi.org/10.1016/S0013-9351\(02\)00037-3](https://doi.org/10.1016/S0013-9351(02)00037-3)
- [48]. cDonald, J., Hession, M., Rickard, A., Nieuwenhuijsen, M.and Kendall, M.(2002).Air Quality Management in UK Local Authorities: Public Understanding and Participation. *Journal of Environmental Planning and Management*, 45, 571-590. <https://doi.org/10.1080/09640560220143567>
- [49]. Schwartz, J.(2006) Air Pollution: Why Is Public Perception So Different from Reality *Environmental Progress & Sustainable Energy*, 25, 291-297.
- [50]. Oltra, C.and Sala, R.(2014) A Review of the Social Research on Public Perception and Engagement Practices in Urban Air Pollution. CIEMAT/Departamento de Medio Ambiente, Madrid.
- [51]. Gurjar, B., Butlerb, T., Lawrenceb, M.and Lelieveld, J.(2008) Evaluation of Emissions and Air Quality in Megacities. *Atmospheric Environment*, 42, 1593-1606. <https://doi.org/10.1016/j.atmosenv.2007.10.048>
- [52]. Grobety, B., Giere, R., Dietze, V.and Stille, P.(2010) Airborne Particles in the Urban Environment. *Elements*, 6, 229-234. <https://doi.org/10.2113/gselements.6.4.229>
- [53]. Sanchez, E., Ahmed, K.and Awe, Y.(2007) Environmental Priorities and Poverty Reduction: A Country Environmental Analysis of Colombia *Directions in Development: Environment and Sustainable Development*. The World Bank, Washington DC.
- [54]. Green, J.and Sanchez, S.(2013) Air Quality in Latin America: An Overview. Clean Air Institute, Washington DC.
- [55]. Franco, J., Segura, J.and Mura, I.(2016) Air Pollution alongside Bike-Paths in Bogota-Colombia. *Frontiers in Environmental Science*, 4, 77. <https://doi.org/10.3389/fenvs.2016.00077>
- [56]. Tyler, N., Acevedo, J., Bocarejo, J.and Velasquez, J.(2013) Theoretical Framework of Air Pollution in Colombia. University College London/Universidad de Los Andes, Bogota.(In Spanish)
- [57]. Lu, F., Xu, D., Cheng, Y., Dong, Sh., Guo, Ch., Jiang, X.and Zheng, X.(2015) Systematic Review and Meta-Analysis of the Adverse Health Effects of Ambient PM2.5 and PM10 Pollution in the Chinese Population. *Environmental Research*, 136, 196-204. <https://doi.org/10.1016/j.envres.2014.06.029>
- [58]. IPCC—Intergovernmental Panel on Climate Change (2014) Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the

- Intergovernmental Panel on Climate Change. IPCC, Geneva.
- [59]. World Bank (2016) *The Cost of Air Pollution: Strengthening the Economic Case for Action*. The World Bank & IHME, Washington DC.
- [60]. Liu, B., Wang, D., Guo, H., Ling, Z. and Cheung, K. (2015) *Metallic Corrosion in the Polluted Urban Atmosphere of Hong Kong*. *Environmental Monitoring and Assessment*, 187, 4112. <https://doi.org/10.1007/s10661-014-4112-z>
- [61]. Simone, D., Eyles, J., Newbold, K., Kitchen, P. and Williams, A. (2012) *Air Quality in Hamilton: Who Is Concerned Perceptions from Three Neighbourhoods*. *Social Indicators Research*, 108, 239-255. <https://doi.org/10.1007/s11205-012-0064-2>
- [62]. Funtowicz, S. and Ravetz, J. (1990) *Uncertainty and Quality in Science for Policy*. Kluwer Academic Publishers, Dordrecht.
- [63]. Cupples, J. (2009) *Culture, Nature and Particulate Matter—Hybrid Reframings in Air Pollution Scholarship*. *Atmospheric Environment*, 43, 207-217. <https://doi.org/10.1016/j.atmosenv.2008.09.027>
- [64]. Simioni, D. (2003) *Air Pollution and Citizen Awareness*. CEPAL, Santiago de Chile. (In Spanish)
- [65]. Catalan, M., Riojas, H., Jarillo, E. and Delgadillo, H. (2009) *Perception of Health Risks Due to Air Pollution in Adolescents in Mexico City*. *Salud Publica en Mexico*, 51, 148-156. (In Spanish)
- [66]. Liao, X., Tu, H., Maddock, J., Fan, S., Lan, G., Wu, Y., Yuan, Z. and Lu, Y. (2015) *Residents' Perception of Air Quality, Pollution Sources, and Air Pollution Control in Nanchang, China*. *Atmospheric Pollution Research*, 6, 835-841. <https://doi.org/10.5094/APR.2015.092>
- [67]. Weiss, J.A., & Tschirhart, M. (1994). *Public information campaigns as policy instruments*. *Journal of policy analysis and management*, 13(1), 82-119.
- [68]. Kraft, M.E., & Furlong, S.R. (2012). *Public policy: Politics, analysis, and alternatives*. Sage.
- [69]. Ringquist, E.J. (1993). *Environmental protection at the state level: Politics and progress in controlling pollution*. ME Sharpe.
- [70]. Lewis, C.T. (1899). *The indeterminate sentence*. *The Yale Law Journal*, 9(1), 17-30.
- [71]. Pope, D.G. (2009). *Reacting to rankings: evidence from "America's Best Hospitals"*. *Journal of health economics*, 28(6), 1154-1165.