

# HEALTH RISKS PERCEPTION IN THE CONTEXT OF THE CONSTRUCTION OF A PETROCHEMICAL COMPLEX IN BRAZIL<sup>1</sup>

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## Introduction

All around the world, the health risks arising from the stages of construction and operation of the oil refining industry have been arousing great fear and concerns in populations located in areas neighboring this sort of development (ALMANSSOOR, 2008; SIGNORINO, 2012; LÓPEZ-NAVARRO, M. A. et al. 2013).

Surely, the installation and construction processes in the petrochemical industry has been degrading the environmental quality and produced human health risks of populations residing in the neighborhood of the industrial area (MONIZ et al., 2017; LÓPEZ-NAVARRO et al. 2013).

However, the emphasis of scientific studies has been placed on technical assessments of the risks of industrial activities, once the effects on human health caused by environmental exposure to pollutants released by oil refinery plants have been vastly discussed in literature (LUGINAAH, 2002; SIGNORINO, 2012).

Another problem is that the potential risks and impacts on the health of workers and the community generated by the construction stage of industrial oil plants are poorly assessed or partially contemplated in the Environmental Impact Studies (EIS) and Environmental Impact Reports (EIR), let alone in Health Impact Assessment (HIA) Studies to deploy preventive actions (BARBOSA, 2010; MONIZ et al., 2017).

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Performing studies on the perception of environmental quality and health risks caused by the construction stage of oil and gas developments should be systematically considered by public and corporate administrators as a mechanism to involve social stakeholders who are directly affected by such risks in the preparation of policies and making decisions to address this issue (MONIZ et al., 2016).

It is acknowledged that subjective, social, cultural, and risk type-related factors exercise a direct or indirect influence on the perception of individuals and population groups on the risks of potentially hazardous events or activities and, thus, they can contribute to evidence vulnerabilities, needs, and conflict relations revealed in daily life (GIULIO et al., 2015).

The information obtained from risk perception studies can contribute to build environmental health indicators, which in turn have been supporting political and corporate proposals and actions at the public health level (NAVARRO; CARDOSO, 2005; KAMINS et al., 2015; SLOVIC, 2000).

## **Risks, Environment, Health and Construction of a Petrochemical Complex**

In the Brazilian scenario, the Rio de Janeiro Petrochemical Complex (COMPERJ) is a development of the oil and gas industry of the Brazilian economy, which was being built in the city of Itaboraí, in the eastern side of the Rio de Janeiro state, Brazil's southeast region, since 2007. The constructions were interrupted in July 2015 due to an investment cut by the company in charge of the development, PETROBRAS (SOUZA, 2015).

The environmental licensing process for COMPERJ did not include a diagnosis of the health situation of the population in Itaboraí (BARBOSA, 2010). The main environmental and health risks for the communities neighboring the construction area of COMPERJ relate to the site chosen for deployment of this development. There is a risk of reduced groundwater recharge and reduced water availability for maintaining the vitality of local and regional ecosystems and the drinking water supply for human consumption in the area, which is also chronically affected by a water scarcity problem (UFF, 2012; MONIZ et al., 2017).

The digging and earthwork activities and vehicle traffic cause dust dispersion in the air, which can cause or worsen respiratory conditions and other negative health effects. In such situation, there is a risk of increased air emissions of carbon monoxide, carbon dioxide, particulate matters 2, 5, 10, and others, on account of the burning activities during the earthworks stage and the increased flow of vehicles and machinery used (MARIANO, 2001).

There are also risks of microbiological, parasitological, and toxicological contamination of water bodies by the wastewater effluents from the construction site and an increased number of households and businesses not connected to the treatment network. The risk of soil and water contamination is also present due to the office and meal waste from the construction site through improper methods (burning, burying, or disposing of the trash in lands, rivers Aldeia, Porto das Caixas and Caceribu) (MONIZ et al., 2017).

Such environmental risks can in turn lead to a high risk of morbidity and mortality

for infectious and parasitic diseases and chronic illnesses, such as neoplasia, due to the chronic exposure to agrochemicals and heavy metals in the water and soil (GURGEL, 2009).

A risk of occupational and/or environmental exposure to toxic substances (aromatic hydrocarbons and heavy metals) may arise as well through leaks and accidents with vehicle and machinery oil in the soil and water, which can contaminate animals, plants, water and food and, when in contact with a human organism, can cause intoxication, leading to respiratory, neurological, teratogenic and neoplastic diseases (WERNHAM, 2007).

Generally, in the construction stage of petrochemical parks and complexes, which are implemented in socially vulnerable areas, situations of deterritorialization and breakdown of family and local economy structures can be seen, leading to high social mobility and exposure to environments and situations that are hazardous to health (SEIXAS; RENK, 2012; BARBOSA, 1990). In this context, there is a risk of disfigurement of rural and urban spaces, which are important to the social and moral interaction of communities, thus threatening the healthy growth of children and youth (TINOCO, 2007).

The growth rate of the urban population in the city of Itaboraí in southeastern Brazil, was at 23.36% in the 2000-2011 period (UFF, 2012) and this is due to an increased migration flow of workers and the attraction of other people for employment purposes. Such factor has led to risks of occupation of places without proper dwelling and sanitation conditions; slum growth; increased demand for goods, property, and jobs; increased demand and pressure on public utilities (basic sanitation, housing services, security, transportation, leisure, education, and health); prostitution, violence, and an increase in sexually transmitted diseases (MONIZ et al., 2016).

There may be risks of anxiety, depression, and psychosomatic diseases due to the perception and experience of situations such as unemployment, increased violence, criminality, and drug dealing as a result of an uncontrolled urbanization, increased contact between people from outside the area and the local residents, household displacement, environmental degrading, and others, which contribute to affect the population's feeling of well-being (SEIXAS; RENK, 2012; BARBOSA, 1990).

In Brazil, there are no population risk perception studies that take into account the individual and social dimension of the health risk posed by socio-environmental transformations caused by the construction of a petrochemical complex. Therefore, this study aimed to determine the factors that lead to the health risks perception of the process of construction of the Petrochemical Complex of Rio de Janeiro.

## Methods

### *Study Site and Participants*

A cross-sectional study was conducted in the months of November and December 2014 among 240 individuals residing in two localities in the city of Itaboraí, State of Rio de Janeiro, Brazil: Porto das Caixas (residential area surrounding COMPERJ's construction plant) and Manilha (residential area 22 km away from the industrial plant).

Even though Porto das Caixas is an area with only 3,782 inhabitants and Manilha is far more populated, with 60,000 inhabitants, and present a relevant number of businesses, local services, and ceramic and stone plants (IBGE, 2010), the poor life conditions of the populations of both locations in terms of sanitation, leisure, family income, education level, and housing conditions are quite similar (UFF, 2012).

Education institutions were included as a means of accessing and selecting the groups of residents from both study areas. To calculate the sample size from each location, a simple random sampling was carried out, without replacement, and the parameters considered were: 95% confidence level, 10% estimation error, and potential loss or refusal of participation at about 10%.

Three education institutions in each district served as basis for obtaining data for the study and were selected because they had an elevated number of students enrolled, representativeness in the area, cooperation from their directors, and logistics. For the Porto das Caixas area, a sample was estimated with 101 individuals based on an approximate population total of 550 students. However, information was obtained from 120 individuals residing in this location. In the group of residents of the Manilha district, 120 individuals were included as well, from a sample initially estimated at 112 individuals based on a population total of 1,479 students.

Through the students' enrollment in the education units, we requested the competent authority (school principal's office and the education secretary's office in charge) to provide us with a list of persons responsible for them and their relevant addresses so that they could answer the questionnaire at their own houses. The selection of persons responsible for students in each class was based on the attendance sheets. The cooperation of the local health services was requested to locate the households.

### *Questionnaire*

The study used a standardized, semi-structured questionnaire containing questions corresponding to the following variables: socio-demographic features (gender, age, education level, location); health risk perception; perception of COMPERJ's benefits to the local life quality; reported morbidity; and opinion on the location of the development near their place of residence. Other variables were considered as a source of data for other publications.

Mixed questions and the scale items used to measure the variables in this study were obtained from prior validated studies: health risk perception and proximity to hazard (LUGINAAH et al., 2002; LÓPEZ-NAVARRO et al., 2013; SIGNORINO, 2012). After the instrument was built, the pre-trial stage followed. Four interviewers were trained, that were health community agents from the health services in the study areas. At this stage, version I questionnaires were used on a simple random, interview basis, with 20 residents, 10 from each study area. The instrument items were reevaluated and some of them were kept, and it was used again in its version II with the target population.

The dependent variable in the study was the perception of health risks during the construction stage of COMPERJ and assessed through question 35: "Do you think the

current construction stage of COMPERJ can pose any risk to the health of people in the District where you live?”. The answers were dichotomized as yes or no and the information was supported by the open question: “In case you answered yes to the previous question, what risk(s) and why?”.

The independent variables were: sex, age, education level, perception of benefits, location (Porto das Caixas and Manilha), and opinion for or against the complex’s location near their district of residence.

To investigate the knowledge on the perception of benefits brought by the installation and construction of COMPERJ into the participant’s district of residence, the following question was asked: “You must answer how much COMPERJ has already been beneficial to the district where you live in terms of life quality” (No benefit; Little beneficial; Some benefits; Very beneficial; Extremely beneficial). Agreement or disagreement with COMPERJ’s location near their district of residence was assessed through the following question: “Are you in favor of COMPERJ’s location near your district of residence?” (Yes/No).

### Data Analysis

Once the empirical stage was completed, we proceeded to the analytical procedures of database preparation by two typists, independently, in the EPIDATA program, version 3.1, and descriptive data analysis, as well as chi-square tests, Fisher’s exact tests, t-student test to compare their proportions and means across groups.

The multiple correspondence analysis technique was employed to identify profiles and groups of answers on the individuals’ perception. Additionally, Spearman correlations were calculated. All analyses were carried out in the Statistical Package for the Social Sciences (SPSS) software, version 21.0, and in Statistica and a significance level at 5% was adopted across all stages.

## Results

### Socio-demographic Characteristics

The sample includes 240 individuals, 120 of whom (50%) resided in Porto das Caixas and 120 (50%) resided in Manilha. As shown in Table 1, 167 (70%) of the participants were women and 73 (30%) were men. Regarding the education levels, 143 (60%) interviewees were elementary school graduates, 86 (36%) were high school graduates, and 09 (4%) had a college degree.

**Table 1. Socioeconomic variables, perception of benefits, and opinion for and against the Complex's location with 240 study participants**

Independent Variables	N	%
Gender		
Male	73	30
Female	167	70
Location		
Porto das Caixas	120	50
Manilha	120	50
Age group		
18-30 years old	72	30
31-59 years old	136	57
60-80 years old	32	13
Education		
Elementary school	143	60
High school	86	36
Higher education degree	11	4
Perception of the level of benefits brought by COMPERJ's construction in terms of local life quality		
No benefit	125	52
Little beneficial	57	24
Some benefit	35	15
Very beneficial	22	8
Extremely beneficial	1	1
Opinion for or against COMPERJ's location near to the District of residence		
Favorable	95	40
Against	145	60

### *Health risk perception*

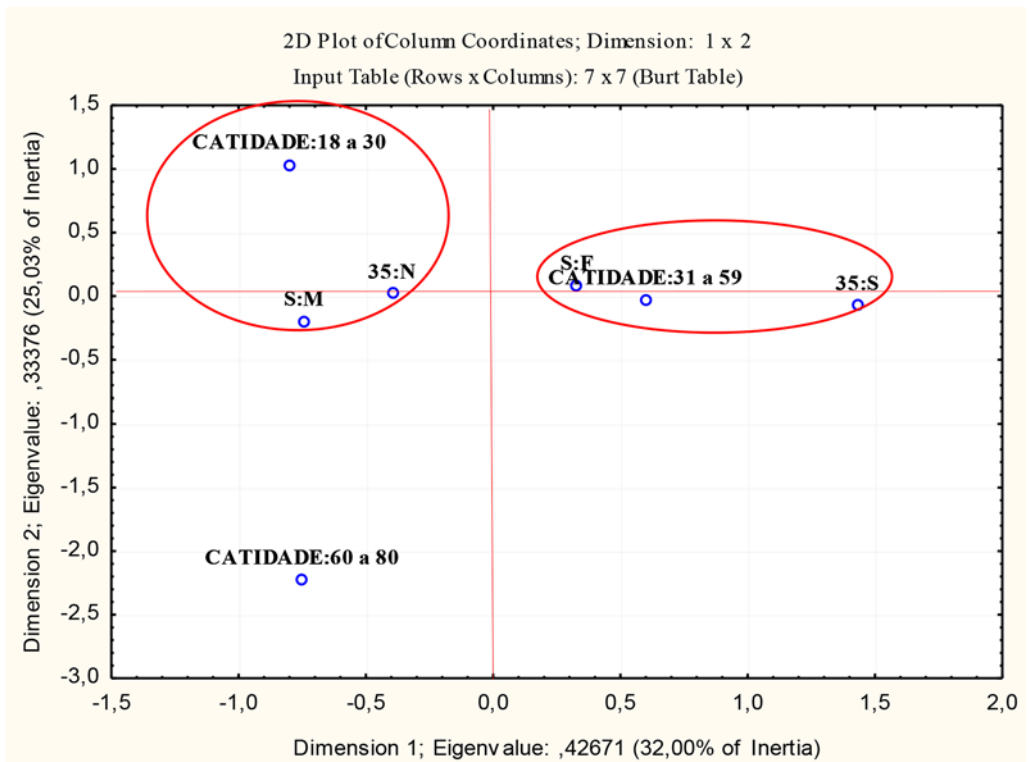
It has been evidenced that only 22% of the interviewees reported that risks were posed to the health of the people in the district where they live due to COMPERJ's construction stage. Out of these, 18% resided in Porto das Caixas and 4% in Manilha. Health risk perception differed between the residents from both study locations ( $p < 0.001$ ) and between the female and male genders ( $p = 0,038$ ). For all other socio-demographic variables, no statistic association has been evidenced.

Among the health risks identified, 18% of the respondents asserted that there are risks of respiratory diseases and 4% said it about allergic diseases. Some Porto das Caixas participants pondered that respiratory issues have always occurred in their communities, but are being worsened by COMPERJ's works.

Figure 1 shows the relationship observed between health risk perception, sex, and age group, through a multiple correspondence analysis. Total inertia was the measure used

to represent the variability proportion explained by each dimension of the chart. Both dimensions together explain 57% of the variation shown in the data. It is found that most subjects who answered that there are health risks fall within the age group of 31-59 years old and the female gender.

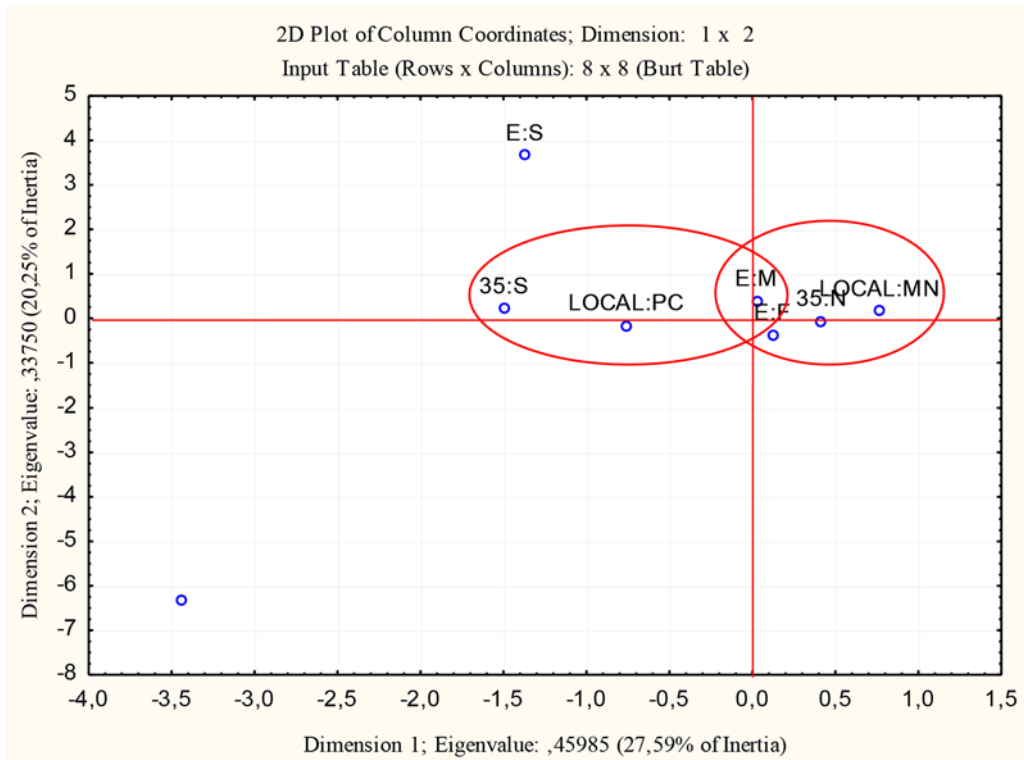
**Figure 1 Relationship between health risks perception from COMPERJ's construction stage and individual variables (age group, sex) of all 240 subjects, 2014.**



Note: S:M= Male; S:F= Female; 35: N= Number of people who answered No to question 35; 35: S= Number of people who answered No to question 35; CATIDADE:18 a 30= Category of the age group of 18-30 years old; CATIDADE 31 a 59= Category of the age group of 31-59 years old; CATIDADE:60 a 80= Category of the age group of 60-80 years old.

Figure 2 addresses the relationship between health risk perception, education level, and location. In this correspondence analysis, both dimensions explain 48% of the variation shown in the data. It is observed that the relative frequency of subjects who did not identify health risks connected with COMPERJ's construction stage is higher among Manilha residents who are elementary school graduates.

**Figure 2 Relationship between health risks perception from COMPERJ's construction stage and social variables (Education level, Location), 2014.**



Note: LOCAL: PC= Porto das Caixas Location; LOCAL: MN = Manilha Location; 35: N= Number of people who answered No to question 35; 35: S= Number of people who answered Yes to question 35; E:F= Elementary School; E: M= High School; E: S= Higher Education Degree.

### *Risks perception x Benefits x Location of the Complex*

Results have shown that 125 (52%) residents reported that COMPERJ did not bring any benefit to the life quality of the population residing in their district, 57 (24%) reported that it was little beneficial, 35 (15%) reported that it brought some benefits, 22 (8%) reported that it was very beneficial, and 1 (1%) reported that it was extremely beneficial (Table 1). As to the type of benefit, jobs were reported by 46% of the interviewees, in addition to an improvement of the local economy mentioned by one subject.

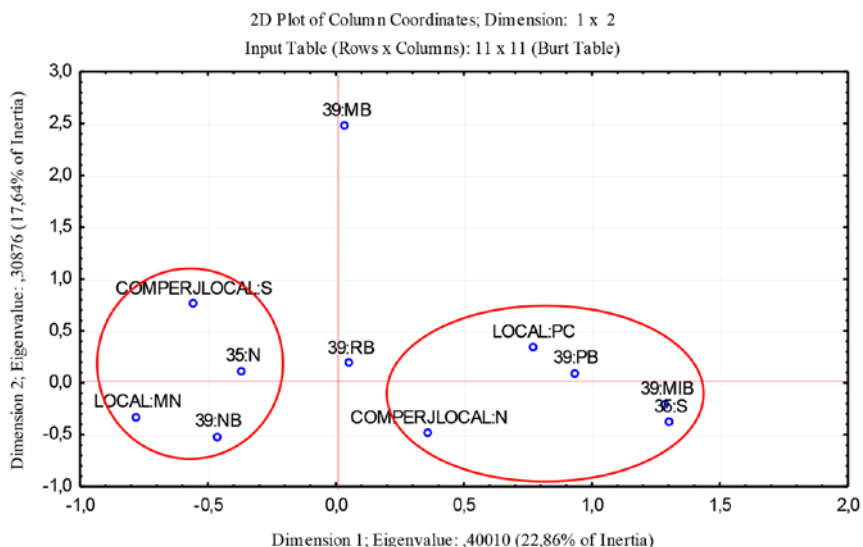


The data also reveal that 145 (60%) residents are not in favor of COMPERJ's location near their place of residence and the reasons described were: risk of loudness/noise, deforestation, increased criminality and violence, increased circulation of vehicles and "outsiders", air pollution, respiratory diseases, environmental damage, harm to life quality, accidents and explosions, and lack of benefits.

There has been evidence of a relationship between health risk perception and an opinion favorable to COMPERJ's location near the place of residence ( $p=0.001$ ). However, no relationship has been evidenced between risk perception and benefit perception.

In the correspondence analysis (Figure 3), both dimensions together account for 40.50% of the variation shown in the data. The correspondence established between these points indicates that the relative frequency of subjects who noticed that there are health risks is higher among Porto das Caixas residents and, also, there is a higher proximity to those who said they were against COMPERJ's location near their place of residence and realized that there were few benefits brought by the construction of this development to the local life quality. On the other hand, most participants from Manilha who did not identify any health risks failed to identify benefits connected with COMPERJ's construction, but were in favor of the location of this enterprise.

**Figure 3** Relationship between health risks perception from the construction stage of COMPERJ, location, perception of benefits, and opinion for and against COMPERJ's location near to the District of residence, 2014.



Note: LOCAL: PC= Porto das Caixas Location; LOCAL:MN = Manilha Location; 35: N= Number of people who answered No to question 35; 35: S= Number of people who answered Yes to question 35; 39: NB= People who answered that there has not been benefits; 39: PB= People who answered that it has been little beneficial; 39: RB= People who answered that there has been some benefits; 39: MB= People who answered that there has been many benefits; 39: MIB= People who answered that it has been extremely beneficial; COMPERJLOCAL:S= People who were favorable to COMPERJ's location near to their District of residence; COMPERJLOCAL:N= People who were against COMPERJ's location near to their District of residence.

## Discussion

The data analysis has made it clear that most of the study population denies the existence of health risks originated in the construction stage of COMPERJ. Risk estimates by non-expert people change when the risk relates to their family members, themselves or other groups (SJOBERG, 2000).

Lapsley and Hill (2010) explain that an individual's risk adaptation and prediction can be influenced by a higher or lower level of acknowledgement of their subjective vulnerability and partial optimism. According to this psychological approach, individuals tend to take conditions that are more favorable to themselves, their family members, and neighbors than to other distant groups.

This study explores the relationship between individual characteristics and health risk perception. With regard to gender, the data are confirmed by other studies that have documented the finding that women tend to judge technological risks as bigger and more problematic than do men (Slovic, 2000).

It has been found that participants who reported many health risks were within the age group of 31-59 years old. A lack of benefits brought to their place of residence ever since the stage of installation of the enterprise has also been suggested as a determinant for these results. Similar results with young people were obtained by Moniz's et al. (2012) study, who found that participants with age 20-30-year were more likely to judge health risks of environmental exposure to asbestos as moderate or high than older people, who tried to assign a higher value to the benefits of the former employability and medical assistance that was still provided by the responsible company.

Regarding the participants' education level, a comparative analysis of the data has revealed that individuals with a higher education level (college degree) could better notice the existence of health risks. People with higher education levels tend to assign higher values to risks than those with lower levels. The education level represents a cultural and socioeconomic barrier connected with the low participation power and influence of the groups impacted by the risks in political decisions (SLOVIC, 2000).

It has been noticed that individuals who realized the existence of health risks had experienced some prior situation of illness or health worsening involving themselves, some family member, or a close neighbor, and related this to the changes in environmental quality caused by COMPERJ's works. Personal experience with the risk or its consequence thus becomes one of the foundational pillars of intuitive risk perception (SLOVIC, 2010).

In this regard, it is assumed that the communication with family and friends and the past experiences of the participants of this study have been used as sources for risk information, since the potential impacts on health have never been communicated to the study populations. These actions of communication of risks should have been carried out by the managers responsible for the enterprise since the permitting stage of the industrial complex.

The risk of respiratory and allergic diseases has been indicated as a frequent concern of the residents of both study locations, but particularly from Porto das Caixas. The reasons reported by the participants were: increased circulation of vehicles and lack of

street paving, leading to large dust dispersion. Similarly, Lima's (2013) research concluded that Porto das Caixas and Manilha are located in an area with great potential for pollution of the city's air and that the prevalence of asthma symptoms in teenagers increased (19.76 to 24.23%) in this area.

Other health risks were not mentioned by the study participants. This data is probably linked to the residents' unawareness and/or uncertainty about the cause-effect relationship between pollution, environmental degrading, social transformations, and specific diseases produced by the installation and construction of a large oil development in their area of residence.

Authors such as López-Navarro et al. (2013), Luginaah et al. (2002) pointed to the fact that awareness about environmental problems originated in the activities of petrochemical complexes usually translates as suffering, stress, and reduced satisfaction at the life quality of the populations living in nearby residential zones.

The construction of oil and gas developments is a stressful event in the populations' life due to spatial disfigurement, daily routine changes, and increased specific environmental and health risks in the area of installation. Thus, the environmental problems experienced can contribute to reducing the welfare, life quality and health risk perception of the groups affected (MONIZ et al., 2016). The public perception about the different socio-environmental conflicts and problems in the area of influence of the project can be determined according to local economic and socio-cultural context (MONIZ et al., 2017).

Luginaah et al. (2002) declared that the individual and collective confrontations with environmental stressors translate as perception and attitude toward reducing the stressing factor, resigning, or denying this factor, depending on the exposure characteristics, the individual, the community capacity, and the social network. When the perception is optimistic regarding the risk (nonrealistic), denying it, it seems to be more related to a past life experience to predict their future vulnerability than to the characteristics of the individuals or the risks (SLOVIC, 2010). These situations were observed with the population of this study, as occurred in the study of Moniz et al., 2017.

In the Brazilian context, the health vulnerability in territories surrounding petrochemical plants is determined by the existence of socio-environmental risks inherent to the installation and operation of this type of industrial plant, even though avoidable and unfair, most of the times (GURGEL et al., 2009).

Perception of benefits related with the socio-cultural context can be a predictor of self-reported awareness of technological risks. However, the results of this study have indicated that benefit perception bore no direct and significant relationship with the health risk perception of both groups of residents, in spite of jobs having been highlighted by 46% of the participants as a benefit that promoted an improvement of the local life quality.

PORTO (2012) discusses on the population's illusion about the increase in the local job supply, economic growth, and life quality in the area receiving a large development, once the distribution of the project's wealth and benefits is not equal and does not compensate for the growing risk of hazardous situations and worsens the health and welfare conditions of populations residing in the vicinities of the development.

A great deal of the Manilha residents pondered that COMPERJ did not bring benefits to a better life quality in their district, but that there are still possibilities that the development may bring benefits in the future. From this data, we can infer that this factor may have influenced their opinion in favor of the location of the development near their place of residence. Another factor correlated with the opinion in favor of COMPERJ's location by most of the participants from Manilha is the zone where the hazard is located, which distance is the furthest from this district, to a significant statistic level ( $p < 0.01$ ). The spatial distance from the hazard is a factor that is determinant of the health risks perception resulting from technological processes (JEWITT; BAKER, 2012).

The data are consistent with the understanding that the risk perception due to an oil complex construction is influenced by interplay of individuals, social and contextual factors. This study evidences the need for new studies covering a more comprehensive knowledge on the association between socio-demographic factors and the health risks perception caused by the construction stage of oil and gas developments in other realities for purposes of comparison with the results obtained.

## Conclusion

In conclusion, most of the residents in both areas are largely unaware of health risks caused by the construction stage of oil and gas complex of Rio de Janeiro. Educational programs as risks communication practices are important to address this critical knowledge gap of the studied communities.

Although the responsible for the project did not carry out such actions, public managers should develop communicative actions contextualized with populations and health professionals with a view to valuing the group's perception and making available the knowledge about health risk situations in order to guarantee the right to health.

## Note

This study is part of a research project called "Perception of the socio-environmental impacts of COMPERJ and their effects on public health in the city of Itaboraí/RJ: use of social technology in outreach activities", which was approved by the Research Ethics Committee of the National Public Health School of Oswaldo Cruz Foundation in November 2013, under process No. 12468613.0.0000.5240. All interviewees agreed to participate in the study and signed an Informed Consent Form.

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Original Article





# HEALTH RISKS PERCEPTION IN THE CONTEXT OF THE CONSTRUCTION OF A PETROCHEMICAL COMPLEX IN BRAZIL

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## HEALTH RISKS PERCEPTION IN THE CONTEXT OF CONSTRUCTION OF A PETROCHEMICAL COMPLEX IN BRAZIL

**Abstract:** This paper discusses the health risks perception in the surrounding from the construction areas of a Petrochemical Complex. The study aimed to determine the factors that lead to the health risks perception of the process of construction of the Petrochemical Complex of Rio de Janeiro. Cross-sectional study conducted with 240 individuals in Brazil's southeast region. It was found that female adult individuals with a high level of schooling and residing in the surrounding of the Complex are capable of perceiving better the health risks and few benefits resulting from the process of construction of this development than the group of residents in the area that is farther from the industrial zone. These results show the need of contextualized risks communication actions are applied to address this critical knowledge gap of the studied communities.

**Keywords:** Risk perception; Public Health and Environment; Petroleum Industry.

## PERCEPÇÃO DE RISCOS À SAÚDE NO CONTEXTO DE CONSTRUÇÃO DE UM COMPLEXO PETROQUÍMICO NO BRASIL

**Resumo:** Este artigo discute a percepção de riscos à saúde no entorno das áreas de construção de um Complexo Petroquímico. O objetivo do estudo foi determinar os fatores que levam à percepção de riscos à saúde do processo de construção do Complexo Petroquímico do Rio de Janeiro. Estudo transversal realizado com 240 indivíduos na região sudeste do Brasil. Verificou-se que indivíduos adultos do sexo feminino com alto nível de escolaridade e residência no entorno do complexo são capazes de perceber melhor os riscos à saúde e poucos benefícios resultantes do processo de construção deste desenvolvimento do que o grupo de residentes da área mais distante da zona industrial. Estes resultados mostram a

necessidade de se aplicar ações contextualizadas de comunicação de riscos para se enfrentar esta lacuna crítica de conhecimento das comunidades estudadas.

**Palavras-chave:** Percepção de Risco; Saúde Pública e Meio Ambiente; Indústria Petroquímica.

## PERCEPCIÓN DE RIESGOS PARA LA SALUD EN EL CONTEXTO DE CONSTRUCCIÓN DE UN COMPLEJO PETROQUÍMICO EN BRASIL

**Resumen:** En este trabajo se analiza la percepción de los riesgos para la salud en los alrededores de las áreas de construcción de un Complejo Petroquímico. El objetivo del estudio fue determinar los factores que conducen a la percepción del riesgos para la salud del proceso de construcción del Complejo Petroquímico do Rio de Janeiro. Estudio transversal realizado con 240 individuos en la región sudeste del Brasil. Se encontró que las mujeres adultas con un alto nivel de escolaridad y residência em los alrededores del Complejo son capaces de percibir mejor los riesgos para la salud y pocos beneficios resultantes del proceso de construcción de este desarrollo que el grupo de residentes em el área que está más distante de la zona industrial. Los resultados muestran la necesidad de aplicar acciones contextualizadas de comunicación de riesgos para enfrentar esta laguna crítica de conocimiento de las comunidades estudiadas.

**Palabras clave:** La percepción del riesgo; Salud Pública y Medio Ambiente; Industria del Petróleo.

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