

# Relationship between exposure to cement and the incidence of respiratory diseases in children: a preventive perspective

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**Abstract.** Respiratory disease in childhood is a factor of concern to health professionals, resulting in a primary determinant of lung function in adulthood. Studies indicate that people placed in areas with established industries, are exposed to pollutants from many industrial processes, thus increasing the risk of diseases. The aim was to examine the connection between exposure to cement and the incidence of respiratory diseases in the Jardins Community. It was a field study, descriptive, conducted in a community in the city of Cabedelo- PB, and result in a qualitative-quantitative approach. The sample comprised 51 children aged between 1 to 12 years who have symptoms or diagnosis of respiratory disease. The survey data was obtained by applying a semi-structured interview, and analysed using chi-square, MacNemar and Mann-Whitney tests for statistical analysis. A high number of complaints about environmental pollution, small houses and subdued, lack of paving and sanitation, a high frequency of respiratory symptoms and especially the occurrence of the onset of symptoms after arrival in the community were found. There is a correlation between environmental exposure and the incidence of respiratory diseases in children; therefore the community requires specific actions to reduce the exposure.

**Keywords:** Environmental Pollutants, Environmental Illness, Health Profile.

## 1. Introduction

Respiratory diseases in childhood have worried health professionals due to its high morbidity, resulting into one of the main determinants of pulmonary functions in adult life.

In Brazil, they are responsible for approximately 10% of the deaths among children under a year old; they are the second cause of death in the population ranging from zero to a year old; and they are the first cause of death among children between one and four years old [6].

Acute respiratory infections in children between 1 and 14 years old are responsible for three to eight diseases per child annually, both in developed and developing countries [18]. Epidemiological studies show that even exposure to pollutants at levels below normal are linked with the deterioration of pulmonary function as well as with the appearance of

other respiratory diseases in children and adolescents [4].

Environmental factors like air pollution and lifestyle are among those which have a direct influence on the increased incidence of childhood respiratory diseases. The association of occupational and environmental exposures corresponds up to 20% of the airway diseases [3].

Studies indicate that populations inserted into industrial areas are subject to exposure to several pollutants produced by the industrial process. Thus, as a consequence, this leads to a high risk to diseases related to environmental exposure. The fabrication of concrete makes up an industry with a great polluter potential, which uses cement as their main raw material. Cement is an emitter of particulate matter, carbon dioxide, sulfur oxides and nitrogen oxides.

The following conditions arise as a result of these environmental aggressors on the respiratory system: bronchial asthma, allergic rhinitis, pneumoconiosis,

and chronic obstructive pulmonary disease (COPD) [13].

This research had as its main aim analyze the relationship between exposure to cement and the incidence of respiratory diseases in children from the Jardins Community.

## 2. Methodology

The research was carried out by conducting an exploratory and descriptive field study with a qualitative-quantitative approach, which took place in the Jardins Community, located in the city of Cabedelo-Paraíba - Brazil.

Fifty-one children were included in the research with ages varying from 1 to 12 years old and who showed a diagnosis of either a respiratory condition or respiratory symptoms. The children who were excluded from the study were children who showed neither respiratory conditions nor respiratory symptoms, who had over 12 years old, whose legal guardians were not found and whose residences were found empty.

The research was carried out in the period of March and April of 2009 with the authorization of the Municipal Health Department of Cabedelo. Firstly, previous visits were made to the location in order to observe and be aware of the explored area, enabling a greater contact with the community health agents (CHA). This provided the means to familiarizing with essential data for the interview conduction: number of houses per subdivisions of the Community, number of children and which residences had children within the age range for the sample.

As the research involves human beings, it was previously approved by the Ethical Committee on Research from the Health Department of the State of Paraíba. Furthermore, the children's parents or legal guardians were rightly instructed as to the contents of the study and the objectives of the data collection. Therefore, it was made clear that personal information and image of the children would be preserved, corroborating with the Children and Adolescent Statute. All of them signed the Free Prior and Informed Consent before conducting the interview.

The data collection was done through the application of a semi-structured interview composed of questions relating to the social demographic profile of the children, living conditions, presence of respiratory symptoms, starting period of symptoms, the duration of these symptoms, clinical follow-up, among others. The interview was recorded using a microcassette recorder, model TP-M200 from Aiwa and later transcribed by the researcher.

The data obtained through the conduction of the semi-structured interview were organized in Statistical Package for the Social Sciences (SPSS). In order to verify the correlation between the studied variables, the chi-squared test was used. The MacDemar test was also used, where dichotomous paired data are analysed and crossed. Also, the Mann-Whitney test was used to compare independent variables. The adopted statistical significance limit was in the value of  $p$  less than 0, 05.

## 3. Results and Discussion

### 3.1 Sample Identification

Predominance of the female gender was found with respect to the children's gender distribution with 55,8% ( $n=29$ ) against 42,3% of males ( $n=22$ ).

Also, predominance of the 5 to 8 years old age group was found with 41,2% ( $n=21$ ), as opposed to the 1 to 4 age group with 33,3% ( $n=17$ ) and the 9 to 12 age group with 25,5% ( $n=13$ ).

### 3.2 Living Conditions

When researching the existence of a correlation between environmental exposure and the occurrence of respiratory disease it was essential to determine how long one has been living in the surrounding area. The data collected during the study period show that the majority of the children live in the Community for a period ranging from 1 to 5 years, totalizing 45,1% ( $n=23$ ). For a living period of 6 to 10 years, 27, 5% ( $n=14$ ) and for over 10 years, 27,5% ( $n=14$ ), as shown in table 1.

Table 1

Correlation test between the exposure period and the occurrence of respiratory symptoms in the Jardins Community

Symptomatology	Residence period				M-W test	
	Minimum	Maximum	Medium	RD	Value	P
Yes	1	20	7,27	6,02	1,41	0,159
No	1	20	9,69	5,80		

Source: Research data, 2009.

There are authors who support that the degree of exposure is the most important determinant and that the period of exposure is not so relevant [7]. This understanding validates the data found in the study, where the majority have a less residence period and yet show occurrence of symptoms and the start of the pathology, which onset after living in the Community. This is shown in table 1 where the Mann-Whitney test indicated that there was no significant difference between the exposure period and the occurrence of symptoms. This led us to believe that the determinant factor is the degree of pollution to which the population is exposed.

With respect to the living conditions it was found that the 51 housings are located in unpaved roads and with no sanitation. Therefore, the unpaved roads and lack of sanitation augments the risk factors for children contracting disease. These services are the ones that show the most marked relationship with health, especially child health [8]. The reality found in the Jardins Community can be seen in the majority of the disadvantaged communities of our country. They are people who live in underprivileged housings, which have a direct impact on the quality of life and on the population's health regress.

Another studied variable was the presence of good ventilation in the house. Of all the participants, 8 children (15,7%) live in ventilated houses. The remaining 43 (84,3%) live in an environment where there is unsatisfactory ventilation. The presence of good ventilation characterized a variable with significant statistical difference. Based on the reports obtained during the interviews it became clear that characteristic of the majority of the houses in the Community are small and not ventilated enough.

Ventilation plays an important role in the way pollutants harm people's health. An airy environment prevents pollution particles from remaining in a given space, increasing the exposure period [5]. The lack of ventilation worsens the pollution inside the houses.

Though the interview it was shown that the houses in the Community of Jardins foment the risk of

acquiring diseases as a result of exposure to pollutants present inside the houses.

With respect to the ventilation where the children sleep, the majority do not live in an airy environment, represented by 82,4% (n=42). Only 17,6% (n=9) of the children sleep in a ventilated place. Much attention must be given to the physical, social and economical environment where children live: housing, including the type of construction, flooring, lightning and ventilation of the house, especially of the room where they sleep. The presence of domestic animals, smokers and domestic dust are also important [14].

The lack of ventilation will impede the air from renovating itself and the pollutant particles will remain in the room, favoring a prolonged contact with the pollutant agent, thus increasing the chances of developing respiratory disease or its symptoms [5].

With regards to the presence of residues of industries in the cleaning of the house: the legal guardians were asked if as they cleaned the house they would find cement residues or constant dust. Among the interviewees, 45 (88,2%) said that they make notice of these pollutants while 6 (11,8%) said not to notice. It was confirmed in the literature that exposure to intra and extra residence airborne pollutants has been associated with potential risk to the development and exacerbation of asthma and other respiratory conditions [12].

The following were reported as effects of airborne pollutants in asthmatic individuals: decreased lung function, increased bronchial hyperreactivity, increased visits to emergency sectors and hospital admissions, greater medicine intake, increased symptoms, inflammatory variations, interaction between air pollution and allergens and variation in the autoimmune system [9].

Some studies investigated the effects of prolonged exposure to environmental irritants during infancy and showed increase in future asthmatic symptoms, contributing to the disease development [15].

### 3.3 Pulmonary Background

Regarding breastfeeding period in children of the Community (table 2), the majority 36, 0% (n=18) breastfed for less than 6 months. The ones that breastfed between 7 to 12 months comprehend 32, 0% (n=16). Children who were breastfed for over 12 months represented 24, 0% (n=12). There were even

those that never breastfed, 8, 0% (n=4). The existence of important predisposing factors to obstructive pulmonary impairment is well known.

Such factors include underweight, lack of breastfeeding, malnutrition, genetic predispositions, atmospheric pollution and the insertion into collectivities like nurseries and school [11].

Table 2

Relationship between the breastfeeding period and the occurrence of respiratory symptoms in the children from the Jardins Community

Were symptoms shown?	Breastfeeding period				M-W test	
	Minimum	Maximum	Medium	RD	Value	P
Yes	0	36	11,72	13,56	0,73	0,048*
No	3	18	7,89	4,62		

Source: Research data, 2009.

\* significant difference.

Some studies which analysed the breastfeeding time confirmed to have a predominance to the disease in children who breastfed for less than 6 months (n=416) compared to those who were breastfed for over 6 months (n=209) [10]. This predominance demonstrated a dose-response curve of correlation, with significant linear tendency for increased hospitalizations by respiratory disease as breastfeeding decreased.

A similar result was obtained in the Community of Jardins, where a positive and significant correlation

between breastfeeding period and history of child symptoms can be observed in table 2.

When questioned about the occurrence of any respiratory symptom such as cough, dyspnoea, wheezing, chest pain or dyspnoea through strain, 82,4% (n=42) reported the child had shown some of these symptoms, whereas 17,6% (n=9) confirmed not to have noticed neither of the symptoms mentioned above (table 3).

Table 3

Distribution of the occurrences of respiratory symptoms in the children of the Jardins Community

Showed cough, dyspnoea...	N	%	$\chi^2$	p-Value
Yes	42	82,4	21,35	<0,001*
No	9	17,6		
Total	51	100,0		

Source: Research data, 2009.

\* significant difference.

The authors corroborate with a general consensus existent in literature that under alerted atmospheric conditions there is an exacerbation of the asthmatic symptoms, decrease in pulmonary function and worsening of the respiratory conditions in children [1].

During episodes of respiratory disease exacerbation, especially asthma, acute lack of air of variable intensity, wheezing expirations, dry cough and difficulty breathing can be observed [16].

Based on the studied literature it can be highlighted that the high percentage for occurrence of respiratory symptoms in the Community is worrying as it could be related to diseases such as asthma.

When questioned if the children ever showed diseases such as bronchiolitis, bronchitis, asthma or pneumonia, 62,0% (n=31) of the interviewees affirmed not to have shown. The remaining 38,0% (n=19) reported to have shown either of the pathologies mentioned above.

The exposure to environmental pollution is one of the major etiologies of chronic respiratory diseases, with the exacerbation of asthma and chronic obstructive pulmonary disease (COPD) being the most common consequences. In addition to these, there is also the increase of acute respiratory insufficiency, inflammation and irritation of the bronchi and the decrease of pulmonary function. Also, there is a clinical correlation between chronic pollution and bronchitis, chronic cough, respiratory diseases, exacerbation of the COPD and asthma, decrease of longevity and pulmonary cancer [13].

With respect to the occurrence of respiratory disease before residing in the Community, 78,4% (n=40) of the interviewees affirmed their children never to have shown respiratory disease. Included into this percentage were the children whose age is inferior or equal to the residence period, thus showing that they live in the Community since birth.

The ones who have already shown respiratory diseases before moving to the Community added up to 21,6% (n=11). The evaluation of this variable was of essential importance to establish a relationship between the time period, suspected exposure and the onset of the clinical signs and symptoms.

Researchers emphasize the importance of the temporal relationship between suspicion of exposure and the clinical panorama for the establishment of the causal nexus [7], corroborating with the findings from the Jardins Community (Table 4).

Table 4

Correlation test between the occurrence of respiratory disease before and after moving to the Jardins Community

Disease before moving to the Community	Respiratory Disease				McNemar's Test	p-Value
	Yes		No			
	n	%	N	%		
Yes	9	18,0	2	4,0	2,31	0,021*
No	10	20,0	29	58,0		
Total	19	38,0	31	62,0		

Source: Research data, 2009.

\* significant difference

It was also investigated if the child had already taken any medication for the respiratory symptoms on more than three occasions. It was found that in 64,7% (n=33) of the children had administered some medication, whilst 35,3% (n=18) never took medicine or took it for less than three occasions.

A greater intake of drugs is seen in asthmatic individuals amongst the effects of air pollution [9]. The number of children in the Community who have taken medication for over three occasions indicate a possible relationship with the impairment of the respiratory system.

### 3.4 Current disease history

When questioned about the onset period of the current respiratory symptoms in their children, 39,2% (n=20) of the interviewees reported it to have initiated for over one year. Symptoms comprehending a time period of up to one year was

reported in 37,3% (n=19) of the cases and the children who were found with no current symptoms correspond to 23,5% (n=12) as shown in the table below.

The latency period is defined as the period of time between the onset of symptoms and the diagnosis. It is confirmed that even the diseases with a short latency period caused by irritant or sensibilizing agents have as common examples the reactive upper airway dysfunction, asthma and pneumonia caused by hypersensitivity [3].

The interviewees were also questioned about the frequent occurrence of symptoms. At the moment of the interview 67,3% (n=33) showed frequent respiratory symptoms, whereas only 32,7% (n=16) did not report symptoms. Amongst the symptoms' reports cough and wheezing stand out.

Emphasis must be given as to the importance of questioning about the characteristics of the respiratory obstruction episodes with wheezing, like

its nature, frequency, intensity and duration as well as the degree of interference on the child's activities and response to therapy during the diagnostic disease evaluation as it is done with asthma [14].

It is assured that the presence of one or more symptoms like chronic cough, wheezing, chest discomfort especially at night or in the early hours of morning are evidence of asthma [2].

The evening cough crises were found in 75,5% (n=36) of the sample. It is described in literature that the most eminent clinical characteristic for asthma is the wheezing, however coughs may be the only symptom to be shown, which makes the diagnosis more difficult [14]. Cough might be the only manifestation of asthma in over 57% of cases, occurring mainly at night, during dawn, at awakening, during exercise or when the child cries or screams [19].

Shortness of breath, the occurrence of dyspnoea might also be triggered by inhaling odors like smoke and strong perfumes. When the interviewees were asked about discomfort shown by their children upon the encounter with these odors, it was shown that 65,3% (n=32) of children feel shortness of breath when inhaling, whereas 34,7% (n=17) did not show any response.

It is put forward that asthma can be worsened by multiple factors, depending on the age and that acute exacerbations may be triggered by inhalable allergens in adolescents.

Triggering of respiratory symptoms may occur by non-immunological mechanisms with the inhalation of non-specific irritant agents (strong odors, cigarette smoke, etc.) [17].

Supported by other studies, it is found that bronchitis during infancy may be acquired through the inhalation of irritant substances like environmental pollutants and cigarette smoke [14].

#### 4. Conclusion

This study shows a serious public health problem in the Jardins Community for which a relationship between environmental exposure and the incidence of respiratory diseases in children became evident, thus concluding that the community is a target of environmental pollution. For this reason, continuous actions of promotion and prevention concerning the health of these children as well as the entire population are needed. Other measures must be taken by the responsible persons involved in the source of

pollution in order to control the emission of pollutants. New studies are necessary to develop strategies focusing on the improvement of educational services, sanitation and health for this community as well as to quantify the emission of these local pollutants for the purpose of contributing to a better quality of life for the population.

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