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# A score for measuring health risk perception in environmental surveys

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## HIGHLIGHTS

- Concern towards environmental hazards may bias questionnaire surveys
- There is no published formal evaluation of a score of health risk perception
- We devised a score of health risk perception in an adult population in Italy
- This score can be used to rate risk perception and assess its effects empirically

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## ABSTRACT

*Background:* In environmental surveys, risk perception may be a source of bias when information on health outcomes is reported using questionnaires. Using the data from a survey carried out in the largest chipboard industrial district in Italy (Viadana, Mantova), we devised a score of health risk perception and described its determinants in an adult population.

*Methods:* In 2006, 3697 parents of children were administered a questionnaire that included ratings on 7 environmental issues. Items dimensionality was studied by factor analysis. After testing equidistance across response options by homogeneity analysis, a risk perception score was devised by summing up item ratings.

*Results:* Factor analysis identified one latent factor, which we interpreted as health risk perception, that explained 65.4% of the variance of five items retained after scaling. The scale (range 0–10, mean ± SD 9.3 ± 1.9) had a good internal consistency (Cronbach's alpha 0.87). Most subjects (80.6%) expressed maximum risk perception (score = 10). Italian mothers showed significantly higher risk perception than foreign fathers. Risk perception was higher for parents of young children, and for older parents with a higher education, than for their counterparts. Actual distance to major roads was not associated with the score, while self-reported intense traffic and frequent air refreshing at home predicted higher risk perception.

*Conclusions:* When investigating health effects of environmental hazards using questionnaires, care should be taken to reduce the possibility of awareness bias at the stage of study planning and data analysis. Including appropriate items in study questionnaires can be useful to derive a measure of health risk perception, which can help to identify confounding of association estimates by risk perception.



## 1. Introduction

Risk perception is known to be influenced by complex psychological, socio-economic, and cultural processes (Bickerstaff, 2004), which include individual and collective cognitive processes, as well as risk communication (Bickerstaff and Walker, 1999; Grasmück and Scholz, 2005; Slovic, 2000). Uncontrollable, potentially catastrophic, involuntary risks, and unfamiliar hazards with delayed effects are considered to be less acceptable (Slovic et al., 1980).

Environmental risks are an important source of stress in exposed populations (Claeson et al., 2013; Moffatt et al., 2000; Sessa et al.,

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2010). When information on health outcomes is reported using questionnaires, risk perception may be a source of bias, because as a consequence of concern towards environmental issues individuals might over report adverse health outcomes (Shusterman et al., 1991; Shusterman, 1992; Moffatt et al., 2000). Even where pollution levels are far below toxicity, there may be an association of exposure with reported symptoms or annoyance that is entirely mediated by health risk perception (Claeson et al., 2013; Dalton, 1999).

People who live in contaminated areas may be worried about pollution (Burger, 2005; Moffatt et al., 2000; Stenlund et al., 2009; Interdonato et al., 2014). On the other hand, it is also possible that people who live close to pollutant sources underestimate health risks (Grasmück and Scholz, 2005; Weber et al., 2001). If one of these hypotheses is verified, health risk perception will act as a confounder of the association between exposure and health outcome. Nonetheless, awareness bias has been poorly considered in the literature of environmental epidemiology and, to the best of our knowledge, a formal evaluation of the reliability and properties of a score on health risk perception has never been carried out.

In 2006, urged by public concern about the possible health effects of industrial pollution, we conducted a study in the district of Viadana, the largest chipboard industrial park in Italy (de Marco et al., 2010; Girardi et al., 2012). Besides its public health objectives, the data collected offers the opportunity to investigate health risk perception and its determinants in a large adult population. In this article, we devised a score of health risk perception using parent-reported ratings on their health concern towards some environmental issues. Then we identified the determinants of health risk perception in this population among parents' and children's characteristics and proxies of air pollution exposure.

## 2. Methods

### 2.1. Study design and population

The Viadana study is a cross-sectional survey that investigated the association between proximity to factories and the children's health in the district of Viadana, Mantova (de Marco et al., 2010), where two big chipboard industries and 22 smaller wood manufacturing facilities are located (Marcon et al., 2014). A questionnaire survey on the pediatric population, in combination with an analysis of administrative health data (Rava et al., 2009), was identified as a cost-effective, first-line strategy for the screening of possible air pollution effects. As health outcomes were not objectively assessed but parent-reported, we were concerned about the potential confounding of public risk perception during study planning. Thus, the study was publicly presented as having the general purpose of describing the health of the pediatric population, with no direct mention of specific hypotheses. Moreover, items on risk perception were included in the questionnaire (available at http://biometria.univr.it/viadanastudy). The study protocol was approved by the ethics committee of the National Health Service Mantua (Azienda Sanitaria Locale di Mantova).

In December 2006, the parents or guardians of all the 4130 children (3–14 years) attending the 50 schools in the district received the questionnaire, delivered during school hours, to be filled in at home and given back within 20 days. Overall, 3907 questionnaires were distributed (223 children were absent), and 3854 (99%) questionnaires were collected, which represented 93% of the eligible population. Of these, 3697 questionnaires were completed by the parents. Since most potential determinants referred to the parents, 157 questionnaires answered by the guardians were not considered in the analyses.

### 2.2. Questionnaire scaling

Questions on risk perception were selected from the Italian version of the International Study of Asthma and Allergies in Childhood (ISAAC) (Galassi et al., 2005). Parents rated the level of risk ("*How much do you think that the following aspects can be a risk for the health of the population?*") associated with 7 environmental issues (Fig. 1). Response options were coded as: "*Not at all*" or "*Don't know* (DK)" = 0, "*A little*" = 1, "*Quite a lot*" = 2 and "*A lot*" = 3. A score was developed as a sequence of two phases (Zanolin et al., 2007). Firstly, after checking for the presence of items weakly correlated with the others (|Pearson's r| < 0.15) to exclude them, an exploratory factor analysis was used to investigate the structure of the Pearson's correlation matrix (Fabrigar et al., 1999). Items that had a very high (>0.60) uniqueness, i.e. the proportion of variance of the item that is not accounted for by all of the extracted factors considered together, were also excluded. The number of factors retrieved was based on eigenvalues of the correlation matrix greater than 1. Secondly, the Homogeneity Analysis (HA) was used to test the internal homogeneity and consistency across the items and the equidistance of the response options of each item (Gifi, 1990). This method uses the response options as nominal categories

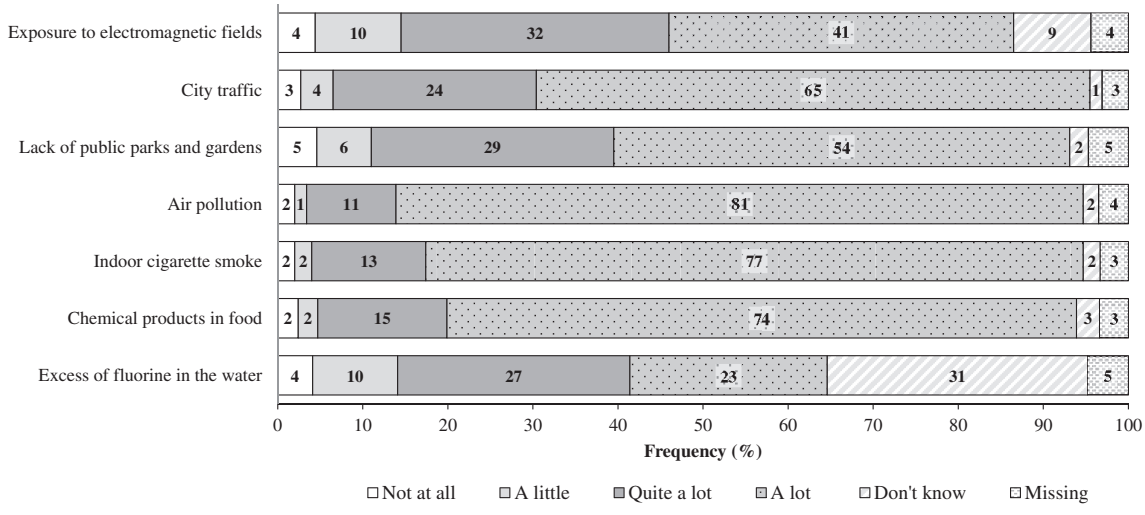


**Fig. 1.** Distribution of the parents' ratings to the questionnaire items relating to environmental issues. Responses to the question: "How much do you think that the following aspects can be a risk for the health of the population?".